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Final Report
Research into the Development of a Knowledge Acquisition Taxonomy

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The RICIS Concept

The University of Houston-Clear Lake established the Research Institute for Computing and Information systems in 1986 to encourage NASA Johnson Space Center and local industry to actively support research in the computing and information sciences. As part of this endeavor, UH-Clear Lake proposed a partnership with JSC to jointly define and manage an integrated program of research in advanced data processing technology needed for JSC's main missions, including administrative, engineering and science responsibilities. JSC agreed and entered into a three-year cooperative agreement with UH-Clear Lake beginning in May, 1986, to jointly plan and execute such research through RICIS. Additionally, under Cooperative Agreement NCC 9-16, computing and educational facilities are shared by the two institutions to conduct the research.

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Preface

This research was conducted under auspices of the Research Institute for Computing and Information Systems by Dr. Pamela K. Fink and Dr. L. Tandy Herren of the Southwest Research Institute. Dr. Glenn B. Freedman served as RICIS research coordinator.

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This technical report is the complete version of the final report delivered by the Southwest Research Institute. Also available is an abridged version. The appendixes listed on page ii are not duplicated in the abridged version of the research.

FINAL REPORT

RESEARCH INTO THE DEVELOPMENT OF A KNOWLEDGE ACQUISITION TAXONOMY

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1 INTRODUCTION

This document constitutes the final report on a project performed by Southwest Research Institute in the area of knowledge acquisition for intelligent tutoring systems. The focus of the research has been on the development of a problem solving taxonomy that can support and direct the knowledge engineering process during the development of an intelligent tutoring system.

1.1 Overview Of The Knowledge Engineering Problem

The process of knowledge engineering, the major methodology for incorporating the knowledge of a human expert into a computer program, has long been marked as a bottleneck in any knowledge-based system development. This is not surprising since the process involves humans who are expert in a given domain, namely the domain experts, communicating with other humans who are not expert in the domain about their expertise and problem solving skills. The non-domain experts are, however, expert in computer programming and knowledge representation and they must be able to organize, structure, and convert the domain expertise as they understand it into a computer program. All of this communication results in a situation similar to the "telephone game," where something is lost or misinterpreted with each communication act. The problem, of course, is magnified by the fact that the individuals involved do not tend to speak the same "language" and the concepts being communicated can be quite complex. A good, simplified description and illustration of the knowledge engineering process is given in Yost and Newell [1989].

The knowledge acquistion problem has been acknowledged since the early days of knowledge-based system development. Many person-years of effort would go into the development of a single knowledge base. The ideal solution, of course, is to skip the knowledge engineer and have the domain expert generate the knowledge base directly. The problem with this approach is that the domain expert usually has no real knowledge or experience in computer programming and knowledge representation. Research into the development of tools to support the knowledge acquisition process has been in two directions: 1) to support the knowledge engineer in structuring and encoding the knowledge acquired and 2) to provide an interface that would allow the domain expert to enter his/her knowledge directly into the computer program.

The first approach, targeting the knowledge engineer as the end user, has generated all of the knowledge-based system development tools such as M.1, S.1, ART, KEE, GoldWorks, and CLIPS. Many of these systems have become commercial products and are treated more or less as high-level programming languages. They have made the knowledge engineer's job easier by providing a variety of knowledge representation and reasoning paradigms as part of the programming language, thus providing a structure into which the knowledge acquired can be entered.

The second approach, targeting the domain expert as the end user, has generated knowledge acquisition systems such as RuleMaster, TIMM, TEIRESIAS, MOLE, ROGET, and ETS. Most of these systems have not become commercial products, indicating clearly that we do not yet understand the knowledge acquistion problem well enough to develop truly viable systems. Some of these systems generalize from examples while others query the expert directly, either about specific knowledge such as class hierarchies and relations or about more general problem solving techniques. Each approach has its advantages and drawbacks. The major trade-offs involve less general elicitation techniques that work on only a single domain but that produce systems with a high level of expertise vs. more general elicitation techniques that work on a range of domains but produce systems that do not have the detailed knowledge needed to solve problems at the expert level. This is a classic trade-off problem and has appeared continuously in one form or another since the early days of AI research and development.

1.2 **Traditional Knowledge Acquisition Techniques**

The literature on knowledge acquisition discusses four basic verbal knowledge elicitation techniques:

1. interviews
2. observational studies
3. retrospective methods
4. verbal protocols

Knowledge can also be pulled from written sources, such as textbooks and manuals. These methods elicit different and sometimes complementary types of knowledge. Most knowledge engineers employ a variety of techniques to build a knowledge base.

Knowledge engineers often use interview techniques in early sessions with the domain experts. Interviews can be descriptive, problem-oriented, or structured. A descriptive interview is usually the first interaction technique applied in knowledge elicitation. The expert presents a structured description of the domain to the knowledge engineer. The interview is similar to a lecture and familiarizes the knowledge engineer with the basic domain concepts. The expert may recommend documents for the knowledge engineer to study on his/her own. Knowledge engineers structure problem-oriented interviews to obtain specific knowledge from the expert. The knowledge engineer presents the expert with a problem and asks predetermined questions at each step in the problem solution. Finally, structured interviews center around inputting domain knowledge into a knowledge representation scheme, such as a hierarchy of frames (Peterson, et. al, 1988).

Interview techniques are useful for eliciting basic domain knowledge or filling in gaps from knowledge gathered with other techniques, but they do not capture the expert's problem-solving strategies and detailed or inaccessible domain knowledge.

In observational studies, the knowledge engineer observes the expert engaged in daily problem-solving activities. The expert follows his/her normal daily schedule and the knowledge engineer simply videotapes the expert during problem-solving and in face-to-face or phone interactions with colleagues. This technique provides information about the expert's role in the problem-solving process, but it seldom yields much detailed domain knowledge.

Retrospective techniques require the expert to recall an incident in which he/she solved a domain problem in as much detail as possible. This methodology provides a detailed analysis of the expert's problem solving process, but is impaired by the problems of human recall. Humans tend to reconstruct events in recall and often report events differently than they occurred (Bartlett, 1932; Bransford and Franks, 1971; Weisberg, 1980). The advantage of retrospective methods is that they yield detailed descriptions of the expert's problem-solving strategies and the alternative choices considered.

Despite advances in automated knowledge acquistion techniques, protocol methodologies (Ericsson and Simon, 1984) are still the most frequently used method of knowledge acquisition in practical applications. And although these methods are demanding and time consuming for knowledge engineers and experts, they demand less of experts than most automated techniques. An expert simply solves a domain problem while speaking aloud and the knowledge engineer records the session. The expert is not obligated to spend many hours interacting with an unfamiliar computer system.

Collecting a protocol allows the knowledge engineer to observe the ongoing problem-solving process and capture detailed information about the domain knowledge used by the expert. This method also permits the knowledge engineer to infer knowledge that is used by the expert but not directly verbalized.

Protocol techniques have two primary disadvantages. Verbalizing knowledge during problem solving may interfere with the task or it may alter the expert's usual approach. And, because at no time during protocol collection does the knowledge engineer disrupt the process, knowledge about problem-solving strategies and alternatives, as seen in retrospective techniques, is not available.

In practice, verbal methods require much more labor than a surface description implies. The knowledge engineer generally employs a wide variety of verbal methods and meets with the domain expert many times throughout the course of system development, refining and adding to the emerging knowledge base. Because the knowledge engineer is generally not a domain expert, he/she relies on the domain expert to supply all the critical domain knowledge. This can lead to a variety of problems as listed below.

1. The expert often has no sense of whether a piece of information is critical and may neglect to mention some important aspect of problem solving until late in the development process. This could cause the entire structure of the knowledge base to change.

2. One characteristic of expertise is that problem solving in the domain is such a well-learned task that the expert is no longer consciously aware of all the steps to a problem solution. Thus, the expert may be unable to report certain critical activities.

3. In the same vein, introspective reports of cognitive activity are notoriously inaccurate, suffering from memory biases, reporting biases, and inability to verbalize all aspects of the process.

4. Finally, experts bring heuristics to the problem solving process that are based on seemingly simple yet powerful analytical models derived from experience with the domain. The expert may have little justification for these heuristics other than "they work." The knowledge engineer is faced with the task of encoding these heuristics and infering information essential to building a working system.

All of these are issues with the knowledge acquisition process, whether the process is performed by humans or by an automated tool.

1.3 State-of-the-Art In Knowledge Acquisition

Most of the systems that might be called automatic knowledge acquisition tools have been directed at providing a means for the computer to elicit the needed knowledge directly from the domain expert and to put it into the knowledge base of an expert system. Much of the literature on such systems appears in what is considered the machine learning area of AI. How such systems acquire the knowledge from the experts can generally be classified into two types: 1) those that create generalized rules from specific examples, called induction-based learning systems and 2) those that fill-in knowledge structures, such as templates, based on querying the user in some structured fashion, usually referred to as interview-based systems.

Induction-based systems, such as RuleMaster, TIMM, and Expert Ease, look similar to a spreadsheet in terms of their user interface. They work by having the user enter example situations by identifying salient features of the problem, providing specific values for those features for each example, and giving the correct answer to the problem for each example. Through logically-based induction techniques, general rules are then developed by the system. The result is a system that can function quite well on any problem that is the same as the examples the system was trained on, but that can have fairly unpredictable behavior on those problems that were not the same as the ones trained on. This kind of approach works in domains where problems can be easily posed as sets of salient features and values, and possible solutions can be enumerated, such as structured selection problems. However, input becomes rather unwieldy if many features, values, and solutions exist in the problem domain, because the number of possible example cases grows exponentially with each additional feature and potential value. Human experts often do think in terms of example cases, but usually only in terms of their similarities and differences with respect to the current problem under consideration. In most complex domains, human experts have already made a lot of generalizations and those could be acquired more efficiently through direct query methods.

Interview-based systems, such as THEIRESIAS (Davis, 1982), MOLE (Eshelman and McDermott, 1986), MORE (Kahn et al., 1985), KNACK (Klinker et al., 1987), SALT (Marcus et al., 1985), ROGET (Bennet, 1983), ETS (Boose, 1985), and ASKE (Patel, 1989), attempt to determine the knowledge content of a domain by querying the domain expert based on some structured methodology. For example, MOLE elicits symptom-hypothesis linkages and the type and strength of the linkages from the domain expert in an attempt to build a diagnostic system. ETS uses a methodology stemming from personal construct theory to query the domain expert concerning the distinctions that exist between possible conclusions that an expert can make and uses distance-based cluster analysis to build concept hierarchies, discrimination networks, and decision trees. Most of these knowledge acquisition systems are oriented towards the building of knowledge-based systems that perform structured selection problem solving, such as diagnostics. Two systems, KNACK and SALT, do address slightly different kinds of problems, namely design evaluation and solution construction, respectively. However, their basic knowledge acquisition strategies are still to construct taxonomies of concepts and concept properties.

Thus, the work to date in the area of automated knowledge acquisition tools has been heavily oriented towards the structured selection problem solving paradigm. This is not surprising since a lot of the work in knowledge-based systems has also been oriented towards this kind of problem solving task. Class hierarchies, and the relationships between them, have been a dominant goal of these knowledge acquisition systems, as well as generalized if-then rules. This kind of knowledge fits very well into the current knowledge representation schemes available in the knowledge-based system development tools on the market today, such as frames, semantic networks, and production rules.

1.4 Foundation For The Next Generation Knowledge Acquisition Tools

Completely automated knowledge acquisition tools that allow a domain expert to generate a sophisticated, complex knowledge-based system with no support from an individual knowledgeable in computer programming and artificial intelligence is a lofty goal. Current understanding of human learning and cognition is not at a level to allow the development of completely general, domain independent automated knowledge acquisition tools capable of developing arbitrarily complex knowledge-based systems in any domain. In addition, most domain experts would not have the time or inclination to submit themselves to extensive, tedious question-answer sessions with a computer program. Another approach to the knowledge acquisition problem, that leaves the human knowledge engineer in the loop, might be a better short-term solution.

It has been readily acknowledged among the practitioners that the knowledge engineering process, as performed currently, is more an art than a science. Of course, there are techniques with names attached to them such as structured and unstructured interviews, example cases, etc., and there are recommended practices such as taping the interviews, generating transcripts, and then editing and modifying the resulting knowledge acquired based on domain expert feedback. However, the quality of the resulting system is still highly dependent on the personalities and skills of the individuals involved. Successful knowledge engineers, aside from having a sound computer science background and an understanding of AI techniques, must also be intelligent, extremely inquisitive, good problem solvers, well-organized, and have excellent communication and interpersonal skills. These knowledge engineers must be capable of putting people at ease during a knowledge engineering session while at the same time asking them to think and introspect about how experts solve problems in their particular area of expertise. The key to a successful knowledge engineering process (i.e., a useful, working knowledge-based system) is the ability to extract the general problem solving methodologies utilized and the specific domain knowledge needed to find a solution to a given problem.

Thus, the goal of the project described in this report for the knowledge acquisition/knowledge engineering problem was to develop a methodology that could be used first to typify the expert problem solving strategies and the types of specific domain knowledge needed that would allow the knowledge engineer to categorize the task. An initial categorization could then provide guidelines for understanding the key characteristics of the given kind of task. These techniques could eventually be automated, but initial experience with, and evaluation of, the techniques should be gained through the use of good human knowledge engineers.

The approach to generating such methodologies and classes was to a study of a broad spectrum of problem solving tasks, analyze the problem solving techniques used, and a pair of the knowledge engineering techniques to the acquisition and codification of specific problem solving strategies into a knowledge-based system. The result of this process is a proposed taxonomy of problem solving tasks characterized by problem solving strategies and types of domain knowledge, as well as some recommendations concerning knowledge acquisition methodologies relevant to the particular task. Some work in this area appears in the literature (see Section 2.2).

1.5 Project Rationale And Approach

The research described in this report involves identifying and analyzing a pre-defined number of problem solving tasks. These tasks were representative of the variety of tasks that are of interest to the Air Force and NASA with respect to issues of training. The tasks included diagnostics, design, data interpretation, procedure execution, planning, categorization, monitoring, etc. The complete list could be extensive, but this effort attempted to identify representative tasks, approximately 36, and was by no means exhaustive.

The intended benefits and goals of the research include the following:

- Gain insight into the types of problem solving tasks that are of interest to the Air Force and NASA in training and what characterizes these types of problems.
- Provide a viable approach to the knowledge engineering process that gives some direction to the knowledge engineer concerning how to interview a domain expert in a given problem area.
- Provide a framework in which a comparison of approaches and techniques for knowledge engineering can be made.

Based on the study that has been performed and is reported in this document, these goals have been partially met, though considerably more research could be performed to develop the ideas further and test the hypotheses that were generated by this study.

The work performed involved identifying a set of representative tasks, interviewing experts in the selected tasks, classifying these tasks into a taxonomy based on their characteristics, and generating recommendations for performing knowledge acquisition based on the task classification. In some sense, the work to develop a taxonomy needed to be done before we could make sense of the results gained from the knowledge acquisition interviews. But, at the same time, the knowledge acquisition interviews supplied the information on tasks that could support the generation of a taxonomy. Thus, because this was an initial research project, a bootstrapping approach had to be taken to get any kind of results. Therefore, interviews were performed in each task area. This allowed us to gain some insight into the problem solving tasks, generate some hypotheses and classification schemes, and then informally test these hypotheses and classifications through a second interview. Further details on these steps are given in the rest of this report.

The approach taken in this research has been a very pragmatic one. An outline of the overall process we followed is provided in Figure 1. The work has been based on years of experience in performing knowledge acquisition for the design and implementation of numerous knowledge-based and intelligent tutoring systems in a wide variety of problem solving domains. One of the underlying goals has been to minimize the amount of time required with the expert. Experience has shown that an expert's time is usually very limited and it helps to make the most of the time that you do have. Another underlying goal of the research was to develop an approach to knowledge acquisition that would help a knowledge engineer characterize the problem solving task in some useful way and to scope the effort. Thus, much of the questioning is oriented towards acquiring knowledge of the inputs to the task, the results or output from the task, reasoning mechanisms that operate on the input and generate the output, the environment in which the problem solving takes place, and the attributes of the experts who perform the task. The effort was less concerned with total accuracy of the knowledge obtained than with discovering the problem solving approach(es) used. Accuracy can come later when the software is under development and the expert can observe the system's behavior and suggest concrete corrections.

STEP 1: Obtain set of task characteristics

STEP 2: Choose set of tasks

STEP 3: Design initial knowledge acquisition interview

STEP 4: Conduct interviews for each task

STEP 5: Evaluate initial interview and construct preliminary classification of tasks

STEP 6: Design follow-on knowledge acquisition procedure based on task characteristics

STEP 7: Conduct second knowledge acquisition session

STEP 8: Evaluate second interview

STEP 9: Construct proposed knowledge acquisition taxonomy

Figure 1. Knowledge acquisition study methodology

This study generated a number of hypotheses about how to conduct knowledge acquistion for a variety of tasks and therefore provides some direction in how knowledge acquisition should proceed. However, the hypotheses need to be verified through more formal experimentation than was possible in this limited effort. Results of the research and recommendations concerning what should be done next are given in Section 7.

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2 PROBLEM SOLVING TAXONOMIES AND TASK CHARACTERISTICS

Practical experience in knowledge-based system development indicates that much of the system design depends on the characteristics of the task that the knowledge-based system needs to perform or teach. Researchers in artificial intelligence (AI) are beginning to evaluate the relationship between knowledge representation, system architecture, and task type. This work is related to the growing awareness that the method of knowledge acquisition should depend on the characteristics of the task and to the continued focus in the psychological and educational literature on the relationship between task characteristics and instructional strategy in curriculum development and on the relationship between task characteristics and human factors engineering.

The growing focus on importance of task characteristics for knowledge-based system design signals the maturation of the field from one searching for the single best representational format and inferencing strategy to one that recognizes the diversity of problems and the need to address each according to its characteristics. Not surprisingly, human cognition appears to utilize multiple representational formats and reasoning techniques. Different representations store different types of information (e.g., scripts store simple, well-structured sequences of events) and dictate the appropriate methods for reasoning about that information. The flexibility to employ the best representation and reasoning strategy for a given problem undoubtedly contributes to human intelligence.

Research in knowledge acquisition has implicitly recognized the need to tailor the knowledge acquisition process to the task characteristics. For example, structured interviews center around filling knowledge into the chosen representational format. As such, the format determines the knowledge that is needed and the reasoning strategies that will be effective. Knowledge engineers who use this strategy correctly look to their experience to select the representation format based on the problem type. However, much too often the cart comes before the horse, i.e., the representation is selected and the problem is forced to fit to the representation.

In addition, most automated knowledge acquisition tools are specific to a problem type, such as diagnosis or design (although some such as AQUINAS claim to be more general). For example, tools such as MOLE (Eshelman, Ehret, McDermott and Tan, 1987), TEIRESIAS (Davis, 1985), ROGET (Bennett, 1983), and TKAW (Kahn, Breaux, Joseph, and Deklerk, 1987) acquire knowledge about diagnostic application tasks. While systems such as SALT (Marcus, 1987; Marcus, McDermott, and Wang, 1985) and OPAL (Musen, Fagan, Combs, and Shortliffe, 1987) collect knowledge about design and planning tasks, respectively.

Recently, the relationship of task characteristics to the knowledge acquisition process has become more explicit. McDermott (1988) has proposed a preliminary taxonomy of problem-solving methods and described how those methods can be mapped onto tasks. Bylander and Chandrasekaran (1987) have suggested that generic tasks can serve to focus knowledge acquisition. And Gaines (1987) has suggested a hierarchy of knowledge transfer techniques based on areas of application.

The study presented in this paper addresses the characteristics of tasks in an attempt to formulate a method for formally describing tasks in support of knowledge acquisition. The first step in the study was to evaluate methods of characterizing tasks. In order to do so, we reviewed the literature on factors affecting human performance and on the relationship between knowledge acquisition and task type. The following sections discuss the details of the review.

2.1 Factors Affecting Human Performance

A number of researchers over the years have developed taxonomies of factors that affect human performance. Not all of the taxonomies produced included a comprehensive listing of all relevant factors. Some focused on a sub-set of the factors affecting human performance. However taken together, these taxonomies allow researchers to characterize the cognitive operations that transpire when a person performs a task. They also allow a complete characterization of the environment in which the task is performed and the characteristics of the subject who performs the task. Gawron, Drury, Gzaja, and Wilkins (1989) combined the existing taxonomies to provide a comprehensive one. They first reviewed taxonomies of information processing factors that affect human performance. The goal of their review was to form a composite taxonomy based on the categories included in human performance taxonomies over the years.

One early taxonomy was Miller's (1962) taxonomy of the behaviors associated with the performance of a task, relying on behavior analysis for task modeling. As a behaviorist, he did not discuss cognitive operations, but he did include some task characteristics that he considered covert behavior, e.g., short-term retention. These behaviors could be inferred but not directly observed. His taxonomy made no allowance for the influence of environment on task performance. A similar, more detailed taxonomy was developed by Berliner, Angell, and Shearer (1964).

A taxonomy by Fitt (1965) recognized that the human is embedded in the environment and that stimulus characteristics affect human performance. His taxonomy included nervous system activity, such as receptor, central nervous system (CNS), and effector activity, as well as the relationship of the task to the environment, control, machine, and display characteristics. Thus, this taxonomy recognizes that task performance involves perceptual, cognitive, and motor activity mediated by environmental variables. Fitt's taxonomy was not very detailed and other authors have elaborated on the categories in his taxonomy (Blanchard, 1973; Willis, 1961; Chambers, 1973; Hindmarch, 1980).

Willis (1961) provided a detailed breakdown of nervous system input and output. Receptor activity involves discriminating non-verbal cues and discriminating verbal cues. CNS activity includes recall of information of facts, principles, and procedures and symbolic data operations. Finally, effector activity is broken into skilled motor acts and overt verbalization. This was one of the earliest taxonomies to explicitly include cognitive operations and be based on the information processing perspective of human cognition.

Gagne (1974) focused on central nervous system processes, including intellectual skills, cognitive strategies, verbal information, and attitude. Intellectual skills involve generating a solution to a novel problem, applying a rule, classifying an object, identifying a class, and discriminating between objects. Willis' and Gagne's taxonomies highlight the importance of the cognitive representations that support human performance.

Other researchers have developed special purpose taxonomies. For example, Shingledecker, Crabtree and Acton (1982) developed a taxonomy for indentifying workload in a fighter aircraft that includes very specific tasks, such as flight decision assessment. Meyer, Laveson, Pape, and Edwards (1978) developed a different taxonomy for the same environment. Carter (1986) developed a taxonomy for computer functions, including categories such as information functions, task execution functions, peripheral functions, and data functions.

Gavron, et. al. combined these taxonomies and added independent variables manipulated in psychological studies, such as stimulus attributes, and added individual difference variables, such as gender and age, to create the Human's taxonomy. This taxonomy is intended to be a comprehensive tâxonomy of factors in human performance. The taxonomy contains three top level categories (environment, subject, and task characteristics) and has a depth of up to eight levels (see Appendix P).

Kyllonen and Shute (1989) approached their review of taxonomies from a different perspective. They were more interested in taxonomies of learning skills rather than factors that affect human performance in all types of tasks. Their review argued that taxonomies of learning skills fall into three categories:

1. rational taxonomies based on a rational analysis of the domain,

2. correlational taxonomies based on an individual-differences analysis,

3. model-based taxonomies based on formal models of learning processes.

Rational taxonomies are frequently based on a conditions-of-learning analysis of the domain, defining tasks in relation to characteristics that help or hinder learning. Melton (1964) proposed a taxonomy based on learning tasks popular at the time: conditioning, rote learning, probability learning, skill learning, concept learning, and problem solving (see also Estes, 1982). Jensen (1967) extended this taxonomy to account for the method of the study and the type of stimuli. His taxonomy included a learning type facet, corresponding to Melton's categories, a procedures facet for methodological variables such as the pacing of the task and type of practice, and a content facts to indicate whether the stimuli were verbal, numerical, or spacial. Gagne's (1974) learning outcome taxonomy, discussed earlier, is another example of a rational taxonomy.

Kyllonen and Shute argue that rational taxonomies are subject to imprecision because they are not based on a strong theoretical model of learning and have no foundation in empirical relationships. These taxonomies do not include actual psychological process dimensions and, according to Kyllonen and Shute, process dimensions are the most important commonality between tasks.

Correlational taxonomies stem from empirical results examining the correlation between tasks. Highly correlated tasks are assumed to require similar learning skills. Underwood, Boruch, and Malmi (1978) examined the intercorrelation between paired associate, free recall, serial recall, memory span, and frequency judgment memory tests. Most of the variance was due to individual differences in associative learning related to type of task (free recall versus paired associates and serial learning).

Other correlational studies have examined a wider variety of learning tasks (Stake, 1961; Allison, 1960). Kyllonen and Shute criticize the correlational approach because there is no a priori reason for selecting tasks to study, thus approaching theory building from the bottom up (i.e., using experimental results to drive the theory building process which deviates from the normal scientific process of developing theories that can be disproven experimentally). While correlational studies may be useful to explore the relationships between tasks, they cannot cover a complete set of tasks because there is no theoretical basis for including tasks in the study. Finally, any study attempting to sample a large enough diversity of tasks to begin to generate a comprehensive taxonomy would be prohibitively expensive.

Model-based taxonomies are not new. Teichner (1970) developed a taxonomy of tasks based on information theory. What is new is the use of cognitive models stemming from the information-processing perspective to drive the development of taxonomies of learning skills. One model-based taxonomy stems from Anderson's (1983) ACT (Adaptive Control of Thought) theory. This theory proposes two fundamental forms of knowledge: procedural knowledge and declarative knowledge. Procedural knowledge is knowledge of how to perform an operation, and declarative knowledge is factual knowledge. ACT specifies that declarative is knowledge is learned by the probabilistic transfer of information to long-term memory and that procedural knowledge is learned by knowledge compilation.

Another area in which model-based taxonomies have arisen is in machine learning. Researchers in this area have developed taxonomies of learning strategies. For example, Carbonell, et. al. (1983) proposed a taxonomy of learning strategies consisting of rote learning, learning from instruction, learning by drill and practice, and inductive learning. Michalski (1986) extended this to include learning by deduction.

From the ACT and learning strategies model-based taxonomies, Kyllonen and Shute proposed a taxonomy of learning consisting of four dimensions:

1. Instructional Environment - including learning by rote, discovery, practice, analogy, examples, and didactic learning

2. Knowledge Type - including propositions, schema, rules, general rules, skills, general skills, automatic skills, and mental models.

3. Domain - the degree of quantitativeness and the importance of quality versus speed in decision making

4. Learning systems - including a variety of dimensions such as holistic/serial processing, theory/data driven, spatial/verbal representation, etc.

In addition to capturing the type of knowledge and instruction involved in a learning task, this taxonomy captures characteristics of the environment, the subject material, and the learner. The authors discuss how their taxonomy could be applied to instructional system development.

In the study described in this report, we selected characteristics from the comprehensive taxonomy generated by Gawron, et. al. This taxonomy includes most of the knowledge type, domain, and learning systems dimensions discussed by Kyllonen and Shute.

2.2 **Knowledge Acquisition And Task Type**

Knowledge acquisition is another area in which relativism has come of age. Recently researchers have become more and more interested in basing their selection of a knowledge acquisition technique on the characteristics of the task. The ultimate goal is to find a way to attenuate the well-known knowledge acquisition bottleneck. Gaines (1987) reviewed the major problems associated with expertise elicitation:

1. Expertise may not be available to awareness.

2. Expertise may not be expressible in language.

3. Expertise may not be understandable when expressed in language.

4. Expertise may not be applicable even when expressed in language.

5. Expertise expressed may be irrelevant.

6. Expertise expressed may be incomplete.

7. Expertise expressed may be incorrect.

8. Expertise may depend on situational variable.

Presumably, tailoring the knowledge acquisition process to the task will reduce the problems associated with eliciting expertise.

Clancey (1986) proposed a taxonomy of tasks and suggested that two fundamental problem solving methods could be applied to these tasks: heuristic classification and heuristic construction. Heuristic classification involves the identification of classes that can be defined by a set of attributes and into which items can be categorized by their goodness of match to each class' attributes. It is used for diagnosis, repair, interpretation, and selection. Heuristic construction is used for synthetic tasks, such as design, configuration, scheduling, and planning. In heuristic construction, the problem solver utilizes building blocks, i.e., problem components or partial solutions, and either incrementally builds a solution or constructs a complete solution that then requires refinement until the solution is sufficient.

Chandrasekaran (1985) describes six generic problem-solving tasks in knowledge-based reasoning, including classification, state abstraction, knowledge-directed retrieval, object synthesis by plan selection and refinement, hypothesis matching, and assembly of compound hypotheses for abduction. These tasks correspond to problem solving methods that can be combined to perform knowledge-based reasoning for an application. Bylander and Chandrasekaran (1987) suggest that generic tasks can be associated with a specific knowledge acquisition methodology.

Boose and Bradshaw (1987) proposed a set of knowledge acquisition strategies that link with appropriate problem-solving methods. The knowledge acquisition strategies are establishing distinctions between alternatives, problem decomposition, combining and propagating information, testing of knowledge, combining multiple sources of knowledge, incremental expansion of knowledge, and providing process guidance. Kitto and Boose (1990) developed the Dialog Manager subsystem for the AQUINAS system to select knowledge acquisition strategies for particular application tasks. Dialog manager is only capable of recommending methods associated with heuristic construction or heuristic classification problem-solving tasks, both of which involve primarily problem decomposition and establishing distinctions as knowledge acquisition strategies.

Kitto and Boose caution that a knowledge acquisition system must be able to acquire knowledge about aspects of the problem-solving process that are unique to a given application. For example, Jacobson and Freiling (1988) identified specific knowledge requirements for troubleshooting tasks in addition to the requirements for the more general task of differential diagnosis, such as test set-up and measurement, strategies to control test selection, and interpretations relating test results to diagnostic beliefs. Kitto and Boose report that for electromechanical diagnosis information about component failure rates, test times, test costs, test utility and test dependencies are required.

McDermott (1988) presented a preliminary taxonomy of problem-solving methods based on the assumption that there are families of tasks that share abstract control knowledge and the abstract control knowledge provides strong guidance as to what knowledge is required and how that knowledge should be encoded. He refers to the control methods as role-limiting methods because they strongly guide knowledge collection and encoding, i.e., task specific knowledge fills one of a few number of roles within the control framework. McDermott argues that it is likely there are hundreds of role-limiting methods. He discusses the following role-limiting methods and knowledge acquisition tools:

1. cover and differentiate - implemented in MOLE

2. propose and refine - implemented in SALT

3. qualitative reasoning - implemented in YAKA

4. acquire and present - implemented in KNACK

5. extrapolate from a similar case - implemented in SIZZLE

Finally, Garg-Janardan and Salvendy (1987) describe a conceptual framework for knowledge elicitation that synthesizes Newell and Simon's (1972) theory of problem solving with Kelly's (1955) theory of personal constructs. Their framework suggests that the invariant and variant parts of the problem must be identified by the expert during knowledge acquisition. The invariant parts of the problem space can be defined by a set of characteristics, reflecting the nature of the components of the problem, the problem-solving process, and the adequacy of a problem solution. The variant part of the problem consists of a set of states, initial states, intermediate states, and final states, that cannot be fully enumerated. However, the expert should describe a set of final states and how each of these states may be reached. The authors suggest using the theory of personal constructs to elicit information about the invariant and variant portions of the problem.

2.3 The Goal Of The Current Study

What researchers in psychology and artificial intelligence have neglected to specify is how to determine in the first place whether or not an application task involves a certain characteristic. How do you identify a diagnostic task? How do you know if the task requires declarative or procedural knowledge? Or both? This issue is not entirely self evident but is, in fact, the reason that knowledge acquisition remains largely an art. Good knowledge engineers have little difficulty discerning the fundamental requirements of a task, but there is no formal method for making these judgments and no indication of how accurate they are once the judgments are made. The current study explores these issues and attempts to provide a method for initiating knowledge acquisition that will elucidate the key characteristics of a task and support further knowledge acquisition activities.

3 THE FIRST INTERVIEW

Initially, the research was to entail only a single interview with each of the experts in the selected fields. However, we determined early in the research that one interview would not be sufficient for developing and performing even minimal verification of a taxonomy. Thus, it was decided that two interviews would be performed: one to provide a means of analyzing the problem solving task and generating an initial classification, and one to apply the recommendations made based on the first interview and observe the results. Thus, the primary goal of the first interview was to acquire enough knowledge about each problem solving task to be able to characterize it in some way so that a taxonomy could be developed to direct the second interview. The second interveiw would then be used to informally verify this taxonomy. The following sections describe the approach used to develop the first interview, perform the first interview, and how the interview was performed.

3.1 Developing The First Interview

In developing the first interview, three major aspects had to be addressed. First, a means by which each task could be characterized and rated had to be developed so that a comparison could be made between tasks. Second, a set of problem solving tasks had to be selected for analysis using this method of characterization. Third, a knowledge acquisition approach had to be identified/developed that could be used to acquire the information on each problem solving task. Each of these aspects of the approach is addressed in turn below.

3.1.1 Generating A Set Of Task Characteristics -

As discussed in Section 2, a literature search was performed in both the psychology and artificial intelligence fields to identify existing approaches to problem solving taxonomies. This search helped to identify a list of 123 characteristics that fell into 15 different categories on which a particular problem solving task could be rated. The orignial list of 123 characteristics is provided in Appendix A, along with a discussion of the characteristics by category. This list was intended to be relatively exhaustive by including all the attributes that might be relevant to how problem solving tasks could be categorized. We suspected that some redundancy existed and that some of the characteristics would not prove to be relevant for the problem of knowledge acquisition. However, we wanted to be sure that as much as possible was considered when analyzing a problem solving task.

The list of characteristics compiled for this study originated from a compilation of existing taxonomies (Gawron, Drury, Czaja, and Wilkins, 1989). From this compilation, we generated a list of characteristics which fell into 15 categories:

1. Reasoning Techniques - characteristics related to the manipulation of information during task performance
2. Problem-Solving Techniques - search strategies for finding a solution
3. Inputs - data input to the problem solving process
4. Task Complexity - characteristics of the data array and problem solving space that influence the task
5. Technical Dimension - the degree to which the task requires a technical background or skill
6. Motor Processes - physical requirements of the task
7. Information Processing - characteristics of the way data is manipulated
8. Problem Solving Tasks - cognitive operations on the data
9. Recall - the role of memory in the task
10. Perceptual Processes - the perceptual requirements of the task
11. Environment - physical and psychological characteristics of the environment in which the task is performed
12. Personal Characteristics - characteristics required to perform the task
13. Type of Domain - knowledge-rich and/or high performance
14. Hardware/Equipment/Tools - items or devices used during the task
15. Communication Processes - verbal and nonverbal communication during task performance

We selected these categories and characteristics because of their relevance to knowledge acquisition and system development. We felt that some of the characteristics would be related to how knowledge acquisition should be conducted and others would be more related to how an intelligent system for the task should be designed.

3.1.2 **Selecting A Set Of Problem Solving Tasks -**

In selecting a set of problem solving tasks for analysis in this research, the goal was to find a representative set with as much the variety as was possible. Initially, only 10-12 tasks were to be analyzed, but it became apparent that 15-16 would be necessary to obtain sufficient variety. The following is a list of the tasks/jobs identified for a preliminary analysis:

- maintain systems/diagnostics
- repair systems/making the fix
- communications monitoring/analysis
- photo analysis
- training pilots
- training astronauts
- training air crews (groups to work together)
- training instructors
- air traffic control
- console operations
- weather forecasting/modelling
- program management
- facilities management
- cargo loading
- operating a piece of equipment
- software design
- software maintenance/debugging
- form fill-out
- training reading
- training foreign language
- oil accident investigation
- prospecting
- power grid management
- computer configuration
- chemical analysis
- personnel management
- customer service

- sales
- weapons director/air intercept
- use RMS/other remote manipulator
- leadership training
- surgery
- medical diagnosis
- accounting
- marketing/advertising
- knowledge engineering
- scientific protocol design

This list was generated based on discussions between SwRI and the sponsor. These problem solving tasks cover a broad range of expertise. The goal was to identify as many different areas as possible initially, and then to narrow the set down both in number and specificity, so that human experts could be identified and interviews could take place within the time and budget restrictions.

In order to begin developing some mechanism for categorizing tasks so that we could make a selection based on variability between tasks, we went through each of the 37 initial candidate tasks and checked the characteristics out of the 123 we listed that were relevant. The matrix that was generated appears in Appendix F. Based on this preliminary analysis, a set of distinctive attributes and task types became apparent. The following list provides the task types that we felt needed to be represented in the set selected for interview.

1. diagnostic task
2. training task
3. high performance task
4. form fill-out
5. people-oriented (soft) task
6. design task
7. planning task
8. monitoring with a time factor
9. perceptually-oriented task

10. bin-packing/np-complete task (exponential/combinatorial growth problem)
11. numerical task
12. data intensive (no real time factor), ie. acquire and present

As a result, we interviewed experts in the following areas:

1. **(diagnostics)** medical diagnosis
2. **(diagnostics)** equipment diagnosis
3. **(training)** training pilots
4. **(training)** training a foreign language
5. **(high performance)** flight controller console operations
6. **(high performance/KR)** surgery
7. **(form fill-out)** contracting
8. **(people-oriented)** personnel management/leadership training
9. **(design)** sofware design
10. **(planning)** acquisition program management
11. **(monitoring/time)** air traffic control
12. **(perceptual)** weather forecasting
13. **(bin-packing)** cargo loading
14. **(numerical)** accounting
15. **(data intensive/no time)** DRAIR generation
16. **(planning)** scientific protocol design

Obviously, these tasks were still rather broad and we did not intend to try to perform knowledge acquisition on the entire area indicated by certain labels. Instead, we planned on allowing the experts' specific job requirements to narrow the scope in each problem solving area. Individuals considered experts in the selected areas were identified and asked to take part in the effort. Some of the experts were available through the Air Force, while others were available through SwRI contacts. Most were found in the San Antonio area so as to minimize the time and expense required for travel. A description of each of the tasks, along with the source of expertise and issues concerning the selection of an approach for the second interview, is provided in Appendix B, the Technical Journal.

3.1.3 **Content Of The First Interview** -

The goal of the first interview was to acquire sufficient information about the problem solving task to rate each task on a scale of one to four in each of the 123 task characteristics. However, the interview could not simply consist of asking the expert if he/she felt that the task had certain attributes. For example, we could not ask whether they thought that they used any spatial reasoning or induction. As a result, we had to develop an interview that would allow us to determine, based on the expert's responses, to what extent a particular task involved a particular characteristic. For example, to evaluate the inputs to the task, we constructed the following question:

What types of inputs to the problem do you have? How do you recognize the problem? Do you:
- see something
- hear something
- talk to someone
- feel something
- read something -- book, test equipment, computer display
- detect it based on past data?

These questions provided a guide to ensure that we obtained information about each of the 123 characteristics during the interview. We framed the questions such that they were understandable to a lay person; we attempted not to use any jargon.

Because the first interview was done with little to no knowledge of the task, the interview had to be designed so that it would be appropriate for any task type. Thus, to design the interview, we examined the literature on problem solving in order to identify a standard format for how problems are solved. The standard structure to problem solving comes from the field of "heuristic." Heuristic (or heuretic) is the study of the methods and rules of discovery and invention. Webster's dictionary defines it as involving or serving as an aid to learning, discovery, or problem solving by experimental trial and error methods. The process of problem solving can be subdivided into four major steps (Polya, 1957):

1. Understanding the problem

2. Devising a plan

3. Carrying out the plan

4. Looking back/assessing the results

These steps provide a process by which all problems can be solved. As a result, we used these steps as a way of organizing and classifying the questions that we wished to ask the experts. The questions centered on obtaining the information we needed to determine how an expert performs each of the four steps in problem solving. Such information would then be useful in determining how to rate each of the task characteristics with respect to a problem solving task. The result was a questionnaire consisting of 67 questions. The original questionnaire is given in Appendix D. Not all of these questions needed to be asked in every interview. Some depended on the answers to other questions. The primary questions are marked with an asterisk.

3.2 Performing The First Interview

The length of the questionnaire in the initial interview was rather intimidating. In order to put the expert at ease from the start, we made sure that he/she understood what was stated at the top of the questionnaire:

> "There are no right answers or good answers to these questions. Some of the questions may be phrased so that you believe one or another response is appropriate or somehow better than another. For example, it may sound good to say you plan up front all your actions in solving a problem or doing the job even if some of those actions occur somewhat automatically. Please do not fall into this bias. For this example, it is good to plan but it is also good not to plan too much and to have some actions that occur automatically. We want to assess all aspects of your job with as much fidelity as possible. What results from these interviews will help us to better understand the unique aspects of your work and how we could learn more about it in the future so we can design computer systems that help you perform your job more easily.
>
> Also, we want to assure you that under no circumstances will your answers go to your supervisor or anyone else outside of this room. You are responding to this questionnaire completely anonomyously. Because of this, we want you to provide the operational answers to these questions, not the official ones. We want to know what you really do on your job."

These instructions attempted to win the confidence of the expert and to provide a sense of anonymity. We did not read these instructions verbatim at each interview, instead on the first contact over the phone, we discussed the research project and paraphrased these instructions. All of the experts seemed very comfortable in the interview and seemed to attempt to present a completely faithful description of their tasks.

We conducted the initial interview in an open question/answer format. We attempted to keep the interview as flexible as possible, allowing the expert to continue to discuss an issue until he/she had exhausted that line of inquiry. At those points, we would ask another question. Our only goal was to have answers for each of the questions whether we had directly asked the question or the expert had volunteered the answer during the course of discussion.

We conducted the interview at the expert's workplace -- either in their office or a nearby conference room. The experts had access to the material they generally use in the course of their jobs and could refer to the material if necessary. In a couple of cases, we obtained a brief tour of the facility or lab where the task was performed.

In the initial interview, we collected audiotapes of the interview and took notes. We found the audiotapes were not useful to us later in characterizing the task because we were able to acquire the detail that we needed from our handwritten notes. Furthermore, the quality of the tapes were not always very good. The lack of use of audio tapes is not a general conclusion for knowledge acquisition, rather we found they were not useful for this research project. Where extensive and accurate detail is needed, we suspect that audio tapes are quite useful.

4 EVALUATING THE FIRST INTERVIEW

The major goal in evaluating the results of the first interview was to develop a principled way of classifying tasks based on the knowledge acquired from the first interview and to make recommendations concerning how to proceed with the knowledge aquisition process based on this classification. The data generated from the first set of interviews consisted of a 16 by 123 matrix with a rating of zero to four for each of the 123 characteristics for each of the 16 tasks. Rating of the characteristics for each task was performed as follows:

- Two raters reached agreement on the ratings for each task on the 123 attributes. The raters used a 5 point Likert-type scale in which 0 indicated the attribute is not relevant at all for the task up to 4 indicating that the attribute is critical for task performance.
- The ratings were used as a measure of the importance of a characteristic for task performance. Initially, before the first interview, we simply checked whether or not the characteristic was involved in task performance. That approach allowed no discrimination between central and peripheral characteristics of a task. We adopted the 5 point scale to provide greater discrimination.
- We assigned the ratings for each task after the inital interview and again after the second interview. We considered each characteristic in relation to a task and reached agreement on a value based on the information we acquired in the interview. Rating each task on the 123 characteristics required approximately 30 minutes.

The resulting matrix is provided in Appendix G. We wanted to answer a number of questions concerning the data in the matrix, including what characteristics are relevant for a meaningful classification of the tasks, which tasks are related based on their characteristics and which were not, and what the key characteristics are about a class of tasks that would affect the way we would want to proceed with the second interview.

Based on the first interview, we had a good, general sense of what each task involved. We also felt comfortable in making recommendations concerning how an intelligent tutoring system should be developed and how the subsequent interviews should proceed. However, the ideas on how we would approach the rest of the knowledge acquisition process for a given task was highly dependent on our experience in performing knowledge acquisition. We found it difficult to verbalize what made us decide to choose one direction over another. The approach was more a "gut feel," which was exactly what we were trying to avoid. As a result, we analyzed the data in a number of formal ways, including simple permutations of the data such as orderings and comparisons and statistical analyses such as cluster and factor analysis. These analyses are described below.

4.1 A Preliminary Look At The Data

A preliminary look at the data involved an informal approach to manipulating the data. The ratings for each task on the 123 task characteristics were entered into a database and various analyses were performed, including pairwise comparisons, orderings, and counts. The following summarizes these informal analyses and the results. The data reports appear in Appendix I.

4.1.1 Pairwise Comparison -

The pairwise comparison of the data generated a count of the number of equal ratings for each possible pairing of the 16 tasks. Thus, for example, the rating given to each of the 123 characteristics was compared for pilot training and accounting and a count generated for how many were exactly equal and how many were either equal or different by only one point on the rating scale. The pairwise comparison for pilot training and accounting resulted in a count of 29 out of 123 characteristics that were rated identically, and a count of 53 of the 123 characteristics that were rated similarly. Of all of the 124 pairs generated, the minimum count of identical ratings was 28 and the maximum count was 72. The minimum count of similar ratings was 51, while the maximum count was 101. Using these pairwise comparisons, the data was printed ordered by least to most equal and least to most similar. These reports appear in Appendix I.

Based on the orderings, it is possible to quickly identify tasks that appear to be more and less similar according to the ratings they received on the 123 task characteristics. For example, it is apparent that pilot training is very dissimilar to almost all other tasks examined because it appears in nine of the first ten pairs in the least similar ordering. Air traffic control, surgery, and console operations also appear consistently as being least similar to most other tasks. These tasks seem to generate individual clusterings, possibly based on the fact that they all had a physical component to performance of the task. On the other hand, tasks such as form fill-out, leadership training, accounting, program management, DRAIR generation, software design, and protocol design constitute the majority of the pairings in the twenty-five pairs that were most similar (the last 25 pairings in the similar listing). Based on this analysis, one could conclude that these seven tasks clustered due to some common set of attributes, possibly related to issues in communications and lack of procedural knowledge to direct the progress of task performance. The remaining tasks, such as cargo loading, weather prediction, equipment diagnosis, medical diagnosis, and language training appear to be scattered around among the most and least similar tasks. It is unclear from this minimal analysis to what this scattering may be attributed.

4.1.2 Ordered Characteristic Count -

Another analysis performed on the data involved examining the ratings with respect to the characteristics themselves. This analysis indicated which characteristics were discriminating. Those characteristics that receive similar ratings for all 16 tasks do not discriminate between those task. Those that are maximally different between tasks are the most discriminating.

A count was generated for each characteristic for each of the five possible ratings. That is, the number of tasks receiving a rating of 0, of 1, of 2, of 3, and of 4 was provided for each characteristic. Thus, for example, the characteristic "statistical" had 13 tasks where the rating was 0, two tasks where the rating was 1, one task where the rating was 2, zero tasks where the rating was 3, and zero tasks where the rating was 4. This count was then printed out in two different reports, one ordered by lowest to highest count for the zero ratings and one ordered by lowest to highest count for the four ratings. These reports appear in Appendix I.

Based on this analysis, several characteristics appear to be non-discriminating because they have a 0 rating for most of the tasks. These characteristics are: kinesthetic, sleep, lighting, scanning a display, statistical reasoning, computerize, tabulate, vehicles, reflex, weight, acceleration, complex continuous motor responses, contaminants, age, compound (actions), electricity, gender, height, code, isolation, magnetism, and weapon systems. Only a few characteristics seemed to be non-discrinimating due to a high count in four ratings. These were verbal (10), temporal (10), and procedural (12). Other characteristics, such as branching, dynamism, cognitive attentiveness, instruments, spatial, visual, historical, instrumentation, plan, direct, supervise, and monitoring, appear to have high counts in the 0 and 4 ratings, and lesser counts in the middle ratings of 1, 2, and 3, thus forming a concave curve with their task counts. These characteristics should, therefore, provide a means of distinguishing tasks.

4.1.3 Important/Unimportant Characteristics By Task -

A final informal data analysis examined the most and least important characteristics for each task. A list was generated for each task that provided the characteristics that received a zero rating and a four rating. This provided a means of seeing, by task, which were key attributes and which were not. These lists appear in Appendix I. In addition, the 0-rated and 4-rated characteristics are listed for each task in the Technical Journal, Appendix B.

4.2 Statistical Analyses

The ratings of the characteristics entered into a factor analysis and cluster analysis. Some characteristics were dropped from the analysis because the ratings for all 16 tasks was 0. Additionally, we collapsed the scores across a category of characteristics if a summary score for that category made sense. For example, a summary score for the category "inputs" reflects the degree to which the task requires a lot of external information. A summary score for the category "reasoning techniques" would not produce a meaningful index.

4.2.1 Factor Analysis Of The 123 Task Characteristics -

An inspection of the eigenvalues of the principle components factor analysis lead to three factors being retained. The three factors were rotated with a varimax rotation to allow for correlated factors.

Factor 1 accounted for 28% of the variance. This factor seems to be a design factor with characteristics such as propose and refine, decompose, communication, and a large amount of information recalled loading heavily on the factor. Factor 2 accounted for 18% of the variance. This factor indicates an underlying dimension in the questionnaire corresponding to tasks in which a physically-based skill plays a large role. Characteristics such as spatial reasoning, deduction, specialization, a large number of inputs, high complexity, a large perceptual component, an adverse environment, psychologically stressful, and high performance domain had high loadings on this factor. Finally, factor 3 accounted for 12% of the variance and revealed a factor for tasks requiring statistical reasoning, modelling, and inductive reasoning.

4.2.2 Cluster Analysis Of The 16 Tasks -

An eight cluster solution revealed the following task clusters:

1. software design and protocol design
2. pilot training and surgery
3. cargo loading, accounting, program management, leadership training, equipment diagnosis, drair generation, form fill-out
4. medical diagnosis
5. teaching a foreign language
6. air traffic control
7. weather forecasting
8. console operations

Software design and protocol design clustered because of their similarity on the following characteristics: temporal reasoning, forming sub-goals, generate and test problem solving, propose and refine problem solving, acquire and present, decomposition of the problem, and their perceptual, environmental, psychological, and physical requirements. These problems are synthetic problems, requiring the problem solver to decompose the problem, synthesize a solution, and present the results. They do not involve perceptual skills, are not performed in an adverse environment, are not stressful and do not require specific physical characteristics.

Pilot training and surgery clustered because they correspond on the following characteristics: spatial reasoning, temporal reasoning, modelling, forming sub-goals, use of a formula/procedure/algorithm, specialization, psychological stress, large amount of information recalled during task performance, and the overall task has both knowledge rich and high performance components. Although on the surface pilot training and surgery may appear to be very different, they share many fundamental characteristics. The problem solver must reason about spatial and temporal information. They form sub-goals and often use a formula or procedure to accomplish a sub-goal. Finally, they are both stressful.

The third cluster emerged because of correspondence on the following characteristics: forming sub-goals, acquire and present problem solving strategy, no perceptual, physical, or psychological requirement, and they are all knowledge rich tasks. This cluster relates to the differentiation that has emerged from this study concerning the type of training received to become proficient at the task. This differentiation will be discussed in detail in Sections 4.5 and 4.6.

4.2.3 **Summary** -

The factor analysis revealed three main factors in the questionnaire. The first factor consisted of characteristics related to design tasks, the second factor consisted of characteristics of tasks involving a physically-based skill, and the third factor corresponded to characteristics of tasks involving statistical reasoning and mental modelling. These factors were evident in the task clustering. The first cluster, software design and protocol design, includes the design tasks we examined. The second cluster, pilot training and surgery, are tasks that require physically-based skills. The relevance of the third factor is less clear. Protocol design, medical diagnosis, weather forecasting, and drair generation require statistical reasoning while software design, weather forecasting, console operations, surgery and medical diagnosis require the use of mental models. This factor does not clearly map to the cluster analysis.

4.3 An Analysis Based On Experience

Once all of the data was analyzed, both informally and formally, to see if any insight could be gained into the relationships among tasks and characteristics, we still had difficulty developing an interpretation of the data that could provide some direction to the research. As a result, we spent some time brainstorming based on our own experience in knowledge acquisition, describing what we felt would be a reasonable approach to the second interview for each task and why. We also discussed how we imagined a tutoring system for such a task should be designed and why. Initially, much of what was generated was based on "gut feel" or intuition, which was exactly what we were trying to avoid in this research. However, after a while some patterns began to emerge that determined how we should proceed with each of the sixteen tasks and why. Many of the rules of thumb for preceding with the second interview are listed at the beginning of the notes in the Technical Journal, Appendix B. However, some other more general patterns also emerged that revolved around whether or not the task was formally trained.

The issue of whether or not a task is formally trained was not clearly delineated in the characteristics by which we were rating each task. However, it was clear from our initial interview the process of becoming an expert differed between tasks, and we found ourselves recommending an examination of the curriculum for the second interview for any task that was formally trained in the operational environment. As a result, we categorized the tasks by whether or not an individual received formal training in performing the actual task(s) that constituted their area of expertise. The tasks fell into two relatively equal sets where aircraft piloting, air traffic control, console operations, weather forecasting, cargo loading, foreign language, surgery, and medical diagnosis all are heavily trained before an individual is allowed to perform the task, and where equipment diagnosis, form fill-out, program management, DRAIR generation, software design, leadership, accounting, and protocol design are not formally trained. Tasks in the former set may or may not require any general education beyond high school, but they are extensively trained, often to the point where the problem solving methodology for the task has become highly proceduralized. Tasks appearing in the latter set tend to require at least a general background education in a particular field such as business, computer science operations research as a foundation on which they can build expert skill through experience on the job.

Once these two sets of tasks were generated, we then examined the other characteristics of the tasks to see if there were any unifying themes. Among the formally trained tasks, the unifying characteristics seemed to be an issue involving human safety, as well as quite often a physical component. They were also highly proceduralized, even if the experts did not necessarily follow a procedure once they became expert. Individuals entering the field are taught a procedure to follow that allows them to become efficient problem solvers in the domain. Tasks that were not formally trained tended to be less well-defined in terms of goals and results. Such tasks did not tend to have definitive right and wrong answers and problem solving tended to be oriented towards breaking the task down into relatively independent subtasks. This approach helped to deal with the complexity and inexactness of the problem.

In addition in those tasks that involved a procedure, the skills required for the task tended to build sequentially on one another. So for example, when a person learns to fly a plane they begin by learning how to fly level, then to perform simple maneuvers, then to take-off, then to land. Each skill builds on the previous skill. However, the skills required in the set of tasks that are not formally trained tended to be componential. That is, the problem solver has a toolbox of skills relevant for different aspects of the problem solving process. They learn each of the skills relatively independently. For example, the expert in protocol analysis had skill in experimental design, statistical analysis, research methodology, and electronics. These are independent skills and are learned during a formal education in a content areas, such as biomedical engineering. Based on these observations, we labeled the first set of tasks sequential tasks and the second set we call componential tasks.

4.4 Results And Conclusions From The First Interview

When all of the various analyses of the data from the first interview were compared, we began to see patterns in the data that confirmed our experiential analysis. For example, the seven cluster statistical analysis generated the following clusters:

1. pilot training, surgery
2. software design, protocol design, cargo loading, accounting, program management, leadership, equipment diagnosis, DRAIR generation, form fill-out
3. medical diagnosis
4. foreign language training
5. air traffic control
6. weather forecasting
7. console operations

The list of tasks in the second cluster corresponds exactly, except for cargo loading, with the set of tasks that ware not formally trained. The remaining seven clusters, which almost all are made up of a single task, correspond to the set of tasks that are formally trained.

The eight cluster analysis given in Section 4.2.2 corresponds with and reinforces our informal analyses. The first cluster, software design and protocol design, and the large third cluster primarily contain tasks that do not receive formal training in the operational environment, such as program management, accounting, and drair generation. However, these tasks require a lot of background knowledge often obtained through formal education. The remaining clusters are tasks that receive a large amount of training in the operational environment. Surgical training stems from years of internships and residencies, air traffic control involves training specific to each airport at which the controller works, and console operations requires both a formal educational relevant to the specific console and continual on-the-job training to remain proficient.

In addition, the factor analysis of the characteristics indicated that the clusterings from both the seven and eight cluster analyses were due to differences among the design, high performance, and model-based/statistical factors that roughly correspond to the attributes we saw intuitively as being key to the commonalities that were repsonsible for the generation of the two sets of tasks. The information gained from correlating all of these various analyses was used to begin generating a tentative problem solving taxonomy to support the knowledge acquisition process. Figure 2 illustrates a proposed taxonomy as a result of the research. At the point of completing the analysis of the first interview, we had generated the first layer of this taxonomy, namely the breakdown into sequential vs. componential.

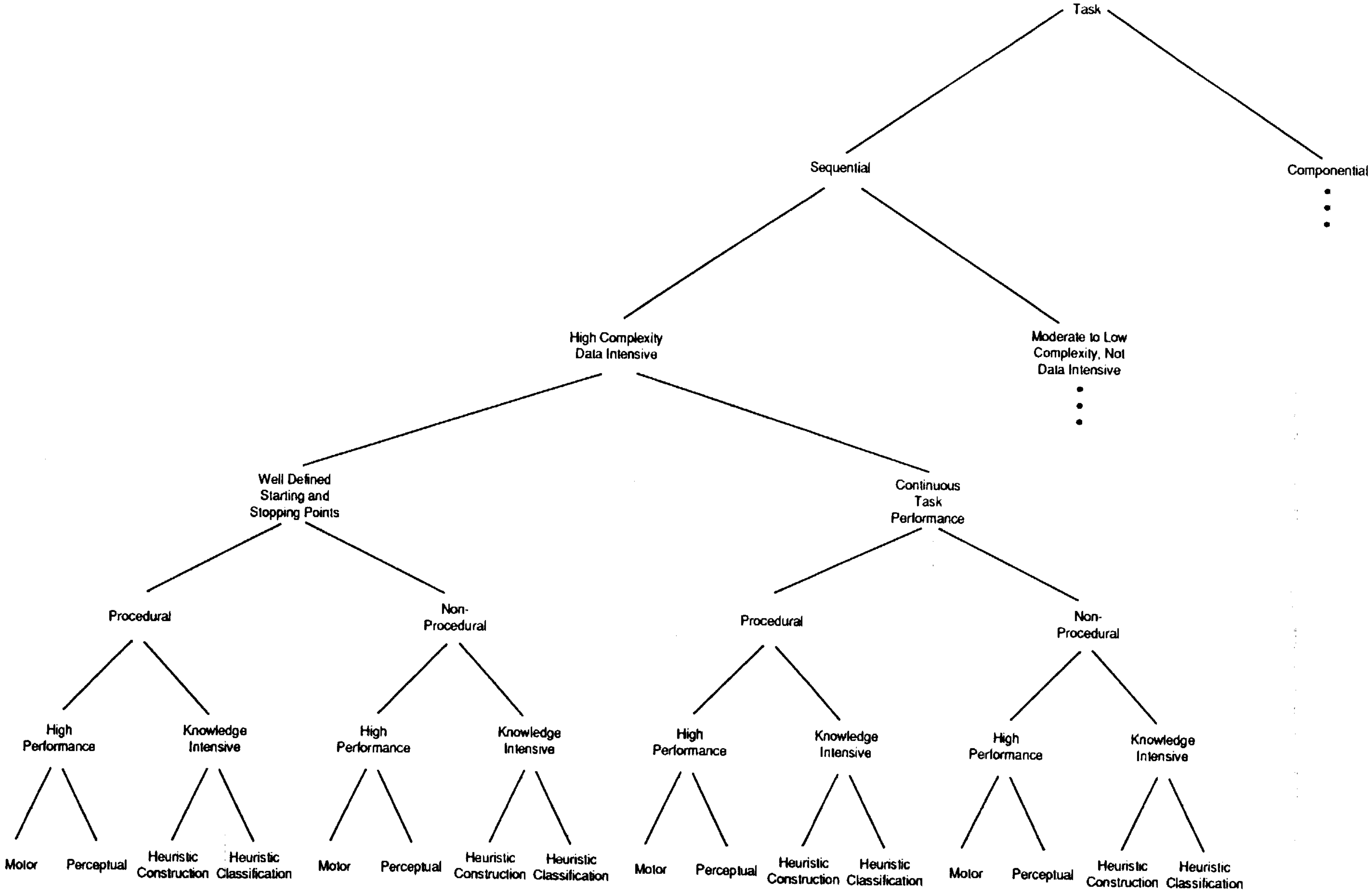

Figure 2. The proposed problem solving taxonomy to support knowledge acquisition

5 THE SECOND INTERVIEW

As a result of the analysis of the first interview, we generated a particular approach to each of the sixteen follow-up interviews that we would perform. Further details on the approach suggested for each task, and the justifications, are provided in the Technical Journal, Appendix B. In the Technical Journal, we also attempted to document many of the rules of thumb that seemed to be driving the decision to use an example, discuss a curriculum, or perform a task breakdown, and to what level of detail.

5.1 Developing The Second Interview

Once a clustering of the tasks became apparent, we examined the implications for the second interview for each task. However, when we compared what we felt we should do for the second interview based on our own intuition, versus what seemed appropriate based on the clusterings, we saw that the clusterings did not have as much impact as expected on the desired approach. Based on this assessment, we determined that the second interview is still too early in the knowledge acquisition process for much delineation to take place in terms of how to proceed with the knowledge acquisition task. For example, even though a wealth of information is available through existing curriculums for those tasks that are formally trained, we sometimes felt that the second interview was too early to effectively utilize the information. In most cases, we believed that going through an example in some form would be the most appropriate approach to the second interview. The differences among tasks was exploited mainly in how the second interview should elicit the example, how many examples should be examined, and the way the examples should be framed to gain further insight into the task.

The major exceptions to the use of an example were foreign language training, software design, program management, and leadership training. Foreign language training was an exception because an example is almost meaningless, so examination of a component of the curriculum was recommended. Software design and program management were exceptions because the tasks are so large and ill-defined at their highest level that an example would have little meaning even if it could be formulated. Thus, we selected one of the components of software design and of program management on which to focus further discussion. This would allow an iterative and principled approach to breaking the task down into sub-tasks until a task of a workable size was found. Leadership training was an exception because it was unclear how an example could even be formulated from which a discussion could evolve. Because there are a number of techniques that are used in leadership training (TQM) we chose to examine one of those techniques, namely team building.

One minor exception to the use of examples in the second interview occured with aircraft pilot training. For this task, the desired approach was to examine an example, but we wanted to examine the easiest examples, preferably from the first few flights that a student pilot would take. In this case, a well-defined curriculum existed and it was used to guide the selection of the examples that would be most useful in futhering our understanding of the task. Of course, this is how they teach the students to perform the task, as well, through the use of well-selected examples.

In the cases where the second interview should consist of examining an example, the differences among tasks was exploited mainly in how the second interview should elicit the example and how many examples should be examined in that second interview. In general, if the task is data intensive, then a sequence of examples that built on increasing data complexity was used. In cases where the task included a strong procedural component, the example was to be used to provide structure, but general rules were expected as part of the outcome of the interview.

As a result of the process of generating recommendations on how to approach the second interview for each task, additional levels in the problem solving taxonomy were becoming apparent. Issues concerning

1. complex/data intensive vs. less complex/minimal use of data

2. well-defined begin and end points vs. continuous task

3. procedural vs. non-procedural

were used to help determine the appropriate approach to the second interview. These levels can be seen in the taxonomy provided in Figure 2.

5.2 **Performing The Second Interview**

The second interview was performed much as the first. After we developed the approach to the second interview, we contacted the expert. If we wanted the expert to discuss a specific example or if we wanted them to describe the data that they use in problem solving, we asked the expert to bring the appropriate materials to the interview. This material and our chosen strategy guided the interview process. We had much less control than in the first interview because the example or relevant data were unknown to us at the start. However, the process was still an interview; we asked questions freely during the problem solving process. We also interjected suggestions concerning how to simplify or complicate an example in order to test our conception of what caused a task to become more complicated.

Again, we conducted the interview at the expert's workplace and they had access to any additional material they needed. In many cases, we were able to conduct the interview in the environment where the task took place, such as in aircraft cockpit simulator, an operating room, or the weather map room. We chose not to audio tape any of the interviews because we found the quality of the tapes to be low, they interrupted the flow of the interview, and we did not need them later for our purposes. However, we did take extensive notes and based our analysis on how much knowledge we accumulated on whether or not we could write down information that could serve as a guide for designing and building a tutoring system. The experts were assured that their responses would remain anonymous. The interviews lasted an average of 1.5 hours.

6 EVALUATING THE SECOND INTERVIEW

Two goals existed for evaluating the results of the second interview. One goal was to confirm or refute the classification scheme devised for the selected problem solving tasks from the first interview. This was important in order to determine the effectiveness of that first interview. The second goal was more fundamental with respect to the goals of the overall project, namely to determine if the classification scheme and the pairing with knowledge acquisition techniques was appropriate. The first goal was fairly easy to assess and is discussed in Sections 6.1 and 6.2. The second goal is much harder, and is addressed in Section 6.3.

Once a second interview for a task was performed, we again rated the tasks along the set of characteristics. However, this set consisted of 124 characteristics because we broke the training characteristic used in the initial ratings into general education vs. specific training in the operational environment for each of the sixteen tasks. This allowed the impact that the existence of formal training seems to have on knowledge acquisition to be explicitly represented.

The rating based on the second interview was performed independently of the ratings given after the first interview. This would allowed us to look at how much the ratings changed from one interview to the next, thus providing some indication of how our impression of each task changed. Based on the ratings given for the 124 characteristics for each of the sixteen tasks, the same analyses were performed on the resulting matrix to see if any significant changes occurred in how the tasks clustered based on the second interview. These analyses are discussed further below.

6.1 A Preliminary Look At The Data

The same informal data analyses that were performed on the ratings from the first set of interviews was performed on the ratings from the second set of interviews. The results of these analyses appear in Appendix L. A comparison between the analyses from interview one and two appear below.

6.1.1 Pairwise Comparison -

The pairwise comparison for the second interview did differ some from the first interview. For example, pilot training did not dominate quite so heavily the position of being least similar to any other task. It constituted only four of the first ten entries in the table, whereas in the first interview it constituted nine of the first ten entries. However, pairs containing pilot training, air traffic control, or surgery made up the first ten pairs in the least similar listing. In the set of the ten least similar task pairings, one of these three appeared with such tasks as DRAIR generation, accounting, language training, leadership, and program management. These pairings illustrate the distinction between the tasks that have physically-based component and some of the tasks that are larger in scope and less well-defined. In addition, the less well-defined tasks in these pairings, along with form fill-out, protocol design, and software design again constitute the majority of the pairings in the twenty-five pairs that are considered most similar (the last 25 pairings listing in the similar listing). Thus, the primarily knowledge-based tasks still cluster, with the addition of language training, as they did in the analysis from the first interview. The remaining tasks, cargo loading, weather prediction, equipment diagnosis, and medical diagnosis, appear to be scattered among the most and least similar tasks as they were in the initial analysis. Thus, though certain differences appear between the analyses from the first and the second interview, the basic relationships still hold between the sixteen tasks based on their characteristic ratings.

6.1.2 **Ordered Characteristic Count** -

The major difference between the characteristic counts from the first and the second interviews is that in the second interview we rated many more characteristics with a zero. This was probably due to the fact that the second interview helped us to focus on the specific task and thus, many characteristics became less relevant. Based on the analysis from the second interview, the following characteristics appear to be non-distinguishing because they have a 0 rating for most of the tasks: inductive, kinesthetic, perceptual speed, gross (motor skills), contaminants, lighting, scan display, repetitive, fatigue, negotiates, induce, response chaining, code, introspective accuracy, schedule, physical strain, instructs, confinement electricity, relfex, analogical, compound, complex continuous, interpretive movement, weight, computerize, test equipment, analogs, acceleration, vehicles, height, gender, weapon systems, sleep, magnetism, and isolation. This list constitutes 14 more characteristics where thirteen or more tasks received a rating of zero for the characteristic than did in the rating after the initial interview. In the analysis of the data from the second interview, no characteristics seemed to be non-distinguishing due to a high count in four ratings (10 or more tasks getting a four rating for the characteristic). Many of the characteristics that had high counts in the 0 and 4 ratings, and lesser counts in the middle ratings of 1, 2, and 3 from the first interview did not have nearly the concave shape to their rating numbers based on the second interview. Thus, these characteristics may not be as distiguishing as they might have appeared to be initially.

6.1.3 **Important/Unimportant Characteristics By Task** -

As with the data from the first interview, this informal data analysis examined the most and least important characteristics for each task. A list was generated for each task that provided the characteristics that received a zero rating and a four rating for each task. This provided a means of seeing, by task, which were key attributes and which were not. These lists appear in Appendix L. In addition, the 0-rated and 4-rated characteristics are listed for each task in the Technical Journal, Appendix B.

6.2 Statistical Analyses

The second ratings of the characteristics entered into a factor analysis and cluster analysis. The characteristics entered into the analyses included the additional characteristics concerning training and, as in the first analyses, we collapsed the scores across a category of characteristics if a summary score for that category made sense.

6.2.1 Factor Analysis Of The 124 Task Characteristics -

An inspection of the eigenvalues of the principle components factor analysis lead to three factors being retained. The three factors were rotated with a varimax rotation to allow for correlated factors.

Factor 1 accounted for 30% of the variance. Characteristics such as cover and differentiate, inputs to the problem, problem complexity, perceptual requirements, psychological stressors, spatial reasoning, temporal reasoning, and communication loaded heavily on this factor. This factor appears to represent a cluster of characteristics associated with very complex, very demanding tasks. Factor 2 accounted for 15% of the variance and is associated with characteristics such as case-based reasoning, generalization, knowledge rich aspects, and no perceptual, psychological or physical requirements. This set of characteristics describes tasks that are cognitively-oriented, requiring a knowledge of past problems but with no physical component. Finally, factor 3 accounted for 15% of the variance and is associated with the use of means-ends analysis in problem solving and data oriented heuristic search. This represents a set of tasks in which the data drives a means-ends search of the problem space.

6.2.2 Cluster Analysis Of The 16 Tasks -

An eight cluster solution revealed the following task clusters:

1. software design and leadership training

2. air traffic control, surgery, and pilot training

3. cargo loading, accounting, program management, form fill-out, and drair generation

4. console operations and medical diagnosis

5. protocol analysis

6. weather forecasting

7. equipment diagnosis

8. foreign language training

Software design and leadership training clustered because of correspondence on the following characteristics: temporal reasoning, case-based reasoning, means-ends analysis, forming sub-goals, generate and test strategy, and problem decomposition. These tasks also require communication between participants.

Air traffic control, surgery, and pilot training have both knowledge rich and high performance components. They are different than most of the other tasks we examined because they require so much input to the task and the input is very complex. These tasks clustered because they can be characterized as tasks requiring spatial reasoning, means-ends analysis, formation of sub-goals, use of formula/procedure/algorithm, problem decomposition, a large number of inputs to the problem, complexity, and perceptual, psychological, and physical requirements.

The third cluster is similar to the third cluster obtained in the cluster analysis of the initial ratings but it lacks leadership training and equipment diagnosis. This roughly corresponds to our breakout of tasks that require a lot of background knowledge but are not trained formally for the environment in which they will be performed. These tasks cluster because of correspondence on the following characteristics: formation of sub-goals, use of formula/procedure/algorithm, a moderate amount of input to the problem solving process, a lot of communication processes, no statistical or spatial reasoning, and no perceptual, environmental, psychological, or physical requirements.

Console operations and medical diagnosis are both diagnostic tasks. They require the problem solver to engage in temporal and case-based reasoning and to model the system states. Also, they are data driven, utilize a cover and differentiate problem solving strategy, have some use of procedures, and occasionally require the problem solver to return to the definition. Finally, there are some perceptual, environmental, and psychological requirements for task performance.

6.2.3 **Summary** -

The factor analysis revealed three main factors in the questionnaire. The first factor consisted of characteristics associated with tasks involving a physically-based skill, having perceptual requirements, and requiring spatial and temporal reasoning. The second factor corresponded to knowledge rich tasks involving no perceptual requirements or environmental/psychological stressors. The third factor was related to tasks involving means-ends heuristic search in a data-driven fashion.

As in the first set of analyses, these factors were related to the clustering solution in the cluster analysis. Air traffic control, surgery, and pilot training as well as console operations and medical diagnosis have physical and perceptual requirements. The remaining tasks can be characterized as primarily knowledge-based and involving no perceptual requirements or environmental/psychological stressors. The relationship of the third factor to the clustering solution is less clear. Many of the tasks (e.g., medical diagnosis, console operations, and weather forecasting) are data-driven and require some means-ends analysis (e.g., program management and pilot training).

The clusters are fairly similiar to those that emerged from the first ratings. Cargo loading, accounting, program management, form fill-out, and drair generation clustered in both solutions as did pilot training and surgery. Weather forecasting and foreign language training never clustered with other tasks. In the second clustering solution, medical diagnosis and console operations clustered which was not suprising because they both involve diagnosis. There was inconsistency between the cluster from the original ratings of software design and protocol design and the cluster from the second ratings of software design and leadership training. We determined that software design and protocol design are very different tasks. Protocol design involves a knowledge of experimental and statistical methods and is much more formalized than software design. Software design is a true design task, involving decomposition, and propose/refine and generate/test problem solving strategies.

Also, the second clustering solution confirmed our contention that two main categories of tasks exist: those that are formally trained and those that are not. Clusters 2, 4, and 6 (containing air traffic control, surgery, pilot training, console operations, medical diagnosis, and weather forecasting) include the formally trained tasks. With the exception of cargo loading, the others are not formally trained.

6.3 An Analysis Based On Experience

In evaluating the results of the second interview to determine how effective the knowledge acquisition approach used was, a key issue arose concerning how one can determine the amount of knowledge acquired from a knowledge acquisition session. It seemed that the best way to assess the effectiveness of a knowledge acquisition technique is to somehow quantify the amount of knowledge that was obtained in a given period of time. In addition, in order to truly determine if one knowledge acquisition technique is superior to another in a given situation, a formal experiment must be run that is designed to remove all potential biases from the process, such as variances due to the domain experts and knowledge engineers. Interviews and ratings must be performed independently. Thus, to fully assess the effectiveness of the second interview with respect to the knowledge acquisition technique was well beyond the resources of the current effort. Some suggested approaches to the problem are discussed in Section 7.2.

In a less formal way, however, we did have one data point concerning the amount of knowledge obtained from an interview. Though most of the analysis of the interviews was done based on the ratings for each task, we did have one additional source of data for each interview performed, namely our hand-taken notes from the interview itself. In most cases, the amount of notes taken and the ease with which they were obtained seemed to provide a rough assessment of the success of an interview with respect to the amount of knowledge obtained. For example, the notes from one interviewer on cargo loading were 10 pages, on air traffic control seven pages, and on weather forecasting 10 pages. We felt that these interviews were highly successful due to the amount of information gained and the organization of that information. Most of the other interviews were only two to four pages in length, indicating that a lesser amount of information was obtained. There were some exceptions, such as accounting, surgery, and aircraft piloting, where fewer notes were taken because some much of the information was visual. However, in general fewer notes often coincided with the feeling that less information was obtained because it was not available or the task was still just too nebulous. Striking examples of this latter situation were program management and equipment diagnosis.

6.4 Results And Conclusions From The Second Interview

Based on the results of the second interview, the delineation between tasks that are formally taught and those that were learned more or less on the job remained from the first to the second interview. Task clusterings remained very similar, though the characteristics themselves were not always rated the same across the tasks. When examining the amount of knowledge we felt that we acquired from an interview and the ease with which it was acquired, the fact that a task was explicitly trained played a tremendous role. Those individuals who had taught, or were teaching, the task were much better prepared to talk about the task in an organized and explicit fashion. They were also much more capable of generating examples and explaining them since this is something in which they have had considerable practice. When the task is not formally trained, the knowledge acquisition process is much more dependent on the skills of the knowledge engineer to guide the interview and make sense of the information collected. This is not always possible in only a couple of hours of discussion with an expert. However, it is also important to be able to detect when the expert does not know enough about the area of interest and to try to find another expert. We had two experts in this effort that, if we were tasked with actually building a tutoring system, would need to be supplemented with other experts more involved performing of the actual task on a day-to-day basis.

Based on this experience, we offer the following rules of thumb for developing a second interview based on the results of the first interview:

- In general, if the task has a distinct starting and stopping point and the task is well-defined, then try to go through at least one example in the second interview. This example should be selected from a continuum of easy to hard, starting with easier ones. What makes the task easier or harder should be identified up front and explained with each example. There are a number of exceptions:
  - If the problem solving task extends over more than a couple of hours, then you should break the task down further into sub-tasks and examine them before preceding to an example.

  - If the task is distinctly procedural, then the example should be used only as a way of eliciting the general procedure and following how it is applied to a specific situation. There is no point in getting specific information on an example and then having to try to generalize from it when the generalization exists in the expert's head.
  - If the task is very data intensive, then a summary of the relevant data elements, where they come from, and how they are used should be discussed before the example is discussed.
  - If the task uses a complex interface such as a console, cockpit, or set of tools, then these should be discussed in terms of their components and their functions before going into an example.
  - If the task is formally taught, then the examples should be selected initially from the early part of the curriculum and discussed as they progress to more complex ones.

- If the task is ill-defined, but a curriculum exists, then use the curriculum to guide the interview process and ignore using examples.
- If the task is ill-defined or takes too long to go through an example, then the interview process should continue to explore the task area to determine subtasks that can be examined further.

Thus, the recommendation for the second interview is heavily example-based. However, a word of caution is in order. The examples that we discussed with the experts were not usually easily reduced to a series of attributes and values that could be entered into a knowledge acquisition tool for generalization into rules. The examples often had many aspects and were quite complex. In addition, though the examples were always used as a way of structuring the interview, they were not the sole source of knowledge from the interview. The experts provided many insights into the relevance of various attributes and their effect on the problem solving task that would be lost on an automated knowledge acquisition tool. In addition, there was often a general procedure implicitly used within the analysis of a specific example that would not necessarily be apparent just from a few examples or even from many hundreds of examples. Thus, just a collection of examples from which we could generalize would be a highly inefficient and ineffective way to acquire knowledge for building a tutoring system or a knowledge-based system. Use of examples can provide a much richer medium for obtaining knowledge than simply the collection of attributes and values as they relate to a solution. Thus, most automated knowledge acquisition tools available today are at an extreme disadvantage because they do not have the variety of methods for obtaining knowledge that are available to a human.

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7 CONCLUSIONS

The results of this research are necessarily general. Being only a small initial attempt at a fundamental problem in artificial intelligence and cognitive psychology, the process has had to be bootstrapped and the results can only provide pointers to further, more formal research designs. Much of the results of the research have already been discussed in earlier sections of the report. Thus, what is discussed in this final section involves the resulting proposed taxonomy, how we would approach this problem if we were to do it again, and recommendations for formal experimentation that could lead to verification, modification, and enhancements of the proposed taxonomy.

7.1 The Proposed Problem Solving Taxonomy For Knowledge Acquisition

The proposed problem solving taxonomy to support knowledge acquisition based on the research described in this document appears in Figure 2. How this taxonomy evolved has been discussed in previous sections. We believe that the first few levels of the taxonomy including how the task was learned by the expert, the complexity/data intensiveness of the task, and the continuity with which the task is performed are areas that have not been addressed previously by a problem solving taxonomy of this sort. Thus, they are unique findings of this research. Other attributes, such as procedural orientation, issues in cognitive vs. high performance, and issues is construction vs. classification have been discussed by other researchers. However, we believe that these latter attributes really only affect the knowledge acquisition process in the later stages of a development effort and to a lesser degree the first three levels.

This research has provided an efficient and effective method of approaching the first few interviews in the knowledge acquisition process. Total time required by the expert is between two and four hours. By using the revised first interview questionnaire provided in Appendix E and rating the task characteristics on a scale of 0-4 for the final task characteristics listed in Appendix O, a knowledge engineer should be able to classify the task according to the taxonomy in Figure 2. In addition, the rules-of-thumb for approaching the second interview that are provided in Section 6.4, along with the classification, should provide a means for continuing the knowledge acquisition process for a given problem solving domain. Though many of the characteristics of a task that are evaluated by this approach have little or no impact on the knowledge acquisition approach to take, they do provide input to other design decisions in the development of an intelligent tutoring system or a knowledge-based system.

7.2 Assessment Of Approach

If similar informal research were to be performed again, such as to verify the findings or duplicate the general results, much of the approach that we used we believe should remain unchanged. (More formal research to address some of the other problems encountered in the effort are discussed in Section 7.2.) Using two interviewers worked well to help maintain a balance to the interviews and the assessment of those interviews. The data analysis techniques used proved to be relevant and useful. However, based on our experience, both the task characteristics list and the initial interview could be refined and improved. These two issues are discussed below.

7.2.1 Changes In The Task Characteristics List -

The list of characteristics actually changed very little over the course of the study. Early on we added general health and verbosity to the list of personal characteristics. Also, we added boredom to the list of psychological stressors and negotiates to the list of communication processes. However, we added these characteristics early enough to rate them following the first round of interviews.

During the first set of ratings, we noticed that certain characteristics were not meaningful to us. For example, we were uncertain how to rate characteristics such as difficulty, analysis, expertise, and perceived probability of success. Additionally, we found that some of the characteristics were redundant; inductive reasoning was listed under reasoning techniques and under problem solving tasks. However, at this point we elected to retain the redundancies through the second interview.

When planning the second round of interviews, we realized that our characteristic "education/training" was very influential in the way tasks are taught and in how to acquire knowledge from an expert in the task. However, we originally rated this as one characteristic; it is, in fact, two. On the second round of interviews, we rated education and training separately.

During the planning process, we also recognized that the characteristics in the list fell into at least three categories: those relevant for knowledge acquisition, those relevant for system design, and those that were not particularly relevant to developing knowledge-based systems. Some of the characteristics dictated how we chose to approach the second interview. For example, the amount of formal training (not education) for a task determined whether or not we recommended that the second interview involve looking at the training curriculum. If a training curriculum exists it greatly accelerates the knowledge acquisition process. Also, if a task is governed by a formula, procedure, or algorithm, it is important to discover that process early in the knowledge acquisition process.

The second category of characteristics is more relevant for how a knowledge-based or intelligent tutoring system should be designed for that task. For example, if the task is performed in a noxious environment or is very psychologically stressful, the design of an intelligent tutoring system for the task should include a method of stressing the student to simulate performance under adverse circumstances. Additionally, if the perceptual requirements of the task are high, a student interface should have fidelity to the actual task in order to ensure good transfer to the operational environment.

The final category of characteristics were those that did no have much relevance to knowledge acquisition or system design. Characteristics such as non-discursive communication, physical characteristics, and whether or not the task was technical did not influence our knowledge acquisition strategy nor would they influence a system design.

Appendix O contains the final list of characteristics. We removed the redundancies and those characteristics that are not relevant to knowledge based system design. This final list consists of 15 categories of characteristics and 119 total characteristics. We also combined and re-labeled categories as necessary to consolidate the list.

7.2.2 **Changes In The First Interview** -

We altered the initial interview after completing all interviews in the study. We deleted questions that were unclear, ambiguous, vague, redundant, or useless. For example, the initial interview contained a question about interaction with others during each of the four phases of problem solving (i.e., understanding the problem, devising the plan, carrying out the problem, and looking back). We had originally included the four identical questions to ensure that we would receive information about interaction across all of the phases. However, the breakdown of the interview into the four phases of problem solving was transparent to the expert during the interview. We did not want to confuse them with aspects of our approach that were not relevant to their role in the effort. As a result, this redundancy was unnecessary because, when experts responded to a question, they discussed interaction throughout the problem solving process. In addition, we added several questions that tried to get at the education versus training issue for a task. Further, we re-ordered many of the questions so that the interview would flow more smoothly. Appendix E contains the revised first interview.

7.3 **Recommended Future Directions**

This research project was not large enough to provide the opportunity to test the hypotheses we generated. Over the course of the project, we generated an initial knowledge acquisition interview, a hypothesis about the task characteristics that are of particular importance to knowledge acquisition, and a set of hypotheses about how to proceed with knowledge acquisition based on the results of the first interview. To validate our assertions, we would need to perform experimental research that would confirm or deny our hypotheses. These studies would evaluate the initial interview and the relationship of the sequential and componential categorization to knowledge acquisition.

One of the first problems we encounter when attempting to design a follow-on study to evaluate the initial interview is the issue of determining how much knowledge is gained in an interview. As mentioned earlier, there is no clear way to quantitatively measure knowledge acquisition. Even general qualitative measures are elusive as well. What defines an element of knowledge (like an element of information in information theory)? It may not even make sense to talk in those terms since knowledge, by definition involves the structuring of elements as well as the elements themselves. If the knowledge engineer can design a system, is that the sign of adequate knowledge acquisition? Or is it whether or not the system performs exactly like the expert. Even so, the ability to design and implement a system depends on the skill of the knowledge engineer and may not necessarily reflect the amount of knowledge obtained during the knowledge acquisition process.

Because of these problems, we would need to resort to subjective ratings of the effectiveness of knowledge acquisition. An unbiased observer would rate the knowledge acquisition interview on a series of scales. In this way, we could test our initial interview against a variety of other verbal knowledge acquisition techniques. There would, of course, need to be adequate control by having raters rate all interviews in counterbalanced order and by keeping knowledge engineers blind to the hypotheses.

To test our hypotheses about the relationship of task characteristics to knowledge acquisition, we would need to select two tasks in each category and perform knowledge acquisition appropriately with one and inappropriately with the other. Independent raters would evaluate the sessions on a series of scales. This study would have to be tightly controlled because of the tendency of knowledge engineers (and all humans engaged in interaction) to try to repair an interaction that is going badly. In addition, tasks would have to be paired carefully and different knowledge engineers would need to perform the good and bad techniques. (We would covary out variance due to the task type and knowledge engineer in the statistical analyses.)

Figure 2 shows a possible knowledge acquisition taxonomy that has been developed based on the research reported on here. One hypothesis that this study also generated was that one of the most important distinctions for knowledge acqusition is whether the task is sequential or componential. This is the first layer in the taxonomy. The componential/sequential distinction proposed in this study is a superordinate level and the lower levels also influence the knowledge acquisition process, although to a lesser extent. Lower levels separate complex from non-complex tasks and procedural from non-procedural tasks. Although we didn't evaluate the relationship of knowledge acquisition farther than the fourth level, it is likely that distinctions discussed by other researchers influence knowledge acquisition also. Studies to validate this hierarchy are important for the goal of formalizing the knowledge acquisition process.

REFERENCES

Allison, R. B., Jr. (1960). *Learning parameters and human abilities.* Unpublished doctoral dissertation, Educational Testing Service and Princeton University.

Anderson, J. R. (1983). *The Architecture of Cognition*. Cambridge, MA: Harvard University Press.

Bartlett, F. C. (1932). */Remembering: A Study in Experimental and Social Psychology*, Cambridge, Eng.: Cambridge University Press.

Bennet, J. (1983). "ROGET: A Knowledge-Based Consultant for Acquiring the Conceptual Structure of an Expert System," Stanford Heuristic Programming Project, Memo HPP-83-24.

Blanchard, R. E. (1973). *Requirements, Concept, and Specification for a Navy Human Performance Data Store* (Report No. 102-2). Santa Monica, CA: Behaviormetrics.

Boose, J. H. and Bradshaw, J. M. (1987). Expertise transfer and complex problems: Using AQUINAS as a knowledge acquistion workbench for expert systems. *International Journal of Man-Machine Studies, 26*, 21-25.

Boose, J. (1985). "A Knowledge Acquisition Program for Expert Systems Based on Personal Construct Psychology," *International Journal of Man-Machine Studies,* Vol. 23, pp. 495-525

Bransford, J. D. and Franks, J. J. (1971). The abstraction of linguistic ideas. *Cognitive Psychology, 2*, 331-350.

Bylander, T. and Chandrasekaran, B. (1987). Generic tasks for knowledge based reasoning: the "right" level of abstraction for knowledge acquisition. *International Journal of Man-Machine Studies, 26*, 231-244.

Carbonell, J. G., Michalski, R. S., and Mitchell, T. M. (1983). An overview of machine learning. In R.S. Michalski, J. G. Carbonell, and T. M. Mitchell (Eds.), *Machine learning: An artificial intelligence approach*. Los Altos, CA: Morgan Kaufmann.

Carter, J. A., Jr. (1986). A taxonomy of user-oriented functions. *International Journal of Man-Machine Studies, 24*, 195-292.

Chambers, A. N. (1973). Development of a taxonomy of human performance: A heuristic model for the development of classification systems. *JSAS Catalog of Selected Documents in Psychology, 3*, 24-25.

Chandrasekaran, B. (1985). Generic tasks in knowledge based reasoning: Characterizing and designing expert systems at the "right" level of abstraction. *Proceedings of the Second Conference on Artiticial Intelligence Applications*, Miami Beach Florida, New York: IEEE

Computer Society, 294-300.

Chandrasekaran, B. (1983). "Towards a Taxonomy of Problem Solving Types," AI Magazine, Vol. 4, No. 1, pp. 9-17.

Clancey, W. J. (1986). Heuristic classification. In J. S. Kowalik (Ed.), Knowledge Based Problem Solving. Englewood Cliffs, NJ: Prentice Hall, 1-67.

Davis, R. (1985). Intteractive transfer of expertise. In B. Buchanan, and Shortliffe, E. (Eds.), Rule-based Expert Systems: The MUCIN Experiments of the Stanford Heuristic Programming Project. Reading, MA: Addison-Wesley, 171-205.

Davis, R. and Lenat, D. (1982). Knowledge-Based Systems in Artificial Intelligence, McGraw Hill.

Ericsson, K. and Simon, H. (1984). Protocol Analysis. Cambridge, MA: MIT Press.

Eshelman, L., Ehret, D., McDermott, J., and Tan, M. (1987). MOLE: A tenacious knowledge acquisition tool. International Journal of Man-Machine Studies, 26, 41-54.

Eshelman, L. and McDermott, J. (1986). "MOLE: A Knowledge Acquisition Tool that Uses Its Head," Proceedings of the Fifth National Conference on Artificial Intelligence, pp. 950-955.

Estes, W. K. (1982). Learning, memory, and intelligence. In R. J. Sternberg (Ed.), Handbook of Human Intelligence. Cambridge: Cambridge University Press.

Fitts, P. M. (1965). Factors in complex skill training. In R. Glaser (Ed.), Trainig Research and Education. New York: Wiley.

Gagne, R. M. (1974). Essentials of Learning for Instruction. New York" Holt, Rinehart, and Winston.

Gaines, B. R. (1987). An overview of knowledge-acquisition and transfer. International Jounrnal of Man-Machine Studies, 26, 453-472.

Garg-Janardan, C. and Salvendy, G. (1987). A conceptual framework for knowledge elicitation. International Journal of Man-Machine Studies, 26, 521-531.

Gawron, V. J., Drury, C. G., Czaja, S. J., and Wilkins, D. M. (1989). A taxonomy of independent variables affecting human performance. International Journal of Man-Machine Studies, 31, 643-672.

Hindmarch, I. (1980). Psychomotor function and psychoactive drugs. Journal of Clinical Pharmacology, 10, 189-209.

Jacobson, C. and Freiling, M. J. (1988). ASTEK" A multi-paradigm knowledge acquisition tool for complex structured knowledge. International Journal of Man-Machine Studies, 29, 167-180.

Kahn, G. S., Breaux, E. H., Joseph, R. L., and DeKlerk, P. (1987). An intelligent mixed initiative workbench for knowledge acquisition. International Journal of Man-Machine Studies, 27, 167-180.

Kahn, G., Nowlan, S., and McDermott, J. (1985). "MORE: An Intelligent Knowledge Acquisition Tool," Proceedings of the Ninth International Joint Conference on Artificial Intelligence, pp. 581-584.

Kelly, G. A. (1955). The Psychology of Personal Constructs. New York: Norton.

Kitto, C. M. and Boose, J. H. (1990). Selecting knowledge acquisition tools and strategies based on application characteristics. In J. Boose and B. Gaines (Eds.), The Foundations of Knowledge Acquistion. San Diego: Academic Press.

Klinker, G., Boyd, C., Genetet, S., and McDermott, J. (1987). "A KNACK for Knowledge Acquisition," Proceedings of the Sixth National Conference on Artificial Intelligence, pp. 488-493.

Kyllonen, P. C., and Shute, V. J. (1989). A taxonomy of learning skills. In P. L. Ackerman, R. J. Sternberg, and R. Glaser (Eds.), Learning and individual differences. New York: W. H. Freeman, 117-163.

Marcus, S. (1987). Taking backtracking with a grain of SALT. International Journal of Man-Machine Studies, 26,, 383-398.

Marcus, S., McDermott, J., and Wang, T. (1985). "Knowledge Acquisition for Constructive Systems," Proceedings of the Ninth International Joint Conference on Artificial Intelligence, pp. 637-639.

Marcus, S., McDermott, J., and Wang, T. (1985). Knowledge acquisition for constructive system. Proceedings of the Ninth Joint Conference on Artificial Intelligence, Los Angeles, CA.

McDermott, J. (1988). Preliminary steps toward a taxonomy of problem-solving methods. In S. Marcus (Ed.), Automating Knowledge Acquisition for Expert Systems. New York: Kluwer Academic Publishers.

Melton, A. W. (1964). A Taxonomy of human learning: Overview. In A. W. Melton (Ed.), Categories of Human Learning. New York: Academic Press.

Meyer, R. P., Laveson, J. I., Pape, G. L., and Edwards, B. (1978). Development and Application of a Task Taxonomy for Tactical Flying. (AFHRL- TR-78-42). Brooks Air Force Base, TX: Human Resources Laboratory.

Michalski, R. S. (1986). Understanding the nature of learning: Issues and research directions. In R. S. Michalski, J. G. Carbonell, and T. M. Mitchell (Eds.), Machine learning: An artificial intelligence approach, Vol. II. Los Altos, CA: Morgan Kaufmann.

Miller, R. B. (1962). Task description and analysis. In R. M. Gagne (Ed.), Psychological Principles in System Development, New York: Holt, Rinehart, and Winston.

Musen, M.A., Fagan, L. M., Combs, D. M., and Shortliffe, E. H. (1987). Use of a domain model to drive and interactive knowledge editing tool. International Journal of Man-Machine Studies, 26, 105-121.

Newell, A., and Simon, H. A. (1972). Human Problem Solving. New Jersey: Prentice Hall.

Patel, J. (1989). "On the Road to Automatic Knowledge Engineering," Proceedings of the Eleventh International Joint Conference on Aritifical Intelligence, pp. 628-632.

Polya, G. (1971). How to Solve It, New Jersey: Princton University Press.

Shingledecker, C. A., Crabtree, M. S., and Acton, W. H. (1982). Standardixed tests for the evaluation and classificaition of workload metrics. Proceedings of the Human Factors Society - 26th Annual Meeting, 648-651.

Stake, R. E. (1961). Learning parameters, aptitudes, and achievement. Psychometric monographs, No. 9.

Teichner, W. H. (1970). An information-theoretic approach to task classification. In E. A. Fleishmean, W. Teichner, and R. W. Stephenson, Development of a Taxonomy of Human Performance (AIR-726-1/70-T(R2)/ Washington, D.C.: Advanced Research Projects Agency.

Underwood, B. J., Boruch, R. F., and Malmi, R. A. (1978). Composition of episodic memory. Journal of Experimental Psychology: General. 107, 393-419.

Weisberg, R. W. (1980). Memory, Thought, and Behavior, Oxford, Eng: Oxford University Press.

Willis, M.P. (1961). Deriving Training Device Implications for Learning Theory Principles (NAVTRADEVCEN 784-1). Port Washington, NY: USNNTDC.

Yost, G. and Newell, A. (1989). "A Problem Space Approach to Expert System Specification," Proceedings of the Eleventh International Joint Conference on Aritifical Intelligence, pp. 621-627.

APPENDIX A

LIST OF CHARACTERISTICS

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LIST OF CHARACTERISTICS

1. Reasoning Techniques - characteristics related to the use of information to perform the task

   statistical
   spacial
   temporal
   analogical
   case-based
   modelling
   mathematical
   deductive
   inductive

2. Problem-Solving Techniques - search strategies for finding a solution

   means-ends analysis
   forming sub-goals
   generate-and-test
   heuristic search - goal-directed/data-driven
   cover & differentiate
   propose & refine
   acquire & present
   formula/procedure/algorithm
   decomposing
   recombining
   generalizing
   specialization
   return to definition

3. Inputs - information input to the task

   visual
   verbal
   auditory
   kinesthetic
   written material
   instrumentation/test results
   man/machine interface
   databases
   historical information
   propadeutics

4. Task Complexity - characteristics of the data array and problem solving space that influence the task

   branching factor
   dynamism
   time factors/constraints
   uncertainty
   difficulty

5. Technical Dimension - the degree to which the task requires a technical background or skill

   high to low
   quantitative vs. qualitative

6. Motor Processes - physical manipulation during the task

   Complex-continuous
   compound
   reflex
   simple-discrete
   fine
   gross
   repetitive

7. Information Processing - characteristics of the way data is manipulated

   categorize
   calculate
   code
   computerize
   interpolate
   itemize
   learn
   tabulate
   translate

8. Problem Solving Tasks - cognitive operations on the data

   analyze
   deduce
   induce
   choose
   compare
   compute
   estimate
   integrate
   plan
   supervise
   monitor
   interpret

9. Recall - the role of memory in the task

   facts
   principles
   procedures
   analogs
   cases

10. Perceptual - use of the visual input during task performance

    perceptual speed
    searching for and receiving information
    identifying objects, actions, and events
    scanning a display

11. Environment - physical and psychological characteristics of the environment in which the task is performed

    11.1 Physical

    acceleration
    confinement
    isolation
    contaminants
    electricity
    lighting
    magnetism
    noise

    11.2 Psychological

    fatigue
    mental strain
    stress
    physical strain
    precision
    attention/automaticity
    response chaining
    attention span
    amount of sleep
    work schedule

12. Personal Characteristics - characteristics required to perform the task

    12.1 Physical

    age
    gender
    height
    weight

12.2 Psychological

- education/training
- expertise
- introspective accuracy/willingness
- perceived probability of success

13. Type of Domain

knowledge-rich to high performance

14. Hardware/Equipment/Tools Involved - items or devices used during the task

- computer
- vehicles/aircraft
- weapon system
- instruments
- notation
- test equipment

15. Communication Processes - communication during task performance

15.1 Verbal

- negotiates
- supervises
- transmits
- requests
- instructs
- informs
- indicates
- directs
- communicates
- answers
- advises

15.2 Nonverbal

- interpretive movement
- expressive movement

APPENDIX B

TECHNICAL JOURNAL

APPENDIX B

TECHNICAL JOURNAL

NOTES ON THE TASKS USED IN THE KNOWLEDGE ACQUISITION INTERVIEWS

The research performed in this project has centered on the development of a problem solving taxonomy that will allow a knowledge engineer to classify a problem solving task and then, based on the classification, obtain direction on how to proceed with the knowledge acquisition process. The effort has focused on how the first and second interviews in the knowledge acquisition process should take place. The first interview has been designed as a general set of questions that can be used to identify the relevant characteristics of the problem solving domain to be studied. It should last one to two hours, depending on the subject matter. From this interview, the knowledge engineer should be able to fill-in values between zero and four indicating the relevance of each of 123 problem characteristics to the problem solving task. The approach to the second interview is then recommended based on the way that the problem solving task is rated in certain categories. The second interview should also last one to two hours, depending on the subject matter. Some "Rules of Thumb" are emerging to help guide this approach to the second interview. For example, the preferred approach to the second interview appears to be to examine an example, no matter what the type of task. This example can be specific, but it should also be generalizable so that some of the basic rules-of-thumb and procedures can become apparent. However, many exceptions occur:

1. If the task is continuous or requires skills that are not easily observed visually with commentation, then watching is not very useful and a piece/level/component of the task should be selected for discussion. This is best selected from the curriculum for teaching the task (ie. foreign language training).

2. If a task cannot be observed firsthand due to restrictions of access, a verbal walk-through of an example from actual experience should be used (ie. console operations, surgery).

3. If a specific example will not be generalizable due to the complexity, amount of background knowledge required, etc. then use the example as a structure and have the expert generalize to the rules that govern the decisions that are made (ie. form fill-out).

4. If the task consists of a number of subtasks, then select a subtask for further discussion before going into examples (ie. software design).

5. If the task involves observing/assembling/assessing a large amount of data in a dynamic situation, then watching actual examples will not be of value because the knowledge engineer will not be able to discern what is relevant at a given point in time from what is not. Then the knowledge acquisition process should center on identifying the data, identifying techniques for selecting the relevant data, and identifying analysis techniques used in processing the data to make a decision (i.e., air traffic control).

6. If a procedure exists for performing the task, then the procedure should be followed using an example. This will allow the knowledge engineer to obtain the general rules while seeing how they apply, rather than having to extract the rules strictly from examples (i.e., equipment diagnosis).

7. If equipment or tools are used in the task (i.e., cockpit in aircraft piloting, surgical tools in surgery) then the second interview should include a discussion of these items and a description of what they are, how they work, and how they are used.

It should be noted that both the first and second interviews are oriented towards identifying and acquiring the problem solving strategies used by the subject matter experts. Acquisition of lots of detailed domain knowledge that guides specific decisions is not the goal of these initial interviews. Instead, the goal is to develop a problem solving framework for a given problem solving area from which subsequent knowledge engineering sessions can be designed that will get at the domain details.

Based on what we are learning from the second interview, we still believe that observing the problem solving task is a good idea in the second round. However, it should be understood up front that the knowledge engineer will not get everything that goes on in that second interview. Especially with tasks that involve assimilation of a lot of data or the use of complex equipment/interfaces the knowledge engineer will become confused. However, we believe that it is valuable to actually see the process early on so that the knowledge engineer can become aware of all of the different things that will have to be discussed in a later interview.

TYPE A TASKS

1. Foreign Language Training

Brief Task Description - During the first interview, we discussed the requirements of her job, including developing the curriculum, course modification, achievement testing, and course review. The curriculum must account for four levels of proficiency: grammer, vocabulary, language skills, and language functions.

Expert Characteristics - Instructors in the area of foreign language training usually have at least a Bachelor's degree, often in a foreign language or a foreign studies program. Individuals at the Defense Language Institute who teach English as a foreign language do not necessarily need to know another language. However, it is helpful to know one foreign language which provides a broader experience in language.

Source of Expertise:
Peggy Goitia
Defense Language Institute
English Language Center
Lackland AFB, Texas

(512) 671-2991

Characterization of the Task Based on Interview 1 - We rated the following characteristics as essential to training a foreign language: forming sub-goals, acquire and present material, decompose the problem, recombine, verbal and written inputs, instrumentation, dynamism, translation, planning, supervising, monitoring, interpreting, recall of facts and principles, introspective accuracy, articulation, answering questions, communication, directing, indicating, informing, requesting, transmitting, and supervising. According to a pairwise comparison of the raw data, training a foreign language was most similar to leadership training (90) and least similar to surgery (67). Foreign language training emerged as an independent cluster in the eight-cluster analysis.

Approach - The approach to knowledge acquisition should be based on the curriculum and how the skill is taught. In addition, language training can be broken down into several components, including vocabulary, grammar, verb conjugation, noun/adjective inflection, pronunciation, etc. Therefore, we should look at two to four weeks of the curriculum, identify the levels taught of each of the components, and query concerning how each of these are taught and why.

Justifications - Observing the process of actually speaking a language will not be very enlightening at this point. Little can be gained from "watching" the task because it is so continuous and much of what is driving decisions is not visible. In addition, when skilled in the speaking of a language, decisions are quite often not made consciously. Thus, a level of skill along the continuum should be selected and the rationale for what is taught and how should be investigated.

Results - For the second interview, Peggy had assembled all of the written material used in teaching one segment of English as a foreign language. This consisted of four books, two for the instructor and two for the student. We examined these books and developed an understanding of what various categories of information are taught and how. The books provided a means of observing how the four major areas they use in teaching language (function, grammar, vocabulary, and skills) are actually used in teaching English. Because Peggy also had other level books available, we were able to compare the types of items taught in the four areas in Lesson 1, Book 1 and Lesson 1, Book 24. Earlier lessons are very dependent on visuals and all lessons require a laboratory portion where the student spends time listening and responding to audio tapes. This approach allowed us to get into quite a bit of detail while still discussing the rationale behind the curriculum.

2. Aircraft Pilot

Brief Task Description - The aircraft pilot maintains control of the aircraft from take-off to landing. The task requires both cognitive and physical skills. The pilot must observe instrumentation indicating altitute, attitude, speed, direction, etc. and adjust the aircraft accordingly. Piloting an aircraft can be broken down into sets of maneuvers such as take-off, banking at various angles and speeds, climbing, and landing. In military piloting, pilots are briefed before flight on the mission and debriefed after the mission concerning what actually happened.

Expert Characteristics - An aircraft pilot must be in general good health. Training is very regimented and involves an apprenticeship approach where the student pilot goes up with an instructor pilot for a minimum number of flying hours. The student is initially taught key maneuevers and then is expected to put them together into a complete mission. Training is very dependent on the class of aircraft and somewhat dependent on the specific aircraft type. Instructors receive specific training in order to become a pilot instructor.

Source of Expertise:
Bill Ercoline, Pilot Instructor
Building 170
Brooks Air Force Base
(512) 536-3521

Characterization of the Task Based on Interview 1 - Aircraft pilot received a rating of four in the following attributes: spacial, temporal, deductive, sub-goals, acquire-and-present, procedural, visual, kinesthetic, instrumentation, man-machine-interface, branching, dynamism, constraints, uncertainty, simple-discrete, compare, monitor, procedures, perceptual-speed, scan-display, confinement, noise, cognitive-attentiveness, general-health, articulation, vehicles, instruments, advises, answers, directs, indicates, informs, and instructs. The task received a rating of zero in the following attributes: statistical, mathematical, generateandtest, coveranddifferentiate, proposeandrefine, recombine, databases, historical, propadeutics, compound, reflex, calculate, code, computerize, interpolate, learn, tabulate, translate, compute, estimate, isolation, contaminants, electricity, lighting, magnetism, sleep, boredom, computer, weapon systems, test equipment, negotiates, and expressivemovement. According to a pairwise comparison, aircraft pilot is most similar to to air traffic control (82) and least similar to DRAIR generation (51). It clustered with surgery in the eight-cluster analysis.

Approach - The approach should be based on the curriculum and how the skill is taught. Therefore, we should look at a set of two to four maneuvers and go through how each is trained. These maneuvers need to be broken down into how the student/pilot manages the various attributes of the maneuver such as speed, direction, altitude, etc.

Justifications - Observing the process of flying an aircraft will not be very enlightening at this point. Little can be gained from "watching" the task be performed because it is so continuous and much of what drives decisions is not visible. Correlation of pilot behaviors to the response of the aircraft would be difficult without further knowledge of how the behaviors effect the aircraft. In addition, pilot reaction to aircraft behavior would be difficult to understand. Thus, a level of skill along the continuum should be selected and the rationale for what is taught and how should be investigated.

Results - The interview with Bill Ercoline took place in an aircraft training mock-up. This allowed us to observe the actual displays and devices available to a pilot during flight. We began the interview with the intention of going through a number of maneuvers taught early in the curriculum to a new pilot. However, we found that it was difficult to follow the expert due to the number of different items used in the cockpit that we did not yet understand. In the end, we began to ask about how the cockpit is set-up and the types of attributes that the pilot controls in an aircraft and how. This made the examples much more understandable. Thus, eventhough this task did not appear to be terribly data intensive, a considerable amount of information is observed and processed by the pilot and it should be discussed in general before going into specific details on particular tasks.

3. Weather Forecasting

Brief Task Description - Generating a weather forecast involves the collection of a large amount of data, analyzing it in terms of its meaning with respect to effect on temperature, wind direction and speed, precipitation, etc. Data is usually collected early in the day and entered into one or more models run by the National Weather Service. Based on the output of the models, the raw data, the weather forecasters expertise, and the area of the world of interest, a prediction is made, in written format, for one to five days.

Expert Characteristics - Weather forecasters obtain a lot of training in the specifics of data collection and utilization of models. They are trained in meteorology in general. However, forecasting is highly dependent on the area of the world in which the predictions are being made and on the time of year. Thus, once a forecaster has received general training, he/she still requires some experience in the area of the world in which he/she will perform the task. No specific physical attributes are necessary for the job.

Source of Expertise:
Mr. James Skowronski,
Air Force Weather Forecast Instructor
Chinoot Air Force Base, Illinois
(217) 495-2645

Characterization of the Task Based on Interview 1 - Weather forecasting received a rating of four in the following attributes: spacial, temporal, model-based, acquire-and-present, visual, branching, dynamism, uncertainty, interpolate, learn, analyze, induce, estimate, integrate, facts, principles, procedures, and notation. The task received a rating of zero in the following attributes: analogical, case-based, deductive, means-ends, generate-and-test, cover-and-differentiate, proposeandrefine, decompose, specialize, return-to-definition, auditory, kinesthetic, man-machine-interface, databases, complex-continuous, fine, gross, repetitive, code, computerize, itemize, tabulate, deduce, plan, supervise, analogs, perceptual speed, scan-display, acceleration, confinement, isolation, contaminants, electricity, lighting, magnetism, noise, fatigue, mental-strain, stress, physical-strain, preciseness, cognitive-attentiveness, response-chaining, attention-span, sleep, schedule, boredom, general health, age, gender, height, weight, introspective-accuracy, articulation, vehicles, weapon-systems, test equipment, advises, answers, communicates, directs, indicates, informs, instructs, requests, transmits, supervises, negotiates, expressivemovement, and interpretive-movement. According to a pairwise comparison, weather forecasting is most similar to to DRAIR generation (94) and least similar to aircraft pilot (54). It remained an independent cluster in the eight-cluster analysis.

Approach - We have two choices - follow the forecaster around while he/she is generating a forecast or select an area of the curriculum and go into some detail. Either way, we need to focus on the data collection and how the patterns are recognized for classifcation into a particular type of weather forecast.

Justifications - Currently we are leaning towards looking at a live example with expert commentation due to the amount of data that is involved. The task, though seemingly dynamic and continuous to some degree, involves basically a snapshop of the atmospheric data from which interpretation is made. Thus, though it may at first appear that watching the task would not be possible, since there is a distinct start and finish to the task and it is apparently fairly procedural, watching the task should result in learning something useful.

Results - We asked Jim Skowronsky to produce the five-day weather forecast based on the data available to him the morning that we were there for the Champaign-Urbana area. We began by examining a set of 20 weather charts, taken at 12 hour intervals for four different weather phenomena: vorticity, humidity, thickness, and precipitation. These charts are generated from models based on data points scattered throughout the area. The thickness and vorticity charts were used to identify the locaiton of warm and cold fronts and the Jet Stream. These were drawn on copies of the charts using colored pens. This was a very visual task and he used a lot of knowledge of weather models to complete the task. Once these charts were analyzed, a satellite picture was obtained that shows what is actually there. This satellite picture is then compared with the vorticity and thickness charts to verify differences between the actual and the predicted based on the models. The last step is to try to identify items that will effect the forecast, such when any fronts may come through the area and how much moisture is in the air. There are various other sources of data available to the forecaster now, as well, that are on computers. These computer sources allow the forecaster to compare various up-to-the-minute charts next to each other on the computer screen. In addition, the forecaster will check the previous forecast and look out the window to see what is going on. Then a forecast is generated that contains cloud cover, temperature, and chance of precipitation for today, tonight, and the next three days.

4. **Air Traffic Control**

Brief Task Description - Air traffic control involves the monitoring of radar screens and weather data in order to ensure that aircraft can travel safely through a given area. An air traffic controller is responsible for the aircraft in a particular air space and at a particular phase in their flight --- take-off, landing, flight, ground, etc. The task involves the observation of large amounts of data that change dynamically. Based on the data the air traffic controller must generate a plan for each aircraft in his/her airspace and communicate with the pilots of those aircraft based on what they must do in terms of changing altitute, speed, and direction. Time is a critical issue --- an air traffic controller works for a set number of hours and shift work is standard. Difficult of the task depends on the level of activity (number of aircraft) that must be handled at one time.

Expert Characteristics - Air traffic controllers undergo a large amount of training in the area of air traffic control, learning how to read radar scopes, communicate with pilots, etc. However, much experience is required at the actual airport where the controller is to work in order for the controller to become good. Individuals who are air traffic controllers tend to be very decisive people. They also have health problems due to the stress and shift schedules and divorces are common.

Source of Expertise:
Mr. Jim Johnson, Radar Air Traffic Control Instructor
FAA Training Facility
Oklahoma City, Oklahoma
(405) 680-6932

Characterization of the Task Based on Interview 1 - Air traffic control received a rating of four in the following attributes: spacial, temporal, means-ends, sub-goals, decompose, visual, verbal,, instrumentation, dynamism, constraints, choose, estimate, plan, supervise, monitor, facts, procedures, perceputal-speed, search-receive-information, identify-object/action/event, scan-display, fatigue, mental-strain, stress, cognitive-attentiveness, attention-span, sleep, schedule, general-health, instruments, notation, communicates, directs, informs, requests, and supervises. The task received a rating of zero in the following attributes: statistical, analogical, mathematical, deductive, inductive, generate-and-test, proposeandrefine, formula-procedure-algorithm, recombine, generalize, specialize, return-to-definition, auditory, kinesthetic, databases, historical, branching, complex-continuous, compound, gross, calculate, code, computerize, tabulate, translate, analyze, deduce, induce, compute, integrate, analogs, acceleration, isolation, contaminants, electricity, lighting, magnetism, physical-strain, preciseness, boredom, age, gender, height, weight, introspective-accuracy, computer, vehicles, weapon-systems, test equipment, answers, indicates, negotiates, expressivemovement, and interpretive-movement. According to a pairwise comparison, air traffic control is most similar to to surgery (83) and least similar to form-fill-out (58). It remained an independent cluster in the eight-cluster analysis.

Approach - The key should be to determine what factors influence priority setting and how priorities are set. We cannot yet watch the task actually being performed because there are too many things going on to be able to interpret the actions of the expert, and they can not usually discuss what they are doing during the task due to the dynamism and time constraints. Thus, we will have to perform an interview, though it will still be based on examples. The examples, however, should be contrived along a level of complexity so that the factors that affect air traffic control decision making can be observed.

Justifications - We are still at a higher level on this task than some of the others because we cannot not yet perform any kind of task breakdown. This may be due to the dynamism and lack of distinct start and completion points in the task, beyond the shift time itself. We will acquire the factors and priorities by looking first at the simplest example problem --- getting one aircraft down. Then we will increase the complexity of the task (ie. add another aircraft into the scenario) and query concerning how the problem is approached and why.

Results - The interview began with a discussion of the simplest case, one aircraft landing at an airport where one air traffic controller owned all of the airspace. Discussion centered on drawings of the RADAR scope on the blackboard with indications of airspace, airport, and aircraft. We then moved to a more complicated scenario and it became clear that higher level traffic is handled by partitioning the airspace around an airport and the various goals of the aircraft (i.e., landing, departing, crossing through). The task builds in complexity based on the number of aircraft having to be serviced in a given period of time. Since this changes with the time of day, an air traffic controller's job can change many times within a single shift. Though we were discussing examples, they were not detailed examples so the general rules of how the air traffic controller could handle the situation was available. This approach allowed us to acquire a lot of information about how decisions are made and how the task is broken down into subcomponents.

5. Console Operations

Brief Task Description - The console operation task selected was the propulsion console in Mission Control at Johnson Space Center. The console is used by flight controllers to monitor the propulsion system of the Space Shuttle during a mission. The task involves observation and interpretation of a large amount of raw data concerning the status of the propulsion system during the various phases of a mission --- lift-off, orbit (coast vs. burn), and re-entry. To monitor this data, the flight controller must be adept at manipulating a variety of keyboards, thumbwheels, and level switches in order to bring up data on VDT screens and to format sets of indicator lights. The task can be very time critical if a problem arises, but is often very quiet.

Expert Characteristics - Flight controllers for the propulsion system are educated in areas such as mechanical engineering and fluid dynamics. They have a broad background of engineering-type knowledge that allows them to understand the system they are monitoring. In addition to the broad background knowledge, they receive apprenticeship-type instruction in the flight controller job (the cognitive part of the task). They receive little to no training in the actual manipulation of the console. This they gain from practice during simulations. General health is important, but no other physical characteristics are relevant to proper performance of the task.

Source of Expertise:
Mr. Matt Barry, Propulsion Flight Controller
NASA/Johnson Space Center
Houston, Texas
(713) 483-0876

Characterization of the Task Based on Interview 1 - Console operations received a rating of four in the following attributes: temporal, deductive, formula-procedure-algorithm, visual, verbal, instrumentation, man-machine-interface, dynamism, constraints, simple-discrete, fine, repetitive, categorize, interpolate, learn, analyze, deduce, plan, monitor, facts, procedures, perceputal-speed, search-receive-information, identify-object/action/event, scan-display, noixe, cognitive-attentiveness, general-health, computer, communicates, and informs. The task received a rating of zero in the following attributes: statistical, spatial, analogical, means-ends, generate-and-test, propose-and-refine, recombine, generalize, return-to-definition, auditory, kinesthetic, databases, branching, complex-continuous, compound, gross, code, computerize, itemize, tabulate, induce, analogs, acceleration, isolation, contaminants, electricity, magnetism, sleep, gender, height, introspective-accuracy, vehicles, weapon-systems, instructs, supervises, negotiates, and interpretive-movement. According to a pairwise comparison, console operations is most similar to to aircraft pilot (78) and least similar to software design (61). It remained an independent cluster in the eight-cluster analysis.

Approach - It would be difficult to observe the task actually being performed because of the limited access to MCC during a shuttle flight or simulation. However, we could have the expert verbalize a particular task, such as monitoring during liftoff or the leak detect procedure for the propellant tank.

Justifications - This task involves a lot of data acquisition and monitoring. This sort of activity is difficult to observe and obtain relevant knowledge conerning what the expert is looking at and why. Thus, a verbal description of the process while going through an example that is not actually happening at the time would be the most effective way to get at what the expert is doing and why.

Results - We asked Matt Barry to discuss the problem of engine failures and how they are manifested in the console. He drew a diagram of the fuel system on the blackboard in order to illustrate how the system works and the components he was talking about. Engine failures can be divided into two types, engine and propellant. The key issue in performing the task is the ability to see the changes in the pressure readings instantly so that appropriate actions can be taken to shut the engine down. In order to be able to perform the task rapidly, the flight controller memorizes the various pressure and temperature readings for each type of failure. Where the problem gets hard is when there is more than one failure at a time because they are not able to memorize what dual failures look like, so additional reasoning is required which takes time.

6. Surgery

Brief Task Description - When patients are refered to a surgeon, the surgeon collects a complete history and performs a complete physical examination to confirm the diagnosis. The surgeon attempts to rule out alternative diagnoses and analyzes the patient's fitness for surgery. During the surgery, the surgeon heads a team of health care professionals, including an anesthesiologist, 2 or 3 assisting nurses, and 1 to 4 assistants who are possibly residents or interns. The surgeon makes decisions that range from how to incise the patient to whether or not tissue should be removed. The surgeon must contend with the fact that each patient's anatomy is slightly different as well as with the numerous complications that can arise during the procedure. In addition, the surgeon attempts to perform the procedure as quickly as possible.

Expert Characteristics - Surgeons undergo the same initial education and training as general medical doctors --- They undergo a four year medical program at a medical school. Upon completion of this study, however, they then specialize and undergo additional residencies to obtain the necessary training. Surgery can then specialize further into various types of surgery based on the location and system of the body.

Source of Expertise:
Dr. C. William Hall
Cardiologist
Southwest Research Institute
(512) 522-2670

Dr. C. William Hall completed his medical degree in 1956. The then completed a 5 year residency in thoracic surgery. He was part of a fellowship program at Baylor University, during which he was part of the team that designed and implanted the first blood pump in humans. He taught at the medical school at Baylor and headed the artificial heart program.

Characterization of the Task Based on Interview 1 - We rated the following characteristics as essential to surgery: spacial reasoning, temporal reasoning, means-ends analysis, formation of sub-goals, procedures, decomposition, visual input, verbal input, kinesthetic input, written input, instrumentation, historical data, a large branching factor, complex- continuous motor movements, simple-discrete motor movements, fine motor control, gross motor control, repetition, categorization, learning, analysis, deduction, choosing, planning, supervising, monitoring, interpreting, recall of facts, principles, and procedures, identifying objects, actions, and events, stress, precision, cognitive attentiveness, attention span, work schedule, high perceived probability of success, instruments, notation, directing, supervising. According to a pairwise comparison of the raw data, surgery is most similar to medical diagnosis (87) and least similar to DRAIR generation (54). A cluster including surgery and pilot training emerged from the eight-cluster analysis. They had high correspondence on the following characteristics: spatial reasoning, temporal reasoning, mental modeling, formation of sub-goals, procedures, and specialization.

Approach - It would be difficult to observe the task actually being performed because of the limited access to operating rooms. However, we could have the expert describe a particular operation, such as removal of the appendix. The expert can use visual aids, such as a diagram of the human body, to discuss the various decisions and procedures.

Justifications - This task is very visual and procedural in nature. Discussion of a specific surgical procedure should help to illuminate the process that is used in general.

Results - We were lucky enough to have the opportunity to actually observe a surgical procedure in the operating facilities at SwRI. Dr. Hall had to perform an operation to insert a catheter into the Illiac artery of a baboon. We were able to observe preparation of the surgeon and the surgical team, though not the preparation of the operating room or the patient. Dr. Hall talked through the process and showed us the anatomy and what he was doing at each step. From the observation it became quite clear that surgery depends on many other subskills from the ability to recognize an artery vs. a vein vs. a nerve, to the ability to recognize and describe the various instruments used in the surgical process. To the untrained eye they all look pretty much the same. In addition, the procedure hinges on a complete understanding of the anatomy involved and an ability to palpate to determine where you are in the body.

7. Medical Diagnosis

Brief Task Description - Primary care medical diagnosis involves collecting a complete patient history, performing a physical examination, and using the data collect to categorize the symptoms into a disease category. He feels that most of his diagnosis is based on pattern recognition. He recognizes a gestalt of symptoms that is representative of a disease category. In fact, he's willing to allow some symptoms to remain unexplained by the diagnosis as long as they are unimportant. And he uses time as a diagnostic tool; the pattern of the symptoms are just as important as their current presentation. The challenge is accumulating the data and grouping it into diagnostic patterns.

Expert Characteristics - Medical doctors are highly trained both in formal education and in an extensive appreticeship period. They usually obtain a biology or chemistry bachelor's degree, and then enter medical school for four years. During that four years, students perform rotations that expose them to the various areas of medical care. They actually perform the tasks of a phsysician, with a physician watching and verifying their performance.

Source of Expertise:
Dr. James D. Legler
Assistant Professor
Department of Family Practice
University of Texas Health Sciences Center
San Antonio, TX
(512) 270-3934

Characterization of the Task Based on Interview 1 - We rated the following characteristics as essential to medical diagnosis: temporal reasoning, deduction, propose and refine, acquire and present, visual input, verbal input, written input, instrumentation, historical data, large branching factor, categorization, learning, analysis, choosing, interpreting, recalling facts, principles, and procedures, a perceived probability of success, notation, advising, answering, communicating, directing, and informing. According to a pairwise comparison, medical diagnosis was most similar to protocol design (88) and least similar to air traffic control. In the eight-cluster analysis, medical diagnosis emerged as a singleton cluster.

Approach - Medical diagnosis can be broken down into a number of different areas: anatomy/physiology, patient history/interview, signs/symptoms associated with diseases, and treatment plan. It would be difficult to observe the task actually being performed because of the limited access to medical records of a patient. However, we could have the expert describe a particular case, based on a paitent's file where the name has been deleted.

Justifications - Going through an example case would allow us to observe the actual process of performing a patient diagnosis. When it is not in an actual situation, we would also be able to ask questions and have the benefit of hindsight. This hindsight should be useful in earlier interviews. Later interviews would probably be better handled in an actual, on-the-spot performance, in order to avoid that hindsight.

Results - Dr. Legler pulled a file of a 20-month old patient that he was called in on at the time of her birth. He selected this file because it was an unusual case and many of the paitent's problems have still not been resolved. We went through the patient record visit by visit, discussing the examination and the outcome. Based on this interview, we developed a fairly clear understanding of the process, but more detail on actual history taking and linking of signs and symptoms to problems would be necessary in order to build a tutoring system.

TYPE B TASKS

1. Software Design

Brief Task Description - From Susan Crumrine's perspective, one of the major tasks associated with software design is the definition study. This study specifies the purpose of the system and determines the functionality it must achieve to meet the purpose. The output of this process is a conceputal design of the system.

The definition study answers nine questions: 1) the purpose of the system; 2) the functionality requirements; 3) the sequence of operations necessary to perform the task; 4) the components of the system/organization of the system; 5) external interfaces; 6) characteristics of the user interface; 7) fault tolerances; 8) error detection/self diagnostics; and 9) any environmental considerations.

During the design phase, you must also specify which parts of the functionality will be covered by commercial, off-the-shelf (COTS) products and which parts will need custom software to complete. In addition, the design phase of software development requires enormous input from the customer. It is at this point that the developers must communicate with the targeted users to ensure that the product will reflect their needs.

Expert Characteristics - Individuals who are trained in performing software design are usually degreed computer scientists. These individuals could have a bachelor's, Masters', or Ph.D. in the field. However, the various steps performed in software design in the real world are only trained generally, if at all, at a university or college. True expertise is gained on the job working for someone who is already skilled at the task. Often, the various stages that lead to an implementation of a software system are performed by different individuals with different skills. More design-oriented tasks tend to be performed by the better-degreed, more-skilled individuals while coding is left to the less-degreed, less-experienced individuals.

Source of Expertise:
Susan Crumrine
Manager, Software Engineering Section
Southwest Research Institute
San Antonio, TX
(512) 522-2089

Characterization of the Task Based on Interview 1 - We rated the following characteristics as essential to software design: temporal reasoning, mean-ends analysis, formation of sub-goals, generate and test strategy, propose and refine strategy, acquire and present data, decompose the problem, recombine the sub-problems, verbal inputs, written inputs, translation, analysis, integration, computers, notation, and negotiation. Based on a pairwise comparison of the data, software design emerged as most similar to protocol design (96) and least similar to pilottraining (54). This was confirmed in the cluster analysis: protocol design and software design emerged as a cluster. The cluster was based on similarity on the following characteristics: temporal reasoning, analogical reasoning, deductive reasoning, generation of sub-goals, generate and test strategy, goal drive problem solving, lack of cover and differentiate strategy, propose and refine strategy, acquire and present data, and decomposition.

Approach - Software design can be broken down into several major subgoals including requirements specification, system design, system coding, and system testing. We first need to pick one of these subgoals and concentrate on it for the second interview. Follow-on interviews may continue to select sub-subgoals, etc.

Justifications - Software design is a very large, complex task. In order to effectively perform knowledge acquisition, the task must be broken down into its component parts and examined independently.

Results - We gave Susan the task of describing how the design of a software system is generated. She began by explaining the steps involved with design at any level: 1) break the system down into lower level funtions, 2) identify the functions of each subcomponent, and 3) identify the interaction between subcomponents. Task complexity is handled by breaking into subcomponents and defining interfaces between them so that they can then be handled independently as needed. The real key and difficulty is identifying logical, useful subcomponent breakdowns. This appears to be an ability that is associated with generic problem solving skills and is difficult if not impossible to train. This second interview was much more successful than some of the others that we have had with experts in the larger, less-defined tasks because Susan has spent a lot of time thinking about how to do the task and how to get others to do it as well.

2. Protocol Design

Brief Task Description - Scientific protocol design involves designing an experiment to test a hypothesis. It involves an assessment of ethical and legal standards as well as the operationalization of the hypothesis. To develop a protocol, the researchers must have a clear statment of the objectives and hypotheses. In addition, they must set up the constraints that have to be fulfilled. Protocol execution is a six step process: 1) assemble resources; 2) prepare resources; 3) use resources; 4) analyse results; 5) draw conclusions; and 6) report the conclusions.

Expert Characteristics - Experts in the field of protocol design tend to have engineering or scientific degrees. They are trained in the scientific method and apply it to the development of protocols for research in their specific area of interest.

Source of Expertise:
Herb Peel
Principle Scientist in Biomedical Engineering
Southwest Research Institute
San Antonio, TX

(512) 522-2692

Herb Peel received a B.S. in Engineering at the University of Texas at Austin. He worked as a clinical engineer at a hospital before coming to Southwest Research Institute 15 years ago.

Characterization of the Task Based on Interview 1 - We rated the following characteristics as essential to protocol design: temporal reasoning, case-based reasoning, developing sub-goals, generate and test, propose and refine, acquire and present, decomposition, verbal inputs, historical inputs, propadeutics, categorization, itemization, translation, choosing, planning, interpreting, procedures, cases and examples, perceived probability of success, instruments, and communication. Protocol design was most similar and most equivalent to software design. Software design and protocol design clustered in the cluster analysis.

Approach - A particular situation should be generated so that the expert is required to walk through the process of generating a protocol.

Justifications - Protocol design is "case-based" and utilizes "propose and refine" heavily. We needed a way of looking at how the initial case is selected/proposed and how it is refined to fit the current problem.

Results - The situation selected was to pretend that we were a potential client, and that we represent a company that makes and markets an automated blood pressure monitor (ABPM). Herb was to develop a protocol that he would use to compare our ABPM against two other competitor's ABPMs and a gold standard. We did not give him the problem in advance because we wanted him to solve the problem while we were there, not retrospectively. Herb basically stuck to the specific example. Giving him a situation resulted in learning right away that a standard existed to cover the situation. Thus, we discussed the standard and how/why it would be modified to fit our particular scenario.

3. **Program Management**

Brief Task Description - Program management within the Air Force involves a knowledge of how acquisitions are performed and a knowledge of the procurement process. Within the Logistics Command, no formal methodology exists and much of the process has been borrowed from Systems Command and customized. The standard series of steps that must be followed, usually involving the generation of a document, can be tailored further for a particular procurement. A program manager must monitor the progress of a particular activity and help to ensure that the acquisition goes along on schedule. When it becomes difficult to keep to the original schedule, then decisions have to be made concerning how to modify the schedule and the impact of these modifications on the other parts of the acquisition.

Expert Characteristics - Program managers receive no formal training. They learn how to perform the required tasks on-the-job and with the help of more experienced program managers in their office. The task requires the ability to write and to deal with people.

Source of Expertise:
Mr. Xavier Pena, Program Manager
Air Force Air Logistics Command/LDAT
Kelly Air Force Base, Texas
(512) 925-4714

Characterization of the Task Based on Interview 1 - Program management received a rating of four in the following attributes: temporal, sub-goals, verbal, written, historical, plan, supervise, monitor, procedures, communicates, and negotiates. The task received a rating of zero in the following attributes: statistical, spatial, analogical, model-based, mathematical, deductive, inductive, means-ends, generate-and-test, cover-and-differentiate, recombine, generalize, specialize, visual, auditory, kinesthetic, instrumentation, propadeutics, complex-continuous, compound, reflex, simple-discrete, fine, gross, repetitive, calculate, code, computerize, interpolate, tabulate, translate, deduce, induce, compute, integrate, analogs, perceptual-speed, search-receive-information, identify-objects-actions-events, scan-display, acceleration, confinement, isolation, contaminants, electricity, lighting, magnetism, noise, fatigue, mental-strain, stress, physical-strain, preciseness, cognitive-attentiveness, response-chaining, attention-span, sleep, schedule, boredom, general-health, age, gender, height, weight, introspective-accuracy, articulation, vehicles, weapon-systems, instruments, notation, test-equipment, advises, indicates, instructs, expressive-movement, and interpretive-movement. According to a pairwise comparison, program management is most similar to to leadership (99) and least similar to aircraft pilot (57). It clustered with cargo loading, accounting, leadership, equipment diagnosis, DRAIR generation, and form fill-out in the eight-cluster analysis.

Approach - Program Management can be broken down into fairly independent subtasks, such as statement of need (SON), statement of work (SOW), request for proposal (RFP), etc. Each of these subtasks is an "acquire and present" task, so they are very similar. We need to acquire the general set of subtasks, and then select one for further study.

Justifications - Program management is a very large, ill-defined task. However, it has many subtasks associated with it and the knowledge acquisition process can be simplified if these subtasks can be identified and then further studied independently.

Results - We began the interview by discussing potential documents that they need to generate in order to perform their task. However, it appears that most of the documents are actually delivered under contract or by the governing command. The Logistics Command has the problem of being handed programs that are already underway that they then have to pick up and manage. After discussing other tasks such as review of progress reports and presentation of programs to management, we got into the funding document. From that discussion we were able to learn something about how money is programmed and the types of money that exist for the various functions within AFLC. However, more discussions would be required in order to obtain a sufficient understanding of this process.

4. Leadership Training

Brief Task Description - We examined the total quality management (TQM) initiative in relation to leadership training. In this initiative, students learn the basic tools and techniques used to ensure the sucess of participative management through team building. The students learn about how to develop process action teams that focus on improving an existing management or technical function.

Expert Characteristics - Individuals involved with leadership training are usually involved with management in general. They tend to have at least a Bachelor's degree. Little other formal training is provided, except for some on-the-job experiences.

Source of Expertise:
Jim Shawley
Wright Patterson AFB, Ohio
(513) 257-1602 (3931)

Jim Shawley worked as a management analyst for the Foreign Technology Division at WPAFB for 32 years. He now works in the Total Quality Management office.

Characterization of the Task Based on Interview 1 - We rated the following characteristics as essential for leadership training: verbal inputs, analysis, supervision, procedures, introspective accuracy, articulation, advising, communication, informing, and instructing. According to a pairwise comparison, leadership training was most similar to program management (99) and least similar to pilot training (61). In the eight-cluster analysis, leadership training clustered with cargo loading, accounting, program management, equipment diagnosis, drair generation, and form fill-out.

Approach - Leadership training in the form that we are examining involves the area of Total Quality Maintenance (TQM). TQM consists of a set of tools and procedures for data collection and application of the tools. We should identify the set of tools and select a single tool for further examination.

Justifications - Leadership training is a fairly nebulous task but it consists of using many different tools. Learning about the tools and how they are applied, one at a time, will help to better define the goals of the knowledge acquisition process.

Results - We examined the Student Guide for a three day teambuilding course that Jim was currently teaching. Teambuilding is one aspect of the leadership training that is provided at Wright Patterson. This teambuilding concept can be used to support a variety of the teams that may be built based on the TQM philosophy (ie. PAT, PIT, etc.). The Student Guide provided an excellent structure to the discussion of a very nebulous and general technique. One of the key tools discussed was brainstorming and how it should be performed within the teambuilding concept. Fishbone diagrams, Pareto diagrams, and control charts were also discussed based on their use in support of brainstorming and recording the results.

5. Cargo Loading

Brief Task Description - Cargo loading involves the determining where to place a given set of items in the hold of a specific aircraft. The task involves a knowledge of what types of items can go next to each other, how the various types of items must be secured, the weigths and packaging of the various items, and to balance the load for the given aircraft. Formulas exist for the calculations, but experience is often used as a start point for arranging the items.

Expert Characteristics - Individuals are trained to perform the task, but a background in basic arithmetic is necessary in order to learn how to peform the various calculations. The individuals do not tend to have a college degree. The heuristics for knowing how to combine and place loads come through experience and practice.

Source of Expertise:
Senior Master Sgt. Ronald Whitmer
Building 901
Randolph Air Force Base, Texas
(512) 652-2030

Characterization of the Task Based on Interview 1 - Cargo loading received a rating of four in the following attributes: spatial, temporal, mathematical, sub-goals, formula-procedure-algorithm, written, calculate, itemize, compute, estimate, plan, monitor, facts, principles, and supervises. The task received a rating of zero in the following attributes: statistical, analogical, inductive, generate-and-test, cover-and-differentiate, propose-and-refine, generalize, verbal, auditory, kinesthetic, instrumentation, man-machine-interface, databases, historical, uncertainty, complex-continuous, compound, reflex, simple-discrete, fine, gross, repetitive, code, computerize, tabulate, translate, induce, integrate, interpret, analogs, perceptual-speed, search-receive-information, identify-objects-actions-events, scan-display, isolation, contaminants, electricity, lighting, magnetism, fatigue, mental-strain, stress, preciseness, cognitive-attentiveness, response-chaining, attention-span, sleep, schedule, age, gender, height, weight, introspective-accuracy, probability-of-success, computer, weapon-systems, instruments, test-equipment, advises, indicates, informs, instructs, transmits, negotiates, and interpretive-movement. According to a pairwise comparison, cargo loading is most similar to to program management (92) and least similar to aircraft pilot (56). It clustered with accounting, program management, leadership, equipment diagnosis, DRAIR generation, and form fill-out in the eight-cluster analysis.

Approach - Cargo loading involves the use of a number of formulas and calculations, as well as heuristics gained from experience. What exactly is taken into consideration in planning a cargo is dependent on the cargo and the aircraft. We should then watch the expert perform the task for a single aircraft and in increasingly more complex set of cargo, discussing the process as he goes along.

Justifications - Cargo loading is very procedural, but variations occur due to the type of aircraft and type of cargo. Thus, we should begin to investigate the knowledge by selecting one area and learning the procedures as they apply to that selected area, then move on to other areas.

Results - SMSgt. Whitmer was prepared with one of the training books used to teach cargo loading. He began with a discussion of certain terminology, which required diagramming an aircraft. He explained what all of the terms meant, why they were needed, and how to generate the input data to the problem. We then went through the formulas used to evaluate a load plan. Basically, these formulas are used to verify that the planned load meets requirements. Then we went through the process of planning a load for a simple case, namely an all-pallet load. Then we moved into how vehicles are calculated in to the load and planned for. The interview provided an enormous amount of specific information that could be used in teaching this task.

6. Equipment Diagnosis

Brief Task Description - Diagnosis and repair of complex equipment requires a variety of support equipment and documentation. In diagnosing problems with aircraft engines, automatic test equipment provides a lot of data concerning the functioning and non-functioning of the problem engine. In addition, work control documents provide the general procedures to follow for first diagnosing, and then repairing an identified problem. A history is kept on each engine so that the individual who must fix it knows when it was in last, what the problems were, and how these problems were resolved. Though all of this support is available to the individual faced with fixing the engine, the task still requires experience in order to be effective.

Expert Characteristics - Experts are not necessarily degreed or even provided formal training in the diagnosis and repair of the items they are responsible for. They work their way up through the ranks based on their experience, gained primarily on the job. The job can become repetitive, and there is often pressure from upper level management to produce at a more rapid rate than is possible.

Source of Expertise:
Arthur Martinez
Air Force Air Logistics Command/
Kelly Air Force Base, Texas
(512)925-8757

Characterization of the Task Based on Interview 1 - Equipment diagnosis received a rating of four in the following attributes: formula-procedure-algorithm, instruments, test-equipment, repetitive, compare, procedures, and noise. The task received a rating of zero in the following attributes: statistical, analogical, mathematical, inductive, means-ends, cover-and-differentiate, propose-and-refine, generalize, specialize, verbal, kinesthetic, dynamism, complex-continuous, compound, reflex, simple-discrete, code, computerize, interpolate, tabulate, translate, induce, choose, compute, estimate, integrate, plan, supervise, monitor, analogs, perceptual-speed, search-receive-information, identify-objects-actions-events, scan-display, acceleration, confinement, isolation, lighting, magnetism, fatigue, mental-strain, stress, preciseness, cognitive-attentiveness, response-chaining, sleep, age, gender, height, weight, introspective-accuracy, probability-of-success, articulation, vehicles, weapon-systems, notation, advises, answers, communicates, directs, indicates, informs, instructs, requests, transmits, supervises, negotiates, expressive-movement, and interpretive-movement. According to a pairwise comparison, equipment diagnosis is most similar to to accounting (88) and least similar to aircraft pilot (56). It clustered with cargo loading, accounting, program management, leadership, DRAIR generation, and form fill-out in the eight-cluster analysis.

Approach - Ideally, we should follow a specific engine from start to finish through the repair process. However, that can take a period of a month or more, and we will only obtain information on the problems that that particular engine had. Because an attempt has been made to proceduralize the task through the use of technical orders and test equipment, an example technical order should be examined.

Justifications - Examination of the technical order will provide a basis for understanding the processes and procedures that are followed during a repair. However, it is important to also learn where they stop using the technical orders and why. For example, the technical orders may not be up-to-date or they have discovered a more efficient approach based on experience.

Results - Mr. Martinez was prepared with a couple of example technical orders (TOs) which we examined during the interview. These TOs contain the step-by-step procedure, including drawings, in order to perform any task that may appear on the work control document (WCD). It became apparent in this second interview that to truly interview someone in diagnosis we need to talk with members of the On-Condition Maintenance (OCM) team. The area where Mr. Martinez works performs the actual repair but does not actually do the diagnosis. The diagnosis is handled by OCM team members through an inspection, and the results are placed on a WCD for use by individuals in the shop in repairing a given item. The TOs provide the information on how to perform the repairs.

7. DRAIR Generation

Brief Task Description - DRAIR generation is a databased-decision making task. The process of generating a Deficiency Report Analysis Information Report (DRAIR) requires the acquisition of a large amount of data that must then be interpreted with respect to maintenance times, support costs, etc. A DRAIR is generated based on an inquiry from an equipment specialist, item manager, or other individual who suspects that a problem might exist with the reliability of a particular item. The result is a written document that describes the findings of the data analysis and provides an assessment of whether or not the data indicates a material deficiency, and if so, what should be done about it.

Expert Characteristics - Experts have primarily an operations research degree. They are not formally trained in the generation of DRAIRs but learn by doing the task on-the-job. An individual is usually assigned a particular weapon system or set of weapon systems for which they gain more detailed expertise based on generating DRAIRs. The individuals do not necessarily have much expertise in the engineering areas of the items themselves, such as hydraulics or electronics.

Source of Expertise:
Gayle Davis
Air Force Air Logistics Command/TIETP
Tinker Air Force Base, Oklahoma
(405) 736-5015 (5034)

Characterization of the Task Based on Interview 1 - DRAIR generation received a rating of four in the following attributes: inductive, acquire-and-present, verbal, databases, historical, itemize, analyze, induce, integrate, interpret, facts, articulation, computer, answers, communicates, and informs. The task received a rating of zero in the following attributes: spatial, model-based, means-ends, generate-and-test, cover-and-differentiate, propose-and-refine, specialize, return-to-definition, visual, auditory, kinesthetic, instrumentation, man-machine-interface, propadeutics, branching, dynamism, constraints, complex-continuous, compound, reflex, simple-discrete, fine, gross, repetitive, calculate, code, computerize, choose, compute, plan, supervise, monitor, principles, perceptual-speed, search-receive-information, identify-objects-actions-events, scan-display, acceleration, confinement, isolation, contaminants, electricity, lighting, magnetism, noise, fatigue, mental-strain, stress, preciseness, cognitive-attentiveness, response-chaining, attention-span, sleep, schedule, boredom, general-health, age, gender, height, weight, introspective-accuracy, probability-of-success, vehicles, weapon-systems, instruments, test-equipment, advises, directs, indicates, instructs, supervises, negotiates, expressive-movement, and interpretive-movement. According to a pairwise comparison, DRAIR generation is most similar to to accounting (101) and least similar to aircraft pilot (51). It clustered with cargo loading, accounting, program management, leadership, equipment diagnosis, and form fill-out in the eight-cluster analysis.

Approach - Generation of a DRAIR can be broken down by the sources of data and what that data means. We should select one set of data and concentrate on how it is obtained, what it means, and it is interpreted and summarized in the preparation of a DRAIR. This should be done using an example of the data that has been extracted from the appropriate data system and the resulting DRAIR.

Justifications - An example is always useful to help provide structure and direction to an interview. However, simply going through an example with no discussion of the generalities behind the decisions and interpretations would not be very enlightening at this point in the knowledge engineering process. The experts use generalizations and it is more efficient to obtain those directly, rather than trying to generalize from a bunch of examples.

Results - Gayle Davis was prepared for the interview with example SAFE and CPA reports, plus documents on the data systems that are used in her job. We examined the data reports and discussed the useful data points, where they come from, what they mean, and how decisions are made based on the data points. These decisions are then documented in the DRAIR. the structure of the DRAIR report itself was also discussed briefly and how the data feeds the various components. Based on this interview, we were able to obtain considerable information concerning the data to look for, where to look for it, and what to say based on it in the generation of a DRAIR.

8. Form Fill-Out

Brief Task Description - Our initial interview with Bill Bayliss covered the basic task of generating a cost proposal for submission to a DOD agency. He discussed the data in an RFP that drives the contents of the cost proposal, including the type of contract and the FAR clauses. From this interview, we targeted a specific form he completes to specify all documentation included in the cost proposal.

Expert Characteristics - Form fill-out is a very broad topic and could be subsumed under many other tasks. Thus, expert characteristics can vary significantly, depending on the type and purpose of the form.

Source of Expertise:
Bill Bayliss
Contract Administrator
Southwest Research Institute
San Antonio, TX
(512) 522-2238

Bill Bayliss is a contract administrator at Southwest Research Institute. He has a background in finance of over 40 years experience in addition to a masters degree in finance and accounting. Prior to working at SwRI, he was a contract administrator for the Air Force.

Characterization of the Task Based on Interview 1 - We rated the following characteristics as essential to form fill-out: generate sub-goals, acquire and present data, written inputs, making choices, procedures, use of a computer, transmitting information, and negotiation. According to a pairwise comparison, form fill-out is most similar to leadership training (98) and least similar to pilot training (54). In the eight-cluster analysis, form fill-out clustered with cargo loading, accounting, leadership training, equipment diagnosis, and drair generation, based primarily on the formation of sub-goals, acquire and presentation of data, and well-specified procedures.

Approach - Form fill-out is defined by the form itself and the background knowledge required to fill it out. We should select an example form and the data sources to support it, and watch the expert fill the form out, discussing the process as he goes along.

Justifications - The task is basically defined by the form to be completed which provides the "procedure." It is an "acquire and present" task that requires the current situation as data and a broad background of general knowledge about the area for which the form is used.

Results - We selected the form that Bill Bayliss uses to outline the construction of a contract based on an RFP. We took the ICATT RFP that he had worked on about one year ago and followed the process required by the form. Bill was told in advance about the problem, but did not fill-out the form in advance. Though a specific example was discussed, most of the information was provided in generalities, with rules about how you would fill-in each slot. The specific example would not have lead to the same understanding and it is apparent that even after many specific examples it would be difficult to generalize without the support of the expert in making those generalizations.

9. **Accounting**

Brief Task Description - In the initial interview, we discussed the variety of tasks performed by an accountant. Accounting is very procedure oriented; the books must be in compliance with the Generally Accepted Accounting Principles (GAP). These principles largely establish accounting practice. The details not established by GAP are institution specific and established on-site. There is some ambiguity in interpretation that occassionally must be resolved.

Expert Characteristics - Experts in accounting usually have at least a Bachelor's degree with a major in accounting. Additional tests can be taken that authorizes the individual as a Certified Public Accountant. However, the accounting degree usually just helps the individual to understand the general principles behind the accounting task at a particular institution. Thus, on-the-job training that familiarizes the individual with the standard practices and procedures of the specific company are usually required.

Source of Expertise:
Linda Boehm, CPA
Accounting Department
Southwest Research Institute
San Antonio, TX
(512) 522-2965

Characterization of the Task Based on Interview 1 - We rated the following characteristics as essential for accounting: temporal reasoning, case-based reasoning, formation of sub-goals, generate and test, acquire and present, decompose, verbal inputs, historical inputs, propadeutics, categorization, itemizing, translating, choosing, planning, interpreting, procedures, use of past cases, perceived probability of success, instruments, and communication. According to a pairwise comparison, accounting was most similar to DRAIR generation (101) and least similar to pilot training (53). It clusters with cargo loading, program management, leadership training, equipment diagnosis, drair generation and form fill-out in the eight-cluster analysis.

Approach - We need to have the expert select a task that she performs on a regular basis that takes one to two hours and watch her perform the task, discussing the process as she goes along.

Justifications - Accounting consists of many diverse tasks and the tasks vary depending on the individual's job. In order to get a handle on the procedures used and to train anything useful, the knowledge acquisition process should center initially on a particular task.

Results - Linda selected the task of reconciling the general ledger with the projects ledger. The task is performed every quarter and is used to verify that the Institute's financial report is accurate. She went through the procedure, which basically involved filling out a form, while we asked questions concerning where she was getting the data, what the data meant, and when a problem occurred in the balancing where she tended to look in order to reconcile it. The process is highly procedural in terms of filling out the form, but the knowledge concerning where and how to look for problems that occur is much more heuristically-based.

APPENDIX C

LIST OF KNOWLEDGE ACQUISITION TECHNIQUES

APPENDIX C

LIST OF KNOWLEDGE ACQUISITION TECHNIQUES AND TOOLS

I. TRADITIONAL METHODS

A. Written Materials

texts, manuals, etc.

B. Verbal Reports

1. Interviews - descriptive, problem-oriented, structured

2. Observational Studies

   - discourse analysis

3. Protocol Methods - retrospective reports, current problem

C. Psychometric Techniques

1. Personal Constructs

2. Multidimensional Scaling/Cluster Analysis

3. Candidate Elimination/Version Spaces in concept learning

II. AUTOMATED ACQUISITION TOOLS

A. Induction-Based Tools/Concept Learning

1. RuleMaster
2. TIMM
3. Expert Ease
4. ID3 - generates decision tree
5. PRISM - generates production rules
6. MARVIN - induces and represents function recursively
7. NODDY - represents function in nested numeric expressions
8. BACON - clustering
9. COPER
10. LEX-II - explanation-based concept learning
11. AM - discovery-based concept learning
12. FOO - learning by being told
13. BRZDYL1 - a learning system for conceptual engineering design

B. Interview-Based Systems

1. THEIRESIAS - ka for MYCIN
2. MOLE - symptom/hypothesis linkages - successor to MORE
3. PLANET - repertory grid methods
4. ROGET - method oriented conceptual model
5. ASK - tool for acquiring strategic knowledge
6. ETS - personal constructs used to build concept hierarchies
7. KNACK - evaluation - task-based approach for advice systems
8. SALT - solution construction - proposed and revise
9. MORE - model of classification problem solving
10. KITTEN - another rep grid tool
11. KREME - for developing and editing large kbs
12. ASTEK - structured ka for troubleshooting
13. SIZZLE - ka tool for the sizing task
14. RIME - knowledge acquisition for XCON
15. KAS - ka for prospector - semantic networks
16. HYDRA - augmented transition networks
17. AQUINAS - successor to ETS
18. OPAL - elicits specific cancer treatment plans
19. KADS - develop term taxonomies/construct knowledge-level models
20. NEXTRA - uses repertory grid analysis
21. YAKA - combination of qualitative reasoning/cover & differentiate
22. $K^{n}{}_{A}c$ - tool for knowledge assimilation given existing knowledge base
23. SMEE - personal construct elicitation
24. Tranowski's KAE for scene analysis
25. FMS Aid, KSSO, KRITON - rep grid tools
26. TEST/TDE - for diagnostic problem solving

III. COMMERCIAL KNOWLEDGE ACQUISITION PRODUCTS

A. ADS (Aion Corporation)
KA module within expert system

B. Knowledge Shaper (Perceptics, Inc.)
ID3/decision tree oriented tool for KA

C. Socrates (CIM Solutions, Inc.)
KA module within expert system

D. Exsys Professional (Exsys, Inc.)
KA module within expert system

E. G-2 Real-time Expert (Gensym)
object-oriented rule modeler

F. VP-Expert (Paperback Software, Int'l)
KA module within expert system

G. Nextra (Neuron Data)
Repertory grid based KA took at front end for Nexpert Object

H. GURU (mdbs Inc.)
KA module within expert system

I. Mercury KBE (Artificial Intelligence Technologies)
object oriented/Lisp based KA module

J. KAM (Phase-Linear, Inc.)
KA from text/documentation parsing service

K. Knowledge Analysis Tool (Gary Ribar, Inc.)
modified repertory grid based KA tool

L. FOCUS (Information Builders)
crude KA facsimile

M. PIUS (COGENSYS)
captures judgmental expertise without knowledge engineering
Personal Insurance Underwriting System

N. CLS (COGENSYS)
same as above
Consumer Lending System

O. MUS (GOGENSYS)
same as above
Mortgage Underwriting System

P. TRILOGY (Metavision, Inc.)
intelligent tutoring system; automatically constructs courseware

Q. 1st Class (AICorp Inc.)
induction, hypertext

R. Turbo Shell v3.0 (Berkshire Software Co.)
creates, modifies, and consults knowledge base, uses confidence factors and fuzzy logic

S. ALEX (Harris and Hall Associates) ??
incremental expert system development

T. Level5 (Information Builders, Inc.)
facilitates the transfer of expertise into usable knowledge bases

U. IXL 2.0 (Intelligence Ware, Inc)
generates rules from a set of hypotheses using a proprietary induction algorithm

V. Autointelligence (Intelligence Ware, Inc.)
captures and distills knowledge of an expert to generate an expert system

W. Crystal Induction System (Intelligent Environments)
generates rules from a series of examples entered in text or spreadsheet form

X. Sophos (Cognisys Teleport de Montreal)
knowledge acquisition rule generator

Y. Knowledge Quest (Computer Aided Knowledge)
knowledge into rules

Z. MAINGEN (OXKO Corp.)
up to 100 rules on any maintenance task with fill-in-the blank Q and A automated interview

AA. INDUCPRL (OXKO Corp)
takes as input a spreadsheet or table of data and outputs production rules

BB. LogicTree (CAM Software, Inc.)
uses decision trees for capturing information

CC. KnowledgeMaker (Knowledge Garden, Inc.)
induction-based

APPENDIX D

FIRST INTERVIEW QUESTIONNAIRE

Appendix D

Initial Interview Questions

Initial Discussion:

There are no right answers or good answers to these questions. Some of the questions may be phrased so that you believe one or another response is appropriate or somehow better than another. For example, it may sound good to say you plan up front all your actions in solving a problem or doing the job even if some of those actions occur somewhat automatically. Please do not fall into this bias. For this example, it is good to plan but it is also good not to plan too much and to have some actions that occur automatically. We want to assess all aspects of your job with as much fidelity as possible. What results from these interviews will help us to better understand the unique aspects of your work and how we could learn more about it in the future so we can design computer systems that help you perform your job more easily.

Also, we want to assure you that under no circumstances will your answers go to your supervisor or anyone else outside of this room. You are responding to this questionnaire completely anonymously. Because of this, we want you to provide the operational answers to these questions, not the official ones. We want to know what you really do on your job.

A) UNDERSTANDING THE PROBLEM

**A1) Tell us a little bit about your field, yourself, and how you got into this field.

**A2) What initiates the problem solving process?

A3) What types of inputs to the problem do you have? How do you recognize the problem? Do you:

- see something
- hear something
- talk to someone
- feel something
- read something -- book, test equipment, output computer display
- detect it based on past data

**A4) Does solving the problem require a lot of data? If so, about what and how do you acquire the data? Do you try to group data together into categories that have some unifying principle?

A5) Is the data you work with primarily numerical or is it more qualitative?

A6) What assumptions can be made that would simplify the problem solving task? What is the effect when these assumptions are removed?

A7) What could happen to complicate the task?

A8) Are there manuals or desk procedures that document/direct what you do?

A9) When you are defining/identifying the problem, do you spend a lot of time looking up information or thinking about different aspects of the problem or do you perform the task mostly automatically? What types of interactions, if any, are required in terms of documents, data systems, or other people when performing problem definition?

**A10) What types of information come to mind when you do the task in the sense of inputs into the problem?

- facts
- principles/rules/laws
- procedures
- similar problems/analogies
- past problems

A11) Do you interact with other people while you're defining the problem? If so, how? Do you:

- advise
- answer
- direct
- indicate
- inform
- instruct
- request
- transmit
- supervise

A12) Do you think body language such as gestures and facial expressions are important in communicating at this time?

**A13) Is there a lot of uncertainty in the problem -- maybe even to the extent that it's hard to know if there is a problem? How do you go about identifying/defining the problem?

A14) Do the problem characteristics change frequently, maybe even while you're solving it? If so, what changes -- data, rules by which you solve the problem? What drives the change - e.g., time intervals?

**A15) Do you have to solve the problem quickly or are there other constraints on the problem? e.g., Is time a factor - what is "real-time" in this situation -- seconds, minutes, hours? How flexible are any constraints on the problem?

**A16) Do you use solutions to past problems to help you solve the current problem? How similar do they tend to be and how do you modify them?

A17) How do you decide what past problem to use? Do you use a specific problem or some general version?

A18) Do you try to draw parallels to similar but not identical problems, see how those problems were solved, and use that information in the current problem?

A19) What equipment do you use while defining the problem?

A20) How many alternative answers are there for a problem? Do you have to check for many as you solve it? Is one answer obviously better than another? How can you tell? Must you find the best answer or is a certain level of answer good enough?

**A21) How would you describe the output of your task? Do you generate a document, a decision, a recommendation, an action, a piece of equipment, an interaction with someone, etc.?

A22) Can you list all possible solutions to your problem at the start? If so, approximately how many are there?

B) DEVISING THE PLAN

**B23) When you think about a problem do you:

a) visualize it in your mind
b) formalize it in a set of equations and work it out mathematically
c) explain it and solve it in English

B24) Do you calculate or look at statistics to help you solve the problem?

B25) Do you order elements of the problem in time or do you have to think about a time element during the solution? (i.e., such as data or input changing over time).

B26) Do you generate a model to help you solve the problem, such as a mathematical model, a physical model, or some other symbolic representation of the problem? Do you "simulate" the behavior of a device in your head.

B27) When you plan the job, do you spend a lot of time looking up information or thinking about different aspects of the problem or do you perform the task mostly automatically? What types of interactions are required in terms of documents, data systems, or other people?

B28) Do you break the problem into parts? Are there sequential tasks you perform or logically distinct subcomponents of the problem? If so, what are they?

B29) When you plan the task, do you have to do one thing after another, such that one set of conditions causes you to respond with a whole series of actions? Do you wait after each one to see the results before you go any further?

B30) Do you interact with other people while planning the task? If so, how? Do you:

- advise
- answer
- direct
- indicate
- inform
- instruct
- request
- transmit
- supervise
- body language

B31) What type of formal education do you have? Both in general as well as specific to your job. What role does experience play? Do you have an apprenticeship? How do you become qualified for what you do?

B32) Do you think personal factors such as age, gender, height, or weight influence yours or others ability to do the task?

B33) Do you think you have to have a certain attitude or personality to work well on this job?

B34) Do you generate solutions and then test them to see if they work?

B35) Do you think of past solutions and then modify them to suit the current problem?

B36) Do you look at data and find the problem or a method, then look at more data, etc. Or do you have a goal and collect data to meet that goal?

B37) When you solve the problem do you have a goal and take incremental steps in an attempt to step by step get to that goal?

B38) Are there set procedures or formulas you use for your task?

B39) Are the procedures you use to solve the problem known?

B40) Do you gather data and then present it by writing about it or discussing it with others?

**B41) Do you break your problem into sub-parts and then solve those? After you solve the sub-parts do you have to reassemble them into an overall solution?

B42) Do you ever go back and return to the specifications or original definition of the problem?

B43) Do you generate solutions that explain part of the problem, and then determine what part is solved and try to generate a solution to solve any remaining portions of the problem?

B44) During your task do you have to:

- calculate
- code
- computerize
- interpolate
- itemize
- tabulate
- translate
- estimate
- compute

B45) Do you choose between alternatives? Do you compare alternatives?

B46) Do you integrate portions of the problem in the final solution?

B47) Do you have to do a lot of planning? Plan the task -- or create a plan?

B48) Do you categorize parts of the problem together? Or categorize data in order to solve the problem?

B49) Are there general principles that you know to be true in your field? Do you use those to help determine what's going on in a specific situation?

**B50) If you make a wrong choice, is it easy to undo and if it is, how do you undo it?

B51) What equipment do you use when planning the problem solution?

C) CARRYING OUT THE PROBLEM

**C52) What are the major steps you perform?

C53) Where is your problem solving generally performed? Describe your work environment. Do you work at a desk with paper and pencil, at a console or in front of a piece of equipment, walking around and talking to people, or flying an aircraft? Is there:

- acceleration
- confinement
- isolation
- contaminants - what are they?
- electricity
- lighting
- magnetism
- noise

C54) How demanding is the task physically and psychologically?

- fatigue
- mental strain
- stress
- physical strain
- precision
- amount of sleep
- work schedule
- have to pay attention all the time

C55) Do you have to pay close attention to the task for long periods of time?

C56) What types of physical movements do you make when you do the job?

(we will assess motor processes and perceptual requirements from the demonstration)

C57) Do you interact with other people during the actual execution of the task? How? Do you:

- advise
- answer
- direct
- indicate
- inform
- instruct
- request
- transmit
- supervise
- body language

C58) When you do the job, do you spend a lot of time looking up information or thinking about different aspects of the problem or do you perform the task mostly automatically? What types of interactions are required in terms of documents, data systems, or other people during task execution?

C59) Do you monitor some set of indicators as the task progresses?

C60) Do you have to interpret information you receive maybe forming new indicators?

C61) What type of equipment is involved in actually performing the task?

C62) When you perform the job, do you have to do one thing after another, such that one set of conditions causes you to respond with a whole series of actions? Do you wait after each one to see the results before you go any further?

**C63) What is the hardest/easiest thing you do? What is the most important

D) LOOKING BACK

**D64) How many alternative answers do you usually come up with? Do you have to check for many as you solve it? Is one answer obviously better than another? How can you tell? Must you find the best answer or is a certain level of answer good enough?

D65) Do you interact with other people in verifying the task? How? Do you:

- advise
- answer
- direct
- indicate
- inform
- instruct
- request
- transmit
- supervise
- body language

D66) When you evaluate your solution, do you spend a lot of time looking up information or thinking about different aspects of the problem?

D67) Can the quality of a solution be characterized as better or worse rather than acceptable/not acceptable?

APPENDIX E

REVISED FIRST INTERVIEW QUESTIONNAIRE

Appendix E

Revised First Interview Questions

Initial Discussion:

There are no right answers or good answers to these questions. Some of the questions may be phrased so that you believe one or another response is appropriate or somehow better than another. For example, it may sound good to say you plan up front all your actions in solving a problem or doing the job even if some of those actions occur somewhat automatically. Please do not fall into this bias. For this example, it is good to plan but it is also good not to plan too much and to have some actions that occur automatically. We want to assess all aspects of your job with as much fidelity as possible. What results from these interviews will help us to better understand the unique aspects of your work and how we could learn more about it in the future so we can design computer systems that help you perform your job more easily.

Also, we want to assure you that under no circumstances will your answers go to your supervisor or anyone else outside of this room. You are responding to this questionnaire completely anonymously. Because of this, we want you to provide the operational answers to these questions, not the official ones. We want to know what you really do on your job.

A) UNDERSTANDING THE PROBLEM

A1) Tell us a little bit about your field, yourself, and how you got into this field.

A2) What type of formal education do you have, both in general as well as specific to your job? What role does experience play? Did you have an apprenticeship? How do you become qualified for what you do?

A3) About how long does it take to perform the task (start to finish) -- is there a start and a finish, how well defined are they and what defines them?

A4) What types of inputs to the problem do you have? How do you recognize the problem? Do you:

- see something
- hear something
- talk to someone
- feel something
- read something -- book, test equipment, output computer display
- detect it based on past data

A5) Does solving the problem require a lot of data? If so, about what and how do you acquire the data? Do you try to group data together into categories that have some unifying principle? Is the data you work with primarily numerical or is it more qualitative?

A6) Are there manuals or desk procedures that document/direct what you do?

A7) What types of information come to mind when you do the task in the sense of inputs into the problem?

- facts
- principles/rules/laws
- procedures
- similar problems/analogies
- past problems

A8) Is there a lot of uncertainty in the problem -- maybe even to the extent that it's 9hard to know if there is a problem? How do you go about identifying/defining the problem?

A9) Do you have to solve the problem quickly or are there other constraints on the problem? e.g., Is time a factor - what is "real-time" in this situation -- seconds, minutes, hours? How flexible are any constraints on the problem?

A10) Do you use solutions to past problems to help you solve the current problem? How similar do they tend to be and how do you modify them? How do you decide what past problem to use? Do you use a specific problem or some general version?

A11) Can you list all possible solutions to your problem at the start? If so, approximately how many are there?

B) DEVISING THE PLAN

B12) When you think about a problem do you:

a) visualize it in your mind
b) formalize it in a set of equations and work it out mathematically
c) explain it and solve it in English

B13) Do you order elements of the problem in time or do you have to think about a time element during the solution? (i.e., such as data or input changing over time). Do you have to do a lot of planning? Plan the task -- or create a plan?

B14) Do you generate a model to help you solve the problem, such as a mathematical model, a physical model, or some other symbolic representation of the problem? Do you "simulate" the behavior of a device in your head?

B15) Do you break the problem into sub-parts? Are there sequential tasks you perform or logically distinct subcomponents of the problem? If so, what are they? After you solve the sub-parts do you have to reassemble them into an overall solution?

B16) Do you generate solutions and then test them to see if they work or do you think of past solutions and then modify them to suit the current problem?

B17) When you solve the problem do you have a goal and take incremental steps in an attempt to step by step get to that goal?

B18) Are there set procedures or formulas you use for your task? Are there general principles that you know to be true in your field? Do you use those to help determine what's going on in a specific situation?

B19) Do you ever go back and return to the specifications or original definition of the problem?

B20) Do you generate solutions that explain part of the problem, and then determine what part is solved and try to generate a solution to solve any remaining portions of the problem?

B21) Do you choose between alternatives? Do you compare alternatives?

C) CARRYING OUT THE PROBLEM

C22) What are the major steps you perform?

C23) Where is your problem solving generally performed? Describe your work environment. Do you work at a desk with paper and pencil, at a console or in front of a piece of equipment, walking around and talking to people, or flying an aircraft?

C24) How demanding is the task physically and psychologically?

C25) Do you have to pay close attention to the task for long periods of time?

C26) What types of physical movements do you make when you do the job?

C27) Do you interact with other people during the actual execution of the task? How?

C28) Do you gather data and then present it by writing about it or discussing it with others?

C29) Do you monitor some set of indicators as the task progresses?

C30) Do you have to interpret information you receive maybe forming new indicators?

C31) Do you calculate or look at statistics to help you solve the problem?

C32) What type of equipment is involved in actually performing the task?

C33) When you perform the job, do you have to do one thing after another, such that one set of conditions causes you to respond with a whole series of actions? Do you wait after each one to see the results before you go any further?

C34) Do you think personal factors such as age, gender, height, or weight influence yours or others ability to do the task? Do you think you have to have a certain attitude or personality to work well on this job?

C35) What could happen to complicate the task?

C36) If you make a wrong choice, is it easy to undo and if it is, how do you undo it?

D) LOOKING BACK

D37) How would you describe the output of your task? Do you generate a document, a decision, a recommendation, an action, a piece of equipment, an interaction with someone, etc.?

D38) How many alternative answers do you usually come up with? Do you have to check for many as you solve it? Is one answer obviously better than another? How can you tell? Must you find the best answer or is a certain level of answer good enough?

D39) How do you evaluate your solution? Can the quality of a solution be characterized as better or worse rather than acceptable/not acceptable?

D40) What is the hardest/easiest thing you do? What is the most important?

	maintain systems diagnostics	repair systems [illegible]	communic. monitor/analysis	photo analysis	training pilots	training astronauts	training air crews	training instructors	air traffic control	console operations	weather forecast/model	~~program management~~	facilities management	cargo loading	operations [illegible]	software design	software maintenance or [illegible]	~~software~~ debugging	form fill-out	training reading	training foreign lang.	oil accident investig.	prospecting	power grid management	computer configuration	chemical analysis	personnel - management -	customer service	sales	weapons director	use RMS/or other remote manipulation	leadership training	surgery	medical diagnosis	accounting	marketing
1. Reasoning Techniques																																				
statistical	✓		✓			✓					✓		✓									✓	✓	✓		✓		✓	✓				✓	✓	✓	✓
spacial	✓	✓		✓	✓		✓		✓				✓	✓	✓							✓		✓	✓	✓					✓		✓			
temporal	✓	✓	✓		✓	✓	✓		✓		✓	✓			✓					✓				✓							✓		✓	✓		✓
analogical	✓				✓	✓	✓	✓								✓	✓										✓	✓	✓			✓				✓
case-based	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓						✓		✓	✓	✓	✓		✓	✓	✓	✓	✓			✓	✓	✓		✓
modelling	✓		✓					✓			✓					✓	✓	✓				✓	✓	✓		✓					✓	✓	✓	✓		
mathematical											✓											✓		✓		✓									✓	
deductive	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓			✓	✓	✓	✓	✓	✓	✓		✓				✓	✓	✓		
inductive			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓							✓									✓				
2. Problem-Solving Techniques																																				
means-ends analysis												✓		✓	✓	✓	✓								✓				✓		✓				✓	✓
forming sub-goals	✓	✓			✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
generate-and-test									✓?				✓	✓		✓	✓							✓	✓	✓		✓	✓		✓					✓
heuristic search/goal vs. data	5'0	G	O	D	D	O	G?	G	D	D	D	G	D·G	D	G	G	D	G		G	G	D	G	D		D	D	D	G		G	G	G	O	O	GD
cover & differentiate	✓		✓														✓					✓		✓		✓							✓	✓		
propose & refine											✓	✓	✓	✓								✓		✓	✓	✓	✓	✓			✓					✓
acquire & present			✓	✓	✓	✓	✓			✓	✓	✓	✓										✓				✓	✓	✓			✓		✓		✓
formula/procedure/algorithm	✓	✓								✓			✓	✓				✓		✓	✓	✓		✓	✓	✓		✓			✓	✓	✓		✓	
decomposing		✓		✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓			✓	✓	✓		✓	✓	✓	✓				✓	✓	✓	✓	✓	✓
recombining	✓			✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓		✓		✓	✓			✓	✓		✓				✓	✓	✓			
generalizing					✓	✓	✓	✓				✓			✓								✓									✓				
specialization	✓		✓	✓	✓	✓	✓	✓				✓					✓	✓		✓	✓	✓	✓	✓	✓	✓		✓				✓	✓	✓	✓	
return to definition	✓				✓	✓	✓	✓									✓			✓	✓					✓							✓	✓	✓	
3. Inputs																																				
visual - scenes, icons, charts	✓	✓		✓	✓		?		✓	✓	✓		✓	✓	✓					✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
verbal	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓		✓	✓	✓			✓		✓	✓	✓			✓	✓	✓		✓
auditory	✓	✓			✓		✓		✓						✓?					✓	✓	✓											✓	✓		✓
kinesthetic		✓			✓		?	✓							✓?						✓										✓		✓	✓		
written material	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓			✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
instrumentation/test results /system behavior	✓				✓	✓	✓		✓	✓	✓						✓						✓	✓	✓	✓							✓	✓		
man/machine interface	✓				✓	✓	✓		✓	✓			✓		✓	✓	✓							✓							✓					
databases	✓		✓			✓					✓	✓	✓					✓				✓	✓	✓		✓								✓	✓	✓
historical information	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓
propadeutics	✓	✓			?		?								✓			✓		✓	✓				✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
4. Task Complexity																																				
branching factor	?			?			✓				✓		✓	✓		✓	✓			✓	✓	✓	✓	✓		✓	✓	✓	✓			✓		M		✓
dynamism	?	?		?	✓	✓	✓		✓	✓?	✓		✓		✓							✓		✓			✓	✓	✓		✓	✓	✓	✓		✓
time factors/constraints	?	?	✓	?	✓	✓	✓		✓	✓?	✓				✓	✓						✓		✓		?			✓		✓		✓	✓		✓
uncertainty	?	?	✓	✓		✓			✓	✓	✓		✓		?							✓	✓				✓	✓	✓		✓	✓	✓	✓		
difficulty		?		?		?	?																													

APPENDIX F

TASK CHARACTERISTICS RATING MATRIX BEFORE FIRST INTERVIEW

difficulty		?		?		?	?		✓	✓	✓		✓		?						✓	✓				✓	✓	✓		✓	✓	✓	✓		✓
5. Technical Dimension																																			
high to low	H	H	M	L	M	H	H	H-L	L	L	H	L	M	L	L	H	H	L	L	L	M	H	H	H	H	L	L	L		L	L	H	H	M	L
quantitative vs. qualitative	L	L	T	L	T-L	T-L	T-L	T-L	L	L	T	L	M	L	L	L	-	H ?	L	L	L	L	T	M	T	L	L	L		L	L	L	T-L	T	L
6. Motor Processes																																			
Complex-continuous					✓				✓						✓	✓	✓	✓																	
compound		✓		—											✓															✓		✓			
reflex					✓										✓															✓		✓			
simple-discrete	✓	✓			✓										✓																				
fine	?	✓		-	✓					✓				✓	✓								✓		✓								✓		
gross	?	✓		-	✓				✓	✓					✓	✓	✓	✓												✓		✓	✓		
repetitive					✓				✓	✓					✓										✓					✓					
7. Information Processing																																			
categorize	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
calculate			✓			✓			✓	✓	✓						✓	✓			✓	✓	✓	✓	✓			✓		✓			✓	✓	✓
code	✓		✓										✓	✓	✓	✓	✓	✓		✓														✓	
computerize																✓	✓	✓			✓	✓												✓	
interpolate			✓			✓			✓		✓											✓		✓	✓					✓					✓
itemize	✓	✓				✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓			✓	✓	✓	✓	✓		✓	✓			✓	✓	✓	✓	✓
learn	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
tabulate		✓	✓			✓			✓	✓	✓	✓	✓	✓		✓		✓				✓	✓	✓	✓		✓	✓					✓	✓	
translate			✓	✓		✓				✓			✓			✓			✓	✓				✓		✓	✓	✓		✓	✓		✓	✓	✓
8. Problem-solving Tasks																																			
analyse	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓					✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
deduce	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓	✓						✓	✓	✓	✓	
induce				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓								✓									✓				
choose	✓	✓			✓	✓	✓	✓	✓			✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓
compare	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
compute						✓			✓	✓	✓		✓	✓		✓	✓	✓			✓	✓	✓	✓										✓	
estimate						✓			✓	✓	✓		✓	✓				✓	✓		✓	✓	✓	✓				✓		✓			✓	✓	✓
integrate	✓					✓			✓		✓		✓	✓	✓	✓		✓	✓	✓				✓										✓	
plan		✓			✓	✓	✓	✓	✓			✓	✓	✓		✓			✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓			✓
supervise					✓	✓	✓	✓	✓			✓				✓			✓	✓	✓					✓					✓	✓	✓		✓
monitor	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓			✓	✓	✓		✓			✓				✓		✓	✓		✓
interpret	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
9. Recall (The Role of Memory)																																			
facts	↘	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓
principles	↘				✓	✓	✓	✓								✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓
procedures	↘	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓		✓			✓	✓	✓	✓	✓	
analogs	↘				✓	✓	✓	✓							✓											✓	✓	✓			✓				✓
cases (experiences)	↘	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓			✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			✓	✓	✓	✓	✓
10. Perceptual Requirements of the Task																																			
perceptual speed					✓	✓	✓		✓	✓																						✓			
searching for and receiving information	↘		✓	✓	✓	✓	✓		✓	✓					✓								✓							✓		✓	✓		
identifying objects, actions, and events		✓	✓-	✓	✓		✓		✓	✓	✓								✓				✓		✓					✓		✓	✓		
scanning a display			✓	✓	✓	✓	✓		✓	✓					✓															✓					
11. Environment in which tasks are performed																																			
11.1 Physical																																			
acceleration					✓		✓																												
confinement		✓			✓		✓																									✓			
isolation										✓																				✓					
contaminants		✓								?																				✓					
electricity																																			
lighting																																✓			
magnetism																																			
noise	↘	✓			✓	✓										?																			

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scanning a display	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
11. Environment in which tasks are performed	
11.1 Physical	
acceleration	✓ ✓ ✓
confinement	✓ ✓ ✓ ✓ ✓
isolation	✓ ✓
contaminants	✓ ? ✓
electricity	✓
lighting	–
magnetism	
noise	✓ ✓ ✓ ✓
11.2 Psychological - Mental State	
fatigue	✓ ✓ ✓
mental strain	✓ ✓ ✓
stress	✓ ✓
physical strain	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
precision	✓ ✓ ✓ ✓ ✓ ✓
cognitive attentiveness	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
response chaining	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
attention span	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
amount of sleep	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
work schedule	✓ ✓ ✓
12. Personal Characteristics	
12.1 Physical	
age	
gender	
height	
weight	
12.2 Psychological	
education/training expertise ~~expertise~~	M M M M H H M-H M L H L M L M H H L H M H H H H H L L L H M H H H M
introspective accuracy/willingness	✓ ✓
perceived probability of success	
Type of Domain	
knowledge-rich to high performance	KR M KK M M KR KK KK H HP KR KR KK KK HP KR KR KR KR KR KR KR KR KR KR M M M HP KR M KR KR KR
Hardware/Equipment/Tools Involved	
computer	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
vehicles/aircraft etc.	✓ ✓ ✓ ✓ ✓ ✓
Weapon system	✓ ✓ ✓ ✓
instruments	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
notation - character-based graphic, charts	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
test equipment	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
5 Communication Processes	
Advises	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
Answers	✓ ✓
Communicates	✓ ✓
Directs	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
Indicates	✓ ✓
Informs	✓ ✓
Instructs	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
Requests	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
Transmits	✓ ✓
Supervises	✓ ✓
	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
6 Non-discursive communication	
expressive movement	✓ ✓ ? ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
interpretative movement	✓ ✓ ? H ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓

APPENDIX G

TASK CHARACTERISTICS RATING MATRIX AFTER FIRST INTERVIEW

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1. Reasoning Techniques
   - statistical
   - spatial
   - temporal
   - analogical
   - case-based
   - modelling/simulation
   - mathematical
   - deductive
   - inductive
2. Problem-Solving Techniques
   - means-ends analysis
   - forming sub-goals
   - generate-and-test
   - heuristic search/goal vs. data
   - cover & differentiate
   - propose & refine
   - acquire & present
   - formula/procedure/algorithm
   - decomposing
   - recombining
   - generalizing
   - specialization
   - return to definition
3. Inputs
   - visual - scenes, graphs, charts
   - verbal
   - auditory
   - kinesthetic
   - written material
   - instrumentation/test results
   - man/machine interface
   - databases
   - historical information
   - propadeutics
4. Task Complexity
   - branching factor
   - dynamism
   - time factors/constraints
   - uncertainty

maintain systems diagnostics
repair systems making the fix
communic. monitor/analysis
photo analysis
training pilots
training astronauts
training air crews
training instructors
air traffic control
console operations
weather forecast/model
program management
~~facilities management~~
cargo loading
operations
software design
software maintenance
software-debugging
form fill-out
training reading
training foreign lang.
oil accident investig.
prospecting
power grid management
computer configuration
chemical analysis
personnel - management -
customer service
sales
weapons director air intercept
use RMS/ or other
leadership training
surgery
medical diagnosis
accounting
marketing
knowledge engineering
protocol design

5. Technical Dimension
high to low — 2 H M L 2 H H H-L 2 1 3 2 3
quantitative vs. qualitative — 3 L T L 2 T L T-L T-L 2 3 3 2 2 3

H-1 H-1
L-15 L-3
L-2 T-1
T-10 L-2
M-3 L-3

6. Motor Processes			
Complex-continuous	8	0	2
compound	4	0	0
reflex	2	0	0
simple-discrete	9	0	4
fine ?1	11	2	3
gross ?1	5	2	3
repetitive	4	4	1
7. Information Processing			
categorize	30	3	3
calculate	20	0	0
code	8	0	0
computerize	6	0	0
interpolate	9	0	0
itemize	26	3	2
? learn something new to perform task	32	1	0
tabulate	19	0	0
translate	20	0	0
8. Problem-solving Tasks			
? analyse	30	2	3
deduce	25	2	3
induce	14	0	1
choose	30	0	3
compare	33	4	4
compute	12	0	0
estimate	20	0	0
integrate	11	0	3
plan	25	0	3
supervise	14	0	3
monitor	22	0	4
interpret	30	13	3
9. Recall (The Role of Memory)			
facts	32	2	1
principles	23	1	1
procedures	22	4	4
analogs	10	0	3
cases (experiences)	30	1	3
10. Perceptual Requirements of the Task			
perceptual speed	7	0	4
searching for and receiving information	14	0	3
identifying objects, actions, and events	15	0	3
scanning a display	9	0	4

11. Environment in which tasks are performed																														
11.1 Physical																														
acceleration		3	0				3	✓			0	0	0	0	0	1	0	0		0				0	0	0	2			0
confinement		5	0	✓			4	✓			3	1	0	0	0	1	0	0		0			✓	0	2	0	0			0
isolation	?1	1	0				0				0	0	0	0	0	0	0	0		0			✓	0	0	0	0			0
contaminants		2	2	✓			0				0	0	0	0	0	0	0	0		0				0	1	0	0			0
electricity			3				0				0	0	0	0		0	0	0		0				0	2	0	0			0
lighting			0				0				2	1	0	0		0	0			0				0	0	0	0			0
magnetism			0				0				0	0	0	0		0	0			0				0	0	0	0			0
noise		4	4	✓			4	✓			3	4	0	0	0	3	0	0		0				0	0	0	0			0
11.2 Psychological - Mental State																														
fatigue		4	0				3				4	1	0	0	0	0	0	0		0	✓			0	3	1	0			0
mental strain		3	0		✓		3				4	2	0	0	0	0	0	0		0				0	[illegible]	2	0			0
stress		8	0				3	✓			4	3	0	0	0	✓✓	0	0		0	✓ ✓		✓	0	4	3	0			0
physical strain	√?-1	3	3	✓			1				0	1	0	0	0	✓	0	0		0				0	3	0	0			0
precision		8	0	✓			3	✓			0	1	0	0	0	0	0	0		0			✓	0	4	0	4			0
cognitive attentiveness		12	0		✓		4	✓	✓		4	4	0	0	0	0	0	0	✓	0	✓ ✓		✓	0	4	0	0			0
response chaining		9	0				1				3	1	0	0	0	0	0	0		0	✓ ✓	✓ ✓ ✓	✓	0	2	0	0			0
attention span		9	1		✓		3			✓	4	3	0	0	0	0	0	0		0	✓ ✓			0	4	0	0			0
amount of sleep		2	0				0				4	0	0	0		0	0	0		0				0	2	1	0			0
work schedule		1	2				3				4	2	0	0		0	0	0		0				0	4	2	0			0
boredom			3				0				0	2	0	0		2	0	0		0				0	1	1	0			0
12. Personal Characteristics																														
12.1 Physical general health			0				4				4	4	0	0	0	2	0	0		0				0	0	0	0			
age			0				3				0	1	0	0	0	0	0	0		0				0	0	0	0			0
gender			0				2				0	0	0	0	0	0	0	0		0				0	0	0	0			0
height			0				1				0	0	0	0	0	0	0	0		0				0	0	0	0			0
weight			0				3				0	2	0	0	0	0	0	0		0				0	0	0	0			0
12.2 Psychological	M-12	L:1																												
education/training /expertise	~~H-4~~	M:2	1	M	M	M	3	H	H	M-H	3	3	2	1	2	2 M	3 H	2	H	M 2 4	H H H H	L L L	H	1	2	3	3	M	H	3
~~expertise~~	L-3	H:3	0	~~M~~	~~M~~																									
introspective accuracy/willingness		3	0				3			✓	0	0	0	0	0	0	0	0		4				4	0	3	0		✓	0
perceived probability of success			0				3				3	3	1	1	0	0	0	0		[illegible]				3	4	4	0			4
verbosity/articulation			0				4				3	2	0	0	4	[illegible]	3	0		4				4	1	3	0			3
13. Type of Domain	KR-24																													
knowledge-rich to high performance	M-7 HP-4 KR-1 HP-2 both-3		3	M	KK	M	3	KR	KL	KR	2	2	1	1	1	1 M	1 KR	1	KR	1	KR KR KR KR	M M M	HP	1	3	1	1	KR	KR	1
14. Hardware/Equipment/Tools Involved											0	4	1	2	4	0	4 ✓	4		2	✓ ✓ ✓ ✓ ✓			2	0	0	4	✓	✓	2
computer	?-1	15	0		✓	✓	0	✓			0	0	0	0	0	2	0	0		0				0	0	0	0			0
vehicles/aircraft etc.	?-1	6	0	✓			4	✓	✓		0	0	0	0	0	0	0	0		0				0	0	0	2			0
weapon system	?-1	4	0	✓			0				4	3	1	0	0	0	0	0		0	✓ ✓ ✓ ✓ ✓		✓	0	4	2	2			4
instruments	?-1	18	4	✓	✓		4	✓	✓		4	2	4	0	1	2	4	3	✓	0	✓ ✓ ✓ ✓ ✓			3	4	4	3	✓	✓	0
notation - character-based, graphs, charts	?-1	20	0		✓	✓	2	✓			4	1	0	0	0	0 ✓	0	0		0	✓ ✓ ✓ ✓			0	3	2	0			1
test equipment	?-1	8	4				0				0	1	0	0	0	0														
15 Communication Processes																														
Advises		20	0		✓	✓	4	✓	✓	✓	3	2	0	0	0	0	0	0	✓	2	✓ ✓ ✓	✓ ✓ ✓		4	3	4	0	✓		0
Answers		25	0				4	✓	✓	✓	0	3	0	3	4	2 ✓	2	3	✓	4	✓ ✓ ✓	✓ ✓ ✓		2	3	4	2	✓	✓	3
Communicates		30	0		✓	✓	2	✓	✓	✓	4	4	0	4	1	2 ✓	3	3	✓	4	✓ ✓	✓ ✓ ✓		4	3	4	4	✓	✓	4
Directs		17	0				4	✓	✓	✓	4	1	0	2	0	3	0	0	✓	4	✓ ✓	✓		2	4	4	0	✓		3
Indicates		21	0		✓	✓	4	✓	✓	✓	0	1	0	0	0	0	0	0	✓	4	✓ ✓	✓ ✓ ✓		2	2	2	0	✓	✓	0
Informs		23	0	✓	✓		4	✓	✓	✓	4	4	0	2	4	0	0	2	✓	4	✓ ✓	✓ ✓ ✓		4	2	4	2	✓	✓	3
Instructs/Teaches		11	0				4	✓	✓	✓	0	0	0	0	0	0	0	0	✓	4		✓ ✓		4	0	1	2			0
Requests		27	0				3	✓	✓	✓	4	3	0	3	0	2 ✓	0	2	✓	4	✓ ✓ ✓	✓ ✓ ✓		3	2	1	1	✓	✓	2
Transmits		27	0	✓	✓	✓	2	✓	✓	✓	3	3	0	2	0	0 ✓	2	4	✓	4	✓ ✓ ✓	✓ ✓ ✓		3	0	2	3	✓	✓	3
Supervises		14	0				3	✓	✓	✓	4	0	0	3	0	4	0	0	✓	4	✓	✓		3	4	1	0	✓		3
negotiate							0				0	0	0	4	0	0	4	4		0				3	0	0	0			0
16 Non-discursive communication																														
expressive movement	?-1 √?-1	12	0				0		✓	?	0	3	0	0	0	2 ✓	0	0	✓	3		✓ ✓ ✓		3	2	2	0	✓	✓	0
interpretative movement	?-1 √?-1	11	0				0		✓	?	0	0	0	0	0	0	0	0	✓	3		✓ ✓ ✓		3	0	3	0	✓		0

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```
_AIVAX$DUA1:[AI.KATAX]REASONING_TECHS.LIS;1                              13-JUN-1991 09:10

task_name         |statistical|spatial|temporal|analogical|case_based|model_based|mathematical|deductive|inductive
------------------------------------------------------------------------------------------------------------------
drair_gen         |          1|      0|       2|         1|         1|          0|           1|        1|        4
program_mgmt      |          0|      0|       4|         0|         3|          0|           0|        0|        0
weather           |          1|      4|       4|         0|         0|          4|           2|        0|        3
console_ops       |          0|      0|       4|         0|         3|          2|           3|        4|        1
air_traffic       |          0|      4|       4|         0|         1|          1|           0|        0|        0
pilot_training    |          0|      4|       4|         3|         3|          3|           0|        4|        1
equip_diag        |          0|      1|       1|         0|         2|          1|           0|        2|        0
language_train    |          0|      0|       0|         3|         3|          0|           0|        2|        2
form_fill_out     |          0|      0|       2|         2|         3|          0|           2|        0|        2
sw_design         |          0|      0|       4|         0|         3|          3|           1|        0|        2
cargo_loading     |          0|      4|       4|         0|         2|          1|           4|        1|        0
leadership        |          0|      0|       2|         1|         3|          0|           0|        0|        2
surgery           |          0|      4|       4|         1|         2|          3|           0|        3|        2
medical_diag      |          0|      3|       4|         0|         3|          2|           0|        4|        2
accounting        |          0|      0|       3|         0|         2|          0|           4|        0|        0
protocol_des      |          2|      1|       4|         0|         4|          2|           2|        0|        3
```

```
_AIVAX$DUA1:[AI.KATAX]PROB_SOLV_TECHS1.LIS;1                          13-JUN-1991 09:11

task_name        |means_ends|sub_goals|gen_and_test|goal_vs_data|cover_and_diff|prop_and_ref|acq_and_pres
---------------------------------------------------------------------------------------------------------
drair_gen        |         0|        2|           0|           3|             0|           0|           4
program_mgmt     |         0|        4|           0|           1|             0|           3|           3
weather          |         0|        3|           0|           2|             0|           0|           4
console_ops      |         0|        1|           0|           2|             3|           0|           2
air_traffic      |         4|        4|           0|           2|             1|           0|           2
pilot_training   |         3|        4|           0|           3|             0|           0|           4
equip_diag       |         0|        3|           1|           3|             0|           0|           2
language_train   |         1|        4|           1|           1|             2|           2|           4
form_fill_out    |         2|        4|           3|           3|             3|           2|           4
sw_design        |         4|        4|           4|           1|             0|           4|           4
cargo_loading    |         3|        4|           0|           3|             0|           0|           3
leadership       |         0|        2|           3|           1|             0|           3|           3
surgery          |         4|        4|           0|           1|             2|           0|           3
medical_diag     |         1|        2|           0|           2|             1|           4|           4
accounting       |         0|        3|           0|           2|             0|           0|           4
protocol_des     |         0|        4|           4|           1|             0|           4|           4
```

```
_AIVAX$DUA1:[AI.KATAX]PROB_SOLV_TECHS2.LIS;1                    13-JUN-1991 09:11

task_name      |form_proc_alg|decompose|recombine|generalize|specialize|ret_to_def
----------------------------------------------------------------------------------
drair_gen      |            3|        1|        3|         3|         0|         0
program_mgmt   |            3|        2|        0|         0|         0|         3
weather        |            3|        0|        3|         3|         0|         0
console_ops    |            4|        2|        0|         0|         2|         0
air_traffic    |            0|        4|        0|         0|         0|         0
pilot_training |            4|        3|        0|         2|         3|         1
equip_diag     |            4|        3|        1|         0|         0|         1
language_train |            0|        4|        4|         3|         1|         0
form_fill_out  |            4|        3|        3|         3|         0|         2
sw_design      |            2|        4|        4|         2|         0|         1
cargo_loading  |            4|        2|        1|         0|         2|         2
leadership     |            3|        3|        0|         1|         0|         0
surgery        |            4|        4|        0|         1|         3|         1
medical_diag   |            2|        3|        0|         2|         2|         2
accounting     |            4|        2|        2|         0|         3|         0
protocol_des   |            1|        4|        3|         3|         0|         1
```

```
_AIVAX$DUA1:[AI.KATAX]INPUTS.LIS;1                          13-JUN-1991 09:11

task_name       |visual|verbal|auditory|kinesthetic|written|instrumentation|mm_interface|databases|historical|propadeutics
-------------------------------------------------------------------------------------------------------------------------
drair_gen       |     0|     4|       0|          0|      1|              0|           0|        4|         4|           0
program_mgmt    |     0|     4|       0|          0|      4|              0|           1|        2|         4|           0
weather         |     4|     1|       0|          0|      3|              1|           0|        0|         2|           1
console_ops     |     4|     4|       0|          0|      3|              4|           4|        0|         2|           3
air_traffic     |     4|     1|       0|          0|      1|              4|           2|        0|         0|           1
pilot_training  |     4|     3|       2|          4|      2|              4|           4|        0|         0|           0
equip_diag      |     1|     0|       1|          0|      3|              4|           1|        1|         3|           2
language_train  |     0|     4|       0|          0|      4|              4|           0|        0|         0|           2
form_fill_out   |     0|     3|       0|          0|      4|              0|           0|        1|         2|           2
sw_design       |     0|     4|       0|          0|      4|              0|           0|        0|         0|           1
cargo_loading   |     3|     0|       0|          0|      4|              0|           0|        0|         0|           2
leadership      |     0|     4|       0|          0|      3|              0|           0|        2|         3|           2
surgery         |     4|     4|       2|          4|      4|              4|           1|        0|         4|           1
medical_diag    |     4|     4|       2|          1|      4|              4|           0|        0|         4|           1
accounting      |     0|     3|       0|          0|      4|              0|           4|        4|         4|           2
protocol_des    |     0|     4|       0|          0|      3|              2|           0|        0|         4|           4
```

```
_AIVAX$DUAL:[AI.KATAX]TASK_COMPLEX.LIS;1                          13-JUN-1991 09:12

task_name      |branching|dynamism|constraints|uncertainty|high_low_tech|quant_qual
-----------------------------------------------------------------------------------
drair_gen      |        0|       0|          0|          2|            3|         2
program_mgmt   |        2|       1|          2|          3|            2|         2
weather        |        4|       4|          1|          4|            3|         3
console_ops    |        0|       1|          4|          3|            1|         3
air_traffic    |        4|       4|          4|          1|            2|         2
pilot_training |        4|       4|          4|          4|            2|         2
equip_diag     |        1|       0|          3|          1|            2|         3
language_train |        3|       4|          3|          3|            2|         2
form_fill_out  |        0|       0|          2|          0|            2|         2
sw_design      |        3|       0|          1|          1|            1|         2
cargo_loading  |        1|       1|          1|          0|            2|         3
leadership     |        1|       0|          0|          1|            2|         2
surgery        |        4|       2|          2|          2|            1|         2
medical_diag   |        4|       0|          1|          3|            1|         3
accounting     |        0|       1|          1|          1|            2|         1
protocol_des   |        1|       0|          0|          0|            1|         3
```

```
_AIVAX$DUA1:[AI.KATAX]MOTOR_PROC.LIS;1                                   13-JUN-1991 09:12

task_name       |complex_cont|compound|reflex|simple_disc|fine|gross|repetitive
-------------------------------------------------------------------------------
drair_gen       |           0|       0|     0|          0|   0|    0|         0
program_mgmt    |           0|       0|     0|          0|   0|    0|         0
weather         |           0|       0|     0|          0|   0|    0|         0
console_ops     |           0|       0|     3|          1|   4|    0|         4
air_traffic     |           0|       0|     1|          2|   2|    0|         2
pilot_training  |           2|       0|     0|          4|   3|    3|         1
equip_diag      |           0|       0|     0|          0|   2|    2|         4
language_train  |           0|       0|     0|          0|   0|    0|         0
form_fill_out   |           0|       0|     0|          0|   0|    0|         0
sw_design       |           0|       0|     0|          0|   0|    0|         0
cargo_loading   |           0|       0|     0|          0|   0|    0|         0
leadership      |           0|       0|     0|          0|   0|    0|         0
surgery         |           4|       2|     0|          4|   4|    4|         4
medical_diag    |           0|       0|     0|          0|   1|    1|         0
accounting      |           0|       0|     0|          0|   0|    0|         0
protocol_des    |           0|       0|     0|          0|   0|    0|         0
```

```
task_name       |categorize|calculate|code|computerize|interpolate|itemize|learn|tabulate|translate
----------------------------------------------------------------------------------------------------
drair_gen       |         1|        0|   0|          0|          1|      4|    2|       1|        2
program_mgmt    |         2|        0|   0|          0|          0|      2|    3|       0|        0
weather         |         3|        2|   0|          0|          4|      0|    4|       0|        2
console_ops     |         4|        3|   0|          0|          4|      0|    4|       0|        2
air_traffic     |         2|        0|   0|          0|          3|      3|    3|       0|        0
pilot_training  |         3|        0|   0|          0|          0|      2|    0|       0|        0
equip_diag      |         3|        0|   0|          0|          0|      3|    1|       0|        0
language_train  |         2|        0|   0|          0|          0|      0|    2|       0|        4
form_fill_out   |         3|        2|   0|          0|          2|      1|    1|       1|        0
sw_design       |         2|        0|   2|          2|          0|      1|    2|       0|        4
cargo_loading   |         3|        4|   0|          0|          2|      4|    2|       0|        0
leadership      |         2|        2|   0|          1|          0|      3|    0|       0|        0
surgery         |         4|        0|   0|          0|          0|      0|    4|       0|        0
medical_diag    |         4|        0|   0|          0|          0|      2|    4|       0|        3
accounting      |         2|        4|   0|          4|          0|      4|    3|       4|        1
protocol_des    |         4|        3|   0|          0|          1|      4|    2|       0|        4
```

```
_AIVAX$DUA1:[AI.KATAX]PROB_SOLV_TASKS.LIS;1                              13-JUN-1991 09:13

task_name        |analyze|deduce|induce|choose|compare|compute|estimate|integrate|plan|supervise|monitor|interpret
------------------------------------------------------------------------------------------------------------------
drair_gen        |      4|     1|     4|     0|      3|      0|       3|        4|   0|        0|      0|        4
program_mgmt     |      2|     0|     0|     3|      2|      0|       2|        0|   4|        4|      4|        2
weather          |      4|     0|     4|     2|      3|      1|       4|        4|   0|        0|      3|        3
console_ops      |      4|     4|     0|     2|      3|      3|       3|        3|   4|        1|      4|        3
air_traffic      |      0|     0|     0|     4|      3|      0|       4|        0|   4|        4|      4|        1
pilot_training   |      3|     3|     1|     3|      4|      0|       0|        2|   3|        3|      4|        3
equip_diag       |      2|     2|     0|     0|      4|      0|       0|        0|   0|        0|      0|        3
language_train   |      3|     2|     2|     1|      3|      0|       0|        0|   4|        4|      4|        4
form_fill_out    |      2|     0|     2|     4|      3|      2|       2|        1|   0|        0|      0|        1
sw_design        |      4|     0|     2|     2|      3|      0|       3|        4|   3|        1|      0|        3
cargo_loading    |      1|     1|     0|     2|      1|      4|       4|        0|   4|        3|      4|        0
leadership       |      4|     0|     1|     3|      3|      1|       1|        2|   3|        4|      0|        0
surgery          |      4|     4|     2|     4|      3|      0|       3|        0|   4|        4|      4|        4
medical_diag     |      4|     4|     2|     4|      2|      0|       2|        0|   1|        0|      2|        4
accounting       |      0|     0|     0|     1|      3|      4|       0|        3|   0|        0|      0|        2
protocol_des     |      0|     0|     2|     4|      3|      3|       2|        3|   4|        1|      0|        4
```

```
_AIVAX$DUA1:[AI.KATAX]RECALL_PERCEP.LIS;1                    13-JUN-1991 09:14

task_name        |facts|principles|procedures|analogs|cases_examples|percep_speed|search_rec_info|id_obj_act_events|scan_display
--------------------------------------------------------------------------------------------------------------------------------
drair_gen        |    4|         0|         3|      1|             1|           0|              0|                0|           0
program_mgmt     |    2|         3|         4|      0|             3|           0|              0|                0|           0
weather          |    4|         4|         4|      0|             1|           0|              3|                3|           0
console_ops      |    4|         1|         4|      0|             2|           4|              4|                4|           4
air_traffic      |    4|         3|         4|      0|             1|           4|              4|                4|           4
pilot_training   |    1|         1|         4|      3|             3|           4|              3|                3|           4
equip_diag       |    2|         1|         4|      0|             1|           0|              0|                0|           0
language_train   |    4|         4|         2|      3|             3|           0|              0|                0|           0
form_fill_out    |    2|         2|         4|      0|             2|           0|              0|                0|           0
sw_design        |    3|         3|         2|      2|             2|           0|              0|                0|           0
cargo_loading    |    4|         4|         2|      0|             2|           0|              0|                0|           0
leadership       |    3|         3|         4|      1|             2|           0|              0|                0|           0
surgery          |    4|         4|         4|      0|             2|           2|              0|                4|           0
medical_diag     |    4|         4|         4|      0|             3|           0|              0|                0|           0
accounting       |    1|         2|         4|      0|             2|           0|              0|                0|           0
protocol_des     |    3|         3|         4|      0|             4|           0|              0|                0|           0
```

```
_AIVAX$DUA1:[AI.KATAX]PHYS_ENVIR.LIS;1                              13-JUN-1991 09:14

task_name       |acceleration|confinement|isolation|contaminants|electricity|lighting|magnetism|noise
-----------------------------------------------------------------------------------------------------
drair_gen       |           0|          0|        0|           0|          0|       0|        0|    0
program_mgmt    |           0|          0|        0|           0|          0|       0|        0|    0
weather         |           0|          0|        0|           0|          0|       0|        0|    0
console_ops     |           0|          1|        0|           0|          0|       1|        0|    4
air_traffic     |           0|          3|        0|           0|          0|       2|        0|    3
pilot_training  |           3|          4|        0|           0|          0|       0|        0|    4
equip_diag      |           0|          0|        0|           2|          3|       0|        0|    4
language_train  |           0|          0|        0|           0|          0|       0|        0|    0
form_fill_out   |           0|          0|        0|           0|          0|       0|        0|    0
sw_design       |           0|          0|        0|           0|          0|       0|        0|    0
cargo_loading   |           1|          2|        0|           0|          0|       0|        0|    3
leadership      |           0|          0|        0|           0|          0|       0|        0|    0
surgery         |           0|          2|        0|           1|          0|       2|        0|    0
medical_diag    |           0|          0|        0|           0|          0|       0|        0|    0
accounting      |           0|          0|        0|           0|          0|       0|        0|    0
protocol_des    |           0|          0|        0|           0|          0|       0|        0|    0
```

```
_AIVAX$DUA1:[AI.KATAX]PSYCH_ENVIR.LIS;1                                13-JUN-1991 09:15

task_name         |fatigue|ment_strain|stress|phys_strain|preciseness|cog_attent|response_chaing|attention_span|sleep|schedule|boredom
--------------------------------------------------------------------------------------------------------------------------------------
drair_gen         |      0|          0|     0|          0|          0|         0|              0|             0|    0|       0|      0
program_mgmt      |      0|          0|     0|          0|          0|         0|              0|             0|    0|       0|      0
weather           |      0|          0|     0|          0|          0|         0|              0|             0|    0|       0|      0
console_ops       |      1|          2|     3|          1|          1|         4|              1|             3|    0|       2|      2
air_traffic       |      4|          4|     4|          0|          0|         4|              3|             4|    4|       4|      0
pilot_training    |      3|          3|     3|          1|          3|         4|              1|             3|    0|       3|      0
equip_diag        |      0|          0|     0|          3|          0|         0|              0|             1|    0|       2|      3
language_train    |      0|          0|     0|          0|          0|         0|              0|             0|    0|       0|      0
form_fill_out     |      0|          0|     0|          0|          0|         0|              0|             0|    0|       0|      0
sw_design         |      0|          0|     0|          0|          0|         0|              0|             0|    0|       0|      0
cargo_loading     |      0|          0|     0|          1|          0|         0|              0|             0|    0|       0|      2
leadership        |      0|          0|     0|          0|          0|         0|              0|             0|    0|       0|      0
surgery           |      3|          3|     4|          3|          4|         4|              2|             4|    2|       4|      1
medical_diag      |      1|          2|     3|          0|          0|         0|              0|             0|    1|       2|      1
accounting        |      0|          0|     0|          0|          4|         0|              0|             0|    0|       0|      0
protocol_des      |      0|          0|     0|          0|          0|         0|              0|             0|    0|       0|      0
```

```
_AIVAX$DUA1:[AI.KATAX]PERSONAL_PHYS.LIS;1                      13-JUN-1991 09:17

task_name        |general_health|age|gender|height|weight
----------------------------------------------------------
drair_gen        |             0|  0|     0|     0|     0
program_mgmt     |             0|  0|     0|     0|     0
weather          |             0|  0|     0|     0|     0
console_ops      |             4|  1|     0|     0|     2
air_traffic      |             4|  0|     0|     0|     0
pilot_training   |             4|  3|     2|     1|     3
equip_diag       |             0|  0|     0|     0|     0
language_train   |             0|  0|     0|     0|     0
form_fill_out    |             0|  0|     0|     0|     0
sw_design        |             0|  0|     0|     0|     0
cargo_loading    |             2|  0|     0|     0|     0
leadership       |             0|  0|     0|     0|     0
surgery          |             0|  0|     0|     0|     0
medical_diag     |             0|  0|     0|     0|     0
accounting       |             0|  0|     0|     0|     0
protocol_des     |             0|  0|     0|     0|     0
```

```
_AIVAX$DUA1:[AI.KATAX]PERSONAL_PSYCH.LIS;1                  13-JUN-1991 09:16

task_name        |edu_train_expert|intro_accuracy|prob_of_success|articulation|kr_hp
------------------------------------------------------------------------------------
drair_gen        |               2|             0|              0|           4|    1
program_mgmt     |               1|             0|              1|           0|    1
weather          |               2|             0|              1|           0|    1
console_ops      |               3|             0|              3|           2|    2
air_traffic      |               3|             0|              3|           3|    2
pilot_training   |               3|             3|              3|           4|    3
equip_diag       |               1|             0|              0|           0|    0
language_train   |               2|             4|              2|           4|    1
form_fill_out    |               2|             0|              0|           0|    1
sw_design        |               3|             0|              0|           3|    1
cargo_loading    |               2|             0|              0|           1|    1
leadership       |               1|             4|              3|           4|    1
surgery          |               3|             0|              4|           1|    3
medical_diag     |               3|             3|              4|           3|    1
accounting       |               3|             0|              0|           0|    1
protocol_des     |               3|             0|              4|           3|    1
```

```
_AIVAX$DUA1:[AI.KATAX]EQUIP_TOOLS.LIS;1                        13-JUN-1991 09:16

task_name       |computer|vehicles|weapon_systems|instruments|notation|test_equip
---------------------------------------------------------------------------------
drair_gen       |       4|       0|             0|          0|       1|         0
program_mgmt    |       2|       0|             0|          0|       0|         0
weather         |       1|       0|             0|          1|       4|         0
console_ops     |       4|       0|             0|          3|       2|         1
air_traffic     |       0|       0|             0|          4|       4|         0
pilot_training  |       0|       4|             0|          4|       2|         0
equip_diag      |       3|       0|             0|          0|       4|         0
language_train  |       2|       0|             0|          0|       0|         0
form_fill_out   |       4|       0|             0|          0|       3|         0
sw_design       |       4|       0|             0|          0|       4|         0
cargo_loading   |       0|       2|             0|          0|       2|         0
leadership      |       2|       0|             0|          0|       2|         0
surgery         |       0|       0|             0|          4|       4|         3
medical_diag    |       0|       0|             0|          2|       4|         2
accounting      |       4|       0|             0|          0|       3|         0
protocol_des    |       2|       0|             0|          4|       0|         1
```

```
_AIVAX$DUA1:[AI.KATAX]COMMUN_PROCS.LIS;1                          13-JUN-1991 09:17

task_name       |advise|answer|communicate|direct|indicate|inform|instruct|request|transmit|supervise|negotiate|expr_move|interp_move
-------------------------------------------------------------------------------------------------------------------------------------
drair_gen       |     0|     4|          4|     0|       0|     4|       0|      2|       2|        0|        0|        0|          0
program_mgmt    |     0|     3|          4|     2|       0|     2|       0|      3|       2|        3|        4|        0|          0
weather         |     0|     0|          0|     0|       0|     0|       0|      0|       0|        0|        0|        0|          0
console_ops     |     2|     3|          4|     1|       1|     4|       0|      3|       3|        0|        0|        3|          0
air_traffic     |     3|     0|          4|     4|       0|     4|       0|      4|       3|        4|        0|        0|          0
pilot_training  |     4|     4|          3|     4|       4|     4|       4|      3|       2|        3|        0|        0|          2
equip_diag      |     4|     0|          0|     0|       0|     0|       0|      0|       0|        0|        0|        0|          0
language_train  |     2|     4|          4|     4|       4|     4|       4|      4|       4|        4|        0|        3|          3
form_fill_out   |     0|     3|          3|     0|       3|     2|       0|      2|       4|        0|        4|        0|          0
sw_design       |     0|     0|          3|     0|       0|     0|       0|      0|       2|        0|        4|        0|          0
cargo_loading   |     0|     2|          3|     3|       0|     0|       0|      2|       0|        4|        0|        2|          0
leadership      |     4|     2|          4|     2|       2|     4|       4|      3|       3|        3|        3|        3|          3
surgery         |     3|     3|          3|     4|       3|     2|       0|      2|       0|        4|        0|        2|          0
medical_diag    |     4|     4|          4|     4|       2|     4|       1|      1|       2|        1|        0|        2|          3
accounting      |     0|     2|          4|     0|       0|     2|       0|      1|       3|        0|        0|        0|          0
protocol_des    |     0|     3|          4|     3|       0|     3|       0|      2|       3|        3|        0|        0|          0
```

APPENDIX H

TASK CHARACTERISTICS RATING MATRIX AFTER SECOND INTERVIEW

```
task_name      |statistical|spatial|temporal|analogical|case_based|model_based|mathematical|deductive|inductive
---------------------------------------------------------------------------------------------------------------
drair_gen      |          1|      0|       1|         0|         0|          0|           3|        4|        0
---------------------------------------------------------------------------------------------------------------
program_mgmt   |          0|      0|       3|         0|         3|          0|           1|        0|        2
---------------------------------------------------------------------------------------------------------------
weather        |          2|      3|       4|         0|         2|          4|           2|        3|        0
---------------------------------------------------------------------------------------------------------------
console_ops    |          0|      2|       4|         0|         2|          3|           0|        2|        0
---------------------------------------------------------------------------------------------------------------
air_traffic    |          0|      4|       4|         0|         0|          1|           0|        0|        1
---------------------------------------------------------------------------------------------------------------
pilot_training |          0|      4|       3|         0|         1|          3|           0|        0|        0
---------------------------------------------------------------------------------------------------------------
equip_diag     |          2|      1|       1|         0|         0|          2|           0|        3|        0
---------------------------------------------------------------------------------------------------------------
language_train |          0|      0|       3|         3|         2|          0|           0|        2|        2
---------------------------------------------------------------------------------------------------------------
form_fill_out  |          0|      0|       0|         0|         3|          0|           0|        1|        0
---------------------------------------------------------------------------------------------------------------
sw_design      |          0|      0|       4|         0|         3|          2|           2|        0|        0
---------------------------------------------------------------------------------------------------------------
cargo_loading  |          0|      1|       2|         0|         1|          2|           4|        1|        0
---------------------------------------------------------------------------------------------------------------
leadership     |          0|      0|       3|         0|         4|          1|           0|        0|        0
---------------------------------------------------------------------------------------------------------------
surgery        |          0|      4|       2|         0|         1|          4|           0|        1|        0
---------------------------------------------------------------------------------------------------------------
medical_diag   |          1|      0|       4|         0|         2|          3|           0|        4|        0
---------------------------------------------------------------------------------------------------------------
accounting     |          0|      0|       2|         0|         1|          0|           4|        3|        0
---------------------------------------------------------------------------------------------------------------
protocol_des   |          4|      0|       3|         0|         2|          0|           0|        0|        0
---------------------------------------------------------------------------------------------------------------
```

```
task_name      |means_ends|sub_goals|gen_and_test|goal_vs_data|cover_and_diff|prop_and_ref|acq_and_pres
-------------------------------------------------------------------------------------------------------
drair_gen      |         0|        3|           0|           D|             0|           0|    4
-------------------------------------------------------------------------------------------------------
program_mgmt   |         1|        3|           1|           G|             0|           1|    3
-------------------------------------------------------------------------------------------------------
weather        |         0|        3|           2|         G&D|             3|           0|    4
-------------------------------------------------------------------------------------------------------
console_ops    |         0|        2|           0|           D|             3|           0|    1
-------------------------------------------------------------------------------------------------------
air_traffic    |         4|        4|           0|         G&D|             0|           0|    2
-------------------------------------------------------------------------------------------------------
pilot_training |         3|        3|           0|           G|             0|           0|    2
-------------------------------------------------------------------------------------------------------
equip_diag     |         0|        2|           4|           D|             1|           0|    2
-------------------------------------------------------------------------------------------------------
language_train |         3|        4|           2|           G|             2|           0|    0
-------------------------------------------------------------------------------------------------------
form_fill_out  |         2|        3|           0|           G|             0|           2|    4
-------------------------------------------------------------------------------------------------------
sw_design      |         4|        4|           4|           G|             0|           3|    4
-------------------------------------------------------------------------------------------------------
cargo_loading  |         2|        2|           1|           D|             0|           0|    1
-------------------------------------------------------------------------------------------------------
leadership     |         3|        4|           3|           G|             1|           1|    4
-------------------------------------------------------------------------------------------------------
surgery        |         4|        4|           0|           G|             1|           0|    0
-------------------------------------------------------------------------------------------------------
medical_diag   |         0|        0|           3|           D|             4|           0|    2
-------------------------------------------------------------------------------------------------------
accounting     |         2|        4|           3|           G|             0|           0|    3
-------------------------------------------------------------------------------------------------------
protocol_des   |         4|        4|           3|           G|             0|           3|    3
-------------------------------------------------------------------------------------------------------
```

```
task_name       |form_proc_alg|decompose|recombine|generalize|specialize|ret_to_def
-----------------------------------------------------------------------------------
drair_gen       |            2|        2|        2|         2|         0|         0
program_mgmt    |            0|        2|        0|         1|         1|         2
weather         |            2|        4|        3|         0|         3|         3
console_ops     |            1|        2|        0|         0|         2|         3
air_traffic     |            3|        4|        0|         0|         3|         0
pilot_training  |            3|        3|        3|         0|         0|         0
equip_diag      |            4|        3|        1|         0|         3|         4
language_train  |            3|        4|        4|         3|         2|         3
form_fill_out   |            4|        3|        0|         0|         2|         2
sw_design       |            1|        4|        4|         0|         2|         1
cargo_loading   |            4|        2|        2|         0|         2|         2
leadership      |            0|        4|        2|         1|         2|         0
surgery         |            3|        4|        0|         0|         3|         2
medical_diag    |            1|        0|        0|         0|         2|         2
accounting      |            4|        4|        2|         0|         2|         2
protocol_des    |            0|        1|        1|         0|         3|         2
```

```
task_name       |visual|verbal|auditory|kinesthetic|written|instrumentation|mm_interface|databases|historical|propadeutics
--------------------------------------------------------------------------------------------------------------------------
drair_gen       |     0|     1|       0|          0|      1|              0|           0|        4|         4|           3
program_mgmt    |     0|     3|       0|          0|      3|              0|           0|        1|         2|           1
weather         |     4|     0|       0|          0|      4|              2|           4|        2|         3|           1
console_ops     |     4|     3|       0|          0|      2|              0|           4|        0|         0|           1
air_traffic     |     4|     4|       0|          0|      2|              4|           4|        1|         0|           0
pilot_training  |     4|     2|       3|          4|      2|              4|           4|        0|         0|           1
equip_diag      |     4|     1|       1|          0|      4|              3|           0|        0|         3|           2
language_train  |     2|     4|       4|          0|      4|              0|           0|        0|         1|           1
form_fill_out   |     0|     2|       0|          0|      4|              0|           0|        3|         2|           4
sw_design       |     0|     3|       0|          0|      4|              0|           0|        0|         0|           4
cargo_loading   |     1|     1|       0|          0|      3|              0|           0|        0|         0|           1
leadership      |     1|     4|       0|          0|      4|              0|           0|        0|         0|           0
surgery         |     4|     3|       2|          2|      0|              4|           0|        0|         0|           4
medical_diag    |     4|     4|       2|          3|      4|              4|           0|        0|         4|           1
accounting      |     0|     0|       0|          0|      4|              0|           2|        4|         3|           2
protocol_des    |     0|     3|       0|          0|      4|              0|           0|        0|         1|           3
```

```
task_name       |branching|dynamism|constraints|uncertainty|high_low_tech|quant_qual
-------------------------------------------------------------------------------------
drair_gen       |        0|       0|          0|          0|            2|         2
program_mgmt    |        0|       0|          2|          1|            1|         3
weather         |        4|       3|          2|          4|            3|         2
console_ops     |        2|       4|          4|          3|            3|         2
air_traffic     |        3|       4|          4|          1|            1|         2
pilot_training  |        4|       4|          2|          0|            2|         2
equip_diag      |        2|       0|          1|          1|            3|         2
language_train  |        2|       2|          2|          1|            1|         3
form_fill_out   |        1|       0|          3|          1|            1|         3
sw_design       |        4|       0|          0|          1|            3|         2
cargo_loading   |        2|       0|          2|          0|            1|         1
leadership      |        3|       0|          1|          2|            1|         3
surgery         |        3|       3|          3|          1|            3|         3
medical_diag    |        4|       2|          2|          3|            3|         2
accounting      |        0|       0|          3|          0|            3|         1
protocol_des    |        4|       0|          2|          0|            3|         2
```

```
task_name      |complex_cont|compound|reflex|simple_disc|fine|gross|repetitive
-------------------------------------------------------------------------------
drair_gen      |           0|       0|     0|          0|   0|    0|         0
program_mgmt   |           0|       0|     0|          0|   0|    0|         0
weather        |           0|       0|     0|          0|   0|    0|         0
console_ops    |           0|       0|     0|          4|   4|    0|         2
air_traffic    |           0|       0|     0|          1|   1|    0|         0
pilot_training |           0|       0|     1|          4|   1|    2|         3
equip_diag     |           0|       0|     0|          2|   2|    2|         1
language_train |           0|       0|     0|          0|   0|    0|         0
form_fill_out  |           0|       0|     0|          0|   0|    0|         0
sw_design      |           0|       0|     0|          0|   0|    0|         0
cargo_loading  |           0|       0|     0|          0|   0|    0|         0
leadership     |           0|       0|     0|          0|   0|    0|         0
surgery        |           4|       3|     0|          4|   4|    1|         0
medical_diag   |           0|       0|     0|          2|   2|    0|         0
accounting     |           0|       0|     0|          0|   0|    0|         0
protocol_des   |           0|       0|     0|          0|   0|    0|         0
```

```
task_name       |categorize|calculate|code|computerize|interpolate|itemize|learn|tabulate|translate
---------------------------------------------------------------------------------------------------
drair_gen       |         2|        4|   0|          0|          1|      0|    1|       2|        2
program_mgmt    |         1|        2|   0|          0|          0|      2|    1|       0|        0
weather         |         4|        0|   0|          0|          4|      1|    2|       1|        3
console_ops     |         3|        2|   0|          0|          3|      0|    3|       0|        3
air_traffic     |         2|        2|   0|          0|          3|      0|    0|       0|        1
pilot_training  |         1|        0|   0|          0|          2|      2|    0|       0|        0
equip_diag      |         3|        0|   0|          0|          0|      2|    1|       0|        2
language_train  |         2|        0|   0|          0|          0|      2|    0|       0|        4
form_fill_out   |         3|        1|   0|          0|          0|      1|    1|       1|        4
sw_design       |         2|        1|   4|          4|          0|      2|    1|       0|        4
cargo_loading   |         2|        4|   0|          0|          0|      3|    1|       0|        0
leadership      |         1|        1|   0|          0|          0|      4|    2|       0|        2
surgery         |         4|        0|   0|          0|          0|      3|    0|       0|        0
medical_diag    |         4|        0|   0|          0|          0|      1|    1|       0|        3
accounting      |         4|        4|   3|          0|          0|      4|    1|       4|        0
protocol_des    |         2|        0|   0|          0|          0|      0|    1|       0|        4
```

```
task_name       |analyze|deduce|induce|choose|compare|compute|estimate|integrate|plan|supervise|monitor|interpret
-----------------------------------------------------------------------------------------------------------------
drair_gen       |      4|     3|     0|     0|      4|      3|       2|        0|   0|        0|      0|        3
program_mgmt    |      1|     0|     1|     2|      2|      0|       2|        0|   2|        3|      0|        1
weather         |      4|     3|     0|     3|      4|      1|       4|        4|   0|        0|      1|        4
console_ops     |      4|     2|     0|     1|      4|      0|       2|        1|   1|        1|      4|        4
air_traffic     |      2|     0|     1|     3|      0|      2|       4|        0|   4|        3|      4|        1
pilot_training  |      1|     0|     0|     3|      1|      0|       3|        4|   4|        0|      4|        4
equip_diag      |      4|     4|     0|     0|      3|      0|       1|        0|   0|        0|      0|        3
language_train  |      2|     2|     2|     4|      4|      0|       0|        0|   2|        4|      1|        3
form_fill_out   |      1|     1|     0|     2|      2|      1|       0|        3|   0|        0|      0|        4
sw_design       |      4|     0|     0|     3|      2|      0|       0|        4|   1|        0|      0|        3
cargo_loading   |      1|     0|     0|     2|      3|      4|       4|        1|   3|        2|      0|        0
leadership      |      4|     2|     0|     2|      3|      0|       0|        3|   3|        0|      0|        2
surgery         |      3|     1|     0|     4|      1|      0|       0|        0|   4|        4|      2|        2
medical_diag    |      3|     2|     0|     4|      4|      0|       2|        3|   4|        1|      0|        3
accounting      |      1|     2|     0|     0|      4|      4|       3|        0|   0|        0|      0|        1
protocol_des    |      3|     0|     0|     3|      1|      0|       2|        0|   4|        0|      0|        3
```

```
task_name       |facts|principles|procedures|analogs|cases_examples|percep_speed|search_rec_info|id_obj_act_events|scan_display
-------------------------------------------------------------------------------------------------------------------------------
drair_gen       |    4|         0|         0|      0|             1|           0|              0|                0|           0
program_mgmt    |    3|         1|         1|      0|             3|           0|              0|                0|           0
weather         |    4|         4|         2|      0|             1|           0|              2|                4|           0
console_ops     |    4|         4|         4|      0|             2|           4|              4|                4|           4
air_traffic     |    3|         2|         4|      0|             0|           2|              4|                3|           4
pilot_training  |    4|         4|         4|      0|             1|           2|              4|                3|           4
equip_diag      |    4|         1|         4|      0|             2|           0|              0|                3|           0
language_train  |    4|         3|         1|      2|             3|           0|              0|                0|           0
form_fill_out   |    3|         0|         1|      0|             3|           0|              0|                0|           0
sw_design       |    3|         4|         0|      0|             2|           0|              0|                0|           0
cargo_loading   |    4|         2|         2|      0|             0|           0|              0|                0|           0
leadership      |    3|         2|         2|      0|             1|           0|              0|                0|           0
surgery         |    4|         4|         4|      0|             1|           0|              4|                4|           0
medical_diag    |    4|         4|         4|      0|             3|           0|              2|                4|           0
accounting      |    2|         1|         4|      0|             1|           0|              1|                1|           0
protocol_des    |    2|         4|         1|      0|             4|           0|              0|                0|           0
```

```
task_name       |acceleration|confinement|isolation|contaminants|electricity|lighting|magnetism|noise
------------------------------------------------------------------------------------------------------
drair_gen       |           0|          0|        0|           0|          0|       0|        0|    0
program_mgmt    |           0|          0|        0|           0|          0|       0|        0|    0
weather         |           0|          0|        0|           0|          0|       0|        0|    0
console_ops     |           0|          0|        0|           0|          0|       1|        0|    2
air_traffic     |           0|          1|        0|           0|          0|       3|        0|    1
pilot_training  |           3|          4|        0|           0|          0|       0|        0|    3
equip_diag      |           0|          0|        0|           3|          2|       0|        0|    3
language_train  |           0|          0|        0|           0|          0|       0|        0|    0
form_fill_out   |           0|          0|        0|           0|          0|       0|        0|    0
sw_design       |           0|          0|        0|           0|          0|       0|        0|    0
cargo_loading   |           0|          0|        0|           0|          0|       0|        0|    0
leadership      |           0|          0|        0|           0|          0|       0|        0|    0
surgery         |           0|          0|        0|           4|          0|       2|        0|    0
medical_diag    |           0|          0|        0|           2|          0|       0|        0|    0
accounting      |           0|          0|        0|           0|          0|       0|        0|    0
protocol_des    |           0|          0|        0|           0|          0|       0|        0|    0
```

```
task_name      |fatigue|ment_strain|stress|phys_strain|preciseness|cog_attent|response_chaing|attention_span|sleep|schedule|boredom
---------------------------------------------------------------------------------------------------------------------------------------------
drair_gen      |      0|          0|     0|          0|          0|         0|              0|             0|    0|       0|      0
program_mgmt   |      0|          0|     0|          0|          0|         0|              0|             0|    0|       0|      0
weather        |      0|          0|     0|          0|          0|         0|              0|             0|    0|       0|      0
console_ops    |      1|          1|     2|          0|          0|         4|              0|             4|    0|       1|      3
air_traffic    |      3|          3|     3|          0|          3|         4|              2|             4|    0|       4|      0
pilot_training |      0|          1|     1|          0|          2|         2|              3|             2|    0|       0|      2
equip_diag     |      0|          0|     0|          2|          1|         0|              0|             0|    0|       0|      1
language_train |      0|          0|     0|          0|          0|         0|              0|             0|    0|       0|      0
form_fill_out  |      0|          0|     0|          0|          0|         0|              0|             0|    0|       0|      0
sw_design      |      0|          0|     0|          0|          0|         0|              0|             0|    0|       0|      0
cargo_loading  |      0|          0|     0|          0|          0|         0|              0|             0|    0|       0|      0
leadership     |      0|          0|     0|          0|          0|         0|              0|             0|    0|       0|      2
surgery        |      3|          3|     3|          3|          4|         4|              0|             4|    0|       0|      0
medical_diag   |      0|          3|     3|          0|          0|         0|              0|             0|    0|       0|      0
accounting     |      0|          0|     0|          0|          0|         0|              0|             0|    0|       0|      0
protocol_des   |      0|          0|     0|          0|          0|         0|              0|             0|    0|       0|      0
```

```
task_name         |general_health|age|gender|height|weight
-------------------------------------------------------------
drair_gen         |             0|  0|     0|     0|     0
program_mgmt      |             0|  0|     0|     0|     0
weather           |             0|  0|     0|     0|     0
console_ops       |             3|  1|     0|     0|     0
air_traffic       |             3|  1|     0|     0|     0
pilot_training    |             3|  1|     0|     0|     1
equip_diag        |             0|  0|     0|     0|     0
language_train    |             0|  0|     0|     0|     0
form_fill_out     |             0|  0|     0|     0|     0
sw_design         |             0|  0|     0|     0|     0
cargo_loading     |             0|  0|     0|     0|     0
leadership        |             0|  0|     0|     0|     0
surgery           |             3|  1|     0|     0|     0
medical_diag      |             0|  0|     0|     0|     0
accounting        |             0|  0|     0|     0|     0
protocol_des      |             0|  0|     0|     0|     0
```

```
task_name       |edu_|train_expert|intro_accuracy|prob_of_success|articulation|kr_hp
------------------------------------------------------------------------------------
drair_gen       |   3|           1|             0|              0|           1|    1
program_mgmt    |   2|           1|             0|              0|           3|    1
weather         |   2|           4|             0|              3|           1|    1
console_ops     |   3|           4|             0|              1|           1|    2
air_traffic     |   0|           4|             0|              4|           3|    2
pilot_training  |   0|           4|             0|              2|           1|    2
equip_diag      |   0|           1|             0|              0|           0|    1
language_train  |   4|           4|             1|              1|           4|    1
form_fill_out   |   3|           1|             0|              0|           2|    1
sw_design       |   3|           0|             0|              0|           2|    1
cargo_loading   |   1|           3|             0|              0|           0|    1
leadership      |   1|           2|             3|              3|           4|    1
surgery         |   4|           4|             0|              3|           1|    2
medical_diag    |   4|           4|             0|              3|           4|    1
accounting      |   4|           1|             0|              0|           1|    1
protocol_des    |   4|           0|             0|              0|           2|    1
```

```
task_name       |computer|vehicles|weapon_systems|instruments|notation|test_equip
--------------------------------------------------------------------------------
drair_gen       |       3|       0|             0|          0|       0|         0
program_mgmt    |       1|       0|             0|          0|       0|         0
weather         |       4|       0|             0|          2|       4|         0
console_ops     |       4|       0|             0|          0|       4|         0
air_traffic     |       4|       0|             0|          4|       2|         0
pilot_training  |       0|       4|             0|          4|       2|         0
equip_diag      |       0|       0|             0|          3|       3|         1
language_train  |       0|       0|             0|          0|       2|         0
form_fill_out   |       2|       0|             0|          0|       1|         0
sw_design       |       4|       0|             0|          0|       3|         0
cargo_loading   |       0|       0|             0|          0|       2|         0
leadership      |       0|       0|             0|          0|       3|         0
surgery         |       0|       0|             0|          4|       2|         0
medical_diag    |       0|       0|             0|          3|       3|         0
accounting      |       3|       0|             0|          0|       4|         0
protocol_des    |       0|       0|             0|          0|       2|         0
```

```
task_name      |advise|answer|communicate|direct|indicate|inform|instruct|request|transmit|supervise|negotiate|expr_move|interp_move
------------------------------------------------------------------------------------------------------------------------------------
drair_gen      |     2|     4|          2|     0|       0|     3|       0|      1|       4|        0|        0|        0|          0
program_mgmt   |     0|     4|          4|     3|       0|     1|       0|      1|       0|        4|        2|        0|          0
weather        |     4|     2|          2|     0|       2|     4|       0|      0|       0|        0|        0|        0|          0
console_ops    |     3|     2|          4|     0|       1|     3|       0|      3|       3|        1|        0|        0|          0
air_traffic    |     3|     0|          4|     4|       1|     3|       0|      1|       1|        3|        0|        0|          0
pilot_training |     0|     2|          2|     0|       1|     3|       0|      3|       2|        0|        0|        0|          0
equip_diag     |     1|     1|          1|     0|       1|     1|       0|      1|       1|        0|        0|        0|          0
language_train |     1|     4|          4|     1|       3|     2|       4|      1|       0|        2|        0|        2|          0
form_fill_out  |     0|     4|          2|     0|       2|     2|       0|      2|       4|        0|        3|        0|          0
sw_design      |     1|     0|          2|     0|       0|     0|       0|      2|       0|        0|        0|        0|          0
cargo_loading  |     0|     2|          1|     3|       1|     0|       0|      1|       1|        1|        0|        0|          0
leadership     |     4|     2|          4|     1|       0|     3|       0|      1|       1|        0|        4|        2|          2
surgery        |     4|     4|          2|     4|       3|     3|       0|      4|       0|        4|        0|        3|          0
medical_diag   |     4|     4|          4|     4|       2|     4|       2|      2|       2|        0|        0|        2|          0
accounting     |     0|     3|          1|     0|       1|     1|       0|      1|       1|        0|        0|        0|          0
protocol_des   |     3|     1|          1|     1|       0|     0|       0|      0|       3|        0|        0|        0|          0
```

APPENDIX I

INITIAL DATA ANALYSES FROM FIRST INTERVIEW

```
task_name1           |task_name2         |equal_count|similar_count
--------------------------------------------------------------------
pilot_training       |protocol_des       |         25|           55
pilot_training       |drair_gen          |         28|           51
pilot_training       |form_fill_out      |         28|           54
pilot_training       |accounting         |         29|           53
pilot_training       |weather            |         32|           54
pilot_training       |sw_design          |         33|           54
console_ops          |form_fill_out      |         34|           67
leadership           |surgery            |         34|           62
equip_diag           |pilot_training     |         35|           56
pilot_training       |cargo_loading      |         35|           56
drair_gen            |surgery            |         36|           54
surgery              |accounting         |         36|           59
console_ops          |leadership         |         36|           69
pilot_training       |leadership         |         37|           61
equip_diag           |console_ops        |         37|           68
console_ops          |drair_gen          |         37|           69
console_ops          |sw_design          |         37|           61
console_ops          |language_train     |         37|           66
pilot_training       |program_mgmt       |         38|           57
equip_diag           |surgery            |         39|           63
air_traffic          |form_fill_out      |         39|           58

task_name1           |task_name2         |equal_count|similar_count
--------------------------------------------------------------------
weather              |surgery            |         39|           64
form_fill_out        |surgery            |         39|           60
console_ops          |program_mgmt       |         41|           66
console_ops          |cargo_loading      |         41|           74
pilot_training       |language_train     |         41|           68
pilot_training       |medical_diag       |         42|           72
air_traffic          |drair_gen          |         43|           66
pilot_training       |surgery            |         44|           81
equip_diag           |medical_diag       |         44|           74
air_traffic          |leadership         |         44|           67
console_ops          |accounting         |         44|           73
surgery              |protocol_des       |         44|           61
pilot_training       |air_traffic        |         45|           82
pilot_training       |console_ops        |         45|           78
console_ops          |protocol_des       |         45|           69
sw_design            |surgery            |         45|           61
cargo_loading        |medical_diag       |         45|           73
cargo_loading        |surgery            |         45|           67
medical_diag         |accounting         |         46|           71
language_train       |surgery            |         46|           67
console_ops          |surgery            |         46|           78

task_name1           |task_name2         |equal_count|similar_count
--------------------------------------------------------------------
console_ops          |medical_diag       |         46|           78
form_fill_out        |medical_diag       |         47|           77
program_mgmt         |surgery            |         47|           67
console_ops          |weather            |         47|           72
equip_diag           |air_traffic        |         47|           66
air_traffic          |medical_diag       |         47|           67
air_traffic          |accounting         |         48|           64
```

```
equip_diag          |language_train      |          48|           73
air_traffic         |cargo_loading       |          48|           77
air_traffic         |protocol_des        |          49|           67
leadership          |medical_diag        |          50|           86
equip_diag          |protocol_des        |          50|           72
air_traffic         |sw_design           |          50|           65
drair_gen           |medical_diag        |          50|           81
cargo_loading       |leadership          |          50|           82
air_traffic         |language_train      |          51|           68
air_traffic         |weather             |          52|           70
equip_diag          |leadership          |          52|           81
weather             |medical_diag        |          52|           81
equip_diag          |drair_gen           |          54|           88
weather             |language_train      |          54|           77

task_name1          |task_name2          |equal_count|similar_count
---------------------------------------------------------------------
equip_diag          |sw_design           |          55|           77
weather             |leadership          |          55|           77
air_traffic         |console_ops         |          56|           77
program_mgmt        |medical_diag        |          56|           81
cargo_loading       |language_train      |          56|           73
medical_diag        |protocol_des        |          57|           88
drair_gen           |cargo_loading       |          57|           79
cargo_loading       |protocol_des        |          57|           80
surgery             |medical_diag        |          57|           87
air_traffic         |program_mgmt        |          57|           72
sw_design           |medical_diag        |          57|           84
language_train      |accounting          |          58|           69
equip_diag          |cargo_loading       |          58|           82
equip_diag          |form_fill_out       |          59|           84
air_traffic         |surgery             |          59|           83
cargo_loading       |sw_design           |          59|           78
equip_diag          |weather             |          60|           79
equip_diag          |program_mgmt        |          60|           85
weather             |cargo_loading       |          60|           81
language_train      |medical_diag        |          60|           83
cargo_loading       |form_fill_out       |          61|           83

task_name1          |task_name2          |equal_count|similar_count
---------------------------------------------------------------------
weather             |program_mgmt        |          61|           84
equip_diag          |accounting          |          61|           88
language_train      |protocol_des        |          62|           85
program_mgmt        |cargo_loading       |          63|           92
form_fill_out       |language_train      |          63|           82
leadership          |protocol_des        |          64|           94
leadership          |accounting          |          64|           88
accounting          |protocol_des        |          65|           88
drair_gen           |language_train      |          65|           82
weather             |accounting          |          66|           86
weather             |form_fill_out       |          66|           85
cargo_loading       |accounting          |          66|           89
form_fill_out       |leadership          |          67|           98
program_mgmt        |drair_gen           |          67|           91
drair_gen           |leadership          |          67|           89
weather             |protocol_des        |          67|           83
weather             |sw_design           |          68|           93
```

```
sw_design          |leadership        |         68|           90
form_fill_out      |protocol_des      |         68|           94
sw_design          |language_train    |         69|           87
sw_design          |accounting        |         69|           89

task_name1         |task_name2        |equal_count|similar_count
--------------------------------------------------------------
drair_gen          |protocol_des      |         69|           93
program_mgmt       |language_train    |         70|           87
language_train     |leadership        |         70|           90
program_mgmt       |protocol_des      |         71|           92
program_mgmt       |sw_design         |         72|           93
drair_gen          |accounting        |         72|          101
drair_gen          |sw_design         |         72|           95
program_mgmt       |form_fill_out     |         73|           95
weather            |drair_gen         |         73|           94
sw_design          |form_fill_out     |         73|           94
drair_gen          |form_fill_out     |         74|           90
sw_design          |protocol_des      |         76|           96
program_mgmt       |accounting        |         76|           93
form_fill_out      |accounting        |         76|           95
program_mgmt       |leadership        |         78|           99
```

```
task_name1          |task_name2          |equal_count|similar_count
--------------------------------------------------------------------
pilot_training      |drair_gen           |         28|           51
pilot_training      |accounting          |         29|           53
pilot_training      |form_fill_out       |         28|           54
pilot_training      |weather             |         32|           54
pilot_training      |sw_design           |         33|           54
drair_gen           |surgery             |         36|           54
pilot_training      |protocol_des        |         25|           55
pilot_training      |cargo_loading       |         35|           56
equip_diag          |pilot_training      |         35|           56
pilot_training      |program_mgmt        |         38|           57
air_traffic         |form_fill_out       |         39|           58
surgery             |accounting          |         36|           59
form_fill_out       |surgery             |         39|           60
pilot_training      |leadership          |         37|           61
console_ops         |sw_design           |         37|           61
sw_design           |surgery             |         45|           61
surgery             |protocol_des        |         44|           61
leadership          |surgery             |         34|           62
equip_diag          |surgery             |         39|           63
weather             |surgery             |         39|           64
air_traffic         |accounting          |         48|           64

task_name1          |task_name2          |equal_count|similar_count
--------------------------------------------------------------------
air_traffic         |sw_design           |         50|           65
console_ops         |language_train      |         37|           66
console_ops         |program_mgmt        |         41|           66
equip_diag          |air_traffic         |         47|           66
air_traffic         |drair_gen           |         43|           66
air_traffic         |medical_diag        |         47|           67
air_traffic         |protocol_des        |         49|           67
cargo_loading       |surgery             |         45|           67
console_ops         |form_fill_out       |         34|           67
language_train      |surgery             |         46|           67
air_traffic         |leadership          |         44|           67
program_mgmt        |surgery             |         47|           67
pilot_training      |language_train      |         41|           68
air_traffic         |language_train      |         51|           68
equip_diag          |console_ops         |         37|           68
console_ops         |protocol_des        |         45|           69
console_ops         |leadership          |         36|           69
language_train      |accounting          |         58|           69
console_ops         |drair_gen           |         37|           69
air_traffic         |weather             |         52|           70
medical_diag        |accounting          |         46|           71

task_name1          |task_name2          |equal_count|similar_count
--------------------------------------------------------------------
equip_diag          |protocol_des        |         50|           72
pilot_training      |medical_diag        |         42|           72
air_traffic         |program_mgmt        |         57|           72
console_ops         |weather             |         47|           72
equip_diag          |language_train      |         48|           73
console_ops         |accounting          |         44|           73
cargo_loading       |language_train      |         56|           73
```

```
cargo_loading           |medical_diag          |           45|          73
console_ops             |cargo_loading         |           41|          74
equip_diag              |medical_diag          |           44|          74
air_traffic             |cargo_loading         |           48|          77
weather                 |leadership            |           55|          77
weather                 |language_train        |           54|          77
equip_diag              |sw_design             |           55|          77
form_fill_out           |medical_diag          |           47|          77
air_traffic             |console_ops           |           56|          77
cargo_loading           |sw_design             |           59|          78
console_ops             |medical_diag          |           46|          78
pilot_training          |console_ops           |           45|          78
console_ops             |surgery               |           46|          78
equip_diag              |weather               |           60|          79

task_name1              |task_name2            |equal_count|similar_count
-------------------------------------------------------------------------
drair_gen               |cargo_loading         |           57|          79
cargo_loading           |protocol_des          |           57|          80
pilot_training          |surgery               |           44|          81
weather                 |cargo_loading         |           60|          81
weather                 |medical_diag          |           52|          81
drair_gen               |medical_diag          |           50|          81
program_mgmt            |medical_diag          |           56|          81
equip_diag              |leadership            |           52|          81
cargo_loading           |leadership            |           50|          82
drair_gen               |language_train        |           65|          82
equip_diag              |cargo_loading         |           58|          82
pilot_training          |air_traffic           |           45|          82
form_fill_out           |language_train        |           63|          82
cargo_loading           |form_fill_out         |           61|          83
weather                 |protocol_des          |           67|          83
air_traffic             |surgery               |           59|          83
language_train          |medical_diag          |           60|          83
weather                 |program_mgmt          |           61|          84
sw_design               |medical_diag          |           57|          84
equip_diag              |form_fill_out         |           59|          84
language_train          |protocol_des          |           62|          85

task_name1              |task_name2            |equal_count|similar_count
-------------------------------------------------------------------------
equip_diag              |program_mgmt          |           60|          85
weather                 |form_fill_out         |           66|          85
weather                 |accounting            |           66|          86
leadership              |medical_diag          |           50|          86
program_mgmt            |language_train        |           70|          87
surgery                 |medical_diag          |           57|          87
sw_design               |language_train        |           69|          87
medical_diag            |protocol_des          |           57|          88
accounting              |protocol_des          |           65|          88
equip_diag              |drair_gen             |           54|          88
leadership              |accounting            |           64|          88
equip_diag              |accounting            |           61|          88
drair_gen               |leadership            |           67|          89
sw_design               |accounting            |           69|          89
cargo_loading           |accounting            |           66|          89
sw_design               |leadership            |           68|          90
drair_gen               |form_fill_out         |           74|          90
```

```
language_train     |leadership          |          70|          90
program_mgmt       |drair_gen           |          67|          91
program_mgmt       |protocol_des        |          71|          92
program_mgmt       |cargo_loading       |          63|          92

task_name1         |task_name2          |equal_count|similar_count
---------------------------------------------------------------------
weather            |sw_design           |          68|          93
drair_gen          |protocol_des        |          69|          93
program_mgmt       |sw_design           |          72|          93
program_mgmt       |accounting          |          76|          93
weather            |drair_gen           |          73|          94
leadership         |protocol_des        |          64|          94
sw_design          |form_fill_out       |          73|          94
form_fill_out      |protocol_des        |          68|          94
drair_gen          |sw_design           |          72|          95
program_mgmt       |form_fill_out       |          73|          95
form_fill_out      |accounting          |          76|          95
sw_design          |protocol_des        |          76|          96
form_fill_out      |leadership          |          67|          98
program_mgmt       |leadership          |          78|          99
drair_gen          |accounting          |          72|         101
```

```
attrib_name           |zero_cnt|one_cnt|two_cnt|three_cnt|four_cnt
-------------------------------------------------------------------
cases_examples        |       0|      4|      7|        4|       1
sub_goals             |       0|      1|      3|        3|       9
high_low_tech         |       0|      5|      9|        2|       0
procedures            |       0|      0|      3|        1|      12
quant_qual            |       0|      1|      9|        6|       0
facts                 |       0|      2|      3|        3|       8
compare               |       0|      1|      2|       11|       2
categorize            |       0|      1|      6|        5|       4
acq_and_pres          |       0|      0|      3|        4|       9
goal_vs_data          |       0|      6|      5|        5|       0
written               |       0|      2|      1|        5|       8
edu_train_expert      |       0|      3|      5|        8|       0
temporal              |       1|      1|      3|        1|      10
principles            |       1|      3|      2|        5|       5
case_based            |       1|      2|      4|        8|       1
kr_hp                 |       1|     11|      2|        2|       0
decompose             |       1|      1|      4|        5|       5
communicates          |       2|      0|      0|        5|       9
form_proc_alg         |       2|      1|      2|        4|       7
verbal                |       2|      1|      0|        3|      10
learn                 |       2|      2|      5|        3|       4

attrib_name           |zero_cnt|one_cnt|two_cnt|three_cnt|four_cnt
-------------------------------------------------------------------
choose                |       2|      2|      4|        3|       5
interpret             |       2|      2|      2|        5|       5
uncertainty           |       3|      5|      2|        4|       2
notation              |       3|      1|      4|        2|       6
requests              |       3|      2|      5|        4|       2
analyze               |       3|      1|      3|        2|       7
propadeutics          |       3|      5|      6|        1|       1
constraints           |       3|      5|      3|        2|       3
transmits             |       4|      0|      5|        5|       2
informs               |       4|      0|      4|        1|       7
estimate              |       4|      1|      4|        4|       3
answers               |       4|      0|      3|        5|       4
itemize               |       4|      2|      3|        3|       4
branching             |       5|      4|      1|        2|       4
historical            |       5|      0|      3|        2|       6
articulation          |       5|      2|      1|        4|       4
computer              |       5|      1|      4|        1|       5
inductive             |       5|      2|      6|        2|       1
plan                  |       5|      1|      0|        3|       7
directs               |       6|      1|      2|        2|       5
supervise             |       6|      3|      0|        2|       5

attrib_name           |zero_cnt|one_cnt|two_cnt|three_cnt|four_cnt
-------------------------------------------------------------------
induce                |       6|      2|      6|        0|       2
model_based           |       6|      3|      3|        3|       1
generalize            |       6|      2|      3|        5|       0
prob_of_success       |       6|      2|      1|        4|       3
dynamism              |       7|      3|      1|        0|       5
ret_to_def            |       7|      5|      3|        1|       0
monitor               |       7|      0|      1|        1|       7
```

```
recombine           |        7|       2|       1|         4|        2
instrumentation     |        7|       1|       1|         0|        7
supervises          |        7|       1|       0|         4|        4
integrate           |        7|       1|       2|         3|        3
advises             |        8|       0|       2|         2|        4
spatial             |        8|       2|       0|         1|        5
deduce              |        8|       2|       2|         1|        3
means_ends          |        8|       2|       1|         2|        3
visual              |        8|       1|       0|         1|        6
mathematical        |        8|       2|       3|         1|        2
translate           |        8|       1|       3|         1|        3
deductive           |        8|       2|       2|         1|        3
calculate           |        9|       0|       3|         2|        2
interpolate         |        9|       2|       2|         1|        2

attrib_name         |zero_cnt|one_cnt|two_cnt|three_cnt|four_cnt
-----------------------------------------------------------------
specialize          |        9|       1|       3|         3|        0
mm_interface        |        9|       3|       1|         0|        3
compute             |        9|       2|       1|         2|        2
indicates           |        9|       1|       2|         2|        2
instruments         |        9|       1|       1|         1|        4
prop_and_ref        |        9|       0|       2|         2|        3
gen_and_test        |       10|       2|       0|         2|        2
express_movement    |       10|       0|       3|         3|        0
cover_and_diff      |       10|       2|       2|         2|        0
analogical          |       10|       3|       1|         2|        0
schedule            |       10|       0|       3|         1|        2
databases           |       10|       2|       2|         0|        2
fine                |       10|       1|       2|         1|        2
fatigue             |       11|       2|       0|         2|        1
noise               |       11|       0|       0|         2|        3
confinement         |       11|       1|       2|         1|        1
repetitive          |       11|       1|       1|         0|        3
stress              |       11|       0|       0|         3|        2
mental_strain       |       11|       0|       2|         2|        1
id_obj_act_events   |       11|       0|       0|         2|        3
boredom             |       11|       2|       2|         1|        0

attrib_name         |zero_cnt|one_cnt|two_cnt|three_cnt|four_cnt
-----------------------------------------------------------------
attention_span      |       11|       1|       0|         2|        2
phys_strain         |       11|       3|       0|         2|        0
analogs             |       11|       2|       1|         2|        0
percep_speed        |       12|       0|       1|         0|        3
preciseness         |       12|       1|       0|         1|        2
gross               |       12|       1|       1|         1|        1
search_rec_info     |       12|       0|       0|         2|        2
cog_attent          |       12|       0|       0|         0|        4
simple_disc         |       12|       0|       1|         0|        3
response_chaining   |       12|       2|       1|         1|        0
interp_movement     |       12|       0|       1|         3|        0
negotiates          |       12|       0|       0|         1|        3
general_health      |       12|       0|       1|         0|        3
instructs           |       12|       1|       0|         0|        3
auditory            |       12|       1|       3|         0|        0
test_equip          |       12|       2|       1|         1|        0
intro_accuracy      |       12|       0|       0|         2|        2
```

```
kinesthetic         |      13|       1|       0|         0|       2
sleep               |      13|       1|       1|         0|       1
lighting            |      13|       1|       2|         0|       0
scan_display        |      13|       0|       0|         0|       3

attrib_name         |zero_cnt|one_cnt|two_cnt|three_cnt|four_cnt
-----------------------------------------------------------------
statistical         |      13|       2|       1|         0|       0
computerize         |      13|       1|       1|         0|       1
tabulate            |      13|       2|       0|         0|       1
vehicles            |      14|       0|       1|         0|       1
reflex              |      14|       1|       0|         1|       0
weight              |      14|       0|       1|         1|       0
acceleration        |      14|       1|       0|         1|       0
complex_cont        |      14|       0|       1|         0|       1
contaminants        |      14|       1|       1|         0|       0
age                 |      14|       1|       0|         1|       0
compound            |      15|       0|       1|         0|       0
electricity         |      15|       0|       0|         1|       0
gender              |      15|       0|       1|         0|       0
height              |      15|       1|       0|         0|       0
code                |      15|       0|       1|         0|       0
isolation           |      16|       0|       0|         0|       0
magnetism           |      16|       0|       0|         0|       0
weapon_systems      |      16|       0|       0|         0|       0
```

```
attrib_name         |zero_cnt|one_cnt|two_cnt|three_cnt|four_cnt
------------------------------------------------------------------
statistical         |      13|      2|      1|        0|       0
interp_movement     |      12|      0|      1|        3|       0
express_movement    |      10|      0|      3|        3|       0
specialize          |       9|      1|      3|        3|       0
ret_to_def          |       7|      5|      3|        1|       0
generalize          |       6|      2|      3|        5|       0
auditory            |      12|      1|      3|        0|       0
cover_and_diff      |      10|      2|      2|        2|       0
analogical          |      10|      3|      1|        2|       0
goal_vs_data        |       0|      6|      5|        5|       0
high_low_tech       |       0|      5|      9|        2|       0
kr_hp               |       1|     11|      2|        2|       0
quant_qual          |       0|      1|      9|        6|       0
compound            |      15|      0|      1|        0|       0
test_equip          |      12|      2|      1|        1|       0
edu_train_expert    |       0|      3|      5|        8|       0
reflex              |      14|      1|      0|        1|       0
weapon_systems      |      16|      0|      0|        0|       0
height              |      15|      1|      0|        0|       0
code                |      15|      0|      1|        0|       0
age                 |      14|      1|      0|        1|       0

attrib_name         |zero_cnt|one_cnt|two_cnt|three_cnt|four_cnt
------------------------------------------------------------------
analogs             |      11|      2|      1|        2|       0
acceleration        |      14|      1|      0|        1|       0
isolation           |      16|      0|      0|        0|       0
contaminants        |      14|      1|      1|        0|       0
weight              |      14|      0|      1|        1|       0
electricity         |      15|      0|      0|        1|       0
gender              |      15|      0|      1|        0|       0
phys_strain         |      11|      3|      0|        2|       0
magnetism           |      16|      0|      0|        0|       0
boredom             |      11|      2|      2|        1|       0
response_chaining   |      12|      2|      1|        1|       0
lighting            |      13|      1|      2|        0|       0
vehicles            |      14|      0|      1|        0|       1
sleep               |      13|      1|      1|        0|       1
model_based         |       6|      3|      3|        3|       1
case_based          |       1|      2|      4|        8|       1
cases_examples      |       0|      4|      7|        4|       1
tabulate            |      13|      2|      0|        0|       1
mental_strain       |      11|      0|      2|        2|       1
fatigue             |      11|      2|      0|        2|       1
propadeutics        |       3|      5|      6|        1|       1

attrib_name         |zero_cnt|one_cnt|two_cnt|three_cnt|four_cnt
------------------------------------------------------------------
inductive           |       5|      2|      6|        2|       1
complex_cont        |      14|      0|      1|        0|       1
gross               |      12|      1|      1|        1|       1
confinement         |      11|      1|      2|        1|       1
computerize         |      13|      1|      1|        0|       1
attention_span      |      11|      1|      0|        2|       2
preciseness         |      12|      1|      0|        1|       2
```

```
intro_accuracy        |       12|       0|       0|         2|        2
schedule              |       10|       0|       3|         1|        2
search_rec_info       |       12|       0|       0|         2|        2
stress                |       11|       0|       0|         3|        2
transmits             |        4|       0|       5|         5|        2
recombine             |        7|       2|       1|         4|        2
mathematical          |        8|       2|       3|         1|        2
requests              |        3|       2|       5|         4|        2
compare               |        0|       1|       2|        11|        2
kinesthetic           |       13|       1|       0|         0|        2
induce                |        6|       2|       6|         0|        2
databases             |       10|       2|       2|         0|        2
gen_and_test          |       10|       2|       0|         2|        2
calculate             |        9|       0|       3|         2|        2

attrib_name           |zero_cnt|one_cnt|two_cnt|three_cnt|four_cnt
------------------------------------------------------------------------
fine                  |       10|       1|       2|         1|        2
compute               |        9|       2|       1|         2|        2
interpolate           |        9|       2|       2|         1|        2
indicates             |        9|       1|       2|         2|        2
uncertainty           |        3|       5|       2|         4|        2
translate             |        8|       1|       3|         1|        3
deduce                |        8|       2|       2|         1|        3
deductive             |        8|       2|       2|         1|        3
id_obj_act_events     |       11|       0|       0|         2|        3
percep_speed          |       12|       0|       1|         0|        3
estimate              |        4|       1|       4|         4|        3
means_ends            |        8|       2|       1|         2|        3
scan_display          |       13|       0|       0|         0|        3
integrate             |        7|       1|       2|         3|        3
prob_of_success       |        6|       2|       1|         4|        3
negotiates            |       12|       0|       0|         1|        3
repetitive            |       11|       1|       1|         0|        3
general_health        |       12|       0|       1|         0|        3
prop_and_ref          |        9|       0|       2|         2|        3
simple_disc           |       12|       0|       1|         0|        3
mm_interface          |        9|       3|       1|         0|        3

attrib_name           |zero_cnt|one_cnt|two_cnt|three_cnt|four_cnt
------------------------------------------------------------------------
instructs             |       12|       1|       0|         0|        3
constraints           |        3|       5|       3|         2|        3
noise                 |       11|       0|       0|         2|        3
answers               |        4|       0|       3|         5|        4
cog_attent            |       12|       0|       0|         0|        4
itemize               |        4|       2|       3|         3|        4
advises               |        8|       0|       2|         2|        4
learn                 |        2|       2|       5|         3|        4
instruments           |        9|       1|       1|         1|        4
branching             |        5|       4|       1|         2|        4
articulation          |        5|       2|       1|         4|        4
supervises            |        7|       1|       0|         4|        4
categorize            |        0|       1|       6|         5|        4
dynamism              |        7|       3|       1|         0|        5
choose                |        2|       2|       4|         3|        5
directs               |        6|       1|       2|         2|        5
interpret             |        2|       2|       2|         5|        5
```

```
supervise           |       6|      3|      0|        2|       5
principles          |       1|      3|      2|        5|       5
computer            |       5|      1|      4|        1|       5
spatial             |       8|      2|      0|        1|       5

attrib_name         |zero_cnt|one_cnt|two_cnt|three_cnt|four_cnt
---------------------------------------------------------------
decompose           |       1|      1|      4|        5|       5
visual              |       8|      1|      0|        1|       6
historical          |       5|      0|      3|        2|       6
notation            |       3|      1|      4|        2|       6
form_proc_alg       |       2|      1|      2|        4|       7
analyze             |       3|      1|      3|        2|       7
instrumentation     |       7|      1|      1|        0|       7
plan                |       5|      1|      0|        3|       7
informs             |       4|      0|      4|        1|       7
monitor             |       7|      0|      1|        1|       7
written             |       0|      2|      1|        5|       8
facts               |       0|      2|      3|        3|       8
communicates        |       2|      0|      0|        5|       9
acq_and_pres        |       0|      0|      3|        4|       9
sub_goals           |       0|      1|      3|        3|       9
verbal              |       2|      1|      0|        3|      10
temporal            |       1|      1|      3|        1|      10
procedures          |       0|      0|      3|        1|      12
```

```
name: equip_diag
statistical
analogical
mathematical
inductive
means_ends
cover-and-diff
prop-and-ref
generalize
specialize
verbal
kinesthetic
dynamism
complex-cont
compound
reflex
simple-disc
calculate
code
computerize
interpolate
tabulate
translate
induce
choose
compute
estimate
integrate
plan
supervise
monitor
analogs
percep-speed
search-rec-info
id-ob-act-events
scan-display
acceleration
confinement
isolation
lighting
magnetism
fatigue
mental-strain
stress
preciseness
cog_attent
response chaining
sleep
general health
age
gender
height
weight
intro accuracy
prob of success
articulation
```

```
vehicles
weapon systems
notation
advises
answers
communicates
directs
indicates
informs
instructs
requests
transmits
supervises
negotiates
express movement
interp movement


name: pilot_training
statistical
mathematical
gen-and-test
cover-and-diff
prop-and-ref
recombine
databases
historical
propadeutics
compound
reflex
calculate
code
computerize
interpolate
learn
tabulate
translate
compute
estimate
isolation
contaminants
electricity
lighting
magnetism
sleep
boredom
computer
weapon systems
test equip
negotiates
express movement


name: air_traffic
statistical
analogical
mathematical
deductive
```

```
inductive
gen-and-test
prop-and-ref
form-proc-alg
recombine
generalize
specialize
ret-to-def
auditory
kinesthetic
databases
historical
branching
complex-cont
compound
gross
calculate
code
computerize
tabulate
translate
analyze
deduce
induce
compute
integrate
analogs
acceleration
isolation
contaminants
electricity
magnetism
phys-strain
preciseness
boredom
age
gender
height
weight
intro accuracy
computer
vehicles
weapon systems
test equip
answers
indicates
instructs
negotiates
express movement
interp movement


name: console_ops
statistical
spacial
analogical
means_ends
gen-and-test
```

```
prop-and-ref
recombine
generalize
ret-to-def
auditory
kinesthetic
databases
branching
complex-cont
compound
gross
code
computerize
itemize
tabulate
induce
analogs
acceleration
isolation
contaminants
electricity
magnetism
sleep
gender
height
intro accuracy
vehicles
weapon systems
instructs
supervises
negotiates
interp movement


name: weather
analogical
case-based
deductive
means_ends
gen-and-test
cover-and-diff
prop-and-ref
decompose
specialize
ret-to-def
auditory
kinesthetic
mm-interface
databases
complex-cont
compound
reflex
simple-disc
fine
gross
repetitive
code
computerize
```

```
itemize
tabulate
deduce
plan
supervise
analogs
percep-speed
scan-display
acceleration
confinement
isolation
contaminants
electricity
lighting
magnetism
noise
fatigue
mental-strain
stress
phys-strain
preciseness
cog_attent
response chaining
attention span
sleep
schedule
boredom
general health
age
gender
height
weight
intro accuracy
articulation
vehicles
weapon systems
test equip
advises
answers
communicates
directs
indicates
informs
instructs
requests
transmits
supervises
negotiates
express movement
interp movement


name: program_mgmt
statistical
spacial
analogical
model-based
mathematical
```

```
deductive
inductive
means_ends
gen-and-test
cover-and-diff
recombine
generalize
specialize
visual
auditory
kinesthetic
instrumentation
propadeutics
complex-cont
compound
reflex
simple-disc
fine
gross
repetitive
calculate
code
computerize
interpolate
tabulate
translate
deduce
induce
compute
integrate
analogs
percep-speed
search-rec-info
id-ob-act-events
scan-display
acceleration
confinement
isolation
contaminants
electricity
lighting
magnetism
noise
fatigue
mental-strain
stress
phys-strain
preciseness
cog_attent
response chaining
attention span
sleep
schedule
boredom
general health
age
gender
height
```

```
weight
intro accuracy
articulation
vehicles
weapon systems
instruments
notation
test equip
advises
indicates
instructs
express movement
interp movement


name: drair_gen
spacial
model-based
means_ends
gen-and-test
cover-and-diff
prop-and-ref
specialize
ret-to-def
visual
auditory
kinesthetic
instrumentation
mm-interface
propadeutics
branching
dynamism
constraints
complex-cont
compound
reflex
simple-disc
fine
gross
repetitive
calculate
code
computerize
choose
compute
plan
supervise
monitor
principles
percep-speed
search-rec-info
id-ob-act-events
scan-display
acceleration
confinement
isolation
contaminants
electricity
```

```
lighting
magnetism
noise
fatigue
mental-strain
stress
phys-strain
preciseness
cog_attent
response chaining
attention span
sleep
schedule
boredom
general health
age
gender
height
weight
intro accuracy
prob of success
vehicles
weapon systems
instruments
test equip
advises
directs
indicates
instructs
supervises
negotiates
express movement
interp movement


name: cargo_loading
statistical
analogical
inductive
gen-and-test
cover-and-diff
prop-and-ref
generalize
verbal
auditory
kinesthetic
instrumentation
mm-interface
databases
historical
uncertainity
complex-cont
compound
reflex
simple-disc
fine
gross
repetitive
```

```
code
computerize
tabulate
translate
induce
integrate
interpret
analogs
percep-speed
search-rec-info
id-ob-act-events
scan-display
isolation
contaminants
electricity
lighting
magnetism
fatigue
mental-strain
stress
preciseness
cog_attent
response chaining
attention span
sleep
schedule
age
gender
height
weight
intro accuracy
prob of success
computer
weapon systems
instruments
test equip
advises
indicates
informs
instructs
transmits
negotiates
interp movement


name: sw_design
statistical
spacial
analogical
deductive
cover-and-diff
specialize
visual
auditory
kinesthetic
instrumentation
mm-interface
databases
```

```
historical
dynamism
complex-cont
compound
reflex
simple-disc
fine
gross
repetitive
calculate
interpolate
tabulate
deduce
compute
monitor
percep-speed
search-rec-info
id-ob-act-events
scan-display
acceleration
confinement
isolation
contaminants
electricity
lighting
magnetism
noise
fatigue
mental-strain
stress
phys-strain
preciseness
cog_attent
response chaining
attention span
sleep
schedule
boredom
general health
age
gender
height
weight
intro accuracy
prob of success
vehicles
weapon systems
instruments
test equip
advises
answers
directs
indicates
informs
instructs
requests
supervises
express movement
```

```
interp movement


name: form_fill_out
statistical
spacial
model-based
deductive
specialize
visual
auditory
kinesthetic
instrumentation
mm-interface
branching
dynamism
uncertainity
complex-cont
compound
reflex
simple-disc
fine
gross
repetitive
code
computerize
translate
deduce
plan
supervise
monitor
analogs
percep-speed
search-rec-info
id-ob-act-events
scan-display
acceleration
confinement
isolation
contaminants
electricity
lighting
magnetism
noise
fatigue
mental-strain
stress
phys-strain
preciseness
cog_attent
response chaining
attention span
sleep
schedule
boredom
general health
age
gender
```

```
height
weight
intro accuracy
prob of success
articulation
vehicles
weapon systems
instruments
test equip
advises
directs
instructs
supervises
express movement
interp movement


name: language_train
statistical
spacial
temporal
model-based
mathematical
form-proc-alg
ret-to-def
visual
auditory
kinesthetic
mm-interface
databases
historical
complex-cont
compound
reflex
simple-disc
fine
gross
repetitive
calculate
code
computerize
interpolate
itemize
tabulate
compute
estimate
integrate
percep-speed
search-rec-info
id-ob-act-events
scan-display
acceleration
confinement
isolation
contaminants
electricity
lighting
magnetism
```

```
noise
fatigue
mental-strain
stress
phys-strain
preciseness
cog_attent
response chaining
attention span
sleep
schedule
boredom
general health
age
gender
height
weight
vehicles
weapon systems
instruments
notation
test equip
negotiates


name: leadership
statistical
spacial
model-based
mathematical
deductive
means_ends
cover-and-diff
recombine
specialize
ret-to-def
visual
auditory
kinesthetic
instrumentation
mm-interface
dynamism
constraints
complex-cont
compound
reflex
simple-disc
fine
gross
repetitive
code
interpolate
learn
tabulate
translate
deduce
monitor
interpret
```

```
percep-speed
search-rec-info
id-ob-act-events
scan-display
acceleration
confinement
isolation
contaminants
electricity
lighting
magnetism
noise
fatigue
mental-strain
stress
phys-strain
preciseness
cog_attent
response chaining
attention span
sleep
schedule
boredom
general health
age
gender
height
weight
vehicles
weapon systems
instruments
test equip


name: surgery
statistical
mathematical
gen-and-test
prop-and-ref
recombine
databases
reflex
calculate
code
computerize
interpolate
itemize
tabulate
translate
compute
integrate
analogs
search-rec-info
scan-display
acceleration
isolation
electricity
magnetism
```

```
noise
general health
age
gender
height
weight
intro accuracy
computer
vehicles
weapon systems
instructs
transmits
negotiates
interp movement


name: medical_diag
statistical
analogical
mathematical
gen-and-test
recombine
mm-interface
databases
dynamism
complex-cont
compound
reflex
simple-disc
repetitive
calculate
code
computerize
interpolate
tabulate
compute
integrate
supervise
analogs
percep-speed
search-rec-info
id-ob-act-events
scan-display
acceleration
confinement
isolation
contaminants
electricity
lighting
magnetism
noise
phys-strain
preciseness
cog_attent
response chaining
attention span
general health
age
```

```
gender
height
weight
computer
vehicles
weapon systems
negotiates


name: accounting
statistical
spacial
analogical
model-based
deductive
inductive
means_ends
gen-and-test
cover-and-diff
prop-and-ref
generalize
ret-to-def
visual
auditory
kinesthetic
instrumentation
branching
complex-cont
compound
reflex
simple-disc
fine
gross
repetitive
code
interpolate
analyze
deduce
induce
estimate
plan
supervise
monitor
analogs
percep-speed
search-rec-info
id-ob-act-events
scan-display
acceleration
confinement
isolation
contaminants
electricity
lighting
magnetism
noise
fatigue
mental-strain
```

```
stress
phys-strain
cog_attent
response chaining
attention span
sleep
schedule
boredom
general health
age
gender
height
weight
intro accuracy
prob of success
articulation
vehicles
weapon systems
instruments
test equip
advises
directs
indicates
instructs
supervises
negotiates
express movement
interp movement


name: protocol_des
analogical
deductive
means_ends
cover-and-diff
specialize
visual
auditory
kinesthetic
mm-interface
databases
dynamism
constraints
uncertainity
complex-cont
compound
reflex
simple-disc
fine
gross
repetitive
code
computerize
tabulate
analyze
deduce
monitor
analogs
```

```
percep-speed
search-rec-info
id-ob-act-events
scan-display
acceleration
confinement
isolation
contaminants
electricity
lighting
magnetism
noise
fatigue
mental-strain
stress
phys-strain
preciseness
cog_attent
response chaining
attention span
sleep
schedule
boredom
general health
age
gender
height
weight
intro accuracy
vehicles
weapon systems
notation
advises
indicates
instructs
negotiates
express movement
interp movement
```

```
name: equip_diag
form-proc-alg
instrumentation
repetitive
compare
procedures
noise
instruments
test equip


name: pilot_training
spacial
temporal
deductive
sub-goals
acq-and-present
form-proc-alg
visual
kinesthetic
instrumentation
mm-interface
branching
dynamism
constraints
uncertainity
simple-disc
compare
monitor
procedures
percep-speed
scan-display
confinement
noise
cog_attent
general health
articulation
vehicles
instruments
advises
answers
directs
indicates
informs
instructs


name: air_traffic
spacial
temporal
means_ends
sub-goals
decompose
visual
verbal
instrumentation
```

```
dynamism
constraints
choose
estimate
plan
supervise
monitor
facts
procedures
percep-speed
search-rec-info
id-ob-act-events
scan-display
fatigue
mental-strain
stress
cog_attent
attention span
sleep
schedule
general health
instruments
notation
communicates
directs
informs
requests
supervises


name: console_ops
temporal
deductive
form-proc-alg
visual
verbal
instrumentation
mm-interface
dynamism
constraints
simple-disc
fine
repetitive
categorize
interpolate
learn
analyze
deduce
plan
monitor
facts
procedures
percep-speed
search-rec-info
id-ob-act-events
scan-display
noise
cog_attent
```

```
general health
computer
communicates
informs


name: weather
spacial
temporal
model-based
acq-and-present
visual
branching
dynamism
uncertainity
interpolate
learn
analyze
induce
estimate
integrate
facts
principles
procedures
notation


name: program_mgmt
temporal
sub-goals
verbal
written
historical
plan
supervise
monitor
procedures
communicates
negotiates


name: drair_gen
inductive
acq-and-present
verbal
databases
historical
itemize
analyze
induce
integrate
interpret
facts
articulation
computer
answers
communicates
informs
```

```
name: cargo_loading
spacial
temporal
mathematical
sub-goals
form-proc-alg
written
calculate
itemize
compute
estimate
plan
monitor
facts
principles
supervises


name: sw_design
temporal
means_ends
sub-goals
gen-and-test
prop-and-ref
acq-and-present
decompose
recombine
verbal
written
translate
analyze
integrate
computer
notation
negotiates


name: form_fill_out
sub-goals
acq-and-present
form-proc-alg
written
choose
procedures
computer
transmits
negotiates


name: language_train
sub-goals
acq-and-present
decompose
recombine
verbal
written
```

```
instrumentation
dynamism
translate
plan
supervise
monitor
interpret
facts
principles
intro accuracy
articulation
answers
communicates
directs
indicates
informs
instructs
requests
transmits
supervises


name: leadership
verbal
analyze
supervise
procedures
intro accuracy
articulation
advises
communicates
informs
instructs


name: surgery
spacial
temporal
means_ends
sub-goals
form-proc-alg
decompose
visual
verbal
kinesthetic
written
instrumentation
historical
branching
complex-cont
simple-disc
fine
gross
repetitive
categorize
learn
analyze
deduce
```

```
choose
plan
supervise
monitor
interpret
facts
principles
procedures
id-ob-act-events
stress
preciseness
cog_attent
attention span
schedule
prob of success
instruments
notation
directs
supervises


name: medical_diag
temporal
deductive
prop-and-ref
acq-and-present
visual
verbal
written
instrumentation
historical
branching
categorize
learn
analyze
deduce
choose
interpret
facts
principles
procedures
prob of success
notation
advises
answers
communicates
directs
informs


name: accounting
mathematical
acq-and-present
form-proc-alg
written
mm-interface
databases
historical
```

```
calculate
computerize
itemize
tabulate
compute
procedures
preciseness
computer
communicates


name: protocol_des
temporal
case-based
sub-goals
gen-and-test
prop-and-ref
acq-and-present
decompose
verbal
historical
propadeutics
categorize
itemize
translate
choose
plan
interpret
procedures
cases-examples
prob of success
instruments
communicates
```

pair_data.out
5/16/91

absolute value difference between the characteristic ratings of the pair of tasks

```
namel:  equip_diag
name2:  pilot_training
eq_count:  35
sim_count:  56

---------------------------------

statistical:  0
spatial:  3
temporal:  3
analogical:  3
case_based:  1
model_based:  2
mathematical:  0
deductive:  2
inductive:  1
means_ends:  3
sub_goals:  1
gen_and_test:  1
goal_vs_data:  0
cover_and_diff:  0
prop_and_ref:  0
acq_and_pres:  2
form_proc_alg:  0
decompose:  0
recombine:  1
generalize:  2
specialize:  3
ret_to_def:  0
visual:  3
verbal:  3
auditory:  1
kinesthetic:  4
written:  1
instrumentation:  0
mm_interface:  3
databases:  1
historical:  3
propadeutics:  2
branching:  3
dynamism:  4
constraints:  1
uncertainty:  3
high_low_tech:  0
quant_qual:  1
complex_cont:  2
compound:  0
reflex:  0
simple_disc:  4
fine:  1
gross:  1
repetitive:  3
categorize:  0
calculate:  0
code:  0
computerize:  0
interpolate:  0
itemize:  1
learn:  1
tabulate:  0
translate:  0
analyze:  1
deduce:  1
induce:  1
choose:  3
compare:  0
```

```
compute:  0
estimate:  0
integrate:  2
plan:  3
supervise:  3
monitor:  4
interpret:  0
facts:  1
principles:  0
procedures:  0
analogs:  3
cases_examples:  2
percep_speed:  4
search_rec_info:  3
id_obj_act_events:  3
scan_display:  4
acceleration:  3
confinement:  4
isolation:  0
contaminants:  2
electricity:  3
lighting:  0
magnetism:  0
noise:  0
fatigue:  3
mental_strain:  3
stress:  3
phys_strain:  2
preciseness:  3
cog_attent:  4
response_chaining:  1
attention_span:  2
sleep:  0
schedule:  1
boredom:  3
general_health:  4
age:  3
gender:  2
height:  1
weight:  3
edu_train_expert:  2
intro_accuracy:  3
prob_of_success:  3
articulation:  4
kr_hp:  3
computer:  3
vehicles:  4
weapon_systems:  0
instruments:  4
notation:  2
test_equip:  0
advises:  0
answers:  4
communicates:  3
directs:  4
indicates:  4
informs:  4
instructs:  4
requests:  3
transmits:  2
supervises:  3
negotiates:  0
express_movement:  0
interp_movement:  2

name1:  equip_diag
```

```
name2:  air_traffic
eq_count:  47
sim_count:  66

---------------------------------

statistical:  0
spatial:  3
temporal:  3
analogical:  0
case_based:  1
model_based:  0
mathematical:  0
deductive:  2
inductive:  0
means_ends:  4
sub_goals:  1
gen_and_test:  1
goal_vs_data:  1
cover_and_diff:  1
prop_and_ref:  0
acq_and_pres:  0
form_proc_alg:  4
decompose:  1
recombine:  1
generalize:  0
specialize:  0
ret_to_def:  1
visual:  3
verbal:  4
auditory:  1
kinesthetic:  0
written:  2
instrumentation:  0
mm_interface:  1
databases:  1
historical:  3
propadeutics:  1
branching:  3
dynamism:  4
constraints:  1
uncertainty:  0
high_low_tech:  0
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  1
simple_disc:  2
fine:  0
gross:  2
repetitive:  2
categorize:  1
calculate:  0
code:  0
computerize:  0
interpolate:  3
itemize:  0
learn:  2
tabulate:  0
translate:  0
analyze:  2
deduce:  2
induce:  0
choose:  4
compare:  1
compute:  0
```

```
estimate:  4
integrate:  0
plan:  4
supervise:  4
monitor:  4
interpret:  2
facts:  2
principles:  2
procedures:  0
analogs:  0
cases_examples:  0
percep_speed:  4
search_rec_info:  4
id_obj_act_events:  4
scan_display:  4
acceleration:  0
confinement:  3
isolation:  0
contaminants:  2
electricity:  3
lighting:  2
magnetism:  0
noise:  1
fatigue:  4
mental_strain:  4
stress:  4
phys_strain:  3
preciseness:  0
cog_attent:  4
response_chaining:  3
attention_span:  3
sleep:  4
schedule:  2
boredom:  3
general_health:  4
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  2
intro_accuracy:  0
prob_of_success:  3
articulation:  3
kr_hp:  2
computer:  3
vehicles:  0
weapon_systems:  0
instruments:  4
notation:  0
test_equip:  0
advises:  1
answers:  0
communicates:  4
directs:  4
indicates:  0
informs:  4
instructs:  0
requests:  4
transmits:  3
supervises:  4
negotiates:  0
express_movement:  0
interp_movement:  0

name1:  equip_diag
name2:  console_ops
```

```
eq_count:  37
sim_count:  68

---------------------------------

statistical:  0
spatial:  1
temporal:  3
analogical:  0
case_based:  1
model_based:  1
mathematical:  3
deductive:  2
inductive:  1
means_ends:  0
sub_goals:  2
gen_and_test:  1
goal_vs_data:  1
cover_and_diff:  3
prop_and_ref:  0
acq_and_pres:  0
form_proc_alg:  0
decompose:  1
recombine:  1
generalize:  0
specialize:  2
ret_to_def:  1
visual:  3
verbal:  4
auditory:  1
kinesthetic:  0
written:  0
instrumentation:  0
mm_interface:  3
databases:  1
historical:  1
propadeutics:  1
branching:  1
dynamism:  4
constraints:  1
uncertainty:  2
high_low_tech:  1
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  3
simple_disc:  4
fine:  2
gross:  2
repetitive:  0
categorize:  1
calculate:  3
code:  0
computerize:  0
interpolate:  4
itemize:  3
learn:  3
tabulate:  0
translate:  2
analyze:  2
deduce:  2
induce:  0
choose:  2
compare:  1
compute:  3
estimate:  3
```

```
integrate:  3
plan:  4
supervise:  1
monitor:  4
interpret:  0
facts:  2
principles:  0
procedures:  0
analogs:  0
cases_examples:  1
percep_speed:  4
search_rec_info:  4
id_obj_act_events:  4
scan_display:  4
acceleration:  0
confinement:  1
isolation:  0
contaminants:  2
electricity:  3
lighting:  1
magnetism:  0
noise:  0
fatigue:  1
mental_strain:  2
stress:  3
phys_strain:  2
preciseness:  1
cog_attent:  4
response_chaining:  1
attention_span:  2
sleep:  0
schedule:  0
boredom:  1
general_health:  4
age:  1
gender:  0
height:  0
weight:  2
edu_train_expert:  2
intro_accuracy:  0
prob_of_success:  3
articulation:  2
kr_hp:  2
computer:  1
vehicles:  0
weapon_systems:  0
instruments:  3
notation:  2
test_equip:  1
advises:  2
answers:  3
communicates:  4
directs:  1
indicates:  1
informs:  4
instructs:  0
requests:  3
transmits:  3
supervises:  0
negotiates:  0
express_movement:  3
interp_movement:  0

name1:  equip_diag
name2:  weather
eq_count:  60
```

```
sim_count:  79

---------------------------------

statistical:  1
spatial:  3
temporal:  3
analogical:  0
case_based:  2
model_based:  3
mathematical:  2
deductive:  2
inductive:  3
means_ends:  0
sub_goals:  0
gen_and_test:  1
goal_vs_data:  1
cover_and_diff:  0
prop_and_ref:  0
acq_and_pres:  2
form_proc_alg:  1
decompose:  3
recombine:  2
generalize:  3
specialize:  0
ret_to_def:  1
visual:  3
verbal:  1
auditory:  1
kinesthetic:  0
written:  0
instrumentation:  3
mm_interface:  1
databases:  1
historical:  1
propadeutics:  1
branching:  3
dynamism:  4
constraints:  2
uncertainty:  3
high_low_tech:  1
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  2
gross:  2
repetitive:  4
categorize:  0
calculate:  2
code:  0
computerize:  0
interpolate:  4
itemize:  3
learn:  3
tabulate:  0
translate:  2
analyze:  2
deduce:  2
induce:  4
choose:  2
compare:  1
compute:  1
estimate:  4
integrate:  4
```

```
plan:  0
supervise:  0
monitor:  3
interpret:  0
facts:  2
principles:  3
procedures:  0
analogs:  0
cases_examples:  0
percep_speed:  0
search_rec_info:  3
id_obj_act_events:  3
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  2
electricity:  3
lighting:  0
magnetism:  0
noise:  4
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  3
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  1
sleep:  0
schedule:  2
boredom:  3
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  1
articulation:  0
kr_hp:  1
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  1
notation:  0
test_equip:  0
advises:  4
answers:  0
communicates:  0
directs:  0
indicates:  0
informs:  0
instructs:  0
requests:  0
transmits:  0
supervises:  0
negotiates:  0
express_movement:  0
interp_movement:  0

name1:  equip_diag
name2:  program_mgmt
eq_count:  60
sim_count:  85
```

```
---------------------------------

statistical:  0
spatial:  1
temporal:  3
analogical:  0
case_based:  1
model_based:  1
mathematical:  0
deductive:  2
inductive:  0
means_ends:  0
sub_goals:  1
gen_and_test:  1
goal_vs_data:  2
cover_and_diff:  0
prop_and_ref:  3
acq_and_pres:  1
form_proc_alg:  1
decompose:  1
recombine:  1
generalize:  0
specialize:  0
ret_to_def:  2
visual:  1
verbal:  4
auditory:  1
kinesthetic:  0
written:  1
instrumentation:  4
mm_interface:  0
databases:  1
historical:  1
propadeutics:  2
branching:  1
dynamism:  1
constraints:  1
uncertainty:  2
high_low_tech:  0
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  2
gross:  2
repetitive:  4
categorize:  1
calculate:  0
code:  0
computerize:  0
interpolate:  0
itemize:  1
learn:  2
tabulate:  0
translate:  0
analyze:  0
deduce:  2
induce:  0
choose:  3
compare:  2
compute:  0
estimate:  2
integrate:  0
plan:  4
```

```
supervise:  4
monitor:  4
interpret:  1
facts:  0
principles:  2
procedures:  0
analogs:  0
cases_examples:  2
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  2
electricity:  3
lighting:  0
magnetism:  0
noise:  4
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  3
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  1
sleep:  0
schedule:  2
boredom:  3
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  0
intro_accuracy:  0
prob_of_success:  1
articulation:  0
kr_hp:  1
computer:  1
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  4
test_equip:  0
advises:  4
answers:  3
communicates:  4
directs:  2
indicates:  0
informs:  2
instructs:  0
requests:  3
transmits:  2
supervises:  3
negotiates:  4
express_movement:  0
interp_movement:  0

name1:  equip_diag
name2:  drair_gen
eq_count:  54
sim_count:  88
```

```
---------------------------------

statistical:  1
spatial:  1
temporal:  1
analogical:  1
case_based:  1
model_based:  1
mathematical:  1
deductive:  1
inductive:  4
means_ends:  0
sub_goals:  1
gen_and_test:  1
goal_vs_data:  0
cover_and_diff:  0
prop_and_ref:  0
acq_and_pres:  2
form_proc_alg:  1
decompose:  2
recombine:  2
generalize:  3
specialize:  0
ret_to_def:  1
visual:  1
verbal:  4
auditory:  1
kinesthetic:  0
written:  2
instrumentation:  4
mm_interface:  1
databases:  3
historical:  1
propadeutics:  2
branching:  1
dynamism:  0
constraints:  3
uncertainty:  1
high_low_tech:  1
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  2
gross:  2
repetitive:  4
categorize:  2
calculate:  0
code:  0
computerize:  0
interpolate:  1
itemize:  1
learn:  1
tabulate:  1
translate:  2
analyze:  2
deduce:  1
induce:  4
choose:  0
compare:  1
compute:  0
estimate:  3
integrate:  4
plan:  0
supervise:  0
```

```
monitor:  0
interpret:  1
facts:  2
principles:  1
procedures:  1
analogs:  1
cases_examples:  0
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  2
electricity:  3
lighting:  0
magnetism:  0
noise:  4
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  3
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  1
sleep:  0
schedule:  2
boredom:  3
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  0
articulation:  4
kr_hp:  1
computer:  1
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  3
test_equip:  0
advises:  4
answers:  4
communicates:  4
directs:  0
indicates:  0
informs:  4
instructs:  0
requests:  2
transmits:  2
supervises:  0
negotiates:  0
express_movement:  0
interp_movement:  0

name1:  equip_diag
name2:  cargo_loading
eq_count:  58
sim_count:  82

--------------------------------
```

```
statistical:  0
spatial:  3
temporal:  3
analogical:  0
case_based:  0
model_based:  0
mathematical:  4
deductive:  1
inductive:  0
means_ends:  3
sub_goals:  1
gen_and_test:  1
goal_vs_data:  0
cover_and_diff:  0
prop_and_ref:  0
acq_and_pres:  1
form_proc_alg:  0
decompose:  1
recombine:  0
generalize:  0
specialize:  2
ret_to_def:  1
visual:  2
verbal:  0
auditory:  1
kinesthetic:  0
written:  1
instrumentation:  4
mm_interface:  1
databases:  1
historical:  3
propadeutics:  0
branching:  0
dynamism:  1
constraints:  2
uncertainty:  1
high_low_tech:  0
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  2
gross:  2
repetitive:  4
categorize:  0
calculate:  4
code:  0
computerize:  0
interpolate:  2
itemize:  1
learn:  1
tabulate:  0
translate:  0
analyze:  1
deduce:  1
induce:  0
choose:  2
compare:  3
compute:  4
estimate:  4
integrate:  0
plan:  4
supervise:  3
monitor:  4
```

```
interpret:  3
facts:  2
principles:  3
procedures:  2
analogs:  0
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  1
confinement:  2
isolation:  0
contaminants:  2
electricity:  3
lighting:  0
magnetism:  0
noise:  1
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  2
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  1
sleep:  0
schedule:  2
boredom:  1
general_health:  2
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  0
articulation:  1
kr_hp:  1
computer:  3
vehicles:  2
weapon_systems:  0
instruments:  0
notation:  2
test_equip:  0
advises:  4
answers:  2
communicates:  3
directs:  3
indicates:  0
informs:  0
instructs:  0
requests:  2
transmits:  0
supervises:  4
negotiates:  0
express_movement:  2
interp_movement:  0

name1:  equip_diag
name2:  sw_design
eq_count:  55
sim_count:  77

--------------------------------
```

```
statistical:  0
spatial:  1
temporal:  3
analogical:  0
case_based:  1
model_based:  2
mathematical:  1
deductive:  2
inductive:  2
means_ends:  4
sub_goals:  1
gen_and_test:  3
goal_vs_data:  2
cover_and_diff:  0
prop_and_ref:  4
acq_and_pres:  2
form_proc_alg:  2
decompose:  1
recombine:  3
generalize:  2
specialize:  0
ret_to_def:  0
visual:  1
verbal:  4
auditory:  1
kinesthetic:  0
written:  1
instrumentation:  4
mm_interface:  1
databases:  1
historical:  3
propadeutics:  1
branching:  2
dynamism:  0
constraints:  2
uncertainty:  0
high_low_tech:  1
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  2
gross:  2
repetitive:  4
categorize:  1
calculate:  0
code:  2
computerize:  2
interpolate:  0
itemize:  2
learn:  1
tabulate:  0
translate:  4
analyze:  2
deduce:  2
induce:  2
choose:  2
compare:  1
compute:  0
estimate:  3
integrate:  4
plan:  3
supervise:  1
monitor:  0
interpret:  0
```

```
facts:  1
principles:  2
procedures:  2
analogs:  2
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  2
electricity:  3
lighting:  0
magnetism:  0
noise:  4
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  3
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  1
sleep:  0
schedule:  2
boredom:  3
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  2
intro_accuracy:  0
prob_of_success:  0
articulation:  3
kr_hp:  1
computer:  1
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  0
test_equip:  0
advises:  4
answers:  0
communicates:  3
directs:  0
indicates:  0
informs:  0
instructs:  0
requests:  0
transmits:  2
supervises:  0
negotiates:  4
express_movement:  0
interp_movement:  0

name1:  equip_diag
name2:  form_fill_out
eq_count:  59
sim_count:  84

--------------------------------

statistical:  0
```

```
spatial:  1
temporal:  1
analogical:  2
case_based:  1
model_based:  1
mathematical:  2
deductive:  2
inductive:  2
means_ends:  2
sub_goals:  1
gen_and_test:  2
goal_vs_data:  0
cover_and_diff:  3
prop_and_ref:  2
acq_and_pres:  2
form_proc_alg:  0
decompose:  0
recombine:  2
generalize:  3
specialize:  0
ret_to_def:  1
visual:  1
verbal:  3
auditory:  1
kinesthetic:  0
written:  1
instrumentation:  4
mm_interface:  1
databases:  0
historical:  1
propadeutics:  0
branching:  1
dynamism:  0
constraints:  1
uncertainty:  1
high_low_tech:  0
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  2
gross:  2
repetitive:  4
categorize:  0
calculate:  2
code:  0
computerize:  0
interpolate:  2
itemize:  2
learn:  0
tabulate:  1
translate:  0
analyze:  0
deduce:  2
induce:  2
choose:  4
compare:  1
compute:  2
estimate:  2
integrate:  1
plan:  0
supervise:  0
monitor:  0
interpret:  2
facts:  0
```

```
principles:  1
procedures:  0
analogs:  0
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  2
electricity:  3
lighting:  0
magnetism:  0
noise:  4
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  3
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  1
sleep:  0
schedule:  2
boredom:  3
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  0
articulation:  0
kr_hp:  1
computer:  1
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  1
test_equip:  0
advises:  4
answers:  3
communicates:  3
directs:  0
indicates:  3
informs:  2
instructs:  0
requests:  2
transmits:  4
supervises:  0
negotiates:  4
express_movement:  0
interp_movement:  0

name1:  equip_diag
name2:  language_train
eq_count:  48
sim_count:  73

---------------------------------

statistical:  0
spatial:  1
```

```
temporal:  1
analogical:  3
case_based:  1
model_based:  1
mathematical:  0
deductive:  0
inductive:  2
means_ends:  1
sub_goals:  1
gen_and_test:  0
goal_vs_data:  2
cover_and_diff:  2
prop_and_ref:  2
acq_and_pres:  2
form_proc_alg:  4
decompose:  1
recombine:  3
generalize:  3
specialize:  1
ret_to_def:  1
visual:  1
verbal:  4
auditory:  1
kinesthetic:  0
written:  1
instrumentation:  0
mm_interface:  1
databases:  1
historical:  3
propadeutics:  0
branching:  2
dynamism:  4
constraints:  0
uncertainty:  2
high_low_tech:  0
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  2
gross:  2
repetitive:  4
categorize:  1
calculate:  0
code:  0
computerize:  0
interpolate:  0
itemize:  3
learn:  1
tabulate:  0
translate:  4
analyze:  1
deduce:  0
induce:  2
choose:  1
compare:  1
compute:  0
estimate:  0
integrate:  0
plan:  4
supervise:  4
monitor:  4
interpret:  1
facts:  2
principles:  3
```

INTENTIONALLY BLANK

```
procedures:  2
analogs:  3
cases_examples:  2
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  2
electricity:  3
lighting:  0
magnetism:  0
noise:  4
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  3
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  1
sleep:  0
schedule:  2
boredom:  3
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  4
prob_of_success:  2
articulation:  4
kr_hp:  1
computer:  1
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  4
test_equip:  0
advises:  2
answers:  4
communicates:  4
directs:  4
indicates:  4
informs:  4
instructs:  4
requests:  4
transmits:  4
supervises:  4
negotiates:  0
express_movement:  3
interp_movement:  3

name1:  equip_diag
name2:  leadership
eq_count:  52
sim_count:  81

---------------------------------

statistical:  0
spatial:  1
temporal:  1
```

```
analogical:  1
case_based:  1
model_based:  1
mathematical:  0
deductive:  2
inductive:  2
means_ends:  0
sub_goals:  1
gen_and_test:  2
goal_vs_data:  2
cover_and_diff:  0
prop_and_ref:  3
acq_and_pres:  1
form_proc_alg:  1
decompose:  0
recombine:  1
generalize:  1
specialize:  0
ret_to_def:  1
visual:  1
verbal:  4
auditory:  1
kinesthetic:  0
written:  0
instrumentation:  4
mm_interface:  1
databases:  1
historical:  0
propadeutics:  0
branching:  0
dynamism:  0
constraints:  3
uncertainty:  0
high_low_tech:  0
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  2
gross:  2
repetitive:  4
categorize:  1
calculate:  2
code:  0
computerize:  1
interpolate:  0
itemize:  0
learn:  1
tabulate:  0
translate:  0
analyze:  2
deduce:  2
induce:  1
choose:  3
compare:  1
compute:  1
estimate:  1
integrate:  2
plan:  3
supervise:  4
monitor:  0
interpret:  3
facts:  1
principles:  2
procedures:  0
```

```
analogs:  1
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  2
electricity:  3
lighting:  0
magnetism:  0
noise:  4
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  3
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  1
sleep:  0
schedule:  2
boredom:  3
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  0
intro_accuracy:  4
prob_of_success:  3
articulation:  4
kr_hp:  1
computer:  1
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  2
test_equip:  0
advises:  0
answers:  2
communicates:  4
directs:  2
indicates:  2
informs:  4
instructs:  4
requests:  3
transmits:  3
supervises:  3
negotiates:  3
express_movement:  3
interp_movement:  3

name1:  equip_diag
name2:  surgery
eq_count:  39
sim_count:  63

--------------------------------

statistical:  0
spatial:  3
temporal:  3
analogical:  1
```

```
case_based:  0
model_based:  2
mathematical:  0
deductive:  1
inductive:  2
means_ends:  4
sub_goals:  1
gen_and_test:  1
goal_vs_data:  2
cover_and_diff:  2
prop_and_ref:  0
acq_and_pres:  1
form_proc_alg:  0
decompose:  1
recombine:  1
generalize:  1
specialize:  3
ret_to_def:  0
visual:  3
verbal:  4
auditory:  1
kinesthetic:  4
written:  1
instrumentation:  0
mm_interface:  0
databases:  1
historical:  1
propadeutics:  1
branching:  3
dynamism:  2
constraints:  1
uncertainty:  1
high_low_tech:  1
quant_qual:  1
complex_cont:  4
compound:  2
reflex:  0
simple_disc:  4
fine:  2
gross:  2
repetitive:  0
categorize:  1
calculate:  0
code:  0
computerize:  0
interpolate:  0
itemize:  3
learn:  3
tabulate:  0
translate:  0
analyze:  2
deduce:  2
induce:  2
choose:  4
compare:  1
compute:  0
estimate:  3
integrate:  0
plan:  4
supervise:  4
monitor:  4
interpret:  1
facts:  2
principles:  3
procedures:  0
analogs:  0
```

```
cases_examples:  1
percep_speed:  2
search_rec_info:  0
id_obj_act_events:  4
scan_display:  0
acceleration:  0
confinement:  2
isolation:  0
contaminants:  1
electricity:  3
lighting:  2
magnetism:  0
noise:  4
fatigue:  3
mental_strain:  3
stress:  4
phys_strain:  0
preciseness:  4
cog_attent:  4
response_chaining:  2
attention_span:  3
sleep:  2
schedule:  2
boredom:  2
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  2
intro_accuracy:  0
prob_of_success:  4
articulation:  1
kr_hp:  3
computer:  3
vehicles:  0
weapon_systems:  0
instruments:  4
notation:  0
test_equip:  3
advises:  1
answers:  3
communicates:  3
directs:  4
indicates:  3
informs:  2
instructs:  0
requests:  2
transmits:  0
supervises:  4
negotiates:  0
express_movement:  2
interp_movement:  0

name1:  equip_diag
name2:  medical_diag
eq_count:  44
sim_count:  74

---------------------------------

statistical:  0
spatial:  2
temporal:  3
analogical:  0
case_based:  1
```

```
model_based:  1
mathematical:  0
deductive:  2
inductive:  2
means_ends:  1
sub_goals:  1
gen_and_test:  1
goal_vs_data:  1
cover_and_diff:  1
prop_and_ref:  4
acq_and_pres:  2
form_proc_alg:  2
decompose:  0
recombine:  1
generalize:  2
specialize:  2
ret_to_def:  1
visual:  3
verbal:  4
auditory:  1
kinesthetic:  1
written:  1
instrumentation:  0
mm_interface:  1
databases:  1
historical:  1
propadeutics:  1
branching:  3
dynamism:  0
constraints:  2
uncertainty:  2
high_low_tech:  1
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  1
gross:  1
repetitive:  4
categorize:  1
calculate:  0
code:  0
computerize:  0
interpolate:  0
itemize:  1
learn:  3
tabulate:  0
translate:  3
analyze:  2
deduce:  2
induce:  2
choose:  4
compare:  2
compute:  0
estimate:  2
integrate:  0
plan:  1
supervise:  0
monitor:  2
interpret:  1
facts:  2
principles:  3
procedures:  0
analogs:  0
cases_examples:  2
```

```
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  2
electricity:  3
lighting:  0
magnetism:  0
noise:  4
fatigue:  1
mental_strain:  2
stress:  3
phys_strain:  3
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  1
sleep:  1
schedule:  0
boredom:  2
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  2
intro_accuracy:  3
prob_of_success:  4
articulation:  3
kr_hp:  1
computer:  3
vehicles:  0
weapon_systems:  0
instruments:  2
notation:  0
test_equip:  2
advises:  0
answers:  4
communicates:  4
directs:  4
indicates:  2
informs:  4
instructs:  1
requests:  1
transmits:  2
supervises:  1
negotiates:  0
express_movement:  2
interp_movement:  3

name1:  equip_diag
name2:  accounting
eq_count:  61
sim_count:  88

---------------------------------

statistical:  0
spatial:  1
temporal:  2
analogical:  0
case_based:  0
model_based:  1
```

```
mathematical:  4
deductive:  2
inductive:  0
means_ends:  0
sub_goals:  0
gen_and_test:  1
goal_vs_data:  1
cover_and_diff:  0
prop_and_ref:  0
acq_and_pres:  2
form_proc_alg:  0
decompose:  1
recombine:  1
generalize:  0
specialize:  3
ret_to_def:  1
visual:  1
verbal:  3
auditory:  1
kinesthetic:  0
written:  1
instrumentation:  4
mm_interface:  3
databases:  3
historical:  1
propadeutics:  0
branching:  1
dynamism:  1
constraints:  2
uncertainty:  0
high_low_tech:  0
quant_qual:  2
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  2
gross:  2
repetitive:  4
categorize:  1
calculate:  4
code:  0
computerize:  4
interpolate:  0
itemize:  1
learn:  2
tabulate:  4
translate:  1
analyze:  2
deduce:  2
induce:  0
choose:  1
compare:  1
compute:  4
estimate:  0
integrate:  3
plan:  0
supervise:  0
monitor:  0
interpret:  1
facts:  1
principles:  1
procedures:  0
analogs:  0
cases_examples:  1
percep_speed:  0
```

```
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  2
electricity:  3
lighting:  0
magnetism:  0
noise:  4
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  3
preciseness:  4
cog_attent:  0
response_chaining:  0
attention_span:  1
sleep:  0
schedule:  2
boredom:  3
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  2
intro_accuracy:  0
prob_of_success:  0
articulation:  0
kr_hp:  1
computer:  1
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  1
test_equip:  0
advises:  4
answers:  2
communicates:  4
directs:  0
indicates:  0
informs:  2
instructs:  0
requests:  1
transmits:  3
supervises:  0
negotiates:  0
express_movement:  0
interp_movement:  0

name1:  equip_diag
name2:  protocol_des
eq_count:  50
sim_count:  72

---------------------------------

statistical:  2
spatial:  0
temporal:  3
analogical:  0
case_based:  2
model_based:  1
mathematical:  2
```

```
deductive:  2
inductive:  3
means_ends:  0
sub_goals:  1
gen_and_test:  3
goal_vs_data:  2
cover_and_diff:  0
prop_and_ref:  4
acq_and_pres:  2
form_proc_alg:  3
decompose:  1
recombine:  2
generalize:  3
specialize:  0
ret_to_def:  0
visual:  1
verbal:  4
auditory:  1
kinesthetic:  0
written:  0
instrumentation:  2
mm_interface:  1
databases:  1
historical:  1
propadeutics:  2
branching:  0
dynamism:  0
constraints:  3
uncertainty:  1
high_low_tech:  1
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  2
gross:  2
repetitive:  4
categorize:  1
calculate:  3
code:  0
computerize:  0
interpolate:  1
itemize:  1
learn:  1
tabulate:  0
translate:  4
analyze:  2
deduce:  2
induce:  2
choose:  4
compare:  1
compute:  3
estimate:  2
integrate:  3
plan:  4
supervise:  1
monitor:  0
interpret:  1
facts:  1
principles:  2
procedures:  0
analogs:  0
cases_examples:  3
percep_speed:  0
search_rec_info:  0
```

```
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  2
electricity:  3
lighting:  0
magnetism:  0
noise:  4
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  3
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  1
sleep:  0
schedule:  2
boredom:  3
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  2
intro_accuracy:  0
prob_of_success:  4
articulation:  3
kr_hp:  1
computer:  1
vehicles:  0
weapon_systems:  0
instruments:  4
notation:  4
test_equip:  1
advises:  4
answers:  3
communicates:  4
directs:  3
indicates:  0
informs:  3
instructs:  0
requests:  2
transmits:  3
supervises:  3
negotiates:  0
express_movement:  0
interp_movement:  0

name1:  pilot_training
name2:  air_traffic
eq_count:  45
sim_count:  82

---------------------------------

statistical:  0
spatial:  0
temporal:  0
analogical:  3
case_based:  2
model_based:  2
mathematical:  0
deductive:  4
```

```
inductive:  1
means_ends:  1
sub_goals:  0
gen_and_test:  0
goal_vs_data:  1
cover_and_diff:  1
prop_and_ref:  0
acq_and_pres:  2
form_proc_alg:  4
decompose:  1
recombine:  0
generalize:  2
specialize:  3
ret_to_def:  1
visual:  0
verbal:  1
auditory:  2
kinesthetic:  4
written:  1
instrumentation:  0
mm_interface:  2
databases:  0
historical:  0
propadeutics:  1
branching:  0
dynamism:  0
constraints:  0
uncertainty:  3
high_low_tech:  0
quant_qual:  0
complex_cont:  2
compound:  0
reflex:  1
simple_disc:  2
fine:  1
gross:  3
repetitive:  1
categorize:  1
calculate:  0
code:  0
computerize:  0
interpolate:  3
itemize:  1
learn:  3
tabulate:  0
translate:  0
analyze:  3
deduce:  3
induce:  1
choose:  1
compare:  1
compute:  0
estimate:  4
integrate:  2
plan:  1
supervise:  1
monitor:  0
interpret:  2
facts:  3
principles:  2
procedures:  0
analogs:  3
cases_examples:  2
percep_speed:  0
search_rec_info:  1
id_obj_act_events:  1
```

```
scan_display:  0
acceleration:  3
confinement:  1
isolation:  0
contaminants:  0
electricity:  0
lighting:  2
magnetism:  0
noise:  1
fatigue:  1
mental_strain:  1
stress:  1
phys_strain:  1
preciseness:  3
cog_attent:  0
response_chaining:  2
attention_span:  1
sleep:  4
schedule:  1
boredom:  0
general_health:  0
age:  3
gender:  2
height:  1
weight:  3
edu_train_expert:  0
intro_accuracy:  3
prob_of_success:  0
articulation:  1
kr_hp:  1
computer:  0
vehicles:  4
weapon_systems:  0
instruments:  0
notation:  2
test_equip:  0
advises:  1
answers:  4
communicates:  1
directs:  0
indicates:  4
informs:  0
instructs:  4
requests:  1
transmits:  1
supervises:  1
negotiates:  0
express_movement:  0
interp_movement:  2

name1:  pilot_training
name2:  console_ops
eq_count:  45
sim_count:  78

--------------------------------

statistical:  0
spatial:  4
temporal:  0
analogical:  3
case_based:  0
model_based:  1
mathematical:  3
deductive:  0
inductive:  0
```

```
means_ends:  3
sub_goals:  3
gen_and_test:  0
goal_vs_data:  1
cover_and_diff:  3
prop_and_ref:  0
acq_and_pres:  2
form_proc_alg:  0
decompose:  1
recombine:  0
generalize:  2
specialize:  1
ret_to_def:  1
visual:  0
verbal:  1
auditory:  2
kinesthetic:  4
written:  1
instrumentation:  0
mm_interface:  0
databases:  0
historical:  2
propadeutics:  3
branching:  4
dynamism:  0
constraints:  0
uncertainty:  1
high_low_tech:  1
quant_qual:  1
complex_cont:  2
compound:  0
reflex:  3
simple_disc:  0
fine:  1
gross:  3
repetitive:  3
categorize:  1
calculate:  3
code:  0
computerize:  0
interpolate:  4
itemize:  2
learn:  4
tabulate:  0
translate:  2
analyze:  1
deduce:  1
induce:  1
choose:  1
compare:  1
compute:  3
estimate:  3
integrate:  1
plan:  1
supervise:  2
monitor:  0
interpret:  0
facts:  3
principles:  0
procedures:  0
analogs:  3
cases_examples:  1
percep_speed:  0
search_rec_info:  1
id_obj_act_events:  1
scan_display:  0
```

```
acceleration:  3
confinement:  3
isolation:  0
contaminants:  0
electricity:  0
lighting:  1
magnetism:  0
noise:  0
fatigue:  2
mental_strain:  1
stress:  0
phys_strain:  0
preciseness:  2
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  1
boredom:  2
general_health:  0
age:  2
gender:  2
height:  1
weight:  1
edu_train_expert:  0
intro_accuracy:  3
prob_of_success:  0
articulation:  2
kr_hp:  1
computer:  4
vehicles:  4
weapon_systems:  0
instruments:  1
notation:  0
test_equip:  1
advises:  2
answers:  1
communicates:  1
directs:  3
indicates:  3
informs:  0
instructs:  4
requests:  0
transmits:  1
supervises:  3
negotiates:  0
express_movement:  3
interp_movement:  2

name1:  pilot_training
name2:  weather
eq_count:  32
sim_count:  54

---------------------------------

statistical:  1
spatial:  0
temporal:  0
analogical:  3
case_based:  3
model_based:  1
mathematical:  2
deductive:  4
inductive:  2
means_ends:  3
```

```
sub_goals:  1
gen_and_test:  0
goal_vs_data:  1
cover_and_diff:  0
prop_and_ref:  0
acq_and_pres:  0
form_proc_alg:  1
decompose:  3
recombine:  3
generalize:  1
specialize:  3
ret_to_def:  1
visual:  0
verbal:  2
auditory:  2
kinesthetic:  4
written:  1
instrumentation:  3
mm_interface:  4
databases:  0
historical:  2
propadeutics:  1
branching:  0
dynamism:  0
constraints:  3
uncertainty:  0
high_low_tech:  1
quant_qual:  1
complex_cont:  2
compound:  0
reflex:  0
simple_disc:  4
fine:  3
gross:  3
repetitive:  1
categorize:  0
calculate:  2
code:  0
computerize:  0
interpolate:  4
itemize:  2
learn:  4
tabulate:  0
translate:  2
analyze:  1
deduce:  3
induce:  3
choose:  1
compare:  1
compute:  1
estimate:  4
integrate:  2
plan:  3
supervise:  3
monitor:  1
interpret:  0
facts:  3
principles:  3
procedures:  0
analogs:  3
cases_examples:  2
percep_speed:  4
search_rec_info:  0
id_obj_act_events:  0
scan_display:  4
acceleration:  3
```

```
confinement:  4
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  4
fatigue:  3
mental_strain:  3
stress:  3
phys_strain:  1
preciseness:  3
cog_attent:  4
response_chaining:  1
attention_span:  3
sleep:  0
schedule:  3
boredom:  0
general_health:  4
age:  3
gender:  2
height:  1
weight:  3
edu_train_expert:  1
intro_accuracy:  3
prob_of_success:  2
articulation:  4
kr_hp:  2
computer:  1
vehicles:  4
weapon_systems:  0
instruments:  3
notation:  2
test_equip:  0
advises:  4
answers:  4
communicates:  3
directs:  4
indicates:  4
informs:  4
instructs:  4
requests:  3
transmits:  2
supervises:  3
negotiates:  0
express_movement:  0
interp_movement:  2

name1:  pilot_training
name2:  program_mgmt
eq_count:  38
sim_count:  57

---------------------------------

statistical:  0
spatial:  4
temporal:  0
analogical:  3
case_based:  0
model_based:  3
mathematical:  0
deductive:  4
inductive:  1
means_ends:  3
sub_goals:  0
```

```
gen_and_test:  0
goal_vs_data:  2
cover_and_diff:  0
prop_and_ref:  3
acq_and_pres:  1
form_proc_alg:  1
decompose:  1
recombine:  0
generalize:  2
specialize:  3
ret_to_def:  2
visual:  4
verbal:  1
auditory:  2
kinesthetic:  4
written:  2
instrumentation:  4
mm_interface:  3
databases:  2
historical:  4
propadeutics:  0
branching:  2
dynamism:  3
constraints:  2
uncertainty:  1
high_low_tech:  0
quant_qual:  0
complex_cont:  2
compound:  0
reflex:  0
simple_disc:  4
fine:  3
gross:  3
repetitive:  1
categorize:  1
calculate:  0
code:  0
computerize:  0
interpolate:  0
itemize:  0
learn:  3
tabulate:  0
translate:  0
analyze:  1
deduce:  3
induce:  1
choose:  0
compare:  2
compute:  0
estimate:  2
integrate:  2
plan:  1
supervise:  1
monitor:  0
interpret:  1
facts:  1
principles:  2
procedures:  0
analogs:  3
cases_examples:  0
percep_speed:  4
search_rec_info:  3
id_obj_act_events:  3
scan_display:  4
acceleration:  3
confinement:  4
```

```
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  4
fatigue:  3
mental_strain:  3
stress:  3
phys_strain:  1
preciseness:  3
cog_attent:  4
response_chaining:  1
attention_span:  3
sleep:  0
schedule:  3
boredom:  0
general_health:  4
age:  3
gender:  2
height:  1
weight:  3
edu_train_expert:  2
intro_accuracy:  3
prob_of_success:  2
articulation:  4
kr_hp:  2
computer:  2
vehicles:  4
weapon_systems:  0
instruments:  4
notation:  2
test_equip:  0
advises:  4
answers:  1
communicates:  1
directs:  2
indicates:  4
informs:  2
instructs:  4
requests:  0
transmits:  0
supervises:  0
negotiates:  4
express_movement:  0
interp_movement:  2

name1:  pilot_training
name2:  drair_gen
eq_count:  28
sim_count:  51

--------------------------------

statistical:  1
spatial:  4
temporal:  2
analogical:  2
case_based:  2
model_based:  3
mathematical:  1
deductive:  3
inductive:  3
means_ends:  3
sub_goals:  2
gen_and_test:  0
```

```
goal_vs_data:  0
cover_and_diff:  0
prop_and_ref:  0
acq_and_pres:  0
form_proc_alg:  1
decompose:  2
recombine:  3
generalize:  1
specialize:  3
ret_to_def:  1
visual:  4
verbal:  1
auditory:  2
kinesthetic:  4
written:  1
instrumentation:  4
mm_interface:  4
databases:  4
historical:  4
propadeutics:  0
branching:  4
dynamism:  4
constraints:  4
uncertainty:  2
high_low_tech:  1
quant_qual:  0
complex_cont:  2
compound:  0
reflex:  0
simple_disc:  4
fine:  3
gross:  3
repetitive:  1
categorize:  2
calculate:  0
code:  0
computerize:  0
interpolate:  1
itemize:  2
learn:  2
tabulate:  1
translate:  2
analyze:  1
deduce:  2
induce:  3
choose:  3
compare:  1
compute:  0
estimate:  3
integrate:  2
plan:  3
supervise:  3
monitor:  4
interpret:  1
facts:  3
principles:  1
procedures:  1
analogs:  2
cases_examples:  2
percep_speed:  4
search_rec_info:  3
id_obj_act_events:  3
scan_display:  4
acceleration:  3
confinement:  4
isolation:  0
```

```
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  4
fatigue:  3
mental_strain:  3
stress:  3
phys_strain:  1
preciseness:  3
cog_attent:  4
response_chaining:  1
attention_span:  3
sleep:  0
schedule:  3
boredom:  0
general_health:  4
age:  3
gender:  2
height:  1
weight:  3
edu_train_expert:  1
intro_accuracy:  3
prob_of_success:  3
articulation:  0
kr_hp:  2
computer:  4
vehicles:  4
weapon_systems:  0
instruments:  4
notation:  1
test_equip:  0
advises:  4
answers:  0
communicates:  1
directs:  4
indicates:  4
informs:  0
instructs:  4
requests:  1
transmits:  0
supervises:  3
negotiates:  0
express_movement:  0
interp_movement:  2

name1:  pilot_training
name2:  cargo_loading
eq_count:  35
sim_count:  56

--------------------------------

statistical:  0
spatial:  0
temporal:  0
analogical:  3
case_based:  1
model_based:  2
mathematical:  4
deductive:  3
inductive:  1
means_ends:  0
sub_goals:  0
gen_and_test:  0
goal_vs_data:  0
```

```
cover_and_diff:  0
prop_and_ref:  0
acq_and_pres:  1
form_proc_alg:  0
decompose:  1
recombine:  1
generalize:  2
specialize:  1
ret_to_def:  1
visual:  1
verbal:  3
auditory:  2
kinesthetic:  4
written:  2
instrumentation:  4
mm_interface:  4
databases:  0
historical:  0
propadeutics:  2
branching:  3
dynamism:  3
constraints:  3
uncertainty:  4
high_low_tech:  0
quant_qual:  1
complex_cont:  2
compound:  0
reflex:  0
simple_disc:  4
fine:  3
gross:  3
repetitive:  1
categorize:  0
calculate:  4
code:  0
computerize:  0
interpolate:  2
itemize:  2
learn:  2
tabulate:  0
translate:  0
analyze:  2
deduce:  2
induce:  1
choose:  1
compare:  3
compute:  4
estimate:  4
integrate:  2
plan:  1
supervise:  0
monitor:  0
interpret:  3
facts:  3
principles:  3
procedures:  2
analogs:  3
cases_examples:  1
percep_speed:  4
search_rec_info:  3
id_obj_act_events:  3
scan_display:  4
acceleration:  2
confinement:  2
isolation:  0
contaminants:  0
```

```
electricity:  0
lighting:  0
magnetism:  0
noise:  1
fatigue:  3
mental_strain:  3
stress:  3
phys_strain:  0
preciseness:  3
cog_attent:  4
response_chaining:  1
attention_span:  3
sleep:  0
schedule:  3
boredom:  2
general_health:  2
age:  3
gender:  2
height:  1
weight:  3
edu_train_expert:  1
intro_accuracy:  3
prob_of_success:  3
articulation:  3
kr_hp:  2
computer:  0
vehicles:  2
weapon_systems:  0
instruments:  4
notation:  0
test_equip:  0
advises:  4
answers:  2
communicates:  0
directs:  1
indicates:  4
informs:  4
instructs:  4
requests:  1
transmits:  2
supervises:  1
negotiates:  0
express_movement:  2
interp_movement:  2

name1:  pilot_training
name2:  sw_design
eq_count:  33
sim_count:  54

--------------------------------

statistical:  0
spatial:  4
temporal:  0
analogical:  3
case_based:  0
model_based:  0
mathematical:  1
deductive:  4
inductive:  1
means_ends:  1
sub_goals:  0
gen_and_test:  4
goal_vs_data:  2
cover_and_diff:  0
```

```
prop_and_ref:  4
acq_and_pres:  0
form_proc_alg:  2
decompose:  1
recombine:  4
generalize:  0
specialize:  3
ret_to_def:  0
visual:  4
verbal:  1
auditory:  2
kinesthetic:  4
written:  2
instrumentation:  4
mm_interface:  4
databases:  0
historical:  0
propadeutics:  1
branching:  1
dynamism:  4
constraints:  3
uncertainty:  3
high_low_tech:  1
quant_qual:  0
complex_cont:  2
compound:  0
reflex:  0
simple_disc:  4
fine:  3
gross:  3
repetitive:  1
categorize:  1
calculate:  0
code:  2
computerize:  2
interpolate:  0
itemize:  1
learn:  2
tabulate:  0
translate:  4
analyze:  1
deduce:  3
induce:  1
choose:  1
compare:  1
compute:  0
estimate:  3
integrate:  2
plan:  0
supervise:  2
monitor:  4
interpret:  0
facts:  2
principles:  2
procedures:  2
analogs:  1
cases_examples:  1
percep_speed:  4
search_rec_info:  3
id_obj_act_events:  3
scan_display:  4
acceleration:  3
confinement:  4
isolation:  0
contaminants:  0
electricity:  0
```

```
lighting:  0
magnetism:  0
noise:  4
fatigue:  3
mental_strain:  3
stress:  3
phys_strain:  1
preciseness:  3
cog_attent:  4
response_chaining:  1
attention_span:  3
sleep:  0
schedule:  3
boredom:  0
general_health:  4
age:  3
gender:  2
height:  1
weight:  3
edu_train_expert:  0
intro_accuracy:  3
prob_of_success:  3
articulation:  1
kr_hp:  2
computer:  4
vehicles:  4
weapon_systems:  0
instruments:  4
notation:  2
test_equip:  0
advises:  4
answers:  4
communicates:  0
directs:  4
indicates:  4
informs:  4
instructs:  4
requests:  3
transmits:  0
supervises:  3
negotiates:  4
express_movement:  0
interp_movement:  2

name1:  pilot_training
name2:  form_fill_out
eq_count:  28
sim_count:  54

--------------------------------

statistical:  0
spatial:  4
temporal:  2
analogical:  1
case_based:  0
model_based:  3
mathematical:  2
deductive:  4
inductive:  1
means_ends:  1
sub_goals:  0
gen_and_test:  3
goal_vs_data:  0
cover_and_diff:  3
prop_and_ref:  2
```

```
prob_of_success:  2
articulation:  2
kr_hp:  1
computer:  3
vehicles:  0
weapon_systems:  0
instruments:  2
notation:  2
test_equip:  1
advises:  2
answers:  3
communicates:  4
directs:  1
indicates:  1
informs:  4
instructs:  0
requests:  3
transmits:  3
supervises:  0
negotiates:  0
express_movement:  3
interp_movement:  0

name1:  console_ops
name2:  program_mgmt
eq_count:  41
sim_count:  66

--------------------------------

statistical:  0
spatial:  0
temporal:  0
analogical:  0
case_based:  0
model_based:  2
mathematical:  3
deductive:  4
inductive:  1
means_ends:  0
sub_goals:  3
gen_and_test:  0
goal_vs_data:  1
cover_and_diff:  3
prop_and_ref:  3
acq_and_pres:  1
form_proc_alg:  1
decompose:  0
recombine:  0
generalize:  0
specialize:  2
ret_to_def:  3
visual:  4
verbal:  0
auditory:  0
kinesthetic:  0
written:  1
instrumentation:  4
mm_interface:  3
databases:  2
historical:  2
propadeutics:  3
branching:  2
dynamism:  3
constraints:  2
uncertainty:  0
```

```
high_low_tech:  1
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  3
simple_disc:  4
fine:  4
gross:  0
repetitive:  4
categorize:  2
calculate:  3
code:  0
computerize:  0
interpolate:  4
itemize:  2
learn:  1
tabulate:  0
translate:  2
analyze:  2
deduce:  4
induce:  0
choose:  1
compare:  1
compute:  3
estimate:  1
integrate:  3
plan:  0
supervise:  3
monitor:  0
interpret:  1
facts:  2
principles:  2
procedures:  0
analogs:  0
cases_examples:  1
percep_speed:  4
search_rec_info:  4
id_obj_act_events:  4
scan_display:  4
acceleration:  0
confinement:  1
isolation:  0
contaminants:  0
electricity:  0
lighting:  1
magnetism:  0
noise:  4
fatigue:  1
mental_strain:  2
stress:  3
phys_strain:  1
preciseness:  1
cog_attent:  4
response_chaining:  1
attention_span:  3
sleep:  0
schedule:  2
boredom:  2
general_health:  4
age:  1
gender:  0
height:  0
weight:  2
edu_train_expert:  2
intro_accuracy:  0
prob_of_success:  2
```

```
articulation:  2
kr_hp:  1
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  3
notation:  2
test_equip:  1
advises:  2
answers:  0
communicates:  0
directs:  1
indicates:  1
informs:  2
instructs:  0
requests:  0
transmits:  1
supervises:  3
negotiates:  4
express_movement:  3
interp_movement:  0

name1:  console_ops
name2:  drair_gen
eq_count:  37
sim_count:  69

---------------------------------

statistical:  1
spatial:  0
temporal:  2
analogical:  1
case_based:  2
model_based:  2
mathematical:  2
deductive:  3
inductive:  3
means_ends:  0
sub_goals:  1
gen_and_test:  0
goal_vs_data:  1
cover_and_diff:  3
prop_and_ref:  0
acq_and_pres:  2
form_proc_alg:  1
decompose:  1
recombine:  3
generalize:  3
specialize:  2
ret_to_def:  0
visual:  4
verbal:  0
auditory:  0
kinesthetic:  0
written:  2
instrumentation:  4
mm_interface:  4
databases:  4
historical:  2
propadeutics:  3
branching:  0
dynamism:  4
constraints:  4
uncertainty:  1
high_low_tech:  2
```

```
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  3
simple_disc:  4
fine:  4
gross:  0
repetitive:  4
categorize:  3
calculate:  3
code:  0
computerize:  0
interpolate:  3
itemize:  4
learn:  2
tabulate:  1
translate:  0
analyze:  0
deduce:  3
induce:  4
choose:  2
compare:  0
compute:  3
estimate:  0
integrate:  1
plan:  4
supervise:  1
monitor:  4
interpret:  1
facts:  0
principles:  1
procedures:  1
analogs:  1
cases_examples:  1
percep_speed:  4
search_rec_info:  4
id_obj_act_events:  4
scan_display:  4
acceleration:  0
confinement:  1
isolation:  0
contaminants:  0
electricity:  0
lighting:  1
magnetism:  0
noise:  4
fatigue:  1
mental_strain:  2
stress:  3
phys_strain:  1
preciseness:  1
cog_attent:  4
response_chaining:  1
attention_span:  3
sleep:  0
schedule:  2
boredom:  2
general_health:  4
age:  1
gender:  0
height:  0
weight:  2
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  3
articulation:  2
```

```
kr_hp:  1
computer:  0
vehicles:  0
weapon_systems:  0
instruments:  3
notation:  1
test_equip:  1
advises:  2
answers:  1
communicates:  0
directs:  1
indicates:  1
informs:  0
instructs:  0
requests:  1
transmits:  1
supervises:  0
negotiates:  0
express_movement:  3
interp_movement:  0

name1:  console_ops
name2:  cargo_loading
eq_count:  41
sim_count:  74

---------------------------------

statistical:  0
spatial:  4
temporal:  0
analogical:  0
case_based:  1
model_based:  1
mathematical:  1
deductive:  3
inductive:  1
means_ends:  3
sub_goals:  3
gen_and_test:  0
goal_vs_data:  1
cover_and_diff:  3
prop_and_ref:  0
acq_and_pres:  1
form_proc_alg:  0
decompose:  0
recombine:  1
generalize:  0
specialize:  0
ret_to_def:  2
visual:  1
verbal:  4
auditory:  0
kinesthetic:  0
written:  1
instrumentation:  4
mm_interface:  4
databases:  0
historical:  2
propadeutics:  1
branching:  1
dynamism:  3
constraints:  3
uncertainty:  3
high_low_tech:  1
quant_qual:  0
```

```
complex_cont:  0
compound:  0
reflex:  3
simple_disc:  4
fine:  4
gross:  0
repetitive:  4
categorize:  1
calculate:  1
code:  0
computerize:  0
interpolate:  2
itemize:  4
learn:  2
tabulate:  0
translate:  2
analyze:  3
deduce:  3
induce:  0
choose:  0
compare:  2
compute:  1
estimate:  1
integrate:  3
plan:  0
supervise:  2
monitor:  0
interpret:  3
facts:  0
principles:  3
procedures:  2
analogs:  0
cases_examples:  0
percep_speed:  4
search_rec_info:  4
id_obj_act_events:  4
scan_display:  4
acceleration:  1
confinement:  1
isolation:  0
contaminants:  0
electricity:  0
lighting:  1
magnetism:  0
noise:  1
fatigue:  1
mental_strain:  2
stress:  3
phys_strain:  0
preciseness:  1
cog_attent:  4
response_chaining:  1
attention_span:  3
sleep:  0
schedule:  2
boredom:  0
general_health:  2
age:  1
gender:  0
height:  0
weight:  2
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  3
articulation:  1
kr_hp:  1
```

```
computer:  4
vehicles:  2
weapon_systems:  0
instruments:  3
notation:  0
test_equip:  1
advises:  2
answers:  1
communicates:  1
directs:  2
indicates:  1
informs:  4
instructs:  0
requests:  1
transmits:  3
supervises:  4
negotiates:  0
express_movement:  1
interp_movement:  0

name1:  console_ops
name2:  sw_design
eq_count:  37
sim_count:  61

---------------------------------

statistical:  0
spatial:  0
temporal:  0
analogical:  0
case_based:  0
model_based:  1
mathematical:  2
deductive:  4
inductive:  1
means_ends:  4
sub_goals:  3
gen_and_test:  4
goal_vs_data:  1
cover_and_diff:  3
prop_and_ref:  4
acq_and_pres:  2
form_proc_alg:  2
decompose:  2
recombine:  4
generalize:  2
specialize:  2
ret_to_def:  1
visual:  4
verbal:  0
auditory:  0
kinesthetic:  0
written:  1
instrumentation:  4
mm_interface:  4
databases:  0
historical:  2
propadeutics:  2
branching:  3
dynamism:  4
constraints:  3
uncertainty:  2
high_low_tech:  0
quant_qual:  1
complex_cont:  0
```

compound: 0
reflex: 3
simple_disc: 4
fine: 4
gross: 0
repetitive: 4
categorize: 2
calculate: 3
code: 2
computerize: 2
interpolate: 4
itemize: 1
learn: 2
tabulate: 0
translate: 2
analyze: 0
deduce: 4
induce: 2
choose: 0
compare: 0
compute: 3
estimate: 0
integrate: 1
plan: 1
supervise: 0
monitor: 4
interpret: 0
facts: 1
principles: 2
procedures: 2
analogs: 2
cases_examples: 0
percep_speed: 4
search_rec_info: 4
id_obj_act_events: 4
scan_display: 4
acceleration: 0
confinement: 1
isolation: 0
contaminants: 0
electricity: 0
lighting: 1
magnetism: 0
noise: 4
fatigue: 1
mental_strain: 2
stress: 3
phys_strain: 1
preciseness: 1
cog_attent: 4
response_chaining: 1
attention_span: 3
sleep: 0
schedule: 2
boredom: 2
general_health: 4
age: 1
gender: 0
height: 0
weight: 2
edu_train_expert: 0
intro_accuracy: 0
prob_of_success: 3
articulation: 1
kr_hp: 1
computer: 0

```
vehicles:  0
weapon_systems:  0
instruments:  3
notation:  2
test_equip:  1
advises:  2
answers:  3
communicates:  1
directs:  1
indicates:  1
informs:  4
instructs:  0
requests:  3
transmits:  1
supervises:  0
negotiates:  4
express_movement:  3
interp_movement:  0

name1:  console_ops
name2:  form_fill_out
eq_count:  34
sim_count:  67

---------------------------------

statistical:  0
spatial:  0
temporal:  2
analogical:  2
case_based:  0
model_based:  2
mathematical:  1
deductive:  4
inductive:  1
means_ends:  2
sub_goals:  3
gen_and_test:  3
goal_vs_data:  1
cover_and_diff:  0
prop_and_ref:  2
acq_and_pres:  2
form_proc_alg:  0
decompose:  1
recombine:  3
generalize:  3
specialize:  2
ret_to_def:  2
visual:  4
verbal:  1
auditory:  0
kinesthetic:  0
written:  1
instrumentation:  4
mm_interface:  4
databases:  1
historical:  0
propadeutics:  1
branching:  0
dynamism:  4
constraints:  2
uncertainty:  3
high_low_tech:  1
quant_qual:  1
complex_cont:  0
compound:  0
```

```
reflex:  3
simple_disc:  4
fine:  4
gross:  0
repetitive:  4
categorize:  1
calculate:  1
code:  0
computerize:  0
interpolate:  2
itemize:  1
learn:  3
tabulate:  1
translate:  2
analyze:  2
deduce:  4
induce:  2
choose:  2
compare:  0
compute:  1
estimate:  1
integrate:  2
plan:  4
supervise:  1
monitor:  4
interpret:  2
facts:  2
principles:  1
procedures:  0
analogs:  0
cases_examples:  0
percep_speed:  4
search_rec_info:  4
id_obj_act_events:  4
scan_display:  4
acceleration:  0
confinement:  1
isolation:  0
contaminants:  0
electricity:  0
lighting:  1
magnetism:  0
noise:  4
fatigue:  1
mental_strain:  2
stress:  3
phys_strain:  1
preciseness:  1
cog_attent:  4
response_chaining:  1
attention_span:  3
sleep:  0
schedule:  2
boredom:  2
general_health:  4
age:  1
gender:  0
height:  0
weight:  2
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  3
articulation:  2
kr_hp:  1
computer:  0
vehicles:  0
```

```
weapon_systems:  0
instruments:  3
notation:  1
test_equip:  1
advises:  2
answers:  0
communicates:  1
directs:  1
indicates:  2
informs:  2
instructs:  0
requests:  1
transmits:  1
supervises:  0
negotiates:  4
express_movement:  3
interp_movement:  0

name1:  console_ops
name2:  language_train
eq_count:  37
sim_count:  66

---------------------------------

statistical:  0
spatial:  0
temporal:  4
analogical:  3
case_based:  0
model_based:  2
mathematical:  3
deductive:  2
inductive:  1
means_ends:  1
sub_goals:  3
gen_and_test:  1
goal_vs_data:  1
cover_and_diff:  1
prop_and_ref:  2
acq_and_pres:  2
form_proc_alg:  4
decompose:  2
recombine:  4
generalize:  3
specialize:  1
ret_to_def:  0
visual:  4
verbal:  0
auditory:  0
kinesthetic:  0
written:  1
instrumentation:  0
mm_interface:  4
databases:  0
historical:  2
propadeutics:  1
branching:  3
dynamism:  0
constraints:  1
uncertainty:  0
high_low_tech:  1
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  3
```

```
simple_disc:  4
fine:  4
gross:  0
repetitive:  4
categorize:  2
calculate:  3
code:  0
computerize:  0
interpolate:  4
itemize:  0
learn:  2
tabulate:  0
translate:  2
analyze:  1
deduce:  2
induce:  2
choose:  1
compare:  0
compute:  3
estimate:  3
integrate:  3
plan:  0
supervise:  3
monitor:  0
interpret:  1
facts:  0
principles:  3
procedures:  2
analogs:  3
cases_examples:  1
percep_speed:  4
search_rec_info:  4
id_obj_act_events:  4
scan_display:  4
acceleration:  0
confinement:  1
isolation:  0
contaminants:  0
electricity:  0
lighting:  1
magnetism:  0
noise:  4
fatigue:  1
mental_strain:  2
stress:  3
phys_strain:  1
preciseness:  1
cog_attent:  4
response_chaining:  1
attention_span:  3
sleep:  0
schedule:  2
boredom:  2
general_health:  4
age:  1
gender:  0
height:  0
weight:  2
edu_train_expert:  1
intro_accuracy:  4
prob_of_success:  1
articulation:  2
kr_hp:  1
computer:  2
vehicles:  0
weapon_systems:  0
```

```
instruments:  3
notation:  2
test_equip:  1
advises:  0
answers:  1
communicates:  0
directs:  3
indicates:  3
informs:  0
instructs:  4
requests:  1
transmits:  1
supervises:  4
negotiates:  0
express_movement:  0
interp_movement:  3

name1:  console_ops
name2:  leadership
eq_count:  36
sim_count:  69

---------------------------------

statistical:  0
spatial:  0
temporal:  2
analogical:  1
case_based:  0
model_based:  2
mathematical:  3
deductive:  4
inductive:  1
means_ends:  0
sub_goals:  1
gen_and_test:  3
goal_vs_data:  1
cover_and_diff:  3
prop_and_ref:  3
acq_and_pres:  1
form_proc_alg:  1
decompose:  1
recombine:  0
generalize:  1
specialize:  2
ret_to_def:  0
visual:  4
verbal:  0
auditory:  0
kinesthetic:  0
written:  0
instrumentation:  4
mm_interface:  4
databases:  2
historical:  1
propadeutics:  1
branching:  1
dynamism:  4
constraints:  4
uncertainty:  2
high_low_tech:  1
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  3
simple_disc:  4
```

```
fine:  4
gross:  0
repetitive:  4
categorize:  2
calculate:  1
code:  0
computerize:  1
interpolate:  4
itemize:  3
learn:  4
tabulate:  0
translate:  2
analyze:  0
deduce:  4
induce:  1
choose:  1
compare:  0
compute:  2
estimate:  2
integrate:  1
plan:  1
supervise:  3
monitor:  4
interpret:  3
facts:  1
principles:  2
procedures:  0
analogs:  1
cases_examples:  0
percep_speed:  4
search_rec_info:  4
id_obj_act_events:  4
scan_display:  4
acceleration:  0
confinement:  1
isolation:  0
contaminants:  0
electricity:  0
lighting:  1
magnetism:  0
noise:  4
fatigue:  1
mental_strain:  2
stress:  3
phys_strain:  1
preciseness:  1
cog_attent:  4
response_chaining:  1
attention_span:  3
sleep:  0
schedule:  2
boredom:  2
general_health:  4
age:  1
gender:  0
height:  0
weight:  2
edu_train_expert:  2
intro_accuracy:  4
prob_of_success:  0
articulation:  2
kr_hp:  1
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  3
```

```
notation:  0
test_equip:  1
advises:  2
answers:  1
communicates:  0
directs:  1
indicates:  1
informs:  0
instructs:  4
requests:  0
transmits:  0
supervises:  3
negotiates:  3
express_movement:  0
interp_movement:  3

name1:  console_ops
name2:  surgery
eq_count:  46
sim_count:  78

---------------------------------

statistical:  0
spatial:  4
temporal:  0
analogical:  1
case_based:  1
model_based:  1
mathematical:  3
deductive:  1
inductive:  1
means_ends:  4
sub_goals:  3
gen_and_test:  0
goal_vs_data:  1
cover_and_diff:  1
prop_and_ref:  0
acq_and_pres:  1
form_proc_alg:  0
decompose:  2
recombine:  0
generalize:  1
specialize:  1
ret_to_def:  1
visual:  0
verbal:  0
auditory:  2
kinesthetic:  4
written:  1
instrumentation:  0
mm_interface:  3
databases:  0
historical:  2
propadeutics:  2
branching:  4
dynamism:  2
constraints:  2
uncertainty:  1
high_low_tech:  0
quant_qual:  1
complex_cont:  4
compound:  2
reflex:  3
simple_disc:  0
fine:  0
```

gross: 4
repetitive: 0
categorize: 0
calculate: 3
code: 0
computerize: 0
interpolate: 4
itemize: 0
learn: 0
tabulate: 0
translate: 2
analyze: 0
deduce: 0
induce: 2
choose: 2
compare: 0
compute: 3
estimate: 0
integrate: 3
plan: 0
supervise: 3
monitor: 0
interpret: 1
facts: 0
principles: 3
procedures: 0
analogs: 0
cases_examples: 0
percep_speed: 2
search_rec_info: 4
id_obj_act_events: 0
scan_display: 4
acceleration: 0
confinement: 1
isolation: 0
contaminants: 1
electricity: 0
lighting: 1
magnetism: 0
noise: 4
fatigue: 2
mental_strain: 1
stress: 1
phys_strain: 2
preciseness: 3
cog_attent: 0
response_chaining: 1
attention_span: 1
sleep: 2
schedule: 2
boredom: 1
general_health: 4
age: 1
gender: 0
height: 0
weight: 2
edu_train_expert: 0
intro_accuracy: 0
prob_of_success: 1
articulation: 1
kr_hp: 1
computer: 4
vehicles: 0
weapon_systems: 0
instruments: 1
notation: 2

```
test_equip:  2
advises:  1
answers:  0
communicates:  1
directs:  3
indicates:  2
informs:  2
instructs:  0
requests:  1
transmits:  3
supervises:  4
negotiates:  0
express_movement:  1
interp_movement:  0

name1:  console_ops
name2:  medical_diag
eq_count:  46
sim_count:  78

----------------------------------

statistical:  0
spatial:  3
temporal:  0
analogical:  0
case_based:  0
model_based:  0
mathematical:  3
deductive:  0
inductive:  1
means_ends:  1
sub_goals:  1
gen_and_test:  0
goal_vs_data:  0
cover_and_diff:  2
prop_and_ref:  4
acq_and_pres:  2
form_proc_alg:  2
decompose:  1
recombine:  0
generalize:  2
specialize:  0
ret_to_def:  2
visual:  0
verbal:  0
auditory:  2
kinesthetic:  1
written:  1
instrumentation:  0
mm_interface:  4
databases:  0
historical:  2
propadeutics:  2
branching:  4
dynamism:  4
constraints:  3
uncertainty:  0
high_low_tech:  0
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  3
simple_disc:  4
fine:  3
gross:  1
```

```
repetitive:  4
categorize:  0
calculate:  3
code:  0
computerize:  0
interpolate:  4
itemize:  2
learn:  0
tabulate:  0
translate:  1
analyze:  0
deduce:  0
induce:  2
choose:  2
compare:  1
compute:  3
estimate:  1
integrate:  3
plan:  3
supervise:  1
monitor:  2
interpret:  1
facts:  0
principles:  3
procedures:  0
analogs:  0
cases_examples:  1
percep_speed:  4
search_rec_info:  4
id_obj_act_events:  4
scan_display:  4
acceleration:  0
confinement:  1
isolation:  0
contaminants:  0
electricity:  0
lighting:  1
magnetism:  0
noise:  4
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  1
preciseness:  1
cog_attent:  4
response_chaining:  1
attention_span:  3
sleep:  1
schedule:  0
boredom:  1
general_health:  4
age:  1
gender:  0
height:  0
weight:  2
edu_train_expert:  0
intro_accuracy:  3
prob_of_success:  1
articulation:  1
kr_hp:  1
computer:  4
vehicles:  0
weapon_systems:  0
instruments:  1
notation:  2
test_equip:  1
```

```
advises:  2
answers:  1
communicates:  0
directs:  3
indicates:  1
informs:  0
instructs:  1
requests:  2
transmits:  1
supervises:  1
negotiates:  0
express_movement:  1
interp_movement:  3

name1:  console_ops
name2:  accounting
eq_count:  44
sim_count:  73

--------------------------------

statistical:  0
spatial:  0
temporal:  1
analogical:  0
case_based:  1
model_based:  2
mathematical:  1
deductive:  4
inductive:  1
means_ends:  0
sub_goals:  2
gen_and_test:  0
goal_vs_data:  0
cover_and_diff:  3
prop_and_ref:  0
acq_and_pres:  2
form_proc_alg:  0
decompose:  0
recombine:  2
generalize:  0
specialize:  1
ret_to_def:  0
visual:  4
verbal:  1
auditory:  0
kinesthetic:  0
written:  1
instrumentation:  4
mm_interface:  0
databases:  4
historical:  2
propadeutics:  1
branching:  0
dynamism:  3
constraints:  3
uncertainty:  2
high_low_tech:  1
quant_qual:  2
complex_cont:  0
compound:  0
reflex:  3
simple_disc:  4
fine:  4
gross:  0
repetitive:  4
```

```
acq_and_pres:  0
form_proc_alg:  0
decompose:  0
recombine:  3
generalize:  1
specialize:  3
ret_to_def:  1
visual:  4
verbal:  0
auditory:  2
kinesthetic:  4
written:  2
instrumentation:  4
mm_interface:  4
databases:  1
historical:  2
propadeutics:  2
branching:  4
dynamism:  4
constraints:  2
uncertainty:  4
high_low_tech:  0
quant_qual:  0
complex_cont:  2
compound:  0
reflex:  0
simple_disc:  4
fine:  3
gross:  3
repetitive:  1
categorize:  0
calculate:  2
code:  0
computerize:  0
interpolate:  2
itemize:  1
learn:  1
tabulate:  1
translate:  0
analyze:  1
deduce:  3
induce:  1
choose:  1
compare:  1
compute:  2
estimate:  2
integrate:  1
plan:  3
supervise:  3
monitor:  4
interpret:  2
facts:  1
principles:  1
procedures:  0
analogs:  3
cases_examples:  1
percep_speed:  4
search_rec_info:  3
id_obj_act_events:  3
scan_display:  4
acceleration:  3
confinement:  4
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
```

```
magnetism:  0
noise:  4
fatigue:  3
mental_strain:  3
stress:  3
phys_strain:  1
preciseness:  3
cog_attent:  4
response_chaining:  1
attention_span:  3
sleep:  0
schedule:  3
boredom:  0
general_health:  4
age:  3
gender:  2
height:  1
weight:  3
edu_train_expert:  1
intro_accuracy:  3
prob_of_success:  3
articulation:  4
kr_hp:  2
computer:  4
vehicles:  4
weapon_systems:  0
instruments:  4
notation:  1
test_equip:  0
advises:  4
answers:  1
communicates:  0
directs:  4
indicates:  1
informs:  2
instructs:  4
requests:  1
transmits:  2
supervises:  3
negotiates:  4
express_movement:  0
interp_movement:  2

name1:  pilot_training
name2:  language_train
eq_count:  41
sim_count:  68

---------------------------------

statistical:  0
spatial:  4
temporal:  4
analogical:  0
case_based:  0
model_based:  3
mathematical:  0
deductive:  2
inductive:  1
means_ends:  2
sub_goals:  0
gen_and_test:  1
goal_vs_data:  2
cover_and_diff:  2
prop_and_ref:  2
acq_and_pres:  0
```

```
form_proc_alg:  4
decompose:  1
recombine:  4
generalize:  1
specialize:  2
ret_to_def:  1
visual:  4
verbal:  1
auditory:  2
kinesthetic:  4
written:  2
instrumentation:  0
mm_interface:  4
databases:  0
historical:  0
propadeutics:  2
branching:  1
dynamism:  0
constraints:  1
uncertainty:  1
high_low_tech:  0
quant_qual:  0
complex_cont:  2
compound:  0
reflex:  0
simple_disc:  4
fine:  3
gross:  3
repetitive:  1
categorize:  1
calculate:  0
code:  0
computerize:  0
interpolate:  0
itemize:  2
learn:  2
tabulate:  0
translate:  4
analyze:  0
deduce:  1
induce:  1
choose:  2
compare:  1
compute:  0
estimate:  0
integrate:  2
plan:  1
supervise:  1
monitor:  0
interpret:  1
facts:  3
principles:  3
procedures:  2
analogs:  0
cases_examples:  0
percep_speed:  4
search_rec_info:  3
id_obj_act_events:  3
scan_display:  4
acceleration:  3
confinement:  4
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
```

```
noise:  4
fatigue:  3
mental_strain:  3
stress:  3
phys_strain:  1
preciseness:  3
cog_attent:  4
response_chaining:  1
attention_span:  3
sleep:  0
schedule:  3
boredom:  0
general_health:  4
age:  3
gender:  2
height:  1
weight:  3
edu_train_expert:  1
intro_accuracy:  1
prob_of_success:  1
articulation:  0
kr_hp:  2
computer:  2
vehicles:  4
weapon_systems:  0
instruments:  4
notation:  2
test_equip:  0
advises:  2
answers:  0
communicates:  1
directs:  0
indicates:  0
informs:  0
instructs:  0
requests:  1
transmits:  2
supervises:  1
negotiates:  0
express_movement:  3
interp_movement:  1

name1:  pilot_training
name2:  leadership
eq_count:  37
sim_count:  61

--------------------------------

statistical:  0
spatial:  4
temporal:  2
analogical:  2
case_based:  0
model_based:  3
mathematical:  0
deductive:  4
inductive:  1
means_ends:  3
sub_goals:  2
gen_and_test:  3
goal_vs_data:  2
cover_and_diff:  0
prop_and_ref:  3
acq_and_pres:  1
form_proc_alg:  1
```

```
decompose:  0
recombine:  0
generalize:  1
specialize:  3
ret_to_def:  1
visual:  4
verbal:  1
auditory:  2
kinesthetic:  4
written:  1
instrumentation:  4
mm_interface:  4
databases:  2
historical:  3
propadeutics:  2
branching:  3
dynamism:  4
constraints:  4
uncertainty:  3
high_low_tech:  0
quant_qual:  0
complex_cont:  2
compound:  0
reflex:  0
simple_disc:  4
fine:  3
gross:  3
repetitive:  1
categorize:  1
calculate:  2
code:  0
computerize:  1
interpolate:  0
itemize:  1
learn:  0
tabulate:  0
translate:  0
analyze:  1
deduce:  3
induce:  0
choose:  0
compare:  1
compute:  1
estimate:  1
integrate:  0
plan:  0
supervise:  1
monitor:  4
interpret:  3
facts:  2
principles:  2
procedures:  0
analogs:  2
cases_examples:  1
percep_speed:  4
search_rec_info:  3
id_obj_act_events:  3
scan_display:  4
acceleration:  3
confinement:  4
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  4
```

```
fatigue:  3
mental_strain:  3
stress:  3
phys_strain:  1
preciseness:  3
cog_attent:  4
response_chaining:  1
attention_span:  3
sleep:  0
schedule:  3
boredom:  0
general_health:  4
age:  3
gender:  2
height:  1
weight:  3
edu_train_expert:  2
intro_accuracy:  1
prob_of_success:  0
articulation:  0
kr_hp:  2
computer:  2
vehicles:  4
weapon_systems:  0
instruments:  4
notation:  0
test_equip:  0
advises:  0
answers:  2
communicates:  1
directs:  2
indicates:  2
informs:  0
instructs:  0
requests:  0
transmits:  1
supervises:  0
negotiates:  3
express_movement:  3
interp_movement:  1

name1:  pilot_training
name2:  surgery
eq_count:  44
sim_count:  81

--------------------------------

statistical:  0
spatial:  0
temporal:  0
analogical:  2
case_based:  1
model_based:  0
mathematical:  0
deductive:  1
inductive:  1
means_ends:  1
sub_goals:  0
gen_and_test:  0
goal_vs_data:  2
cover_and_diff:  2
prop_and_ref:  0
acq_and_pres:  1
form_proc_alg:  0
decompose:  1
```

```
recombine:  0
generalize:  1
specialize:  0
ret_to_def:  0
visual:  0
verbal:  1
auditory:  0
kinesthetic:  0
written:  2
instrumentation:  0
mm_interface:  3
databases:  0
historical:  4
propadeutics:  1
branching:  0
dynamism:  2
constraints:  2
uncertainty:  2
high_low_tech:  1
quant_qual:  0
complex_cont:  2
compound:  2
reflex:  0
simple_disc:  0
fine:  1
gross:  1
repetitive:  3
categorize:  1
calculate:  0
code:  0
computerize:  0
interpolate:  0
itemize:  2
learn:  4
tabulate:  0
translate:  0
analyze:  1
deduce:  1
induce:  1
choose:  1
compare:  1
compute:  0
estimate:  3
integrate:  2
plan:  1
supervise:  1
monitor:  0
interpret:  1
facts:  3
principles:  3
procedures:  0
analogs:  3
cases_examples:  1
percep_speed:  2
search_rec_info:  3
id_obj_act_events:  1
scan_display:  4
acceleration:  3
confinement:  2
isolation:  0
contaminants:  1
electricity:  0
lighting:  2
magnetism:  0
noise:  4
fatigue:  0
```

```
mental_strain:  0
stress:  1
phys_strain:  2
preciseness:  1
cog_attent:  0
response_chaining:  1
attention_span:  1
sleep:  2
schedule:  1
boredom:  1
general_health:  4
age:  3
gender:  2
height:  1
weight:  3
edu_train_expert:  0
intro_accuracy:  3
prob_of_success:  1
articulation:  3
kr_hp:  0
computer:  0
vehicles:  4
weapon_systems:  0
instruments:  0
notation:  2
test_equip:  3
advises:  1
answers:  1
communicates:  0
directs:  0
indicates:  1
informs:  2
instructs:  4
requests:  1
transmits:  2
supervises:  1
negotiates:  0
express_movement:  2
interp_movement:  2

name1:  pilot_training
name2:  medical_diag
eq_count:  42
sim_count:  72

--------------------------------

statistical:  0
spatial:  1
temporal:  0
analogical:  3
case_based:  0
model_based:  1
mathematical:  0
deductive:  0
inductive:  1
means_ends:  2
sub_goals:  2
gen_and_test:  0
goal_vs_data:  1
cover_and_diff:  1
prop_and_ref:  4
acq_and_pres:  0
form_proc_alg:  2
decompose:  0
recombine:  0
```

```
generalize:  0
specialize:  1
ret_to_def:  1
visual:  0
verbal:  1
auditory:  0
kinesthetic:  3
written:  2
instrumentation:  0
mm_interface:  4
databases:  0
historical:  4
propadeutics:  1
branching:  0
dynamism:  4
constraints:  3
uncertainty:  1
high_low_tech:  1
quant_qual:  1
complex_cont:  2
compound:  0
reflex:  0
simple_disc:  4
fine:  2
gross:  2
repetitive:  1
categorize:  1
calculate:  0
code:  0
computerize:  0
interpolate:  0
itemize:  0
learn:  4
tabulate:  0
translate:  3
analyze:  1
deduce:  1
induce:  1
choose:  1
compare:  2
compute:  0
estimate:  2
integrate:  2
plan:  2
supervise:  3
monitor:  2
interpret:  1
facts:  3
principles:  3
procedures:  0
analogs:  3
cases_examples:  0
percep_speed:  4
search_rec_info:  3
id_obj_act_events:  3
scan_display:  4
acceleration:  3
confinement:  4
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  4
fatigue:  2
mental_strain:  1
```

```
stress:  0
phys_strain:  1
preciseness:  3
cog_attent:  4
response_chaining:  1
attention_span:  3
sleep:  1
schedule:  1
boredom:  1
general_health:  4
age:  3
gender:  2
height:  1
weight:  3
edu_train_expert:  0
intro_accuracy:  0
prob_of_success:  1
articulation:  1
kr_hp:  2
computer:  0
vehicles:  4
weapon_systems:  0
instruments:  2
notation:  2
test_equip:  2
advises:  0
answers:  0
communicates:  1
directs:  0
indicates:  2
informs:  0
instructs:  3
requests:  2
transmits:  0
supervises:  2
negotiates:  0
express_movement:  2
interp_movement:  1

name1:  pilot_training
name2:  accounting
eq_count:  29
sim_count:  53

---------------------------------

statistical:  0
spatial:  4
temporal:  1
analogical:  3
case_based:  1
model_based:  3
mathematical:  4
deductive:  4
inductive:  1
means_ends:  3
sub_goals:  1
gen_and_test:  0
goal_vs_data:  1
cover_and_diff:  0
prop_and_ref:  0
acq_and_pres:  0
form_proc_alg:  0
decompose:  1
recombine:  2
generalize:  2
```

```
specialize:  0
ret_to_def:  1
visual:  4
verbal:  0
auditory:  2
kinesthetic:  4
written:  2
instrumentation:  4
mm_interface:  0
databases:  4
historical:  4
propadeutics:  2
branching:  4
dynamism:  3
constraints:  3
uncertainty:  3
high_low_tech:  0
quant_qual:  1
complex_cont:  2
compound:  0
reflex:  0
simple_disc:  4
fine:  3
gross:  3
repetitive:  1
categorize:  1
calculate:  4
code:  0
computerize:  4
interpolate:  0
itemize:  2
learn:  3
tabulate:  4
translate:  1
analyze:  3
deduce:  3
induce:  1
choose:  2
compare:  1
compute:  4
estimate:  0
integrate:  1
plan:  3
supervise:  3
monitor:  4
interpret:  1
facts:  0
principles:  1
procedures:  0
analogs:  3
cases_examples:  1
percep_speed:  4
search_rec_info:  3
id_obj_act_events:  3
scan_display:  4
acceleration:  3
confinement:  4
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  4
fatigue:  3
mental_strain:  3
stress:  3
```

```
phys_strain:  1
preciseness:  1
cog_attent:  4
response_chaining:  1
attention_span:  3
sleep:  0
schedule:  3
boredom:  0
general_health:  4
age:  3
gender:  2
height:  1
weight:  3
edu_train_expert:  0
intro_accuracy:  3
prob_of_success:  3
articulation:  4
kr_hp:  2
computer:  4
vehicles:  4
weapon_systems:  0
instruments:  4
notation:  1
test_equip:  0
advises:  4
answers:  2
communicates:  1
directs:  4
indicates:  4
informs:  2
instructs:  4
requests:  2
transmits:  1
supervises:  3
negotiates:  0
express_movement:  0
interp_movement:  2

name1:  pilot_training
name2:  protocol_des
eq_count:  25
sim_count:  55

--------------------------------

statistical:  2
spatial:  3
temporal:  0
analogical:  3
case_based:  1
model_based:  1
mathematical:  2
deductive:  4
inductive:  2
means_ends:  3
sub_goals:  0
gen_and_test:  4
goal_vs_data:  2
cover_and_diff:  0
prop_and_ref:  4
acq_and_pres:  0
form_proc_alg:  3
decompose:  1
recombine:  3
generalize:  1
specialize:  3
```

```
ret_to_def:  0
visual:  4
verbal:  1
auditory:  2
kinesthetic:  4
written:  1
instrumentation:  2
mm_interface:  4
databases:  0
historical:  4
propadeutics:  4
branching:  3
dynamism:  4
constraints:  4
uncertainty:  4
high_low_tech:  1
quant_qual:  1
complex_cont:  2
compound:  0
reflex:  0
simple_disc:  4
fine:  3
gross:  3
repetitive:  1
categorize:  1
calculate:  3
code:  0
computerize:  0
interpolate:  1
itemize:  2
learn:  2
tabulate:  0
translate:  4
analyze:  3
deduce:  3
induce:  1
choose:  1
compare:  1
compute:  3
estimate:  2
integrate:  1
plan:  1
supervise:  2
monitor:  4
interpret:  1
facts:  2
principles:  2
procedures:  0
analogs:  3
cases_examples:  1
percep_speed:  4
search_rec_info:  3
id_obj_act_events:  3
scan_display:  4
acceleration:  3
confinement:  4
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  4
fatigue:  3
mental_strain:  3
stress:  3
phys_strain:  1
```

```
preciseness:  3
cog_attent:  4
response_chaining:  1
attention_span:  3
sleep:  0
schedule:  3
boredom:  0
general_health:  4
age:  3
gender:  2
height:  1
weight:  3
edu_train_expert:  0
intro_accuracy:  3
prob_of_success:  1
articulation:  1
kr_hp:  2
computer:  2
vehicles:  4
weapon_systems:  0
instruments:  0
notation:  2
test_equip:  1
advises:  4
answers:  1
communicates:  1
directs:  1
indicates:  4
informs:  1
instructs:  4
requests:  1
transmits:  1
supervises:  0
negotiates:  0
express_movement:  0
interp_movement:  2

name1:  air_traffic
name2:  console_ops
eq_count:  56
sim_count:  77

---------------------------------

statistical:  0
spatial:  4
temporal:  0
analogical:  0
case_based:  2
model_based:  1
mathematical:  3
deductive:  4
inductive:  1
means_ends:  4
sub_goals:  3
gen_and_test:  0
goal_vs_data:  0
cover_and_diff:  2
prop_and_ref:  0
acq_and_pres:  0
form_proc_alg:  4
decompose:  2
recombine:  0
generalize:  0
specialize:  2
ret_to_def:  0
```

```
visual:  0
verbal:  0
auditory:  0
kinesthetic:  0
written:  2
instrumentation:  0
mm_interface:  2
databases:  0
historical:  2
propadeutics:  2
branching:  4
dynamism:  0
constraints:  0
uncertainty:  2
high_low_tech:  1
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  2
simple_disc:  2
fine:  2
gross:  0
repetitive:  2
categorize:  2
calculate:  3
code:  0
computerize:  0
interpolate:  1
itemize:  3
learn:  1
tabulate:  0
translate:  2
analyze:  4
deduce:  4
induce:  0
choose:  2
compare:  0
compute:  3
estimate:  1
integrate:  3
plan:  0
supervise:  3
monitor:  0
interpret:  2
facts:  0
principles:  2
procedures:  0
analogs:  0
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  2
isolation:  0
contaminants:  0
electricity:  0
lighting:  1
magnetism:  0
noise:  1
fatigue:  3
mental_strain:  2
stress:  1
phys_strain:  1
preciseness:  1
```

```
cog_attent:  0
response_chaining:  2
attention_span:  1
sleep:  4
schedule:  2
boredom:  2
general_health:  0
age:  1
gender:  0
height:  0
weight:  2
edu_train_expert:  0
intro_accuracy:  0
prob_of_success:  0
articulation:  1
kr_hp:  0
computer:  4
vehicles:  0
weapon_systems:  0
instruments:  1
notation:  2
test_equip:  1
advises:  1
answers:  3
communicates:  0
directs:  3
indicates:  1
informs:  0
instructs:  0
requests:  1
transmits:  0
supervises:  4
negotiates:  0
express_movement:  3
interp_movement:  0

name1:  air_traffic
name2:  weather
eq_count:  52
sim_count:  70

---------------------------------

statistical:  1
spatial:  0
temporal:  0
analogical:  0
case_based:  1
model_based:  3
mathematical:  2
deductive:  0
inductive:  3
means_ends:  4
sub_goals:  1
gen_and_test:  0
goal_vs_data:  0
cover_and_diff:  1
prop_and_ref:  0
acq_and_pres:  2
form_proc_alg:  3
decompose:  4
recombine:  3
generalize:  3
specialize:  0
ret_to_def:  0
visual:  0
```

```
verbal:  3
auditory:  0
kinesthetic:  0
written:  2
instrumentation:  3
mm_interface:  2
databases:  0
historical:  2
propadeutics:  0
branching:  0
dynamism:  0
constraints:  3
uncertainty:  3
high_low_tech:  1
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  1
simple_disc:  2
fine:  2
gross:  0
repetitive:  2
categorize:  1
calculate:  2
code:  0
computerize:  0
interpolate:  1
itemize:  3
learn:  1
tabulate:  0
translate:  2
analyze:  4
deduce:  0
induce:  4
choose:  2
compare:  0
compute:  1
estimate:  0
integrate:  4
plan:  4
supervise:  4
monitor:  1
interpret:  2
facts:  0
principles:  1
procedures:  0
analogs:  0
cases_examples:  0
percep_speed:  4
search_rec_info:  1
id_obj_act_events:  1
scan_display:  4
acceleration:  0
confinement:  3
isolation:  0
contaminants:  0
electricity:  0
lighting:  2
magnetism:  0
noise:  3
fatigue:  4
mental_strain:  4
stress:  4
phys_strain:  0
preciseness:  0
cog_attent:  4
```

```
response_chaining:  3
attention_span:  4
sleep:  4
schedule:  4
boredom:  0
general_health:  4
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  2
articulation:  3
kr_hp:  1
computer:  1
vehicles:  0
weapon_systems:  0
instruments:  3
notation:  0
test_equip:  0
advises:  3
answers:  0
communicates:  4
directs:  4
indicates:  0
informs:  4
instructs:  0
requests:  4
transmits:  3
supervises:  4
negotiates:  0
express_movement:  0
interp_movement:  0

name1:  air_traffic
name2:  program_mgmt
eq_count:  57
sim_count:  72

---------------------------------

statistical:  0
spatial:  4
temporal:  0
analogical:  0
case_based:  2
model_based:  1
mathematical:  0
deductive:  0
inductive:  0
means_ends:  4
sub_goals:  0
gen_and_test:  0
goal_vs_data:  1
cover_and_diff:  1
prop_and_ref:  3
acq_and_pres:  1
form_proc_alg:  3
decompose:  2
recombine:  0
generalize:  0
specialize:  0
ret_to_def:  3
visual:  4
verbal:  0
```

```
auditory:  0
kinesthetic:  0
written:  3
instrumentation:  4
mm_interface:  1
databases:  2
historical:  4
propadeutics:  1
branching:  2
dynamism:  3
constraints:  2
uncertainty:  2
high_low_tech:  0
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  1
simple_disc:  2
fine:  2
gross:  0
repetitive:  2
categorize:  0
calculate:  0
code:  0
computerize:  0
interpolate:  3
itemize:  1
learn:  0
tabulate:  0
translate:  0
analyze:  2
deduce:  0
induce:  0
choose:  1
compare:  1
compute:  0
estimate:  2
integrate:  0
plan:  0
supervise:  0
monitor:  0
interpret:  1
facts:  2
principles:  0
procedures:  0
analogs:  0
cases_examples:  2
percep_speed:  4
search_rec_info:  4
id_obj_act_events:  4
scan_display:  4
acceleration:  0
confinement:  3
isolation:  0
contaminants:  0
electricity:  0
lighting:  2
magnetism:  0
noise:  3
fatigue:  4
mental_strain:  4
stress:  4
phys_strain:  0
preciseness:  0
cog_attent:  4
response_chaining:  3
```

```
attention_span:  4
sleep:  4
schedule:  4
boredom:  0
general_health:  4
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  2
intro_accuracy:  0
prob_of_success:  2
articulation:  3
kr_hp:  1
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  4
notation:  4
test_equip:  0
advises:  3
answers:  3
communicates:  0
directs:  2
indicates:  0
informs:  2
instructs:  0
requests:  1
transmits:  1
supervises:  1
negotiates:  4
express_movement:  0
interp_movement:  0

name1:  air_traffic
name2:  drair_gen
eq_count:  43
sim_count:  66

---------------------------------

statistical:  1
spatial:  4
temporal:  2
analogical:  1
case_based:  0
model_based:  1
mathematical:  1
deductive:  1
inductive:  4
means_ends:  4
sub_goals:  2
gen_and_test:  0
goal_vs_data:  1
cover_and_diff:  1
prop_and_ref:  0
acq_and_pres:  2
form_proc_alg:  3
decompose:  3
recombine:  3
generalize:  3
specialize:  0
ret_to_def:  0
visual:  4
verbal:  0
auditory:  0
```

```
kinesthetic:  0
written:  0
instrumentation:  4
mm_interface:  2
databases:  4
historical:  4
propadeutics:  1
branching:  4
dynamism:  4
constraints:  4
uncertainty:  1
high_low_tech:  1
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  1
simple_disc:  2
fine:  2
gross:  0
repetitive:  2
categorize:  1
calculate:  0
code:  0
computerize:  0
interpolate:  2
itemize:  1
learn:  1
tabulate:  1
translate:  2
analyze:  4
deduce:  1
induce:  4
choose:  4
compare:  0
compute:  0
estimate:  1
integrate:  4
plan:  4
supervise:  4
monitor:  4
interpret:  3
facts:  0
principles:  3
procedures:  1
analogs:  1
cases_examples:  0
percep_speed:  4
search_rec_info:  4
id_obj_act_events:  4
scan_display:  4
acceleration:  0
confinement:  3
isolation:  0
contaminants:  0
electricity:  0
lighting:  2
magnetism:  0
noise:  3
fatigue:  4
mental_strain:  4
stress:  4
phys_strain:  0
preciseness:  0
cog_attent:  4
response_chaining:  3
attention_span:  4
```

```
sleep:  4
schedule:  4
boredom:  0
general_health:  4
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  3
articulation:  1
kr_hp:  1
computer:  4
vehicles:  0
weapon_systems:  0
instruments:  4
notation:  3
test_equip:  0
advises:  3
answers:  4
communicates:  0
directs:  4
indicates:  0
informs:  0
instructs:  0
requests:  2
transmits:  1
supervises:  4
negotiates:  0
express_movement:  0
interp_movement:  0

name1:  air_traffic
name2:  cargo_loading
eq_count:  48
sim_count:  77

---------------------------------

statistical:  0
spatial:  0
temporal:  0
analogical:  0
case_based:  1
model_based:  0
mathematical:  4
deductive:  1
inductive:  0
means_ends:  1
sub_goals:  0
gen_and_test:  0
goal_vs_data:  1
cover_and_diff:  1
prop_and_ref:  0
acq_and_pres:  1
form_proc_alg:  4
decompose:  2
recombine:  1
generalize:  0
specialize:  2
ret_to_def:  2
visual:  1
verbal:  4
auditory:  0
kinesthetic:  0
```

```
written:  3
instrumentation:  4
mm_interface:  2
databases:  0
historical:  0
propadeutics:  1
branching:  3
dynamism:  3
constraints:  3
uncertainty:  1
high_low_tech:  0
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  1
simple_disc:  2
fine:  2
gross:  0
repetitive:  2
categorize:  1
calculate:  4
code:  0
computerize:  0
interpolate:  1
itemize:  1
learn:  1
tabulate:  0
translate:  0
analyze:  1
deduce:  1
induce:  0
choose:  2
compare:  2
compute:  4
estimate:  0
integrate:  0
plan:  0
supervise:  1
monitor:  0
interpret:  1
facts:  0
principles:  1
procedures:  2
analogs:  0
cases_examples:  1
percep_speed:  4
search_rec_info:  4
id_obj_act_events:  4
scan_display:  4
acceleration:  1
confinement:  1
isolation:  0
contaminants:  0
electricity:  0
lighting:  2
magnetism:  0
noise:  0
fatigue:  4
mental_strain:  4
stress:  4
phys_strain:  1
preciseness:  0
cog_attent:  4
response_chaining:  3
attention_span:  4
sleep:  4
```

```
schedule:  4
boredom:  2
general_health:  2
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  3
articulation:  2
kr_hp:  1
computer:  0
vehicles:  2
weapon_systems:  0
instruments:  4
notation:  2
test_equip:  0
advises:  3
answers:  2
communicates:  1
directs:  1
indicates:  0
informs:  4
instructs:  0
requests:  2
transmits:  3
supervises:  0
negotiates:  0
express_movement:  2
interp_movement:  0

name1:  air_traffic
name2:  sw_design
eq_count:  50
sim_count:  65

--------------------------------

statistical:  0
spatial:  4
temporal:  0
analogical:  0
case_based:  2
model_based:  2
mathematical:  1
deductive:  0
inductive:  2
means_ends:  0
sub_goals:  0
gen_and_test:  4
goal_vs_data:  1
cover_and_diff:  1
prop_and_ref:  4
acq_and_pres:  2
form_proc_alg:  2
decompose:  0
recombine:  4
generalize:  2
specialize:  0
ret_to_def:  1
visual:  4
verbal:  0
auditory:  0
kinesthetic:  0
written:  3
```

```
instrumentation:  4
mm_interface:  2
databases:  0
historical:  0
propadeutics:  0
branching:  1
dynamism:  4
constraints:  3
uncertainty:  0
high_low_tech:  1
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  1
simple_disc:  2
fine:  2
gross:  0
repetitive:  2
categorize:  0
calculate:  0
code:  2
computerize:  2
interpolate:  3
itemize:  2
learn:  1
tabulate:  0
translate:  4
analyze:  4
deduce:  0
induce:  2
choose:  2
compare:  0
compute:  0
estimate:  1
integrate:  4
plan:  1
supervise:  3
monitor:  4
interpret:  2
facts:  1
principles:  0
procedures:  2
analogs:  2
cases_examples:  1
percep_speed:  4
search_rec_info:  4
id_obj_act_events:  4
scan_display:  4
acceleration:  0
confinement:  3
isolation:  0
contaminants:  0
electricity:  0
lighting:  2
magnetism:  0
noise:  3
fatigue:  4
mental_strain:  4
stress:  4
phys_strain:  0
preciseness:  0
cog_attent:  4
response_chaining:  3
attention_span:  4
sleep:  4
schedule:  4
```

```
boredom:  0
general_health:  4
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  0
intro_accuracy:  0
prob_of_success:  3
articulation:  0
kr_hp:  1
computer:  4
vehicles:  0
weapon_systems:  0
instruments:  4
notation:  0
test_equip:  0
advises:  3
answers:  0
communicates:  1
directs:  4
indicates:  0
informs:  4
instructs:  0
requests:  4
transmits:  1
supervises:  4
negotiates:  4
express_movement:  0
interp_movement:  0

name1:  air_traffic
name2:  form_fill_out
eq_count:  39
sim_count:  58

--------------------------------

statistical:  0
spatial:  4
temporal:  2
analogical:  2
case_based:  2
model_based:  1
mathematical:  2
deductive:  0
inductive:  2
means_ends:  2
sub_goals:  0
gen_and_test:  3
goal_vs_data:  1
cover_and_diff:  2
prop_and_ref:  2
acq_and_pres:  2
form_proc_alg:  4
decompose:  1
recombine:  3
generalize:  3
specialize:  0
ret_to_def:  2
visual:  4
verbal:  1
auditory:  0
kinesthetic:  0
written:  3
instrumentation:  4
```

```
mm_interface:  2
databases:  1
historical:  2
propadeutics:  1
branching:  4
dynamism:  4
constraints:  2
uncertainty:  1
high_low_tech:  0
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  1
simple_disc:  2
fine:  2
gross:  0
repetitive:  2
categorize:  1
calculate:  2
code:  0
computerize:  0
interpolate:  1
itemize:  2
learn:  2
tabulate:  1
translate:  0
analyze:  2
deduce:  0
induce:  2
choose:  0
compare:  0
compute:  2
estimate:  2
integrate:  1
plan:  4
supervise:  4
monitor:  4
interpret:  0
facts:  2
principles:  1
procedures:  0
analogs:  0
cases_examples:  1
percep_speed:  4
search_rec_info:  4
id_obj_act_events:  4
scan_display:  4
acceleration:  0
confinement:  3
isolation:  0
contaminants:  0
electricity:  0
lighting:  2
magnetism:  0
noise:  3
fatigue:  4
mental_strain:  4
stress:  4
phys_strain:  0
preciseness:  0
cog_attent:  4
response_chaining:  3
attention_span:  4
sleep:  4
schedule:  4
boredom:  0
```

```
general_health:  4
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  3
articulation:  3
kr_hp:  1
computer:  4
vehicles:  0
weapon_systems:  0
instruments:  4
notation:  1
test_equip:  0
advises:  3
answers:  3
communicates:  1
directs:  4
indicates:  3
informs:  2
instructs:  0
requests:  2
transmits:  1
supervises:  4
negotiates:  4
express_movement:  0
interp_movement:  0

name1:  air_traffic
name2:  language_train
eq_count:  51
sim_count:  68

--------------------------------

statistical:  0
spatial:  4
temporal:  4
analogical:  3
case_based:  2
model_based:  1
mathematical:  0
deductive:  2
inductive:  2
means_ends:  3
sub_goals:  0
gen_and_test:  1
goal_vs_data:  1
cover_and_diff:  1
prop_and_ref:  2
acq_and_pres:  2
form_proc_alg:  0
decompose:  0
recombine:  4
generalize:  3
specialize:  1
ret_to_def:  0
visual:  4
verbal:  0
auditory:  0
kinesthetic:  0
written:  3
instrumentation:  0
mm_interface:  2
```

```
databases:  0
historical:  0
propadeutics:  1
branching:  1
dynamism:  0
constraints:  1
uncertainty:  2
high_low_tech:  0
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  1
simple_disc:  2
fine:  2
gross:  0
repetitive:  2
categorize:  0
calculate:  0
code:  0
computerize:  0
interpolate:  3
itemize:  3
learn:  1
tabulate:  0
translate:  4
analyze:  3
deduce:  2
induce:  2
choose:  3
compare:  0
compute:  0
estimate:  4
integrate:  0
plan:  0
supervise:  0
monitor:  0
interpret:  3
facts:  0
principles:  1
procedures:  2
analogs:  3
cases_examples:  2
percep_speed:  4
search_rec_info:  4
id_obj_act_events:  4
scan_display:  4
acceleration:  0
confinement:  3
isolation:  0
contaminants:  0
electricity:  0
lighting:  2
magnetism:  0
noise:  3
fatigue:  4
mental_strain:  4
stress:  4
phys_strain:  0
preciseness:  0
cog_attent:  4
response_chaining:  3
attention_span:  4
sleep:  4
schedule:  4
boredom:  0
general_health:  4
```

```
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  4
prob_of_success:  1
articulation:  1
kr_hp:  1
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  4
notation:  4
test_equip:  0
advises:  1
answers:  4
communicates:  0
directs:  0
indicates:  4
informs:  0
instructs:  4
requests:  0
transmits:  1
supervises:  0
negotiates:  0
express_movement:  3
interp_movement:  3

name1:  air_traffic
name2:  leadership
eq_count:  44
sim_count:  67

--------------------------------

statistical:  0
spatial:  4
temporal:  2
analogical:  1
case_based:  2
model_based:  1
mathematical:  0
deductive:  0
inductive:  2
means_ends:  4
sub_goals:  2
gen_and_test:  3
goal_vs_data:  1
cover_and_diff:  1
prop_and_ref:  3
acq_and_pres:  1
form_proc_alg:  3
decompose:  1
recombine:  0
generalize:  1
specialize:  0
ret_to_def:  0
visual:  4
verbal:  0
auditory:  0
kinesthetic:  0
written:  2
instrumentation:  4
mm_interface:  2
databases:  2
```

historical: 3
propadeutics: 1
branching: 3
dynamism: 4
constraints: 4
uncertainty: 0
high_low_tech: 0
quant_qual: 0
complex_cont: 0
compound: 0
reflex: 1
simple_disc: 2
fine: 2
gross: 0
repetitive: 2
categorize: 0
calculate: 2
code: 0
computerize: 1
interpolate: 3
itemize: 0
learn: 3
tabulate: 0
translate: 0
analyze: 4
deduce: 0
induce: 1
choose: 1
compare: 0
compute: 1
estimate: 3
integrate: 2
plan: 1
supervise: 0
monitor: 4
interpret: 1
facts: 1
principles: 0
procedures: 0
analogs: 1
cases_examples: 1
percep_speed: 4
search_rec_info: 4
id_obj_act_events: 4
scan_display: 4
acceleration: 0
confinement: 3
isolation: 0
contaminants: 0
electricity: 0
lighting: 2
magnetism: 0
noise: 3
fatigue: 4
mental_strain: 4
stress: 4
phys_strain: 0
preciseness: 0
cog_attent: 4
response_chaining: 3
attention_span: 4
sleep: 4
schedule: 4
boredom: 0
general_health: 4
age: 0

```
gender:  0
height:  0
weight:  0
edu_train_expert:  2
intro_accuracy:  4
prob_of_success:  0
articulation:  1
kr_hp:  1
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  4
notation:  2
test_equip:  0
advises:  1
answers:  2
communicates:  0
directs:  2
indicates:  2
informs:  0
instructs:  4
requests:  1
transmits:  0
supervises:  1
negotiates:  3
express_movement:  3
interp_movement:  3

name1:  air_traffic
name2:  surgery
eq_count:  59
sim_count:  83

---------------------------------

statistical:  0
spatial:  0
temporal:  0
analogical:  1
case_based:  1
model_based:  2
mathematical:  0
deductive:  3
inductive:  2
means_ends:  0
sub_goals:  0
gen_and_test:  0
goal_vs_data:  1
cover_and_diff:  1
prop_and_ref:  0
acq_and_pres:  1
form_proc_alg:  4
decompose:  0
recombine:  0
generalize:  1
specialize:  3
ret_to_def:  1
visual:  0
verbal:  0
auditory:  2
kinesthetic:  4
written:  3
instrumentation:  0
mm_interface:  1
databases:  0
historical:  4
```

```
propadeutics:  0
branching:  0
dynamism:  2
constraints:  2
uncertainty:  1
high_low_tech:  1
quant_qual:  0
complex_cont:  4
compound:  2
reflex:  1
simple_disc:  2
fine:  2
gross:  4
repetitive:  2
categorize:  2
calculate:  0
code:  0
computerize:  0
interpolate:  3
itemize:  3
learn:  1
tabulate:  0
translate:  0
analyze:  4
deduce:  4
induce:  2
choose:  0
compare:  0
compute:  0
estimate:  1
integrate:  0
plan:  0
supervise:  0
monitor:  0
interpret:  3
facts:  0
principles:  1
procedures:  0
analogs:  0
cases_examples:  1
percep_speed:  2
search_rec_info:  4
id_obj_act_events:  0
scan_display:  4
acceleration:  0
confinement:  1
isolation:  0
contaminants:  1
electricity:  0
lighting:  0
magnetism:  0
noise:  3
fatigue:  1
mental_strain:  1
stress:  0
phys_strain:  3
preciseness:  4
cog_attent:  0
response_chaining:  1
attention_span:  0
sleep:  2
schedule:  0
boredom:  1
general_health:  4
age:  0
gender:  0
```

```
height:  0
weight:  0
edu_train_expert:  0
intro_accuracy:  0
prob_of_success:  1
articulation:  2
kr_hp:  1
computer:  0
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  0
test_equip:  3
advises:  0
answers:  3
communicates:  1
directs:  0
indicates:  3
informs:  2
instructs:  0
requests:  2
transmits:  3
supervises:  0
negotiates:  0
express_movement:  2
interp_movement:  0

name1:  air_traffic
name2:  medical_diag
eq_count:  47
sim_count:  67

---------------------------------

statistical:  0
spatial:  1
temporal:  0
analogical:  0
case_based:  2
model_based:  1
mathematical:  0
deductive:  4
inductive:  2
means_ends:  3
sub_goals:  2
gen_and_test:  0
goal_vs_data:  0
cover_and_diff:  0
prop_and_ref:  4
acq_and_pres:  2
form_proc_alg:  2
decompose:  1
recombine:  0
generalize:  2
specialize:  2
ret_to_def:  2
visual:  0
verbal:  0
auditory:  2
kinesthetic:  1
written:  3
instrumentation:  0
mm_interface:  2
databases:  0
historical:  4
propadeutics:  0
```

```
branching:  0
dynamism:  4
constraints:  3
uncertainty:  2
high_low_tech:  1
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  1
simple_disc:  2
fine:  1
gross:  1
repetitive:  2
categorize:  2
calculate:  0
code:  0
computerize:  0
interpolate:  3
itemize:  1
learn:  1
tabulate:  0
translate:  3
analyze:  4
deduce:  4
induce:  2
choose:  0
compare:  1
compute:  0
estimate:  2
integrate:  0
plan:  3
supervise:  4
monitor:  2
interpret:  3
facts:  0
principles:  1
procedures:  0
analogs:  0
cases_examples:  2
percep_speed:  4
search_rec_info:  4
id_obj_act_events:  4
scan_display:  4
acceleration:  0
confinement:  3
isolation:  0
contaminants:  0
electricity:  0
lighting:  2
magnetism:  0
noise:  3
fatigue:  3
mental_strain:  2
stress:  1
phys_strain:  0
preciseness:  0
cog_attent:  4
response_chaining:  3
attention_span:  4
sleep:  3
schedule:  2
boredom:  1
general_health:  4
age:  0
gender:  0
height:  0
```

```
weight:  0
edu_train_expert:  0
intro_accuracy:  3
prob_of_success:  1
articulation:  0
kr_hp:  1
computer:  0
vehicles:  0
weapon_systems:  0
instruments:  2
notation:  0
test_equip:  2
advises:  1
answers:  4
communicates:  0
directs:  0
indicates:  2
informs:  0
instructs:  1
requests:  3
transmits:  1
supervises:  3
negotiates:  0
express_movement:  2
interp_movement:  3

name1:  air_traffic
name2:  accounting
eq_count:  48
sim_count:  64

--------------------------------

statistical:  0
spatial:  4
temporal:  1
analogical:  0
case_based:  1
model_based:  1
mathematical:  4
deductive:  0
inductive:  0
means_ends:  4
sub_goals:  1
gen_and_test:  0
goal_vs_data:  0
cover_and_diff:  1
prop_and_ref:  0
acq_and_pres:  2
form_proc_alg:  4
decompose:  2
recombine:  2
generalize:  0
specialize:  3
ret_to_def:  0
visual:  4
verbal:  1
auditory:  0
kinesthetic:  0
written:  3
instrumentation:  4
mm_interface:  2
databases:  4
historical:  4
propadeutics:  1
branching:  4
```

```
dynamism:  3
constraints:  3
uncertainty:  0
high_low_tech:  0
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  1
simple_disc:  2
fine:  2
gross:  0
repetitive:  2
categorize:  0
calculate:  4
code:  0
computerize:  4
interpolate:  3
itemize:  1
learn:  0
tabulate:  4
translate:  1
analyze:  0
deduce:  0
induce:  0
choose:  3
compare:  0
compute:  4
estimate:  4
integrate:  3
plan:  4
supervise:  4
monitor:  4
interpret:  1
facts:  3
principles:  1
procedures:  0
analogs:  0
cases_examples:  1
percep_speed:  4
search_rec_info:  4
id_obj_act_events:  4
scan_display:  4
acceleration:  0
confinement:  3
isolation:  0
contaminants:  0
electricity:  0
lighting:  2
magnetism:  0
noise:  3
fatigue:  4
mental_strain:  4
stress:  4
phys_strain:  0
preciseness:  4
cog_attent:  4
response_chaining:  3
attention_span:  4
sleep:  4
schedule:  4
boredom:  0
general_health:  4
age:  0
gender:  0
height:  0
weight:  0
```

```
edu_train_expert:  0
intro_accuracy:  0
prob_of_success:  3
articulation:  3
kr_hp:  1
computer:  4
vehicles:  0
weapon_systems:  0
instruments:  4
notation:  1
test_equip:  0
advises:  3
answers:  2
communicates:  0
directs:  4
indicates:  0
informs:  2
instructs:  0
requests:  3
transmits:  0
supervises:  4
negotiates:  0
express_movement:  0
interp_movement:  0

name1:  air_traffic
name2:  protocol_des
eq_count:  49
sim_count:  67

---------------------------------

statistical:  2
spatial:  3
temporal:  0
analogical:  0
case_based:  3
model_based:  1
mathematical:  2
deductive:  0
inductive:  3
means_ends:  4
sub_goals:  0
gen_and_test:  4
goal_vs_data:  1
cover_and_diff:  1
prop_and_ref:  4
acq_and_pres:  2
form_proc_alg:  1
decompose:  0
recombine:  3
generalize:  3
specialize:  0
ret_to_def:  1
visual:  4
verbal:  0
auditory:  0
kinesthetic:  0
written:  2
instrumentation:  2
mm_interface:  2
databases:  0
historical:  4
propadeutics:  3
branching:  3
dynamism:  4
```

```
constraints:  4
uncertainty:  1
high_low_tech:  1
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  1
simple_disc:  2
fine:  2
gross:  0
repetitive:  2
categorize:  2
calculate:  3
code:  0
computerize:  0
interpolate:  2
itemize:  1
learn:  1
tabulate:  0
translate:  4
analyze:  0
deduce:  0
induce:  2
choose:  0
compare:  0
compute:  3
estimate:  2
integrate:  3
plan:  0
supervise:  3
monitor:  4
interpret:  3
facts:  1
principles:  0
procedures:  0
analogs:  0
cases_examples:  3
percep_speed:  4
search_rec_info:  4
id_obj_act_events:  4
scan_display:  4
acceleration:  0
confinement:  3
isolation:  0
contaminants:  0
electricity:  0
lighting:  2
magnetism:  0
noise:  3
fatigue:  4
mental_strain:  4
stress:  4
phys_strain:  0
preciseness:  0
cog_attent:  4
response_chaining:  3
attention_span:  4
sleep:  4
schedule:  4
boredom:  0
general_health:  4
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  0
```

```
intro_accuracy:  0
prob_of_success:  1
articulation:  0
kr_hp:  1
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  4
test_equip:  1
advises:  3
answers:  3
communicates:  0
directs:  1
indicates:  0
informs:  1
instructs:  0
requests:  2
transmits:  0
supervises:  1
negotiates:  0
express_movement:  0
interp_movement:  0

name1:  console_ops
name2:  weather
eq_count:  47
sim_count:  72

---------------------------------

statistical:  1
spatial:  4
temporal:  0
analogical:  0
case_based:  3
model_based:  2
mathematical:  1
deductive:  4
inductive:  2
means_ends:  0
sub_goals:  2
gen_and_test:  0
goal_vs_data:  0
cover_and_diff:  3
prop_and_ref:  0
acq_and_pres:  2
form_proc_alg:  1
decompose:  2
recombine:  3
generalize:  3
specialize:  2
ret_to_def:  0
visual:  0
verbal:  3
auditory:  0
kinesthetic:  0
written:  0
instrumentation:  3
mm_interface:  4
databases:  0
historical:  0
propadeutics:  2
branching:  4
dynamism:  0
constraints:  3
```

```
uncertainty:  1
high_low_tech:  2
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  3
simple_disc:  4
fine:  4
gross:  0
repetitive:  4
categorize:  1
calculate:  1
code:  0
computerize:  0
interpolate:  0
itemize:  0
learn:  0
tabulate:  0
translate:  0
analyze:  0
deduce:  4
induce:  4
choose:  0
compare:  0
compute:  2
estimate:  1
integrate:  1
plan:  4
supervise:  1
monitor:  1
interpret:  0
facts:  0
principles:  3
procedures:  0
analogs:  0
cases_examples:  1
percep_speed:  4
search_rec_info:  1
id_obj_act_events:  1
scan_display:  4
acceleration:  0
confinement:  1
isolation:  0
contaminants:  0
electricity:  0
lighting:  1
magnetism:  0
noise:  4
fatigue:  1
mental_strain:  2
stress:  3
phys_strain:  1
preciseness:  1
cog_attent:  4
response_chaining:  1
attention_span:  3
sleep:  0
schedule:  2
boredom:  2
general_health:  4
age:  1
gender:  0
height:  0
weight:  2
edu_train_expert:  1
intro_accuracy:  0
```

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```
categorize:  2
calculate:  1
code:  0
computerize:  4
interpolate:  4
itemize:  4
learn:  1
tabulate:  4
translate:  1
analyze:  4
deduce:  4
induce:  0
choose:  1
compare:  0
compute:  1
estimate:  3
integrate:  0
plan:  4
supervise:  1
monitor:  4
interpret:  1
facts:  3
principles:  1
procedures:  0
analogs:  0
cases_examples:  0
percep_speed:  4
search_rec_info:  4
id_obj_act_events:  4
scan_display:  4
acceleration:  0
confinement:  1
isolation:  0
contaminants:  0
electricity:  0
lighting:  1
magnetism:  0
noise:  4
fatigue:  1
mental_strain:  2
stress:  3
phys_strain:  1
preciseness:  3
cog_attent:  4
response_chaining:  1
attention_span:  3
sleep:  0
schedule:  2
boredom:  2
general_health:  4
age:  1
gender:  0
height:  0
weight:  2
edu_train_expert:  0
intro_accuracy:  0
prob_of_success:  3
articulation:  2
kr_hp:  1
computer:  0
vehicles:  0
weapon_systems:  0
instruments:  3
notation:  1
test_equip:  1
advises:  2
```

```
answers:  1
communicates:  0
directs:  1
indicates:  1
informs:  2
instructs:  0
requests:  2
transmits:  0
supervises:  0
negotiates:  0
express_movement:  3
interp_movement:  0

name1:  console_ops
name2:  protocol_des
eq_count:  45
sim_count:  69

---------------------------------

statistical:  2
spatial:  1
temporal:  0
analogical:  0
case_based:  1
model_based:  0
mathematical:  1
deductive:  4
inductive:  2
means_ends:  0
sub_goals:  3
gen_and_test:  4
goal_vs_data:  1
cover_and_diff:  3
prop_and_ref:  4
acq_and_pres:  2
form_proc_alg:  3
decompose:  2
recombine:  3
generalize:  3
specialize:  2
ret_to_def:  1
visual:  4
verbal:  0
auditory:  0
kinesthetic:  0
written:  0
instrumentation:  2
mm_interface:  4
databases:  0
historical:  2
propadeutics:  1
branching:  1
dynamism:  4
constraints:  4
uncertainty:  3
high_low_tech:  0
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  3
simple_disc:  4
fine:  4
gross:  0
repetitive:  4
categorize:  0
```

```
calculate:  0
code:  0
computerize:  0
interpolate:  3
itemize:  4
learn:  2
tabulate:  0
translate:  2
analyze:  4
deduce:  4
induce:  2
choose:  2
compare:  0
compute:  0
estimate:  1
integrate:  0
plan:  0
supervise:  0
monitor:  4
interpret:  1
facts:  1
principles:  2
procedures:  0
analogs:  0
cases_examples:  2
percep_speed:  4
search_rec_info:  4
id_obj_act_events:  4
scan_display:  4
acceleration:  0
confinement:  1
isolation:  0
contaminants:  0
electricity:  0
lighting:  1
magnetism:  0
noise:  4
fatigue:  1
mental_strain:  2
stress:  3
phys_strain:  1
preciseness:  1
cog_attent:  4
response_chaining:  1
attention_span:  3
sleep:  0
schedule:  2
boredom:  2
general_health:  4
age:  1
gender:  0
height:  0
weight:  2
edu_train_expert:  0
intro_accuracy:  0
prob_of_success:  1
articulation:  1
kr_hp:  1
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  1
notation:  2
test_equip:  0
advises:  2
answers:  0
```

```
communicates:  0
directs:  2
indicates:  1
informs:  1
instructs:  0
requests:  1
transmits:  0
supervises:  3
negotiates:  0
express_movement:  3
interp_movement:  0

name1:  weather
name2:  program_mgmt
eq_count:  61
sim_count:  84

---------------------------------

statistical:  1
spatial:  4
temporal:  0
analogical:  0
case_based:  3
model_based:  4
mathematical:  2
deductive:  0
inductive:  3
means_ends:  0
sub_goals:  1
gen_and_test:  0
goal_vs_data:  1
cover_and_diff:  0
prop_and_ref:  3
acq_and_pres:  1
form_proc_alg:  0
decompose:  2
recombine:  3
generalize:  3
specialize:  0
ret_to_def:  3
visual:  4
verbal:  3
auditory:  0
kinesthetic:  0
written:  1
instrumentation:  1
mm_interface:  1
databases:  2
historical:  2
propadeutics:  1
branching:  2
dynamism:  3
constraints:  1
uncertainty:  1
high_low_tech:  1
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  1
calculate:  2
```

```
code:  0
computerize:  0
interpolate:  4
itemize:  2
learn:  1
tabulate:  0
translate:  2
analyze:  2
deduce:  0
induce:  4
choose:  1
compare:  1
compute:  1
estimate:  2
integrate:  4
plan:  4
supervise:  4
monitor:  1
interpret:  1
facts:  2
principles:  1
procedures:  0
analogs:  0
cases_examples:  2
percep_speed:  0
search_rec_info:  3
id_obj_act_events:  3
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  0
articulation:  0
kr_hp:  0
computer:  1
vehicles:  0
weapon_systems:  0
instruments:  1
notation:  4
test_equip:  0
advises:  0
answers:  3
communicates:  4
```

```
directs:  2
indicates:  0
informs:  2
instructs:  0
requests:  3
transmits:  2
supervises:  3
negotiates:  4
express_movement:  0
interp_movement:  0

name1:  weather
name2:  drair_gen
eq_count:  73
sim_count:  94

---------------------------------

statistical:  0
spatial:  4
temporal:  2
analogical:  1
case_based:  1
model_based:  4
mathematical:  1
deductive:  1
inductive:  1
means_ends:  0
sub_goals:  1
gen_and_test:  0
goal_vs_data:  1
cover_and_diff:  0
prop_and_ref:  0
acq_and_pres:  0
form_proc_alg:  0
decompose:  1
recombine:  0
generalize:  0
specialize:  0
ret_to_def:  0
visual:  4
verbal:  3
auditory:  0
kinesthetic:  0
written:  2
instrumentation:  1
mm_interface:  0
databases:  4
historical:  2
propadeutics:  1
branching:  4
dynamism:  4
constraints:  1
uncertainty:  2
high_low_tech:  0
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  2
calculate:  2
code:  0
```

```
computerize:  0
interpolate:  3
itemize:  4
learn:  2
tabulate:  1
translate:  0
analyze:  0
deduce:  1
induce:  0
choose:  2
compare:  0
compute:  1
estimate:  1
integrate:  0
plan:  0
supervise:  0
monitor:  3
interpret:  1
facts:  0
principles:  4
procedures:  1
analogs:  1
cases_examples:  0
percep_speed:  0
search_rec_info:  3
id_obj_act_events:  3
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  0
intro_accuracy:  0
prob_of_success:  1
articulation:  4
kr_hp:  0
computer:  3
vehicles:  0
weapon_systems:  0
instruments:  1
notation:  3
test_equip:  0
advises:  0
answers:  4
communicates:  4
directs:  0
```

```
indicates:  0
informs:  4
instructs:  0
requests:  2
transmits:  2
supervises:  0
negotiates:  0
express_movement:  0
interp_movement:  0

name1:  weather
name2:  cargo_loading
eq_count:  60
sim_count:  81

----------------------------------

statistical:  1
spatial:  0
temporal:  0
analogical:  0
case_based:  2
model_based:  3
mathematical:  2
deductive:  1
inductive:  3
means_ends:  3
sub_goals:  1
gen_and_test:  0
goal_vs_data:  1
cover_and_diff:  0
prop_and_ref:  0
acq_and_pres:  1
form_proc_alg:  1
decompose:  2
recombine:  2
generalize:  3
specialize:  2
ret_to_def:  2
visual:  1
verbal:  1
auditory:  0
kinesthetic:  0
written:  1
instrumentation:  1
mm_interface:  0
databases:  0
historical:  2
propadeutics:  1
branching:  3
dynamism:  3
constraints:  0
uncertainty:  4
high_low_tech:  1
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  0
calculate:  2
code:  0
computerize:  0
```

```
interpolate:  2
itemize:  4
learn:  2
tabulate:  0
translate:  2
analyze:  3
deduce:  1
induce:  4
choose:  0
compare:  2
compute:  3
estimate:  0
integrate:  4
plan:  4
supervise:  3
monitor:  1
interpret:  3
facts:  0
principles:  0
procedures:  2
analogs:  0
cases_examples:  1
percep_speed:  0
search_rec_info:  3
id_obj_act_events:  3
scan_display:  0
acceleration:  1
confinement:  2
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  3
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  1
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  2
general_health:  2
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  0
intro_accuracy:  0
prob_of_success:  1
articulation:  1
kr_hp:  0
computer:  1
vehicles:  2
weapon_systems:  0
instruments:  1
notation:  2
test_equip:  0
advises:  0
answers:  2
communicates:  3
directs:  3
indicates:  0
```

```
informs:  0
instructs:  0
requests:  2
transmits:  0
supervises:  4
negotiates:  0
express_movement:  2
interp_movement:  0

name1:  weather
name2:  sw_design
eq_count:  68
sim_count:  93

---------------------------------

statistical:  1
spatial:  4
temporal:  0
analogical:  0
case_based:  3
model_based:  1
mathematical:  1
deductive:  0
inductive:  1
means_ends:  4
sub_goals:  1
gen_and_test:  4
goal_vs_data:  1
cover_and_diff:  0
prop_and_ref:  4
acq_and_pres:  0
form_proc_alg:  1
decompose:  4
recombine:  1
generalize:  1
specialize:  0
ret_to_def:  1
visual:  4
verbal:  3
auditory:  0
kinesthetic:  0
written:  1
instrumentation:  1
mm_interface:  0
databases:  0
historical:  2
propadeutics:  0
branching:  1
dynamism:  4
constraints:  0
uncertainty:  3
high_low_tech:  2
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  1
calculate:  2
code:  2
computerize:  2
interpolate:  4
```

itemize: 1
learn: 2
tabulate: 0
translate: 2
analyze: 0
deduce: 0
induce: 2
choose: 0
compare: 0
compute: 1
estimate: 1
integrate: 0
plan: 3
supervise: 1
monitor: 3
interpret: 0
facts: 1
principles: 1
procedures: 2
analogs: 2
cases_examples: 1
percep_speed: 0
search_rec_info: 3
id_obj_act_events: 3
scan_display: 0
acceleration: 0
confinement: 0
isolation: 0
contaminants: 0
electricity: 0
lighting: 0
magnetism: 0
noise: 0
fatigue: 0
mental_strain: 0
stress: 0
phys_strain: 0
preciseness: 0
cog_attent: 0
response_chaining: 0
attention_span: 0
sleep: 0
schedule: 0
boredom: 0
general_health: 0
age: 0
gender: 0
height: 0
weight: 0
edu_train_expert: 1
intro_accuracy: 0
prob_of_success: 1
articulation: 3
kr_hp: 0
computer: 3
vehicles: 0
weapon_systems: 0
instruments: 1
notation: 0
test_equip: 0
advises: 0
answers: 0
communicates: 3
directs: 0
indicates: 0
informs: 0

```
instructs:  0
requests:  0
transmits:  2
supervises:  0
negotiates:  4
express_movement:  0
interp_movement:  0

name1:  weather
name2:  form_fill_out
eq_count:  66
sim_count:  85

---------------------------------

statistical:  1
spatial:  4
temporal:  2
analogical:  2
case_based:  3
model_based:  4
mathematical:  0
deductive:  0
inductive:  1
means_ends:  2
sub_goals:  1
gen_and_test:  3
goal_vs_data:  1
cover_and_diff:  3
prop_and_ref:  2
acq_and_pres:  0
form_proc_alg:  1
decompose:  3
recombine:  0
generalize:  0
specialize:  0
ret_to_def:  2
visual:  4
verbal:  2
auditory:  0
kinesthetic:  0
written:  1
instrumentation:  1
mm_interface:  0
databases:  1
historical:  0
propadeutics:  1
branching:  4
dynamism:  4
constraints:  1
uncertainty:  4
high_low_tech:  1
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  0
calculate:  0
code:  0
computerize:  0
interpolate:  2
itemize:  1
```

```
learn:  3
tabulate:  1
translate:  2
analyze:  2
deduce:  0
induce:  2
choose:  2
compare:  0
compute:  1
estimate:  2
integrate:  3
plan:  0
supervise:  0
monitor:  3
interpret:  2
facts:  2
principles:  2
procedures:  0
analogs:  0
cases_examples:  1
percep_speed:  0
search_rec_info:  3
id_obj_act_events:  3
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  0
intro_accuracy:  0
prob_of_success:  1
articulation:  0
kr_hp:  0
computer:  3
vehicles:  0
weapon_systems:  0
instruments:  1
notation:  1
test_equip:  0
advises:  0
answers:  3
communicates:  3
directs:  0
indicates:  3
informs:  2
instructs:  0
```

```
requests:  2
transmits:  4
supervises:  0
negotiates:  4
express_movement:  0
interp_movement:  0

name1:  weather
name2:  language_train
eq_count:  54
sim_count:  77

---------------------------------

statistical:  1
spatial:  4
temporal:  4
analogical:  3
case_based:  3
model_based:  4
mathematical:  2
deductive:  2
inductive:  1
means_ends:  1
sub_goals:  1
gen_and_test:  1
goal_vs_data:  1
cover_and_diff:  2
prop_and_ref:  2
acq_and_pres:  0
form_proc_alg:  3
decompose:  4
recombine:  1
generalize:  0
specialize:  1
ret_to_def:  0
visual:  4
verbal:  3
auditory:  0
kinesthetic:  0
written:  1
instrumentation:  3
mm_interface:  0
databases:  0
historical:  2
propadeutics:  1
branching:  1
dynamism:  0
constraints:  2
uncertainty:  1
high_low_tech:  1
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  1
calculate:  2
code:  0
computerize:  0
interpolate:  4
itemize:  0
learn:  2
```

```
tabulate:  0
translate:  2
analyze:  1
deduce:  2
induce:  2
choose:  1
compare:  0
compute:  1
estimate:  4
integrate:  4
plan:  4
supervise:  4
monitor:  1
interpret:  1
facts:  0
principles:  0
procedures:  2
analogs:  3
cases_examples:  2
percep_speed:  0
search_rec_info:  3
id_obj_act_events:  3
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  0
intro_accuracy:  4
prob_of_success:  1
articulation:  4
kr_hp:  0
computer:  1
vehicles:  0
weapon_systems:  0
instruments:  1
notation:  4
test_equip:  0
advises:  2
answers:  4
communicates:  4
directs:  4
indicates:  4
informs:  4
instructs:  4
requests:  4
```

```
transmits:  4
supervises:  4
negotiates:  0
express_movement:  3
interp_movement:  3

name1:  weather
name2:  leadership
eq_count:  55
sim_count:  77

---------------------------------

statistical:  1
spatial:  4
temporal:  2
analogical:  1
case_based:  3
model_based:  4
mathematical:  2
deductive:  0
inductive:  1
means_ends:  0
sub_goals:  1
gen_and_test:  3
goal_vs_data:  1
cover_and_diff:  0
prop_and_ref:  3
acq_and_pres:  1
form_proc_alg:  0
decompose:  3
recombine:  3
generalize:  2
specialize:  0
ret_to_def:  0
visual:  4
verbal:  3
auditory:  0
kinesthetic:  0
written:  0
instrumentation:  1
mm_interface:  0
databases:  2
historical:  1
propadeutics:  1
branching:  3
dynamism:  4
constraints:  1
uncertainty:  3
high_low_tech:  1
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  1
calculate:  0
code:  0
computerize:  1
interpolate:  4
itemize:  3
learn:  4
tabulate:  0
```

```
translate:  2
analyze:  0
deduce:  0
induce:  3
choose:  1
compare:  0
compute:  0
estimate:  3
integrate:  2
plan:  3
supervise:  4
monitor:  3
interpret:  3
facts:  1
principles:  1
procedures:  0
analogs:  1
cases_examples:  1
percep_speed:  0
search_rec_info:  3
id_obj_act_events:  3
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  4
prob_of_success:  2
articulation:  4
kr_hp:  0
computer:  1
vehicles:  0
weapon_systems:  0
instruments:  1
notation:  2
test_equip:  0
advises:  4
answers:  2
communicates:  4
directs:  2
indicates:  2
informs:  4
instructs:  4
requests:  3
transmits:  3
```

```
supervises:  3
negotiates:  3
express_movement:  3
interp_movement:  3

name1:  weather
name2:  surgery
eq_count:  39
sim_count:  64

---------------------------------

statistical:  1
spatial:  0
temporal:  0
analogical:  1
case_based:  2
model_based:  1
mathematical:  2
deductive:  3
inductive:  1
means_ends:  4
sub_goals:  1
gen_and_test:  0
goal_vs_data:  1
cover_and_diff:  2
prop_and_ref:  0
acq_and_pres:  1
form_proc_alg:  1
decompose:  4
recombine:  3
generalize:  2
specialize:  3
ret_to_def:  1
visual:  0
verbal:  3
auditory:  2
kinesthetic:  4
written:  1
instrumentation:  3
mm_interface:  1
databases:  0
historical:  2
propadeutics:  0
branching:  0
dynamism:  2
constraints:  1
uncertainty:  2
high_low_tech:  2
quant_qual:  1
complex_cont:  4
compound:  2
reflex:  0
simple_disc:  4
fine:  4
gross:  4
repetitive:  4
categorize:  1
calculate:  2
code:  0
computerize:  0
interpolate:  4
itemize:  0
learn:  0
tabulate:  0
translate:  2
```

```
analyze:  0
deduce:  4
induce:  2
choose:  2
compare:  0
compute:  1
estimate:  1
integrate:  4
plan:  4
supervise:  4
monitor:  1
interpret:  1
facts:  0
principles:  0
procedures:  0
analogs:  0
cases_examples:  1
percep_speed:  2
search_rec_info:  3
id_obj_act_events:  1
scan_display:  0
acceleration:  0
confinement:  2
isolation:  0
contaminants:  1
electricity:  0
lighting:  2
magnetism:  0
noise:  0
fatigue:  3
mental_strain:  3
stress:  4
phys_strain:  3
preciseness:  4
cog_attent:  4
response_chaining:  2
attention_span:  4
sleep:  2
schedule:  4
boredom:  1
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  3
articulation:  1
kr_hp:  2
computer:  1
vehicles:  0
weapon_systems:  0
instruments:  3
notation:  0
test_equip:  3
advises:  3
answers:  3
communicates:  3
directs:  4
indicates:  3
informs:  2
instructs:  0
requests:  2
transmits:  0
supervises:  4
```

```
negotiates:  0
express_movement:  2
interp_movement:  0

name1:  weather
name2:  medical_diag
eq_count:  52
sim_count:  81

---------------------------------

statistical:  1
spatial:  1
temporal:  0
analogical:  0
case_based:  3
model_based:  2
mathematical:  2
deductive:  4
inductive:  1
means_ends:  1
sub_goals:  1
gen_and_test:  0
goal_vs_data:  0
cover_and_diff:  1
prop_and_ref:  4
acq_and_pres:  0
form_proc_alg:  1
decompose:  3
recombine:  3
generalize:  1
specialize:  2
ret_to_def:  2
visual:  0
verbal:  3
auditory:  2
kinesthetic:  1
written:  1
instrumentation:  3
mm_interface:  0
databases:  0
historical:  2
propadeutics:  0
branching:  0
dynamism:  4
constraints:  0
uncertainty:  1
high_low_tech:  2
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  1
gross:  1
repetitive:  0
categorize:  1
calculate:  2
code:  0
computerize:  0
interpolate:  4
itemize:  2
learn:  0
tabulate:  0
translate:  1
analyze:  0
```

deduce: 4
induce: 2
choose: 2
compare: 1
compute: 1
estimate: 2
integrate: 4
plan: 1
supervise: 0
monitor: 1
interpret: 1
facts: 0
principles: 0
procedures: 0
analogs: 0
cases_examples: 2
percep_speed: 0
search_rec_info: 3
id_obj_act_events: 3
scan_display: 0
acceleration: 0
confinement: 0
isolation: 0
contaminants: 0
electricity: 0
lighting: 0
magnetism: 0
noise: 0
fatigue: 1
mental_strain: 2
stress: 3
phys_strain: 0
preciseness: 0
cog_attent: 0
response_chaining: 0
attention_span: 0
sleep: 1
schedule: 2
boredom: 1
general_health: 0
age: 0
gender: 0
height: 0
weight: 0
edu_train_expert: 1
intro_accuracy: 3
prob_of_success: 3
articulation: 3
kr_hp: 0
computer: 1
vehicles: 0
weapon_systems: 0
instruments: 1
notation: 0
test_equip: 2
advises: 4
answers: 4
communicates: 4
directs: 4
indicates: 2
informs: 4
instructs: 1
requests: 1
transmits: 2
supervises: 1
negotiates: 0

```
express_movement:  2
interp_movement:  3

name1:  weather
name2:  accounting
eq_count:  66
sim_count:  86

---------------------------------

statistical:  1
spatial:  4
temporal:  1
analogical:  0
case_based:  2
model_based:  4
mathematical:  2
deductive:  0
inductive:  3
means_ends:  0
sub_goals:  0
gen_and_test:  0
goal_vs_data:  0
cover_and_diff:  0
prop_and_ref:  0
acq_and_pres:  0
form_proc_alg:  1
decompose:  2
recombine:  1
generalize:  3
specialize:  3
ret_to_def:  0
visual:  4
verbal:  2
auditory:  0
kinesthetic:  0
written:  1
instrumentation:  1
mm_interface:  4
databases:  4
historical:  2
propadeutics:  1
branching:  4
dynamism:  3
constraints:  0
uncertainty:  3
high_low_tech:  1
quant_qual:  2
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  1
calculate:  2
code:  0
computerize:  4
interpolate:  4
itemize:  4
learn:  1
tabulate:  4
translate:  1
analyze:  4
deduce:  0
```

```
induce:  4
choose:  1
compare:  0
compute:  3
estimate:  4
integrate:  1
plan:  0
supervise:  0
monitor:  3
interpret:  1
facts:  3
principles:  2
procedures:  0
analogs:  0
cases_examples:  1
percep_speed:  0
search_rec_info:  3
id_obj_act_events:  3
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  4
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  1
articulation:  0
kr_hp:  0
computer:  3
vehicles:  0
weapon_systems:  0
instruments:  1
notation:  1
test_equip:  0
advises:  0
answers:  2
communicates:  4
directs:  0
indicates:  0
informs:  2
instructs:  0
requests:  1
transmits:  3
supervises:  0
negotiates:  0
express_movement:  0
```

```
interp_movement:  0

name1:  weather
name2:  protocol_des
eq_count:  67
sim_count:  83

---------------------------------

statistical:  1
spatial:  3
temporal:  0
analogical:  0
case_based:  4
model_based:  2
mathematical:  0
deductive:  0
inductive:  0
means_ends:  0
sub_goals:  1
gen_and_test:  4
goal_vs_data:  1
cover_and_diff:  0
prop_and_ref:  4
acq_and_pres:  0
form_proc_alg:  2
decompose:  4
recombine:  0
generalize:  0
specialize:  0
ret_to_def:  1
visual:  4
verbal:  3
auditory:  0
kinesthetic:  0
written:  0
instrumentation:  1
mm_interface:  0
databases:  0
historical:  2
propadeutics:  3
branching:  3
dynamism:  4
constraints:  1
uncertainty:  4
high_low_tech:  2
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  1
calculate:  1
code:  0
computerize:  0
interpolate:  3
itemize:  4
learn:  2
tabulate:  0
translate:  2
analyze:  4
deduce:  0
induce:  2
```

```
choose:  2
compare:  0
compute:  2
estimate:  2
integrate:  1
plan:  4
supervise:  1
monitor:  3
interpret:  1
facts:  1
principles:  1
procedures:  0
analogs:  0
cases_examples:  3
percep_speed:  0
search_rec_info:  3
id_obj_act_events:  3
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  3
articulation:  3
kr_hp:  0
computer:  1
vehicles:  0
weapon_systems:  0
instruments:  3
notation:  4
test_equip:  1
advises:  0
answers:  3
communicates:  4
directs:  3
indicates:  0
informs:  3
instructs:  0
requests:  2
transmits:  3
supervises:  3
negotiates:  0
express_movement:  0
interp_movement:  0
```

```
compare:  1
compute:  0
estimate:  1
integrate:  4
plan:  4
supervise:  4
monitor:  4
interpret:  2
facts:  2
principles:  3
procedures:  1
analogs:  1
cases_examples:  2
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  1
articulation:  4
kr_hp:  0
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  1
test_equip:  0
advises:  0
answers:  1
communicates:  0
directs:  2
indicates:  0
informs:  2
instructs:  0
requests:  1
transmits:  0
supervises:  3
negotiates:  4
express_movement:  0
interp_movement:  0
```

```
name1:  program_mgmt
name2:  drair_gen
eq_count:  67
sim_count:  91

---------------------------------

statistical:  1
spatial:  0
temporal:  2
analogical:  1
case_based:  2
model_based:  0
mathematical:  1
deductive:  1
inductive:  4
means_ends:  0
sub_goals:  2
gen_and_test:  0
goal_vs_data:  2
cover_and_diff:  0
prop_and_ref:  3
acq_and_pres:  1
form_proc_alg:  0
decompose:  1
recombine:  3
generalize:  3
specialize:  0
ret_to_def:  3
visual:  0
verbal:  0
auditory:  0
kinesthetic:  0
written:  3
instrumentation:  0
mm_interface:  1
databases:  2
historical:  0
propadeutics:  0
branching:  2
dynamism:  1
constraints:  2
uncertainty:  1
high_low_tech:  1
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  1
calculate:  0
code:  0
computerize:  0
interpolate:  1
itemize:  2
learn:  1
tabulate:  1
translate:  2
analyze:  2
deduce:  1
induce:  4
choose:  3
```

```
name1:  program_mgmt
name2:  cargo_loading
eq_count:  63
sim_count:  92

---------------------------------

statistical:  0
spatial:  4
temporal:  0
analogical:  0
case_based:  1
model_based:  1
mathematical:  4
deductive:  1
inductive:  0
means_ends:  3
sub_goals:  0
gen_and_test:  0
goal_vs_data:  2
cover_and_diff:  0
prop_and_ref:  3
acq_and_pres:  0
form_proc_alg:  1
decompose:  0
recombine:  1
generalize:  0
specialize:  2
ret_to_def:  1
visual:  3
verbal:  4
auditory:  0
kinesthetic:  0
written:  0
instrumentation:  0
mm_interface:  1
databases:  2
historical:  4
propadeutics:  2
branching:  1
dynamism:  0
constraints:  1
uncertainty:  3
high_low_tech:  0
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  1
calculate:  4
code:  0
computerize:  0
interpolate:  2
itemize:  2
learn:  1
tabulate:  0
translate:  0
analyze:  1
deduce:  1
induce:  0
choose:  1
compare:  1
```

```
compute:  4
estimate:  2
integrate:  0
plan:  0
supervise:  1
monitor:  0
interpret:  2
facts:  2
principles:  1
procedures:  2
analogs:  0
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  1
confinement:  2
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  3
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  1
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  2
general_health:  2
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  1
articulation:  1
kr_hp:  0
computer:  2
vehicles:  2
weapon_systems:  0
instruments:  0
notation:  2
test_equip:  0
advises:  0
answers:  1
communicates:  1
directs:  1
indicates:  0
informs:  2
instructs:  0
requests:  1
transmits:  2
supervises:  1
negotiates:  4
express_movement:  2
interp_movement:  0

name1:  program_mgmt
```

```
name2:  sw_design
eq_count:  72
sim_count:  93

--------------------------------

statistical:  0
spatial:  0
temporal:  0
analogical:  0
case_based:  0
model_based:  3
mathematical:  1
deductive:  0
inductive:  2
means_ends:  4
sub_goals:  0
gen_and_test:  4
goal_vs_data:  0
cover_and_diff:  0
prop_and_ref:  1
acq_and_pres:  1
form_proc_alg:  1
decompose:  2
recombine:  4
generalize:  2
specialize:  0
ret_to_def:  2
visual:  0
verbal:  0
auditory:  0
kinesthetic:  0
written:  0
instrumentation:  0
mm_interface:  1
databases:  2
historical:  4
propadeutics:  1
branching:  1
dynamism:  1
constraints:  1
uncertainty:  2
high_low_tech:  1
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  0
calculate:  0
code:  2
computerize:  2
interpolate:  0
itemize:  1
learn:  1
tabulate:  0
translate:  4
analyze:  2
deduce:  0
induce:  2
choose:  1
compare:  1
compute:  0
```

```
estimate:  1
integrate:  4
plan:  1
supervise:  3
monitor:  4
interpret:  1
facts:  1
principles:  0
procedures:  2
analogs:  2
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  2
intro_accuracy:  0
prob_of_success:  1
articulation:  3
kr_hp:  0
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  4
test_equip:  0
advises:  0
answers:  3
communicates:  1
directs:  2
indicates:  0
informs:  2
instructs:  0
requests:  3
transmits:  0
supervises:  3
negotiates:  0
express_movement:  0
interp_movement:  0

name1:  program_mgmt
name2:  form_fill_out
```

```
eq_count:  73
sim_count:  95

---------------------------------

statistical:  0
spatial:  0
temporal:  2
analogical:  2
case_based:  0
model_based:  0
mathematical:  2
deductive:  0
inductive:  2
means_ends:  2
sub_goals:  0
gen_and_test:  3
goal_vs_data:  2
cover_and_diff:  3
prop_and_ref:  1
acq_and_pres:  1
form_proc_alg:  1
decompose:  1
recombine:  3
generalize:  3
specialize:  0
ret_to_def:  1
visual:  0
verbal:  1
auditory:  0
kinesthetic:  0
written:  0
instrumentation:  0
mm_interface:  1
databases:  1
historical:  2
propadeutics:  2
branching:  2
dynamism:  1
constraints:  0
uncertainty:  3
high_low_tech:  0
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  1
calculate:  2
code:  0
computerize:  0
interpolate:  2
itemize:  1
learn:  2
tabulate:  1
translate:  0
analyze:  0
deduce:  0
induce:  2
choose:  1
compare:  1
compute:  2
estimate:  0
```

```
integrate:  1
plan:  4
supervise:  4
monitor:  4
interpret:  1
facts:  0
principles:  1
procedures:  0
analogs:  0
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  1
articulation:  0
kr_hp:  0
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  3
test_equip:  0
advises:  0
answers:  0
communicates:  1
directs:  2
indicates:  3
informs:  0
instructs:  0
requests:  1
transmits:  2
supervises:  3
negotiates:  0
express_movement:  0
interp_movement:  0

name1:  program_mgmt
name2:  language_train
eq_count:  70
```

```
sim_count:  87

--------------------------------

statistical:  0
spatial:  0
temporal:  4
analogical:  3
case_based:  0
model_based:  0
mathematical:  0
deductive:  2
inductive:  2
means_ends:  1
sub_goals:  0
gen_and_test:  1
goal_vs_data:  0
cover_and_diff:  2
prop_and_ref:  1
acq_and_pres:  1
form_proc_alg:  3
decompose:  2
recombine:  4
generalize:  3
specialize:  1
ret_to_def:  3
visual:  0
verbal:  0
auditory:  0
kinesthetic:  0
written:  0
instrumentation:  4
mm_interface:  1
databases:  2
historical:  4
propadeutics:  2
branching:  1
dynamism:  3
constraints:  1
uncertainty:  0
high_low_tech:  0
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  0
calculate:  0
code:  0
computerize:  0
interpolate:  0
itemize:  2
learn:  1
tabulate:  0
translate:  4
analyze:  1
deduce:  2
induce:  2
choose:  2
compare:  1
compute:  0
estimate:  2
integrate:  0
```

```
plan:  0
supervise:  0
monitor:  0
interpret:  2
facts:  2
principles:  1
procedures:  2
analogs:  3
cases_examples:  0
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  4
prob_of_success:  1
articulation:  4
kr_hp:  0
computer:  0
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  0
test_equip:  0
advises:  2
answers:  1
communicates:  0
directs:  2
indicates:  4
informs:  2
instructs:  4
requests:  1
transmits:  2
supervises:  1
negotiates:  4
express_movement:  3
interp_movement:  3

name1:  program_mgmt
name2:  leadership
eq_count:  78
sim_count:  99
```

```
---------------------------------

statistical:  0
spatial:  0
temporal:  2
analogical:  1
case_based:  0
model_based:  0
mathematical:  0
deductive:  0
inductive:  2
means_ends:  0
sub_goals:  2
gen_and_test:  3
goal_vs_data:  0
cover_and_diff:  0
prop_and_ref:  0
acq_and_pres:  0
form_proc_alg:  0
decompose:  1
recombine:  0
generalize:  1
specialize:  0
ret_to_def:  3
visual:  0
verbal:  0
auditory:  0
kinesthetic:  0
written:  1
instrumentation:  0
mm_interface:  1
databases:  0
historical:  1
propadeutics:  2
branching:  1
dynamism:  1
constraints:  2
uncertainty:  2
high_low_tech:  0
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  0
calculate:  2
code:  0
computerize:  1
interpolate:  0
itemize:  1
learn:  3
tabulate:  0
translate:  0
analyze:  2
deduce:  0
induce:  1
choose:  0
compare:  1
compute:  1
estimate:  1
integrate:  2
plan:  1
```

```
supervise:  0
monitor:  4
interpret:  2
facts:  1
principles:  0
procedures:  0
analogs:  1
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  0
intro_accuracy:  4
prob_of_success:  2
articulation:  4
kr_hp:  0
computer:  0
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  2
test_equip:  0
advises:  4
answers:  1
communicates:  0
directs:  0
indicates:  2
informs:  2
instructs:  4
requests:  0
transmits:  1
supervises:  0
negotiates:  1
express_movement:  3
interp_movement:  3

name1:  program_mgmt
name2:  surgery
eq_count:  47
sim_count:  67
```

```
---------------------------------

statistical:  0
spatial:  4
temporal:  0
analogical:  1
case_based:  1
model_based:  3
mathematical:  0
deductive:  3
inductive:  2
means_ends:  4
sub_goals:  0
gen_and_test:  0
goal_vs_data:  0
cover_and_diff:  2
prop_and_ref:  3
acq_and_pres:  0
form_proc_alg:  1
decompose:  2
recombine:  0
generalize:  1
specialize:  3
ret_to_def:  2
visual:  4
verbal:  0
auditory:  2
kinesthetic:  4
written:  0
instrumentation:  4
mm_interface:  0
databases:  2
historical:  0
propadeutics:  1
branching:  2
dynamism:  1
constraints:  0
uncertainty:  1
high_low_tech:  1
quant_qual:  0
complex_cont:  4
compound:  2
reflex:  0
simple_disc:  4
fine:  4
gross:  4
repetitive:  4
categorize:  2
calculate:  0
code:  0
computerize:  0
interpolate:  0
itemize:  2
learn:  1
tabulate:  0
translate:  0
analyze:  2
deduce:  4
induce:  2
choose:  1
compare:  1
compute:  0
estimate:  1
integrate:  0
plan:  0
supervise:  0
```

```
monitor:  0
interpret:  2
facts:  2
principles:  1
procedures:  0
analogs:  0
cases_examples:  1
percep_speed:  2
search_rec_info:  0
id_obj_act_events:  4
scan_display:  0
acceleration:  0
confinement:  2
isolation:  0
contaminants:  1
electricity:  0
lighting:  2
magnetism:  0
noise:  0
fatigue:  3
mental_strain:  3
stress:  4
phys_strain:  3
preciseness:  4
cog_attent:  4
response_chaining:  2
attention_span:  4
sleep:  2
schedule:  4
boredom:  1
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  2
intro_accuracy:  0
prob_of_success:  3
articulation:  1
kr_hp:  2
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  4
notation:  4
test_equip:  3
advises:  3
answers:  0
communicates:  1
directs:  2
indicates:  3
informs:  0
instructs:  0
requests:  1
transmits:  2
supervises:  1
negotiates:  4
express_movement:  2
interp_movement:  0

name1:  program_mgmt
name2:  medical_diag
eq_count:  56
sim_count:  81

--------------------------------
```

```
statistical:  0
spatial:  3
temporal:  0
analogical:  0
case_based:  0
model_based:  2
mathematical:  0
deductive:  4
inductive:  2
means_ends:  1
sub_goals:  2
gen_and_test:  0
goal_vs_data:  1
cover_and_diff:  1
prop_and_ref:  1
acq_and_pres:  1
form_proc_alg:  1
decompose:  1
recombine:  0
generalize:  2
specialize:  2
ret_to_def:  1
visual:  4
verbal:  0
auditory:  2
kinesthetic:  1
written:  0
instrumentation:  4
mm_interface:  1
databases:  2
historical:  0
propadeutics:  1
branching:  2
dynamism:  1
constraints:  1
uncertainty:  0
high_low_tech:  1
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  1
gross:  1
repetitive:  0
categorize:  2
calculate:  0
code:  0
computerize:  0
interpolate:  0
itemize:  0
learn:  1
tabulate:  0
translate:  3
analyze:  2
deduce:  4
induce:  2
choose:  1
compare:  0
compute:  0
estimate:  0
integrate:  0
plan:  3
supervise:  4
monitor:  2
```

```
interpret:  2
facts:  2
principles:  1
procedures:  0
analogs:  0
cases_examples:  0
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  1
mental_strain:  2
stress:  3
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  1
schedule:  2
boredom:  1
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  2
intro_accuracy:  3
prob_of_success:  3
articulation:  3
kr_hp:  0
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  2
notation:  4
test_equip:  2
advises:  4
answers:  1
communicates:  0
directs:  2
indicates:  2
informs:  2
instructs:  1
requests:  2
transmits:  0
supervises:  2
negotiates:  4
express_movement:  2
interp_movement:  3

name1:  program_mgmt
name2:  accounting
eq_count:  76
sim_count:  93

--------------------------------
```

```
statistical:  0
spatial:  0
temporal:  1
analogical:  0
case_based:  1
model_based:  0
mathematical:  4
deductive:  0
inductive:  0
means_ends:  0
sub_goals:  1
gen_and_test:  0
goal_vs_data:  1
cover_and_diff:  0
prop_and_ref:  3
acq_and_pres:  1
form_proc_alg:  1
decompose:  0
recombine:  2
generalize:  0
specialize:  3
ret_to_def:  3
visual:  0
verbal:  1
auditory:  0
kinesthetic:  0
written:  0
instrumentation:  0
mm_interface:  3
databases:  2
historical:  0
propadeutics:  2
branching:  2
dynamism:  0
constraints:  1
uncertainty:  2
high_low_tech:  0
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  0
calculate:  4
code:  0
computerize:  4
interpolate:  0
itemize:  2
learn:  0
tabulate:  4
translate:  1
analyze:  2
deduce:  0
induce:  0
choose:  2
compare:  1
compute:  4
estimate:  2
integrate:  3
plan:  4
supervise:  4
monitor:  4
interpret:  0
```

```
facts:  1
principles:  1
procedures:  0
analogs:  0
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  4
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  2
intro_accuracy:  0
prob_of_success:  1
articulation:  0
kr_hp:  0
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  3
test_equip:  0
advises:  0
answers:  1
communicates:  0
directs:  2
indicates:  0
informs:  0
instructs:  0
requests:  2
transmits:  1
supervises:  3
negotiates:  4
express_movement:  0
interp_movement:  0

name1:  program_mgmt
name2:  protocol_des
eq_count:  71
sim_count:  92

--------------------------------

statistical:  2
```

```
spatial:  1
temporal:  0
analogical:  0
case_based:  1
model_based:  2
mathematical:  2
deductive:  0
inductive:  3
means_ends:  0
sub_goals:  0
gen_and_test:  4
goal_vs_data:  0
cover_and_diff:  0
prop_and_ref:  1
acq_and_pres:  1
form_proc_alg:  2
decompose:  2
recombine:  3
generalize:  3
specialize:  0
ret_to_def:  2
visual:  0
verbal:  0
auditory:  0
kinesthetic:  0
written:  1
instrumentation:  2
mm_interface:  1
databases:  2
historical:  0
propadeutics:  4
branching:  1
dynamism:  1
constraints:  2
uncertainty:  3
high_low_tech:  1
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  2
calculate:  3
code:  0
computerize:  0
interpolate:  1
itemize:  2
learn:  1
tabulate:  0
translate:  4
analyze:  2
deduce:  0
induce:  2
choose:  1
compare:  1
compute:  3
estimate:  0
integrate:  3
plan:  0
supervise:  3
monitor:  4
interpret:  2
facts:  1
```

```
principles:  0
procedures:  0
analogs:  0
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  2
intro_accuracy:  0
prob_of_success:  3
articulation:  3
kr_hp:  0
computer:  0
vehicles:  0
weapon_systems:  0
instruments:  4
notation:  0
test_equip:  1
advises:  0
answers:  0
communicates:  0
directs:  1
indicates:  0
informs:  1
instructs:  0
requests:  1
transmits:  1
supervises:  0
negotiates:  4
express_movement:  0
interp_movement:  0

name1:  drair_gen
name2:  cargo_loading
eq_count:  57
sim_count:  79

--------------------------------

statistical:  1
spatial:  4
```

```
temporal:  2
analogical:  1
case_based:  1
model_based:  1
mathematical:  3
deductive:  0
inductive:  4
means_ends:  3
sub_goals:  2
gen_and_test:  0
goal_vs_data:  0
cover_and_diff:  0
prop_and_ref:  0
acq_and_pres:  1
form_proc_alg:  1
decompose:  1
recombine:  2
generalize:  3
specialize:  2
ret_to_def:  2
visual:  3
verbal:  4
auditory:  0
kinesthetic:  0
written:  3
instrumentation:  0
mm_interface:  0
databases:  4
historical:  4
propadeutics:  2
branching:  1
dynamism:  1
constraints:  1
uncertainty:  2
high_low_tech:  1
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  2
calculate:  4
code:  0
computerize:  0
interpolate:  1
itemize:  0
learn:  0
tabulate:  1
translate:  2
analyze:  3
deduce:  0
induce:  4
choose:  2
compare:  2
compute:  4
estimate:  1
integrate:  4
plan:  4
supervise:  3
monitor:  4
interpret:  4
facts:  0
principles:  4
```

```
procedures:  1
analogs:  1
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  1
confinement:  2
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  3
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  1
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  2
general_health:  2
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  0
intro_accuracy:  0
prob_of_success:  0
articulation:  3
kr_hp:  0
computer:  4
vehicles:  2
weapon_systems:  0
instruments:  0
notation:  1
test_equip:  0
advises:  0
answers:  2
communicates:  1
directs:  3
indicates:  0
informs:  4
instructs:  0
requests:  0
transmits:  2
supervises:  4
negotiates:  0
express_movement:  2
interp_movement:  0

name1:  drair_gen
name2:  sw_design
eq_count:  72
sim_count:  95

---------------------------------

statistical:  1
spatial:  0
temporal:  2
```

```
analogical:  1
case_based:  2
model_based:  3
mathematical:  0
deductive:  1
inductive:  2
means_ends:  4
sub_goals:  2
gen_and_test:  4
goal_vs_data:  2
cover_and_diff:  0
prop_and_ref:  4
acq_and_pres:  0
form_proc_alg:  1
decompose:  3
recombine:  1
generalize:  1
specialize:  0
ret_to_def:  1
visual:  0
verbal:  0
auditory:  0
kinesthetic:  0
written:  3
instrumentation:  0
mm_interface:  0
databases:  4
historical:  4
propadeutics:  1
branching:  3
dynamism:  0
constraints:  1
uncertainty:  1
high_low_tech:  2
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  1
calculate:  0
code:  2
computerize:  2
interpolate:  1
itemize:  3
learn:  0
tabulate:  1
translate:  2
analyze:  0
deduce:  1
induce:  2
choose:  2
compare:  0
compute:  0
estimate:  0
integrate:  0
plan:  3
supervise:  1
monitor:  0
interpret:  1
facts:  1
principles:  3
procedures:  1
```

```
analogs:  1
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  0
articulation:  1
kr_hp:  0
computer:  0
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  3
test_equip:  0
advises:  0
answers:  4
communicates:  1
directs:  0
indicates:  0
informs:  4
instructs:  0
requests:  2
transmits:  0
supervises:  0
negotiates:  4
express_movement:  0
interp_movement:  0

name1:  drair_gen
name2:  form_fill_out
eq_count:  74
sim_count:  90

--------------------------------

statistical:  1
spatial:  0
temporal:  0
analogical:  1
```

```
case_based:  2
model_based:  0
mathematical:  1
deductive:  1
inductive:  2
means_ends:  2
sub_goals:  2
gen_and_test:  3
goal_vs_data:  0
cover_and_diff:  3
prop_and_ref:  2
acq_and_pres:  0
form_proc_alg:  1
decompose:  2
recombine:  0
generalize:  0
specialize:  0
ret_to_def:  2
visual:  0
verbal:  1
auditory:  0
kinesthetic:  0
written:  3
instrumentation:  0
mm_interface:  0
databases:  3
historical:  2
propadeutics:  2
branching:  0
dynamism:  0
constraints:  2
uncertainty:  2
high_low_tech:  1
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  2
calculate:  2
code:  0
computerize:  0
interpolate:  1
itemize:  3
learn:  1
tabulate:  0
translate:  2
analyze:  2
deduce:  1
induce:  2
choose:  4
compare:  0
compute:  2
estimate:  1
integrate:  3
plan:  0
supervise:  0
monitor:  0
interpret:  3
facts:  2
principles:  2
procedures:  1
analogs:  1
```

```
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  0
intro_accuracy:  0
prob_of_success:  0
articulation:  4
kr_hp:  0
computer:  0
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  2
test_equip:  0
advises:  0
answers:  1
communicates:  1
directs:  0
indicates:  3
informs:  2
instructs:  0
requests:  0
transmits:  2
supervises:  0
negotiates:  4
express_movement:  0
interp_movement:  0

name1:  drair_gen
name2:  language_train
eq_count:  65
sim_count:  82

---------------------------------

statistical:  1
spatial:  0
temporal:  2
analogical:  2
case_based:  2
```

```
model_based:  0
mathematical:  1
deductive:  1
inductive:  2
means_ends:  1
sub_goals:  2
gen_and_test:  1
goal_vs_data:  2
cover_and_diff:  2
prop_and_ref:  2
acq_and_pres:  0
form_proc_alg:  3
decompose:  3
recombine:  1
generalize:  0
specialize:  1
ret_to_def:  0
visual:  0
verbal:  0
auditory:  0
kinesthetic:  0
written:  3
instrumentation:  4
mm_interface:  0
databases:  4
historical:  4
propadeutics:  2
branching:  3
dynamism:  4
constraints:  3
uncertainty:  1
high_low_tech:  1
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  1
calculate:  0
code:  0
computerize:  0
interpolate:  1
itemize:  4
learn:  0
tabulate:  1
translate:  2
analyze:  1
deduce:  1
induce:  2
choose:  1
compare:  0
compute:  0
estimate:  3
integrate:  4
plan:  4
supervise:  4
monitor:  4
interpret:  0
facts:  0
principles:  4
procedures:  1
analogs:  2
cases_examples:  2
```

```
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  0
intro_accuracy:  4
prob_of_success:  2
articulation:  0
kr_hp:  0
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  1
test_equip:  0
advises:  2
answers:  0
communicates:  0
directs:  4
indicates:  4
informs:  0
instructs:  4
requests:  2
transmits:  2
supervises:  4
negotiates:  0
express_movement:  3
interp_movement:  3

name1:  drair_gen
name2:  leadership
eq_count:  67
sim_count:  89

---------------------------------

statistical:  1
spatial:  0
temporal:  0
analogical:  0
case_based:  2
model_based:  0
```

```
mathematical:  1
deductive:  1
inductive:  2
means_ends:  0
sub_goals:  0
gen_and_test:  3
goal_vs_data:  2
cover_and_diff:  0
prop_and_ref:  3
acq_and_pres:  1
form_proc_alg:  0
decompose:  2
recombine:  3
generalize:  2
specialize:  0
ret_to_def:  0
visual:  0
verbal:  0
auditory:  0
kinesthetic:  0
written:  2
instrumentation:  0
mm_interface:  0
databases:  2
historical:  1
propadeutics:  2
branching:  1
dynamism:  0
constraints:  0
uncertainty:  1
high_low_tech:  1
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  1
calculate:  2
code:  0
computerize:  1
interpolate:  1
itemize:  1
learn:  2
tabulate:  1
translate:  2
analyze:  0
deduce:  1
induce:  3
choose:  3
compare:  0
compute:  1
estimate:  2
integrate:  2
plan:  3
supervise:  4
monitor:  0
interpret:  4
facts:  1
principles:  3
procedures:  1
analogs:  0
cases_examples:  1
percep_speed:  0
```

```
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  4
prob_of_success:  3
articulation:  0
kr_hp:  0
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  1
test_equip:  0
advises:  4
answers:  2
communicates:  0
directs:  2
indicates:  2
informs:  0
instructs:  4
requests:  1
transmits:  1
supervises:  3
negotiates:  3
express_movement:  3
interp_movement:  3

name1:  drair_gen
name2:  surgery
eq_count:  36
sim_count:  54

----------------------------------

statistical:  1
spatial:  4
temporal:  2
analogical:  0
case_based:  1
model_based:  3
mathematical:  1
```

```
deductive:  2
inductive:  2
means_ends:  4
sub_goals:  2
gen_and_test:  0
goal_vs_data:  2
cover_and_diff:  2
prop_and_ref:  0
acq_and_pres:  1
form_proc_alg:  1
decompose:  3
recombine:  3
generalize:  2
specialize:  3
ret_to_def:  1
visual:  4
verbal:  0
auditory:  2
kinesthetic:  4
written:  3
instrumentation:  4
mm_interface:  1
databases:  4
historical:  0
propadeutics:  1
branching:  4
dynamism:  2
constraints:  2
uncertainty:  0
high_low_tech:  2
quant_qual:  0
complex_cont:  4
compound:  2
reflex:  0
simple_disc:  4
fine:  4
gross:  4
repetitive:  4
categorize:  3
calculate:  0
code:  0
computerize:  0
interpolate:  1
itemize:  4
learn:  2
tabulate:  1
translate:  2
analyze:  0
deduce:  3
induce:  2
choose:  4
compare:  0
compute:  0
estimate:  0
integrate:  4
plan:  4
supervise:  4
monitor:  4
interpret:  0
facts:  0
principles:  4
procedures:  1
analogs:  1
cases_examples:  1
percep_speed:  2
search_rec_info:  0
```

```
id_obj_act_events:  4
scan_display:  0
acceleration:  0
confinement:  2
isolation:  0
contaminants:  1
electricity:  0
lighting:  2
magnetism:  0
noise:  0
fatigue:  3
mental_strain:  3
stress:  4
phys_strain:  3
preciseness:  4
cog_attent:  4
response_chaining:  2
attention_span:  4
sleep:  2
schedule:  4
boredom:  1
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  4
articulation:  3
kr_hp:  2
computer:  4
vehicles:  0
weapon_systems:  0
instruments:  4
notation:  3
test_equip:  3
advises:  3
answers:  1
communicates:  1
directs:  4
indicates:  3
informs:  2
instructs:  0
requests:  0
transmits:  2
supervises:  4
negotiates:  0
express_movement:  2
interp_movement:  0

name1:  drair_gen
name2:  medical_diag
eq_count:  50
sim_count:  81

---------------------------------

statistical:  1
spatial:  3
temporal:  2
analogical:  1
case_based:  2
model_based:  2
mathematical:  1
deductive:  3
```

```
inductive:  2
means_ends:  1
sub_goals:  0
gen_and_test:  0
goal_vs_data:  1
cover_and_diff:  1
prop_and_ref:  4
acq_and_pres:  0
form_proc_alg:  1
decompose:  2
recombine:  3
generalize:  1
specialize:  2
ret_to_def:  2
visual:  4
verbal:  0
auditory:  2
kinesthetic:  1
written:  3
instrumentation:  4
mm_interface:  0
databases:  4
historical:  0
propadeutics:  1
branching:  4
dynamism:  0
constraints:  1
uncertainty:  1
high_low_tech:  2
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  1
gross:  1
repetitive:  0
categorize:  3
calculate:  0
code:  0
computerize:  0
interpolate:  1
itemize:  2
learn:  2
tabulate:  1
translate:  1
analyze:  0
deduce:  3
induce:  2
choose:  4
compare:  1
compute:  0
estimate:  1
integrate:  4
plan:  1
supervise:  0
monitor:  2
interpret:  0
facts:  0
principles:  4
procedures:  1
analogs:  1
cases_examples:  2
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
```

```
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  1
mental_strain:  2
stress:  3
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  1
schedule:  2
boredom:  1
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  3
prob_of_success:  4
articulation:  1
kr_hp:  0
computer:  4
vehicles:  0
weapon_systems:  0
instruments:  2
notation:  3
test_equip:  2
advises:  4
answers:  0
communicates:  0
directs:  4
indicates:  2
informs:  0
instructs:  1
requests:  1
transmits:  0
supervises:  1
negotiates:  0
express_movement:  2
interp_movement:  3

name1:  drair_gen
name2:  accounting
eq_count:  72
sim_count:  101

---------------------------------

statistical:  1
spatial:  0
temporal:  1
analogical:  1
case_based:  1
model_based:  0
mathematical:  3
deductive:  1
inductive:  4
```

```
means_ends:  0
sub_goals:  1
gen_and_test:  0
goal_vs_data:  1
cover_and_diff:  0
prop_and_ref:  0
acq_and_pres:  0
form_proc_alg:  1
decompose:  1
recombine:  1
generalize:  3
specialize:  3
ret_to_def:  0
visual:  0
verbal:  1
auditory:  0
kinesthetic:  0
written:  3
instrumentation:  0
mm_interface:  4
databases:  0
historical:  0
propadeutics:  2
branching:  0
dynamism:  1
constraints:  1
uncertainty:  1
high_low_tech:  1
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  1
calculate:  4
code:  0
computerize:  4
interpolate:  1
itemize:  0
learn:  1
tabulate:  3
translate:  1
analyze:  4
deduce:  1
induce:  4
choose:  1
compare:  0
compute:  4
estimate:  3
integrate:  1
plan:  0
supervise:  0
monitor:  0
interpret:  2
facts:  3
principles:  2
procedures:  1
analogs:  1
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
```

```
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  4
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  0
articulation:  4
kr_hp:  0
computer:  0
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  2
test_equip:  0
advises:  0
answers:  2
communicates:  0
directs:  0
indicates:  0
informs:  2
instructs:  0
requests:  1
transmits:  1
supervises:  0
negotiates:  0
express_movement:  0
interp_movement:  0

name1:  drair_gen
name2:  protocol_des
eq_count:  69
sim_count:  93

--------------------------------

statistical:  1
spatial:  1
temporal:  2
analogical:  1
case_based:  3
model_based:  2
mathematical:  1
deductive:  1
inductive:  1
means_ends:  0
```

```
sub_goals:  2
gen_and_test:  4
goal_vs_data:  2
cover_and_diff:  0
prop_and_ref:  4
acq_and_pres:  0
form_proc_alg:  2
decompose:  3
recombine:  0
generalize:  0
specialize:  0
ret_to_def:  1
visual:  0
verbal:  0
auditory:  0
kinesthetic:  0
written:  2
instrumentation:  2
mm_interface:  0
databases:  4
historical:  0
propadeutics:  4
branching:  1
dynamism:  0
constraints:  0
uncertainty:  2
high_low_tech:  2
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  3
calculate:  3
code:  0
computerize:  0
interpolate:  0
itemize:  0
learn:  0
tabulate:  1
translate:  2
analyze:  4
deduce:  1
induce:  2
choose:  4
compare:  0
compute:  3
estimate:  1
integrate:  1
plan:  4
supervise:  1
monitor:  0
interpret:  0
facts:  1
principles:  3
procedures:  1
analogs:  1
cases_examples:  3
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
```

```
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  4
articulation:  1
kr_hp:  0
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  4
notation:  1
test_equip:  1
advises:  0
answers:  1
communicates:  0
directs:  3
indicates:  0
informs:  1
instructs:  0
requests:  0
transmits:  1
supervises:  3
negotiates:  0
express_movement:  0
interp_movement:  0

name1:  cargo_loading
name2:  sw_design
eq_count:  59
sim_count:  78

---------------------------------

statistical:  0
spatial:  4
temporal:  0
analogical:  0
case_based:  1
model_based:  2
mathematical:  3
deductive:  1
inductive:  2
means_ends:  1
sub_goals:  0
```

```
gen_and_test:  4
goal_vs_data:  2
cover_and_diff:  0
prop_and_ref:  4
acq_and_pres:  1
form_proc_alg:  2
decompose:  2
recombine:  3
generalize:  2
specialize:  2
ret_to_def:  1
visual:  3
verbal:  4
auditory:  0
kinesthetic:  0
written:  0
instrumentation:  0
mm_interface:  0
databases:  0
historical:  0
propadeutics:  1
branching:  2
dynamism:  1
constraints:  0
uncertainty:  1
high_low_tech:  1
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  1
calculate:  4
code:  2
computerize:  2
interpolate:  2
itemize:  3
learn:  0
tabulate:  0
translate:  4
analyze:  3
deduce:  1
induce:  2
choose:  0
compare:  2
compute:  4
estimate:  1
integrate:  4
plan:  1
supervise:  2
monitor:  4
interpret:  3
facts:  1
principles:  1
procedures:  0
analogs:  2
cases_examples:  0
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  1
confinement:  2
```

```
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  3
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  1
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  2
general_health:  2
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  0
articulation:  2
kr_hp:  0
computer:  4
vehicles:  2
weapon_systems:  0
instruments:  0
notation:  2
test_equip:  0
advises:  0
answers:  2
communicates:  0
directs:  3
indicates:  0
informs:  0
instructs:  0
requests:  2
transmits:  2
supervises:  4
negotiates:  4
express_movement:  2
interp_movement:  0

name1:  cargo_loading
name2:  form_fill_out
eq_count:  61
sim_count:  83

---------------------------------

statistical:  0
spatial:  4
temporal:  2
analogical:  2
case_based:  1
model_based:  1
mathematical:  2
deductive:  1
inductive:  2
means_ends:  1
sub_goals:  0
gen_and_test:  3
```

```
goal_vs_data:  0
cover_and_diff:  3
prop_and_ref:  2
acq_and_pres:  1
form_proc_alg:  0
decompose:  1
recombine:  2
generalize:  3
specialize:  2
ret_to_def:  0
visual:  3
verbal:  3
auditory:  0
kinesthetic:  0
written:  0
instrumentation:  0
mm_interface:  0
databases:  1
historical:  2
propadeutics:  0
branching:  1
dynamism:  1
constraints:  1
uncertainty:  0
high_low_tech:  0
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  0
calculate:  2
code:  0
computerize:  0
interpolate:  0
itemize:  3
learn:  1
tabulate:  1
translate:  0
analyze:  1
deduce:  1
induce:  2
choose:  2
compare:  2
compute:  2
estimate:  2
integrate:  1
plan:  4
supervise:  3
monitor:  4
interpret:  1
facts:  2
principles:  2
procedures:  2
analogs:  0
cases_examples:  0
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  1
confinement:  2
isolation:  0
```

```
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  3
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  1
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  2
general_health:  2
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  0
intro_accuracy:  0
prob_of_success:  0
articulation:  1
kr_hp:  0
computer:  4
vehicles:  2
weapon_systems:  0
instruments:  0
notation:  1
test_equip:  0
advises:  0
answers:  1
communicates:  0
directs:  3
indicates:  3
informs:  2
instructs:  0
requests:  0
transmits:  4
supervises:  4
negotiates:  4
express_movement:  2
interp_movement:  0

name1:  cargo_loading
name2:  language_train
eq_count:  56
sim_count:  73

--------------------------------

statistical:  0
spatial:  4
temporal:  4
analogical:  3
case_based:  1
model_based:  1
mathematical:  4
deductive:  1
inductive:  2
means_ends:  2
sub_goals:  0
gen_and_test:  1
goal_vs_data:  2
```

```
cover_and_diff:  2
prop_and_ref:  2
acq_and_pres:  1
form_proc_alg:  4
decompose:  2
recombine:  3
generalize:  3
specialize:  1
ret_to_def:  2
visual:  3
verbal:  4
auditory:  0
kinesthetic:  0
written:  0
instrumentation:  4
mm_interface:  0
databases:  0
historical:  0
propadeutics:  0
branching:  2
dynamism:  3
constraints:  2
uncertainty:  3
high_low_tech:  0
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  1
calculate:  4
code:  0
computerize:  0
interpolate:  2
itemize:  4
learn:  0
tabulate:  0
translate:  4
analyze:  2
deduce:  1
induce:  2
choose:  1
compare:  2
compute:  4
estimate:  4
integrate:  0
plan:  0
supervise:  1
monitor:  0
interpret:  4
facts:  0
principles:  0
procedures:  0
analogs:  3
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  1
confinement:  2
isolation:  0
contaminants:  0
```

```
electricity:  0
lighting:  0
magnetism:  0
noise:  3
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  1
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  2
general_health:  2
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  0
intro_accuracy:  4
prob_of_success:  2
articulation:  3
kr_hp:  0
computer:  2
vehicles:  2
weapon_systems:  0
instruments:  0
notation:  2
test_equip:  0
advises:  2
answers:  2
communicates:  1
directs:  1
indicates:  4
informs:  4
instructs:  4
requests:  2
transmits:  4
supervises:  0
negotiates:  0
express_movement:  1
interp_movement:  3

name1:  cargo_loading
name2:  leadership
eq_count:  50
sim_count:  82

---------------------------------

statistical:  0
spatial:  4
temporal:  2
analogical:  1
case_based:  1
model_based:  1
mathematical:  4
deductive:  1
inductive:  2
means_ends:  3
sub_goals:  2
gen_and_test:  3
goal_vs_data:  2
cover_and_diff:  0
```

```
prop_and_ref:  3
acq_and_pres:  0
form_proc_alg:  1
decompose:  1
recombine:  1
generalize:  1
specialize:  2
ret_to_def:  2
visual:  3
verbal:  4
auditory:  0
kinesthetic:  0
written:  1
instrumentation:  0
mm_interface:  0
databases:  2
historical:  3
propadeutics:  0
branching:  0
dynamism:  1
constraints:  1
uncertainty:  1
high_low_tech:  0
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  1
calculate:  2
code:  0
computerize:  1
interpolate:  2
itemize:  1
learn:  2
tabulate:  0
translate:  0
analyze:  3
deduce:  1
induce:  1
choose:  1
compare:  2
compute:  3
estimate:  3
integrate:  2
plan:  1
supervise:  1
monitor:  4
interpret:  0
facts:  1
principles:  1
procedures:  2
analogs:  1
cases_examples:  0
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  1
confinement:  2
isolation:  0
contaminants:  0
electricity:  0
```

```
lighting:  0
magnetism:  0
noise:  3
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  1
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  2
general_health:  2
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  4
prob_of_success:  3
articulation:  3
kr_hp:  0
computer:  2
vehicles:  2
weapon_systems:  0
instruments:  0
notation:  0
test_equip:  0
advises:  4
answers:  0
communicates:  1
directs:  1
indicates:  2
informs:  4
instructs:  4
requests:  1
transmits:  3
supervises:  1
negotiates:  3
express_movement:  1
interp_movement:  3

name1:  cargo_loading
name2:  surgery
eq_count:  45
sim_count:  67

---------------------------------

statistical:  0
spatial:  0
temporal:  0
analogical:  1
case_based:  0
model_based:  2
mathematical:  4
deductive:  2
inductive:  2
means_ends:  1
sub_goals:  0
gen_and_test:  0
goal_vs_data:  2
cover_and_diff:  2
prop_and_ref:  0
```

```
acq_and_pres:  0
form_proc_alg:  0
decompose:  2
recombine:  1
generalize:  1
specialize:  1
ret_to_def:  1
visual:  1
verbal:  4
auditory:  2
kinesthetic:  4
written:  0
instrumentation:  4
mm_interface:  1
databases:  0
historical:  4
propadeutics:  1
branching:  3
dynamism:  1
constraints:  1
uncertainty:  2
high_low_tech:  1
quant_qual:  1
complex_cont:  4
compound:  2
reflex:  0
simple_disc:  4
fine:  4
gross:  4
repetitive:  4
categorize:  1
calculate:  4
code:  0
computerize:  0
interpolate:  2
itemize:  4
learn:  2
tabulate:  0
translate:  0
analyze:  3
deduce:  3
induce:  2
choose:  2
compare:  2
compute:  4
estimate:  1
integrate:  0
plan:  0
supervise:  1
monitor:  0
interpret:  4
facts:  0
principles:  0
procedures:  2
analogs:  0
cases_examples:  0
percep_speed:  2
search_rec_info:  0
id_obj_act_events:  4
scan_display:  0
acceleration:  1
confinement:  0
isolation:  0
contaminants:  1
electricity:  0
lighting:  2
```

```
magnetism:  0
noise:  3
fatigue:  3
mental_strain:  3
stress:  4
phys_strain:  2
preciseness:  4
cog_attent:  4
response_chaining:  2
attention_span:  4
sleep:  2
schedule:  4
boredom:  1
general_health:  2
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  4
articulation:  0
kr_hp:  2
computer:  0
vehicles:  2
weapon_systems:  0
instruments:  4
notation:  2
test_equip:  3
advises:  3
answers:  1
communicates:  0
directs:  1
indicates:  3
informs:  2
instructs:  0
requests:  0
transmits:  0
supervises:  0
negotiates:  0
express_movement:  0
interp_movement:  0

name1:  cargo_loading
name2:  medical_diag
eq_count:  45
sim_count:  73

--------------------------------

statistical:  0
spatial:  1
temporal:  0
analogical:  0
case_based:  1
model_based:  1
mathematical:  4
deductive:  3
inductive:  2
means_ends:  2
sub_goals:  2
gen_and_test:  0
goal_vs_data:  1
cover_and_diff:  1
prop_and_ref:  4
acq_and_pres:  1
```

```
form_proc_alg:  2
decompose:  1
recombine:  1
generalize:  2
specialize:  0
ret_to_def:  0
visual:  1
verbal:  4
auditory:  2
kinesthetic:  1
written:  0
instrumentation:  4
mm_interface:  0
databases:  0
historical:  4
propadeutics:  1
branching:  3
dynamism:  1
constraints:  0
uncertainty:  3
high_low_tech:  1
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  1
gross:  1
repetitive:  0
categorize:  1
calculate:  4
code:  0
computerize:  0
interpolate:  2
itemize:  2
learn:  2
tabulate:  0
translate:  3
analyze:  3
deduce:  3
induce:  2
choose:  2
compare:  1
compute:  4
estimate:  2
integrate:  0
plan:  3
supervise:  3
monitor:  2
interpret:  4
facts:  0
principles:  0
procedures:  2
analogs:  0
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  1
confinement:  2
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
```

```
noise:  3
fatigue:  1
mental_strain:  2
stress:  3
phys_strain:  1
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  1
schedule:  2
boredom:  1
general_health:  2
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  3
prob_of_success:  4
articulation:  2
kr_hp:  0
computer:  0
vehicles:  2
weapon_systems:  0
instruments:  2
notation:  2
test_equip:  2
advises:  4
answers:  2
communicates:  1
directs:  1
indicates:  2
informs:  4
instructs:  1
requests:  1
transmits:  2
supervises:  3
negotiates:  0
express_movement:  0
interp_movement:  3

name1:  cargo_loading
name2:  accounting
eq_count:  66
sim_count:  89

--------------------------------

statistical:  0
spatial:  4
temporal:  1
analogical:  0
case_based:  0
model_based:  1
mathematical:  0
deductive:  1
inductive:  0
means_ends:  3
sub_goals:  1
gen_and_test:  0
goal_vs_data:  1
cover_and_diff:  0
prop_and_ref:  0
acq_and_pres:  1
form_proc_alg:  0
```

```
decompose:  0
recombine:  1
generalize:  0
specialize:  1
ret_to_def:  2
visual:  3
verbal:  3
auditory:  0
kinesthetic:  0
written:  0
instrumentation:  0
mm_interface:  4
databases:  4
historical:  4
propadeutics:  0
branching:  1
dynamism:  0
constraints:  0
uncertainty:  1
high_low_tech:  0
quant_qual:  2
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  1
calculate:  0
code:  0
computerize:  4
interpolate:  2
itemize:  0
learn:  1
tabulate:  4
translate:  1
analyze:  1
deduce:  1
induce:  0
choose:  1
compare:  2
compute:  0
estimate:  4
integrate:  3
plan:  4
supervise:  3
monitor:  4
interpret:  2
facts:  3
principles:  2
procedures:  2
analogs:  0
cases_examples:  0
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  1
confinement:  2
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  3
```

```
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  1
preciseness:  4
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  2
general_health:  2
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  0
articulation:  1
kr_hp:  0
computer:  4
vehicles:  2
weapon_systems:  0
instruments:  0
notation:  1
test_equip:  0
advises:  0
answers:  0
communicates:  1
directs:  3
indicates:  0
informs:  2
instructs:  0
requests:  1
transmits:  3
supervises:  4
negotiates:  0
express_movement:  2
interp_movement:  0

name1:  cargo_loading
name2:  protocol_des
eq_count:  57
sim_count:  80

---------------------------------

statistical:  2
spatial:  3
temporal:  0
analogical:  0
case_based:  2
model_based:  1
mathematical:  2
deductive:  1
inductive:  3
means_ends:  3
sub_goals:  0
gen_and_test:  4
goal_vs_data:  2
cover_and_diff:  0
prop_and_ref:  4
acq_and_pres:  1
form_proc_alg:  3
decompose:  2
```

```
recombine:  2
generalize:  3
specialize:  2
ret_to_def:  1
visual:  3
verbal:  4
auditory:  0
kinesthetic:  0
written:  1
instrumentation:  2
mm_interface:  0
databases:  0
historical:  4
propadeutics:  2
branching:  0
dynamism:  1
constraints:  1
uncertainty:  0
high_low_tech:  1
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  1
calculate:  1
code:  0
computerize:  0
interpolate:  1
itemize:  0
learn:  0
tabulate:  0
translate:  4
analyze:  1
deduce:  1
induce:  2
choose:  2
compare:  2
compute:  1
estimate:  2
integrate:  3
plan:  0
supervise:  2
monitor:  4
interpret:  4
facts:  1
principles:  1
procedures:  2
analogs:  0
cases_examples:  2
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  1
confinement:  2
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  3
fatigue:  0
```

```
mental_strain:  0
stress:  0
phys_strain:  1
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  2
general_health:  2
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  4
articulation:  2
kr_hp:  0
computer:  2
vehicles:  2
weapon_systems:  0
instruments:  4
notation:  2
test_equip:  1
advises:  0
answers:  1
communicates:  1
directs:  0
indicates:  0
informs:  3
instructs:  0
requests:  0
transmits:  3
supervises:  1
negotiates:  0
express_movement:  2
interp_movement:  0

name1:  sw_design
name2:  form_fill_out
eq_count:  73
sim_count:  94

--------------------------------

statistical:  0
spatial:  0
temporal:  2
analogical:  2
case_based:  0
model_based:  3
mathematical:  1
deductive:  0
inductive:  0
means_ends:  2
sub_goals:  0
gen_and_test:  1
goal_vs_data:  2
cover_and_diff:  3
prop_and_ref:  2
acq_and_pres:  0
form_proc_alg:  2
decompose:  1
recombine:  1
```

```
generalize:  1
specialize:  0
ret_to_def:  1
visual:  0
verbal:  1
auditory:  0
kinesthetic:  0
written:  0
instrumentation:  0
mm_interface:  0
databases:  1
historical:  2
propadeutics:  1
branching:  3
dynamism:  0
constraints:  1
uncertainty:  1
high_low_tech:  1
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  1
calculate:  2
code:  2
computerize:  2
interpolate:  2
itemize:  0
learn:  1
tabulate:  1
translate:  4
analyze:  2
deduce:  0
induce:  0
choose:  2
compare:  0
compute:  2
estimate:  1
integrate:  3
plan:  3
supervise:  1
monitor:  0
interpret:  2
facts:  1
principles:  1
procedures:  2
analogs:  2
cases_examples:  0
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
```

```
stress:  0
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  0
articulation:  3
kr_hp:  0
computer:  0
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  1
test_equip:  0
advises:  0
answers:  3
communicates:  0
directs:  0
indicates:  3
informs:  2
instructs:  0
requests:  2
transmits:  2
supervises:  0
negotiates:  0
express_movement:  0
interp_movement:  0

name1:  sw_design
name2:  language_train
eq_count:  69
sim_count:  87

---------------------------------

statistical:  0
spatial:  0
temporal:  4
analogical:  3
case_based:  0
model_based:  3
mathematical:  1
deductive:  2
inductive:  0
means_ends:  3
sub_goals:  0
gen_and_test:  3
goal_vs_data:  0
cover_and_diff:  2
prop_and_ref:  2
acq_and_pres:  0
form_proc_alg:  2
decompose:  0
recombine:  0
generalize:  1
```

```
specialize:  1
ret_to_def:  1
visual:  0
verbal:  0
auditory:  0
kinesthetic:  0
written:  0
instrumentation:  4
mm_interface:  0
databases:  0
historical:  0
propadeutics:  1
branching:  0
dynamism:  4
constraints:  2
uncertainty:  2
high_low_tech:  1
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  0
calculate:  0
code:  2
computerize:  2
interpolate:  0
itemize:  1
learn:  0
tabulate:  0
translate:  0
analyze:  1
deduce:  2
induce:  0
choose:  1
compare:  0
compute:  0
estimate:  3
integrate:  4
plan:  1
supervise:  3
monitor:  4
interpret:  1
facts:  1
principles:  1
procedures:  0
analogs:  1
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
```

```
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  4
prob_of_success:  2
articulation:  1
kr_hp:  0
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  4
test_equip:  0
advises:  2
answers:  4
communicates:  1
directs:  4
indicates:  4
informs:  4
instructs:  4
requests:  4
transmits:  2
supervises:  4
negotiates:  4
express_movement:  3
interp_movement:  3

name1:  sw_design
name2:  leadership
eq_count:  68
sim_count:  90

--------------------------------

statistical:  0
spatial:  0
temporal:  2
analogical:  1
case_based:  0
model_based:  3
mathematical:  1
deductive:  0
inductive:  0
means_ends:  4
sub_goals:  2
gen_and_test:  1
goal_vs_data:  0
cover_and_diff:  0
prop_and_ref:  1
acq_and_pres:  1
form_proc_alg:  1
decompose:  1
recombine:  4
generalize:  1
specialize:  0
```

```
ret_to_def:  1
visual:  0
verbal:  0
auditory:  0
kinesthetic:  0
written:  1
instrumentation:  0
mm_interface:  0
databases:  2
historical:  3
propadeutics:  1
branching:  2
dynamism:  0
constraints:  1
uncertainty:  0
high_low_tech:  1
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  0
calculate:  2
code:  2
computerize:  1
interpolate:  0
itemize:  2
learn:  2
tabulate:  0
translate:  4
analyze:  0
deduce:  0
induce:  1
choose:  1
compare:  0
compute:  1
estimate:  2
integrate:  2
plan:  0
supervise:  3
monitor:  0
interpret:  3
facts:  0
principles:  0
procedures:  2
analogs:  1
cases_examples:  0
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
```

```
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  2
intro_accuracy:  4
prob_of_success:  3
articulation:  1
kr_hp:  0
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  2
test_equip:  0
advises:  4
answers:  2
communicates:  1
directs:  2
indicates:  2
informs:  4
instructs:  4
requests:  3
transmits:  1
supervises:  3
negotiates:  1
express_movement:  3
interp_movement:  3

name1:  sw_design
name2:  surgery
eq_count:  45
sim_count:  61

---------------------------------

statistical:  0
spatial:  4
temporal:  0
analogical:  1
case_based:  1
model_based:  0
mathematical:  1
deductive:  3
inductive:  0
means_ends:  0
sub_goals:  0
gen_and_test:  4
goal_vs_data:  0
cover_and_diff:  2
prop_and_ref:  4
acq_and_pres:  1
form_proc_alg:  2
decompose:  0
recombine:  4
generalize:  1
specialize:  3
ret_to_def:  0
```

```
visual:  4
verbal:  0
auditory:  2
kinesthetic:  4
written:  0
instrumentation:  4
mm_interface:  1
databases:  0
historical:  4
propadeutics:  0
branching:  1
dynamism:  2
constraints:  1
uncertainty:  1
high_low_tech:  0
quant_qual:  0
complex_cont:  4
compound:  2
reflex:  0
simple_disc:  4
fine:  4
gross:  4
repetitive:  4
categorize:  2
calculate:  0
code:  2
computerize:  2
interpolate:  0
itemize:  1
learn:  2
tabulate:  0
translate:  4
analyze:  0
deduce:  4
induce:  0
choose:  2
compare:  0
compute:  0
estimate:  0
integrate:  4
plan:  1
supervise:  3
monitor:  4
interpret:  1
facts:  1
principles:  1
procedures:  2
analogs:  2
cases_examples:  0
percep_speed:  2
search_rec_info:  0
id_obj_act_events:  4
scan_display:  0
acceleration:  0
confinement:  2
isolation:  0
contaminants:  1
electricity:  0
lighting:  2
magnetism:  0
noise:  0
fatigue:  3
mental_strain:  3
stress:  4
phys_strain:  3
preciseness:  4
```

```
cog_attent:  4
response_chaining:  2
attention_span:  4
sleep:  2
schedule:  4
boredom:  1
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  0
intro_accuracy:  0
prob_of_success:  4
articulation:  2
kr_hp:  2
computer:  4
vehicles:  0
weapon_systems:  0
instruments:  4
notation:  0
test_equip:  3
advises:  3
answers:  3
communicates:  0
directs:  4
indicates:  3
informs:  2
instructs:  0
requests:  2
transmits:  2
supervises:  4
negotiates:  4
express_movement:  2
interp_movement:  0

name1:  sw_design
name2:  medical_diag
eq_count:  57
sim_count:  84

---------------------------------

statistical:  0
spatial:  3
temporal:  0
analogical:  0
case_based:  0
model_based:  1
mathematical:  1
deductive:  4
inductive:  0
means_ends:  3
sub_goals:  2
gen_and_test:  4
goal_vs_data:  1
cover_and_diff:  1
prop_and_ref:  0
acq_and_pres:  0
form_proc_alg:  0
decompose:  1
recombine:  4
generalize:  0
specialize:  2
ret_to_def:  1
visual:  4
```

```
verbal:  0
auditory:  2
kinesthetic:  1
written:  0
instrumentation:  4
mm_interface:  0
databases:  0
historical:  4
propadeutics:  0
branching:  1
dynamism:  0
constraints:  0
uncertainty:  2
high_low_tech:  0
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  1
gross:  1
repetitive:  0
categorize:  2
calculate:  0
code:  2
computerize:  2
interpolate:  0
itemize:  1
learn:  2
tabulate:  0
translate:  1
analyze:  0
deduce:  4
induce:  0
choose:  2
compare:  1
compute:  0
estimate:  1
integrate:  4
plan:  2
supervise:  1
monitor:  2
interpret:  1
facts:  1
principles:  1
procedures:  2
analogs:  2
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  1
mental_strain:  2
stress:  3
phys_strain:  0
preciseness:  0
cog_attent:  0
```

```
response_chaining:  0
attention_span:  0
sleep:  1
schedule:  2
boredom:  1
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  0
intro_accuracy:  3
prob_of_success:  4
articulation:  0
kr_hp:  0
computer:  4
vehicles:  0
weapon_systems:  0
instruments:  2
notation:  0
test_equip:  2
advises:  4
answers:  4
communicates:  1
directs:  4
indicates:  2
informs:  4
instructs:  1
requests:  1
transmits:  0
supervises:  1
negotiates:  4
express_movement:  2
interp_movement:  3

name1:  sw_design
name2:  accounting
eq_count:  69
sim_count:  89

---------------------------------

statistical:  0
spatial:  0
temporal:  1
analogical:  0
case_based:  1
model_based:  3
mathematical:  3
deductive:  0
inductive:  2
means_ends:  4
sub_goals:  1
gen_and_test:  4
goal_vs_data:  1
cover_and_diff:  0
prop_and_ref:  4
acq_and_pres:  0
form_proc_alg:  2
decompose:  2
recombine:  2
generalize:  2
specialize:  3
ret_to_def:  1
visual:  0
verbal:  1
```

```
auditory:  0
kinesthetic:  0
written:  0
instrumentation:  0
mm_interface:  4
databases:  4
historical:  4
propadeutics:  1
branching:  3
dynamism:  1
constraints:  0
uncertainty:  0
high_low_tech:  1
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  0
calculate:  4
code:  2
computerize:  2
interpolate:  0
itemize:  3
learn:  1
tabulate:  4
translate:  3
analyze:  4
deduce:  0
induce:  2
choose:  1
compare:  0
compute:  4
estimate:  3
integrate:  1
plan:  3
supervise:  1
monitor:  0
interpret:  1
facts:  2
principles:  1
procedures:  2
analogs:  2
cases_examples:  0
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  4
cog_attent:  0
response_chaining:  0
```

```
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  0
intro_accuracy:  0
prob_of_success:  0
articulation:  3
kr_hp:  0
computer:  0
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  1
test_equip:  0
advises:  0
answers:  2
communicates:  1
directs:  0
indicates:  0
informs:  2
instructs:  0
requests:  1
transmits:  1
supervises:  0
negotiates:  4
express_movement:  0
interp_movement:  0

name1:  sw_design
name2:  protocol_des
eq_count:  76
sim_count:  96

---------------------------------

statistical:  2
spatial:  1
temporal:  0
analogical:  0
case_based:  1
model_based:  1
mathematical:  1
deductive:  0
inductive:  1
means_ends:  4
sub_goals:  0
gen_and_test:  0
goal_vs_data:  0
cover_and_diff:  0
prop_and_ref:  0
acq_and_pres:  0
form_proc_alg:  1
decompose:  0
recombine:  1
generalize:  1
specialize:  0
ret_to_def:  0
visual:  0
verbal:  0
auditory:  0
```

```
kinesthetic:  0
written:  1
instrumentation:  2
mm_interface:  0
databases:  0
historical:  4
propadeutics:  3
branching:  2
dynamism:  0
constraints:  1
uncertainty:  1
high_low_tech:  0
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  2
calculate:  3
code:  2
computerize:  2
interpolate:  1
itemize:  3
learn:  0
tabulate:  0
translate:  0
analyze:  4
deduce:  0
induce:  0
choose:  2
compare:  0
compute:  3
estimate:  1
integrate:  1
plan:  1
supervise:  0
monitor:  0
interpret:  1
facts:  0
principles:  0
procedures:  2
analogs:  2
cases_examples:  2
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
```

```
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  0
intro_accuracy:  0
prob_of_success:  4
articulation:  0
kr_hp:  0
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  4
notation:  4
test_equip:  1
advises:  0
answers:  3
communicates:  1
directs:  3
indicates:  0
informs:  3
instructs:  0
requests:  2
transmits:  1
supervises:  3
negotiates:  4
express_movement:  0
interp_movement:  0

name1:  form_fill_out
name2:  language_train
eq_count:  63
sim_count:  82

--------------------------------

statistical:  0
spatial:  0
temporal:  2
analogical:  1
case_based:  0
model_based:  0
mathematical:  2
deductive:  2
inductive:  0
means_ends:  1
sub_goals:  0
gen_and_test:  2
goal_vs_data:  2
cover_and_diff:  1
prop_and_ref:  0
acq_and_pres:  0
form_proc_alg:  4
decompose:  1
recombine:  1
generalize:  0
specialize:  1
ret_to_def:  2
visual:  0
verbal:  1
auditory:  0
kinesthetic:  0
```

```
written:  0
instrumentation:  4
mm_interface:  0
databases:  1
historical:  2
propadeutics:  0
branching:  3
dynamism:  4
constraints:  1
uncertainty:  3
high_low_tech:  0
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  1
calculate:  2
code:  0
computerize:  0
interpolate:  2
itemize:  1
learn:  1
tabulate:  1
translate:  4
analyze:  1
deduce:  2
induce:  0
choose:  3
compare:  0
compute:  2
estimate:  2
integrate:  1
plan:  4
supervise:  4
monitor:  4
interpret:  3
facts:  2
principles:  2
procedures:  2
analogs:  3
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
```

```
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  0
intro_accuracy:  4
prob_of_success:  2
articulation:  4
kr_hp:  0
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  3
test_equip:  0
advises:  2
answers:  1
communicates:  1
directs:  4
indicates:  1
informs:  2
instructs:  4
requests:  2
transmits:  0
supervises:  4
negotiates:  4
express_movement:  3
interp_movement:  3

name1:  form_fill_out
name2:  leadership
eq_count:  67
sim_count:  98

----------------------------------

statistical:  0
spatial:  0
temporal:  0
analogical:  1
case_based:  0
model_based:  0
mathematical:  2
deductive:  0
inductive:  0
means_ends:  2
sub_goals:  2
gen_and_test:  0
goal_vs_data:  2
cover_and_diff:  3
prop_and_ref:  1
acq_and_pres:  1
form_proc_alg:  1
decompose:  0
recombine:  3
generalize:  2
specialize:  0
ret_to_def:  2
visual:  0
verbal:  1
auditory:  0
kinesthetic:  0
written:  1
```

```
instrumentation:  0
mm_interface:  0
databases:  1
historical:  1
propadeutics:  0
branching:  1
dynamism:  0
constraints:  2
uncertainty:  1
high_low_tech:  0
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  1
calculate:  0
code:  0
computerize:  1
interpolate:  2
itemize:  2
learn:  1
tabulate:  1
translate:  0
analyze:  2
deduce:  0
induce:  1
choose:  1
compare:  0
compute:  1
estimate:  1
integrate:  1
plan:  3
supervise:  4
monitor:  0
interpret:  1
facts:  1
principles:  1
procedures:  0
analogs:  1
cases_examples:  0
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
```

```
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  4
prob_of_success:  3
articulation:  4
kr_hp:  0
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  1
test_equip:  0
advises:  4
answers:  1
communicates:  1
directs:  2
indicates:  1
informs:  2
instructs:  4
requests:  1
transmits:  1
supervises:  3
negotiates:  1
express_movement:  3
interp_movement:  3

name1:  form_fill_out
name2:  surgery
eq_count:  39
sim_count:  60

--------------------------------

statistical:  0
spatial:  4
temporal:  2
analogical:  1
case_based:  1
model_based:  3
mathematical:  2
deductive:  3
inductive:  0
means_ends:  2
sub_goals:  0
gen_and_test:  3
goal_vs_data:  2
cover_and_diff:  1
prop_and_ref:  2
acq_and_pres:  1
form_proc_alg:  0
decompose:  1
recombine:  3
generalize:  2
specialize:  3
ret_to_def:  1
visual:  4
verbal:  1
auditory:  2
kinesthetic:  4
written:  0
instrumentation:  4
```

```
mm_interface:  1
databases:  1
historical:  2
propadeutics:  1
branching:  4
dynamism:  2
constraints:  0
uncertainty:  2
high_low_tech:  1
quant_qual:  0
complex_cont:  4
compound:  2
reflex:  0
simple_disc:  4
fine:  4
gross:  4
repetitive:  4
categorize:  1
calculate:  2
code:  0
computerize:  0
interpolate:  2
itemize:  1
learn:  3
tabulate:  1
translate:  0
analyze:  2
deduce:  4
induce:  0
choose:  0
compare:  0
compute:  2
estimate:  1
integrate:  1
plan:  4
supervise:  4
monitor:  4
interpret:  3
facts:  2
principles:  2
procedures:  0
analogs:  0
cases_examples:  0
percep_speed:  2
search_rec_info:  0
id_obj_act_events:  4
scan_display:  0
acceleration:  0
confinement:  2
isolation:  0
contaminants:  1
electricity:  0
lighting:  2
magnetism:  0
noise:  0
fatigue:  3
mental_strain:  3
stress:  4
phys_strain:  3
preciseness:  4
cog_attent:  4
response_chaining:  2
attention_span:  4
sleep:  2
schedule:  4
boredom:  1
```

```
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  4
articulation:  1
kr_hp:  2
computer:  4
vehicles:  0
weapon_systems:  0
instruments:  4
notation:  1
test_equip:  3
advises:  3
answers:  0
communicates:  0
directs:  4
indicates:  0
informs:  0
instructs:  0
requests:  0
transmits:  4
supervises:  4
negotiates:  4
express_movement:  2
interp_movement:  0

name1:  form_fill_out
name2:  medical_diag
eq_count:  47
sim_count:  77

---------------------------------

statistical:  0
spatial:  3
temporal:  2
analogical:  2
case_based:  0
model_based:  2
mathematical:  2
deductive:  4
inductive:  0
means_ends:  1
sub_goals:  2
gen_and_test:  3
goal_vs_data:  1
cover_and_diff:  2
prop_and_ref:  2
acq_and_pres:  0
form_proc_alg:  2
decompose:  0
recombine:  3
generalize:  1
specialize:  2
ret_to_def:  0
visual:  4
verbal:  1
auditory:  2
kinesthetic:  1
written:  0
instrumentation:  4
mm_interface:  0
```

```
databases:  1
historical:  2
propadeutics:  1
branching:  4
dynamism:  0
constraints:  1
uncertainty:  3
high_low_tech:  1
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  1
gross:  1
repetitive:  0
categorize:  1
calculate:  2
code:  0
computerize:  0
interpolate:  2
itemize:  1
learn:  3
tabulate:  1
translate:  3
analyze:  2
deduce:  4
induce:  0
choose:  0
compare:  1
compute:  2
estimate:  0
integrate:  1
plan:  1
supervise:  0
monitor:  2
interpret:  3
facts:  2
principles:  2
procedures:  0
analogs:  0
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  1
mental_strain:  2
stress:  3
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  1
schedule:  2
boredom:  1
general_health:  0
```

```
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  3
prob_of_success:  4
articulation:  3
kr_hp:  0
computer:  4
vehicles:  0
weapon_systems:  0
instruments:  2
notation:  1
test_equip:  2
advises:  4
answers:  1
communicates:  1
directs:  4
indicates:  1
informs:  2
instructs:  1
requests:  1
transmits:  2
supervises:  1
negotiates:  4
express_movement:  2
interp_movement:  3

name1:  form_fill_out
name2:  accounting
eq_count:  76
sim_count:  95

---------------------------------

statistical:  0
spatial:  0
temporal:  1
analogical:  2
case_based:  1
model_based:  0
mathematical:  2
deductive:  0
inductive:  2
means_ends:  2
sub_goals:  1
gen_and_test:  3
goal_vs_data:  1
cover_and_diff:  3
prop_and_ref:  2
acq_and_pres:  0
form_proc_alg:  0
decompose:  1
recombine:  1
generalize:  3
specialize:  3
ret_to_def:  2
visual:  0
verbal:  0
auditory:  0
kinesthetic:  0
written:  0
instrumentation:  0
mm_interface:  4
databases:  3
```

```
historical:  2
propadeutics:  0
branching:  0
dynamism:  1
constraints:  1
uncertainty:  1
high_low_tech:  0
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  1
calculate:  2
code:  0
computerize:  4
interpolate:  2
itemize:  3
learn:  2
tabulate:  3
translate:  1
analyze:  2
deduce:  0
induce:  2
choose:  3
compare:  0
compute:  2
estimate:  2
integrate:  2
plan:  0
supervise:  0
monitor:  0
interpret:  1
facts:  1
principles:  0
procedures:  0
analogs:  0
cases_examples:  0
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  4
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
```

```
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  0
articulation:  0
kr_hp:  0
computer:  0
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  0
test_equip:  0
advises:  0
answers:  1
communicates:  1
directs:  0
indicates:  3
informs:  0
instructs:  0
requests:  1
transmits:  1
supervises:  0
negotiates:  4
express_movement:  0
interp_movement:  0

name1:  form_fill_out
name2:  protocol_des
eq_count:  68
sim_count:  94

---------------------------------

statistical:  2
spatial:  1
temporal:  2
analogical:  2
case_based:  1
model_based:  2
mathematical:  0
deductive:  0
inductive:  1
means_ends:  2
sub_goals:  0
gen_and_test:  1
goal_vs_data:  2
cover_and_diff:  3
prop_and_ref:  2
acq_and_pres:  0
form_proc_alg:  3
decompose:  1
recombine:  0
generalize:  0
specialize:  0
ret_to_def:  1
visual:  0
verbal:  1
auditory:  0
kinesthetic:  0
written:  1
instrumentation:  2
mm_interface:  0
databases:  1
historical:  2
```

propadeutics: 2
branching: 1
dynamism: 0
constraints: 2
uncertainty: 0
high_low_tech: 1
quant_qual: 1
complex_cont: 0
compound: 0
reflex: 0
simple_disc: 0
fine: 0
gross: 0
repetitive: 0
categorize: 1
calculate: 1
code: 0
computerize: 0
interpolate: 1
itemize: 3
learn: 1
tabulate: 1
translate: 4
analyze: 2
deduce: 0
induce: 0
choose: 0
compare: 0
compute: 1
estimate: 0
integrate: 2
plan: 4
supervise: 1
monitor: 0
interpret: 3
facts: 1
principles: 1
procedures: 0
analogs: 0
cases_examples: 2
percep_speed: 0
search_rec_info: 0
id_obj_act_events: 0
scan_display: 0
acceleration: 0
confinement: 0
isolation: 0
contaminants: 0
electricity: 0
lighting: 0
magnetism: 0
noise: 0
fatigue: 0
mental_strain: 0
stress: 0
phys_strain: 0
preciseness: 0
cog_attent: 0
response_chaining: 0
attention_span: 0
sleep: 0
schedule: 0
boredom: 0
general_health: 0
age: 0
gender: 0

```
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  4
articulation:  3
kr_hp:  0
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  4
notation:  3
test_equip:  1
advises:  0
answers:  0
communicates:  1
directs:  3
indicates:  3
informs:  1
instructs:  0
requests:  0
transmits:  1
supervises:  3
negotiates:  4
express_movement:  0
interp_movement:  0

name1:  language_train
name2:  leadership
eq_count:  70
sim_count:  90

---------------------------------

statistical:  0
spatial:  0
temporal:  2
analogical:  2
case_based:  0
model_based:  0
mathematical:  0
deductive:  2
inductive:  0
means_ends:  1
sub_goals:  2
gen_and_test:  2
goal_vs_data:  0
cover_and_diff:  2
prop_and_ref:  1
acq_and_pres:  1
form_proc_alg:  3
decompose:  1
recombine:  4
generalize:  2
specialize:  1
ret_to_def:  0
visual:  0
verbal:  0
auditory:  0
kinesthetic:  0
written:  1
instrumentation:  4
mm_interface:  0
databases:  2
historical:  3
propadeutics:  0
```

```
branching:  2
dynamism:  4
constraints:  3
uncertainty:  2
high_low_tech:  0
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  0
calculate:  2
code:  0
computerize:  1
interpolate:  0
itemize:  3
learn:  2
tabulate:  0
translate:  4
analyze:  1
deduce:  2
induce:  1
choose:  2
compare:  0
compute:  1
estimate:  1
integrate:  2
plan:  1
supervise:  0
monitor:  4
interpret:  4
facts:  1
principles:  1
procedures:  2
analogs:  2
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
```

```
weight:  0
edu_train_expert:  1
intro_accuracy:  0
prob_of_success:  1
articulation:  0
kr_hp:  0
computer:  0
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  2
test_equip:  0
advises:  2
answers:  2
communicates:  0
directs:  2
indicates:  2
informs:  0
instructs:  0
requests:  1
transmits:  1
supervises:  1
negotiates:  3
express_movement:  0
interp_movement:  0

name1:  language_train
name2:  surgery
eq_count:  46
sim_count:  67

--------------------------------

statistical:  0
spatial:  4
temporal:  4
analogical:  2
case_based:  1
model_based:  3
mathematical:  0
deductive:  1
inductive:  0
means_ends:  3
sub_goals:  0
gen_and_test:  1
goal_vs_data:  0
cover_and_diff:  0
prop_and_ref:  2
acq_and_pres:  1
form_proc_alg:  4
decompose:  0
recombine:  4
generalize:  2
specialize:  2
ret_to_def:  1
visual:  4
verbal:  0
auditory:  2
kinesthetic:  4
written:  0
instrumentation:  0
mm_interface:  1
databases:  0
historical:  4
propadeutics:  1
branching:  1
```

dynamism: 2
constraints: 1
uncertainty: 1
high_low_tech: 1
quant_qual: 0
complex_cont: 4
compound: 2
reflex: 0
simple_disc: 4
fine: 4
gross: 4
repetitive: 4
categorize: 2
calculate: 0
code: 0
computerize: 0
interpolate: 0
itemize: 0
learn: 2
tabulate: 0
translate: 4
analyze: 1
deduce: 2
induce: 0
choose: 3
compare: 0
compute: 0
estimate: 3
integrate: 0
plan: 0
supervise: 0
monitor: 0
interpret: 0
facts: 0
principles: 0
procedures: 2
analogs: 3
cases_examples: 1
percep_speed: 2
search_rec_info: 0
id_obj_act_events: 4
scan_display: 0
acceleration: 0
confinement: 2
isolation: 0
contaminants: 1
electricity: 0
lighting: 2
magnetism: 0
noise: 0
fatigue: 3
mental_strain: 3
stress: 4
phys_strain: 3
preciseness: 4
cog_attent: 4
response_chaining: 2
attention_span: 4
sleep: 2
schedule: 4
boredom: 1
general_health: 0
age: 0
gender: 0
height: 0
weight: 0

```
edu_train_expert:  1
intro_accuracy:  4
prob_of_success:  2
articulation:  3
kr_hp:  2
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  4
notation:  4
test_equip:  3
advises:  1
answers:  1
communicates:  1
directs:  0
indicates:  1
informs:  2
instructs:  4
requests:  2
transmits:  4
supervises:  0
negotiates:  0
express_movement:  1
interp_movement:  3

name1:  language_train
name2:  medical_diag
eq_count:  60
sim_count:  83

-----------------------------------

statistical:  0
spatial:  3
temporal:  4
analogical:  3
case_based:  0
model_based:  2
mathematical:  0
deductive:  2
inductive:  0
means_ends:  0
sub_goals:  2
gen_and_test:  1
goal_vs_data:  1
cover_and_diff:  1
prop_and_ref:  2
acq_and_pres:  0
form_proc_alg:  2
decompose:  1
recombine:  4
generalize:  1
specialize:  1
ret_to_def:  2
visual:  4
verbal:  0
auditory:  2
kinesthetic:  1
written:  0
instrumentation:  0
mm_interface:  0
databases:  0
historical:  4
propadeutics:  1
branching:  1
dynamism:  4
```

```
constraints:  2
uncertainty:  0
high_low_tech:  1
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  1
gross:  1
repetitive:  0
categorize:  2
calculate:  0
code:  0
computerize:  0
interpolate:  0
itemize:  2
learn:  2
tabulate:  0
translate:  1
analyze:  1
deduce:  2
induce:  0
choose:  3
compare:  1
compute:  0
estimate:  2
integrate:  0
plan:  3
supervise:  4
monitor:  2
interpret:  0
facts:  0
principles:  0
procedures:  2
analogs:  3
cases_examples:  0
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  1
mental_strain:  2
stress:  3
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  1
schedule:  2
boredom:  1
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
```

```
intro_accuracy:  1
prob_of_success:  2
articulation:  1
kr_hp:  0
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  2
notation:  4
test_equip:  2
advises:  2
answers:  0
communicates:  0
directs:  0
indicates:  2
informs:  0
instructs:  3
requests:  3
transmits:  2
supervises:  3
negotiates:  0
express_movement:  1
interp_movement:  0

name1:  language_train
name2:  accounting
eq_count:  58
sim_count:  69

---------------------------------

statistical:  0
spatial:  0
temporal:  3
analogical:  3
case_based:  1
model_based:  0
mathematical:  4
deductive:  2
inductive:  2
means_ends:  1
sub_goals:  1
gen_and_test:  1
goal_vs_data:  1
cover_and_diff:  2
prop_and_ref:  2
acq_and_pres:  0
form_proc_alg:  4
decompose:  2
recombine:  2
generalize:  3
specialize:  2
ret_to_def:  0
visual:  0
verbal:  1
auditory:  0
kinesthetic:  0
written:  0
instrumentation:  4
mm_interface:  4
databases:  4
historical:  4
propadeutics:  0
branching:  3
dynamism:  3
constraints:  2
```

```
uncertainty:  2
high_low_tech:  0
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  0
calculate:  4
code:  0
computerize:  4
interpolate:  0
itemize:  4
learn:  1
tabulate:  4
translate:  3
analyze:  3
deduce:  2
induce:  2
choose:  0
compare:  0
compute:  4
estimate:  0
integrate:  3
plan:  4
supervise:  4
monitor:  4
interpret:  2
facts:  3
principles:  2
procedures:  2
analogs:  3
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  4
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  4
```

```
prob_of_success:  2
articulation:  4
kr_hp:  0
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  3
test_equip:  0
advises:  2
answers:  2
communicates:  0
directs:  4
indicates:  4
informs:  2
instructs:  4
requests:  3
transmits:  1
supervises:  4
negotiates:  0
express_movement:  3
interp_movement:  3

name1:  language_train
name2:  protocol_des
eq_count:  62
sim_count:  85

----------------------------------

statistical:  2
spatial:  1
temporal:  4
analogical:  3
case_based:  1
model_based:  2
mathematical:  2
deductive:  2
inductive:  1
means_ends:  1
sub_goals:  0
gen_and_test:  3
goal_vs_data:  0
cover_and_diff:  2
prop_and_ref:  2
acq_and_pres:  0
form_proc_alg:  1
decompose:  0
recombine:  1
generalize:  0
specialize:  1
ret_to_def:  1
visual:  0
verbal:  0
auditory:  0
kinesthetic:  0
written:  1
instrumentation:  2
mm_interface:  0
databases:  0
historical:  4
propadeutics:  2
branching:  2
dynamism:  4
constraints:  3
uncertainty:  3
```

```
high_low_tech:  1
quant_qual:  1
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  2
calculate:  3
code:  0
computerize:  0
interpolate:  1
itemize:  4
learn:  0
tabulate:  0
translate:  0
analyze:  3
deduce:  2
induce:  0
choose:  3
compare:  0
compute:  3
estimate:  2
integrate:  3
plan:  0
supervise:  3
monitor:  4
interpret:  0
facts:  1
principles:  1
procedures:  2
analogs:  3
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  1
intro_accuracy:  4
prob_of_success:  2
```

```
articulation:  1
kr_hp:  0
computer:  0
vehicles:  0
weapon_systems:  0
instruments:  4
notation:  0
test_equip:  1
advises:  2
answers:  1
communicates:  0
directs:  1
indicates:  4
informs:  1
instructs:  4
requests:  2
transmits:  1
supervises:  1
negotiates:  0
express_movement:  3
interp_movement:  3

name1:  leadership
name2:  surgery
eq_count:  34
sim_count:  62

---------------------------------

statistical:  0
spatial:  4
temporal:  2
analogical:  0
case_based:  1
model_based:  3
mathematical:  0
deductive:  3
inductive:  0
means_ends:  4
sub_goals:  2
gen_and_test:  3
goal_vs_data:  0
cover_and_diff:  2
prop_and_ref:  3
acq_and_pres:  0
form_proc_alg:  1
decompose:  1
recombine:  0
generalize:  0
specialize:  3
ret_to_def:  1
visual:  4
verbal:  0
auditory:  2
kinesthetic:  4
written:  1
instrumentation:  4
mm_interface:  1
databases:  2
historical:  1
propadeutics:  1
branching:  3
dynamism:  2
constraints:  2
uncertainty:  1
high_low_tech:  1
```

```
quant_qual:  0
complex_cont:  4
compound:  2
reflex:  0
simple_disc:  4
fine:  4
gross:  4
repetitive:  4
categorize:  2
calculate:  2
code:  0
computerize:  1
interpolate:  0
itemize:  3
learn:  4
tabulate:  0
translate:  0
analyze:  0
deduce:  4
induce:  1
choose:  1
compare:  0
compute:  1
estimate:  2
integrate:  2
plan:  1
supervise:  0
monitor:  4
interpret:  4
facts:  1
principles:  1
procedures:  0
analogs:  1
cases_examples:  0
percep_speed:  2
search_rec_info:  0
id_obj_act_events:  4
scan_display:  0
acceleration:  0
confinement:  2
isolation:  0
contaminants:  1
electricity:  0
lighting:  2
magnetism:  0
noise:  0
fatigue:  3
mental_strain:  3
stress:  4
phys_strain:  3
preciseness:  4
cog_attent:  4
response_chaining:  2
attention_span:  4
sleep:  2
schedule:  4
boredom:  1
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  2
intro_accuracy:  4
prob_of_success:  1
articulation:  3
```

```
kr_hp:  2
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  4
notation:  2
test_equip:  3
advises:  1
answers:  1
communicates:  1
directs:  2
indicates:  1
informs:  2
instructs:  4
requests:  1
transmits:  3
supervises:  1
negotiates:  3
express_movement:  1
interp_movement:  3

name1:  leadership
name2:  medical_diag
eq_count:  50
sim_count:  86

---------------------------------

statistical:  0
spatial:  3
temporal:  2
analogical:  1
case_based:  0
model_based:  2
mathematical:  0
deductive:  4
inductive:  0
means_ends:  1
sub_goals:  0
gen_and_test:  3
goal_vs_data:  1
cover_and_diff:  1
prop_and_ref:  1
acq_and_pres:  1
form_proc_alg:  1
decompose:  0
recombine:  0
generalize:  1
specialize:  2
ret_to_def:  2
visual:  4
verbal:  0
auditory:  2
kinesthetic:  1
written:  1
instrumentation:  4
mm_interface:  0
databases:  2
historical:  1
propadeutics:  1
branching:  3
dynamism:  0
constraints:  1
uncertainty:  2
high_low_tech:  1
quant_qual:  1
```

```
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  1
gross:  1
repetitive:  0
categorize:  2
calculate:  2
code:  0
computerize:  1
interpolate:  0
itemize:  1
learn:  4
tabulate:  0
translate:  3
analyze:  0
deduce:  4
induce:  1
choose:  1
compare:  1
compute:  1
estimate:  1
integrate:  2
plan:  2
supervise:  4
monitor:  2
interpret:  4
facts:  1
principles:  1
procedures:  0
analogs:  1
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  1
mental_strain:  2
stress:  3
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  1
schedule:  2
boredom:  1
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  2
intro_accuracy:  1
prob_of_success:  1
articulation:  1
kr_hp:  0
```

```
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  2
notation:  2
test_equip:  2
advises:  0
answers:  2
communicates:  0
directs:  2
indicates:  0
informs:  0
instructs:  3
requests:  2
transmits:  1
supervises:  2
negotiates:  3
express_movement:  1
interp_movement:  0

name1:  leadership
name2:  accounting
eq_count:  64
sim_count:  88

---------------------------------

statistical:  0
spatial:  0
temporal:  1
analogical:  1
case_based:  1
model_based:  0
mathematical:  4
deductive:  0
inductive:  2
means_ends:  0
sub_goals:  1
gen_and_test:  3
goal_vs_data:  1
cover_and_diff:  0
prop_and_ref:  3
acq_and_pres:  1
form_proc_alg:  1
decompose:  1
recombine:  2
generalize:  1
specialize:  3
ret_to_def:  0
visual:  0
verbal:  1
auditory:  0
kinesthetic:  0
written:  1
instrumentation:  0
mm_interface:  4
databases:  2
historical:  1
propadeutics:  0
branching:  1
dynamism:  1
constraints:  1
uncertainty:  0
high_low_tech:  0
quant_qual:  1
complex_cont:  0
```

```
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  0
calculate:  2
code:  0
computerize:  3
interpolate:  0
itemize:  1
learn:  3
tabulate:  4
translate:  1
analyze:  4
deduce:  0
induce:  1
choose:  2
compare:  0
compute:  3
estimate:  1
integrate:  1
plan:  3
supervise:  4
monitor:  0
interpret:  2
facts:  2
principles:  1
procedures:  0
analogs:  1
cases_examples:  0
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  4
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  2
intro_accuracy:  4
prob_of_success:  3
articulation:  4
kr_hp:  0
computer:  2
```

```
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  1
test_equip:  0
advises:  4
answers:  0
communicates:  0
directs:  2
indicates:  2
informs:  2
instructs:  4
requests:  2
transmits:  0
supervises:  3
negotiates:  3
express_movement:  3
interp_movement:  3

name1:  leadership
name2:  protocol_des
eq_count:  64
sim_count:  94

---------------------------------

statistical:  2
spatial:  1
temporal:  2
analogical:  1
case_based:  1
model_based:  2
mathematical:  2
deductive:  0
inductive:  1
means_ends:  0
sub_goals:  2
gen_and_test:  1
goal_vs_data:  0
cover_and_diff:  0
prop_and_ref:  1
acq_and_pres:  1
form_proc_alg:  2
decompose:  1
recombine:  3
generalize:  2
specialize:  0
ret_to_def:  1
visual:  0
verbal:  0
auditory:  0
kinesthetic:  0
written:  0
instrumentation:  2
mm_interface:  0
databases:  2
historical:  1
propadeutics:  2
branching:  0
dynamism:  0
constraints:  0
uncertainty:  1
high_low_tech:  1
quant_qual:  1
complex_cont:  0
compound:  0
```

```
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  2
calculate:  1
code:  0
computerize:  1
interpolate:  1
itemize:  1
learn:  2
tabulate:  0
translate:  4
analyze:  4
deduce:  0
induce:  1
choose:  1
compare:  0
compute:  2
estimate:  1
integrate:  1
plan:  1
supervise:  3
monitor:  0
interpret:  4
facts:  0
principles:  0
procedures:  0
analogs:  1
cases_examples:  2
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  2
intro_accuracy:  4
prob_of_success:  1
articulation:  1
kr_hp:  0
computer:  0
vehicles:  0
```

```
weapon_systems:  0
instruments:  4
notation:  2
test_equip:  1
advises:  4
answers:  1
communicates:  0
directs:  1
indicates:  2
informs:  1
instructs:  4
requests:  1
transmits:  0
supervises:  0
negotiates:  3
express_movement:  3
interp_movement:  3

name1:  surgery
name2:  medical_diag
eq_count:  57
sim_count:  87

---------------------------------

statistical:  0
spatial:  1
temporal:  0
analogical:  1
case_based:  1
model_based:  1
mathematical:  0
deductive:  1
inductive:  0
means_ends:  3
sub_goals:  2
gen_and_test:  0
goal_vs_data:  1
cover_and_diff:  1
prop_and_ref:  4
acq_and_pres:  1
form_proc_alg:  2
decompose:  1
recombine:  0
generalize:  1
specialize:  1
ret_to_def:  1
visual:  0
verbal:  0
auditory:  0
kinesthetic:  3
written:  0
instrumentation:  0
mm_interface:  1
databases:  0
historical:  0
propadeutics:  0
branching:  0
dynamism:  2
constraints:  1
uncertainty:  1
high_low_tech:  0
quant_qual:  1
complex_cont:  4
compound:  2
reflex:  0
```

```
simple_disc:  4
fine:  3
gross:  3
repetitive:  4
categorize:  0
calculate:  0
code:  0
computerize:  0
interpolate:  0
itemize:  2
learn:  0
tabulate:  0
translate:  3
analyze:  0
deduce:  0
induce:  0
choose:  0
compare:  1
compute:  0
estimate:  1
integrate:  0
plan:  3
supervise:  4
monitor:  2
interpret:  0
facts:  0
principles:  0
procedures:  0
analogs:  0
cases_examples:  1
percep_speed:  2
search_rec_info:  0
id_obj_act_events:  4
scan_display:  0
acceleration:  0
confinement:  2
isolation:  0
contaminants:  1
electricity:  0
lighting:  2
magnetism:  0
noise:  0
fatigue:  2
mental_strain:  1
stress:  1
phys_strain:  3
preciseness:  4
cog_attent:  4
response_chaining:  2
attention_span:  4
sleep:  1
schedule:  2
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  0
intro_accuracy:  3
prob_of_success:  0
articulation:  2
kr_hp:  2
computer:  0
vehicles:  0
weapon_systems:  0
```

```
instruments:  2
notation:  0
test_equip:  1
advises:  1
answers:  1
communicates:  1
directs:  0
indicates:  1
informs:  2
instructs:  1
requests:  1
transmits:  2
supervises:  3
negotiates:  0
express_movement:  0
interp_movement:  3

name1:  surgery
name2:  accounting
eq_count:  36
sim_count:  59

--------------------------------

statistical:  0
spatial:  4
temporal:  1
analogical:  1
case_based:  0
model_based:  3
mathematical:  4
deductive:  3
inductive:  2
means_ends:  4
sub_goals:  1
gen_and_test:  0
goal_vs_data:  1
cover_and_diff:  2
prop_and_ref:  0
acq_and_pres:  1
form_proc_alg:  0
decompose:  2
recombine:  2
generalize:  1
specialize:  0
ret_to_def:  1
visual:  4
verbal:  1
auditory:  2
kinesthetic:  4
written:  0
instrumentation:  4
mm_interface:  3
databases:  4
historical:  0
propadeutics:  1
branching:  4
dynamism:  1
constraints:  1
uncertainty:  1
high_low_tech:  1
quant_qual:  1
complex_cont:  4
compound:  2
reflex:  0
simple_disc:  4
```

```
fine:  4
gross:  4
repetitive:  4
categorize:  2
calculate:  4
code:  0
computerize:  4
interpolate:  0
itemize:  4
learn:  1
tabulate:  4
translate:  1
analyze:  4
deduce:  4
induce:  2
choose:  3
compare:  0
compute:  4
estimate:  3
integrate:  3
plan:  4
supervise:  4
monitor:  4
interpret:  2
facts:  3
principles:  2
procedures:  0
analogs:  0
cases_examples:  0
percep_speed:  2
search_rec_info:  0
id_obj_act_events:  4
scan_display:  0
acceleration:  0
confinement:  2
isolation:  0
contaminants:  1
electricity:  0
lighting:  2
magnetism:  0
noise:  0
fatigue:  3
mental_strain:  3
stress:  4
phys_strain:  3
preciseness:  0
cog_attent:  4
response_chaining:  2
attention_span:  4
sleep:  2
schedule:  4
boredom:  1
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  0
intro_accuracy:  0
prob_of_success:  4
articulation:  1
r_hp:  2
computer:  4
vehicles:  0
weapon_systems:  0
instruments:  4
```

```
notation:  1
test_equip:  3
advises:  3
answers:  1
communicates:  1
directs:  4
indicates:  3
informs:  0
instructs:  0
requests:  1
transmits:  3
supervises:  4
negotiates:  0
express_movement:  2
interp_movement:  0

name1:  surgery
name2:  protocol_des
eq_count:  44
sim_count:  61

---------------------------------

statistical:  2
spatial:  3
temporal:  0
analogical:  1
case_based:  2
model_based:  1
mathematical:  2
deductive:  3
inductive:  1
means_ends:  4
sub_goals:  0
gen_and_test:  4
goal_vs_data:  0
cover_and_diff:  2
prop_and_ref:  4
acq_and_pres:  1
form_proc_alg:  3
decompose:  0
recombine:  3
generalize:  2
specialize:  3
ret_to_def:  0
visual:  4
verbal:  0
auditory:  2
kinesthetic:  4
written:  1
instrumentation:  2
mm_interface:  1
databases:  0
historical:  0
propadeutics:  3
branching:  3
dynamism:  2
constraints:  2
uncertainty:  2
high_low_tech:  0
quant_qual:  1
complex_cont:  4
compound:  2
reflex:  0
simple_disc:  4
fine:  4
```

```
gross:  4
repetitive:  4
categorize:  0
calculate:  3
code:  0
computerize:  0
interpolate:  1
itemize:  4
learn:  2
tabulate:  0
translate:  4
analyze:  4
deduce:  4
induce:  0
choose:  0
compare:  0
compute:  3
estimate:  1
integrate:  3
plan:  0
supervise:  3
monitor:  4
interpret:  0
facts:  1
principles:  1
procedures:  0
analogs:  0
cases_examples:  2
percep_speed:  2
search_rec_info:  0
id_obj_act_events:  4
scan_display:  0
acceleration:  0
confinement:  2
isolation:  0
contaminants:  1
electricity:  0
lighting:  2
magnetism:  0
noise:  0
fatigue:  3
mental_strain:  3
stress:  4
phys_strain:  3
preciseness:  4
cog_attent:  4
response_chaining:  2
attention_span:  4
sleep:  2
schedule:  4
boredom:  1
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  0
intro_accuracy:  0
prob_of_success:  0
articulation:  2
kr_hp:  2
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  0
notation:  4
```

```
test_equip:  2
advises:  3
answers:  0
communicates:  1
directs:  1
indicates:  3
informs:  1
instructs:  0
requests:  0
transmits:  3
supervises:  1
negotiates:  0
express_movement:  2
interp_movement:  0

name1:  medical_diag
name2:  accounting
eq_count:  46
sim_count:  71

--------------------------------

statistical:  0
spatial:  3
temporal:  1
analogical:  0
case_based:  1
model_based:  2
mathematical:  4
deductive:  4
inductive:  2
means_ends:  1
sub_goals:  1
gen_and_test:  0
goal_vs_data:  0
cover_and_diff:  1
prop_and_ref:  4
acq_and_pres:  0
form_proc_alg:  2
decompose:  1
recombine:  2
generalize:  2
specialize:  1
ret_to_def:  2
visual:  4
verbal:  1
auditory:  2
kinesthetic:  1
written:  0
instrumentation:  4
mm_interface:  4
databases:  4
historical:  0
propadeutics:  1
branching:  4
dynamism:  1
constraints:  0
uncertainty:  2
high_low_tech:  1
quant_qual:  2
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  1
gross:  1
```

```
repetitive:  0
categorize:  2
calculate:  4
code:  0
computerize:  4
interpolate:  0
itemize:  2
learn:  1
tabulate:  4
translate:  2
analyze:  4
deduce:  4
induce:  2
choose:  3
compare:  1
compute:  4
estimate:  2
integrate:  3
plan:  1
supervise:  0
monitor:  2
interpret:  2
facts:  3
principles:  2
procedures:  0
analogs:  0
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  1
mental_strain:  2
stress:  3
phys_strain:  0
preciseness:  4
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  1
schedule:  2
boredom:  1
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  0
intro_accuracy:  3
prob_of_success:  4
articulation:  3
kr_hp:  0
computer:  4
vehicles:  0
weapon_systems:  0
instruments:  2
notation:  1
test_equip:  2
```

```
advises:  4
answers:  2
communicates:  0
directs:  4
indicates:  2
informs:  2
instructs:  1
requests:  0
transmits:  1
supervises:  1
negotiates:  0
express_movement:  2
interp_movement:  3

name1:  medical_diag
name2:  protocol_des
eq_count:  57
sim_count:  88

---------------------------------

statistical:  2
spatial:  2
temporal:  0
analogical:  0
case_based:  1
model_based:  0
mathematical:  2
deductive:  4
inductive:  1
means_ends:  1
sub_goals:  2
gen_and_test:  4
goal_vs_data:  1
cover_and_diff:  1
prop_and_ref:  0
acq_and_pres:  0
form_proc_alg:  1
decompose:  1
recombine:  3
generalize:  1
specialize:  2
ret_to_def:  1
visual:  4
verbal:  0
auditory:  2
kinesthetic:  1
written:  1
instrumentation:  2
mm_interface:  0
databases:  0
historical:  0
propadeutics:  3
branching:  3
dynamism:  0
constraints:  1
uncertainty:  3
high_low_tech:  0
quant_qual:  0
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  1
gross:  1
repetitive:  0
```

```
categorize:  0
calculate:  3
code:  0
computerize:  0
interpolate:  1
itemize:  2
learn:  2
tabulate:  0
translate:  1
analyze:  4
deduce:  4
induce:  0
choose:  0
compare:  1
compute:  3
estimate:  0
integrate:  3
plan:  3
supervise:  1
monitor:  2
interpret:  0
facts:  1
principles:  1
procedures:  0
analogs:  0
cases_examples:  1
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  1
mental_strain:  2
stress:  3
phys_strain:  0
preciseness:  0
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  1
schedule:  2
boredom:  1
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  0
intro_accuracy:  3
prob_of_success:  0
articulation:  0
kr_hp:  0
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  2
notation:  4
test_equip:  1
advises:  4
```

```
answers:  1
communicates:  0
directs:  1
indicates:  2
informs:  1
instructs:  1
requests:  1
transmits:  1
supervises:  2
negotiates:  0
express_movement:  2
interp_movement:  3

name1:  accounting
name2:  protocol_des
eq_count:  65
sim_count:  88

---------------------------------

statistical:  2
spatial:  1
temporal:  1
analogical:  0
case_based:  2
model_based:  2
mathematical:  2
deductive:  0
inductive:  3
means_ends:  0
sub_goals:  1
gen_and_test:  4
goal_vs_data:  1
cover_and_diff:  0
prop_and_ref:  4
acq_and_pres:  0
form_proc_alg:  3
decompose:  2
recombine:  1
generalize:  3
specialize:  3
ret_to_def:  1
visual:  0
verbal:  1
auditory:  0
kinesthetic:  0
written:  1
instrumentation:  2
mm_interface:  4
databases:  4
historical:  0
propadeutics:  2
branching:  1
dynamism:  1
constraints:  1
uncertainty:  1
high_low_tech:  1
quant_qual:  2
complex_cont:  0
compound:  0
reflex:  0
simple_disc:  0
fine:  0
gross:  0
repetitive:  0
categorize:  2
```

```
calculate:  1
code:  0
computerize:  4
interpolate:  1
itemize:  0
learn:  1
tabulate:  4
translate:  3
analyze:  0
deduce:  0
induce:  2
choose:  3
compare:  0
compute:  1
estimate:  2
integrate:  0
plan:  4
supervise:  1
monitor:  0
interpret:  2
facts:  2
principles:  1
procedures:  0
analogs:  0
cases_examples:  2
percep_speed:  0
search_rec_info:  0
id_obj_act_events:  0
scan_display:  0
acceleration:  0
confinement:  0
isolation:  0
contaminants:  0
electricity:  0
lighting:  0
magnetism:  0
noise:  0
fatigue:  0
mental_strain:  0
stress:  0
phys_strain:  0
preciseness:  4
cog_attent:  0
response_chaining:  0
attention_span:  0
sleep:  0
schedule:  0
boredom:  0
general_health:  0
age:  0
gender:  0
height:  0
weight:  0
edu_train_expert:  0
intro_accuracy:  0
prob_of_success:  4
articulation:  3
kr_hp:  0
computer:  2
vehicles:  0
weapon_systems:  0
instruments:  4
notation:  3
test_equip:  1
advises:  0
answers:  1
```

```
communicates:  0
directs:  3
indicates:  0
informs:  1
instructs:  0
requests:  1
transmits:  0
supervises:  3
negotiates:  0
express_movement:  0
interp_movement:  0
```

APPENDIX J

FACTOR ANALYSIS OF THE CHARACTERISTICS FROM FIRST INTERVIEW

```
1                                                   SAS                                    14:03 FRIDAY, MARCH 29, 1991  1

 INITIAL FACTOR METHOD: PRINCIPAL COMPONENTS

                                         PRIOR COMMUNALITY ESTIMATES: ONE

                                EIGENVALUES OF THE CORRELATION MATRIX:  TOTAL =       36   AVERAGE =         1

                     1         2         3         4         5         6         7         8         9        10        11        12
 EIGENVALUE   9.361474  5.955761  3.830677  3.075796  2.766888  2.234974  1.863212  1.523088  1.233815  1.068160  0.847205  0.731856
 DIFFERENCE   3.405712  2.125084  0.754881  0.308908  0.531914  0.371762  0.340123  0.289273  0.165655  0.220955  0.115349  0.088979
 PROPORTION     0.2600    0.1654    0.1064    0.0854    0.0769    0.0621    0.0518    0.0423    0.0343    0.0297    0.0235    0.0203
 CUMULATIVE     0.2600    0.4255    0.5319    0.6173    0.6942    0.7563    0.8080    0.8503    0.8846    0.9143    0.9378    0.9581

                    13        14        15        16        17        18        19        20        21        22        23        24
 EIGENVALUE   0.642877  0.563419  0.300798  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000
 DIFFERENCE   0.079458  0.262621  0.300798  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000
 PROPORTION     0.0179    0.0157    0.0084    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
 CUMULATIVE     0.9760    0.9916    1.0000    1.0000    1.0000    1.0000    1.0000    1.0000    1.0000    1.0000    1.0000    1.0000

                    25        26        27        28        29        30        31        32        33        34        35        36
 EIGENVALUE   0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000
 DIFFERENCE   0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000
 PROPORTION     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
 CUMULATIVE     1.0000    1.0000    1.0000    1.0000    1.0000    1.0000    1.0000    1.0000    1.0000    1.0000    1.0000    1.0000

                                     3 FACTORS WILL BE RETAINED BY THE NFACTOR CRITERION
1                                                   SAS                                    14:03 FRIDAY, MARCH 29, 1991  2

 INITIAL FACTOR METHOD: PRINCIPAL COMPONENTS

                                                 FACTOR PATTERN

                                              FACTOR1   FACTOR2   FACTOR3

                                 V1          -0.40103   0.11303   0.66897
                                 V2           0.61216  -0.13073   0.37429
                                 V3           0.41547  -0.11237   0.35918
                                 V4           0.19969   0.48374  -0.08395
                                 V5          -0.04236   0.59670  -0.43581
                                 V6           0.44617   0.07582   0.65240
                                 V7          -0.21463  -0.50372   0.23608
                                 V8           0.71555   0.10747   0.01362
                                 V9          -0.33142   0.43877   0.67015
                                 V10          0.50232   0.20790  -0.06619
                                 V11         -0.00730   0.26182  -0.13447
                                 V12         -0.52665   0.49165  -0.08424
                                 V13          0.11278  -0.63458   0.04274
                                 V14          0.31709   0.22569  -0.12649
                                 V15         -0.45331   0.68533  -0.15275
                                 V16         -0.39003   0.41726   0.43918
                                 V17          0.16207  -0.59879  -0.09150
                                 V18          0.22030   0.66261  -0.44309
                                 V19         -0.67393   0.21869   0.36803
                                 V20         -0.35066   0.54202   0.58100
                                 V21          0.66178  -0.06360  -0.00712
                                 V22         -0.07640   0.03127  -0.36567
                                 INPUTS       0.71659   0.10465  -0.01318
```

```
                                COMPLEX      0.71250    0.13723    0.21324
                                TECH        -0.23455   -0.45734    0.41959
                                INFORM      -0.24569   -0.28452    0.37996
                                SOLVE        0.57623    0.40924    0.46531
                                RECALL       0.17473    0.76963    0.22225
                                PERCEPT      0.81591   -0.12420    0.19984
                                ENVIRON      0.75149   -0.34170   -0.18207
                                PSYCHE       0.92888   -0.03177   -0.04170
                                PHYSICAL     0.74617   -0.06245    0.05883
                                PSYCH        0.41503    0.72614    0.11054
                                EQUIP        0.67036   -0.04855    0.23426
                                COMMUNIC     0.35911    0.68584   -0.32230
                                DOMAIN       0.86518    0.21844    0.17353

                                  VARIANCE EXPLAINED BY EACH FACTOR

                                      FACTOR1    FACTOR2    FACTOR3
                                     9.361474   5.955761   3.830677

                             FINAL COMMUNALITY ESTIMATES: TOTAL =  19.147912

          V1        V2        V3        V4        V5        V6        V7        V8        V9       V10       V11       V12
    0.621128  0.531923  0.314251  0.280925  0.547777  0.630445  0.355534  0.523750  0.751453  0.299929  0.086684  0.526181

         V13       V14       V15       V16       V17       V18       V19       V20       V21       V22    INPUTS   COMPLEX
    0.417235  0.167485  0.698503  0.519111  0.393184  0.683921  0.637452  0.754317  0.442050  0.140527  0.524627  0.571963
                                                                 SAS                           14:03 FRIDAY, MARCH 29, 1991   3
1

 INITIAL FACTOR METHOD: PRINCIPAL COMPONENTS

        TECH    INFORM     SOLVE    RECALL   PERCEPT   ENVIRON    PSYCHE  PHYSICAL     PSYCH     EQUIP  COMMUNIC    DOMAIN
    0.440228  0.285683  0.716030  0.672264  0.721074  0.714646  0.865568  0.564124  0.711749  0.506619  0.703203  0.826368
                                                                 SAS                           14:03 FRIDAY, MARCH 29, 1991   4
1

 ROTATION METHOD: VARIMAX

                                  ORTHOGONAL TRANSFORMATION MATRIX

                                            1          2          3

                                  1      0.92649    0.18406   -0.32822
                                  2      0.00274    0.86889    0.49500
                                  3      0.37630   -0.45952    0.80452

                                     ROTATED FACTOR PATTERN

                                         FACTOR1    FACTOR2    FACTOR3

                                V1      -0.11951   -0.28301    0.72578
                                V2       0.70765   -0.17290    0.03549
                                V3       0.51978   -0.18621    0.09697
                                V4       0.15475    0.49565    0.10637
                                V5      -0.20160    0.71093   -0.04134
                                V6       0.65908   -0.15179    0.41595
                                V7      -0.11140   -0.58566    0.01104
                                V8       0.66838    0.21883   -0.17070
                                V9      -0.05368    0.01229    0.86511
                                V10      0.44106    0.30352   -0.11521
```

```
                                                     V11         -0.05664   0.28794   0.02381
                                                     V12         -0.51829   0.36896   0.34846
                                                     V13          0.11884  -0.55026  -0.31675
                                                     V14          0.24681   0.31259  -0.09412
                                                     V15         -0.47559   0.58223   0.36513
                                                     V16         -0.19495   0.08896   0.68789
                                                     V17          0.11408  -0.44840  -0.42321
                                                     V18          0.03919   0.81989  -0.10079
                                                     V19         -0.48530  -0.10314   0.62554
                                                     V20         -0.10477   0.13943   0.85082
                                                     V21          0.61029   0.06982  -0.25441
                                                     V22         -0.20830   0.18114  -0.25363
                                                     INPUTS       0.65925   0.22888  -0.19400
                                                     COMPLEX      0.74075   0.15240   0.00563
                                                     TECH        -0.06067  -0.63336   0.18817
                                                     INFORM      -0.08543  -0.46703   0.24549
                                                     SOLVE        0.71009   0.24783   0.38779
                                                     RECALL       0.24763   0.59876   0.50243
                                                     PERCEPT      0.83080  -0.04956  -0.16851
                                                     ENVIRON      0.62680  -0.07492  -0.56227
                                                     PSYCHE       0.84483   0.16253  -0.35415
                                                     PHYSICAL     0.71328   0.05604  -0.22849
                                                     PSYCH        0.42811   0.65653   0.31215
                                                     EQUIP        0.70910  -0.02644  -0.05559
                                                     COMMUNIC     0.21331   0.81011  -0.03767
                                                     DOMAIN       0.86749   0.26930  -0.03624

                                                       VARIANCE EXPLAINED BY EACH FACTOR

                                                           FACTOR1   FACTOR2   FACTOR3
                                                           8.578288  5.622419  4.947205
1                                                                    SAS                                       14:03 FRIDAY, MARCH 29, 1991   5

ROTATION METHOD: VARIMAX

                                              FINAL COMMUNALITY ESTIMATES: TOTAL =  19.147912

               V1         V2         V3         V4         V5         V6         V7         V8         V9        V10        V11        V12
         0.621128   0.531923   0.314251   0.280925   0.547777   0.630445   0.355534   0.523750   0.751453   0.299929   0.086684   0.526181

              V13        V14        V15        V16        V17        V18        V19        V20        V21        V22     INPUTS    COMPLEX
         0.417235   0.167485   0.698503   0.519111   0.393184   0.683921   0.637452   0.754317   0.442050   0.140527   0.524627   0.571963

             TECH     INFORM      SOLVE     RECALL    PERCEPT    ENVIRON     PSYCHE   PHYSICAL      PSYCH      EQUIP   COMMUNIC     DOMAIN
         0.440228   0.285683   0.716030   0.672264   0.721074   0.714646   0.865568   0.564124   0.711749   0.506619   0.703203   0.826368
```

APPENDIX K

CLUSTER ANALYSIS OF THE TASKS FROM FIRST INTERVIEW

```
1                                          SAS                        9:39 TUESDAY, APRIL 2, 1991   1

                            CENTROID HIERARCHICAL CLUSTER ANALYSIS

                             EIGENVALUES OF THE COVARIANCE MATRIX

                  EIGENVALUE      DIFFERENCE      PROPORTION      CUMULATIVE

            1        13.8941         6.26352        0.288797         0.28880
            2         7.6306         2.45736        0.158606         0.44740
            3         5.1732         0.57925        0.107529         0.55493
            4         4.5940         1.07205        0.095489         0.65042
            5         3.5219         0.42791        0.073205         0.72363
            6         3.0940         0.57024        0.064311         0.78794
            7         2.5238         0.77827        0.052458         0.84039
            8         1.7455         0.49820        0.036281         0.87668
            9         1.2473         0.03642        0.025926         0.90260
           10         1.2109         0.12309        0.025169         0.92777
           11         1.0878         0.14892        0.022610         0.95038
           12         0.9389         0.30811        0.019515         0.96990
           13         0.6308         0.12608        0.013111         0.98301
           14         0.5047         0.19184        0.010490         0.99350
           15         0.3128         0.31284        0.006503         1.00000
           16         0.0000         0.00000        0.000000         1.00000
           17         0.0000         0.00000        0.000000         1.00000
           18         0.0000         0.00000        0.000000         1.00000
           19         0.0000         0.00000        0.000000         1.00000
           20         0.0000         0.00000        0.000000         1.00000
           21         0.0000         0.00000        0.000000         1.00000
           22         0.0000         0.00000        0.000000         1.00000
           23         0.0000         0.00000        0.000000         1.00000
           24         0.0000         0.00000        0.000000         1.00000
           25         0.0000         0.00000        0.000000         1.00000
           26         0.0000         0.00000        0.000000         1.00000
           27         0.0000         0.00000        0.000000         1.00000
           28        -0.0000         0.00000        -.000000         1.00000
           29        -0.0000         0.00000        -.000000         1.00000
           30        -0.0000         0.00000        -.000000         1.00000
           31        -0.0000         0.00000        -.000000         1.00000
           32        -0.0000         0.00000        -.000000         1.00000
           33        -0.0000         0.00000        -.000000         1.00000
           34        -0.0000         0.00000        -.000000         1.00000
           35        -0.0000         0.00000        -.000000         1.00000
           36        -0.0000                        -.000000         1.00000

             ROOT-MEAN-SQUARE TOTAL-SAMPLE STANDARD DEVIATION =   1.15603
             ROOT-MEAN-SQUARE DISTANCE BETWEEN OBSERVATIONS   =    9.8092

              NUMBER                                FREQUENCY        NORMALIZED
                OF                                    OF NEW          CENTROID
             CLUSTERS    CLUSTERS JOINED             CLUSTER          DISTANCE

                   15    sw_desig    protocol              2          0.578896
                   14    pilot_tr    surgery               2          0.622233
                   13    cargo_lo    accounti              2          0.666616
                   12    program_    leadersh              2          0.671527
                   11    equip_di    CL12                  3          0.663370
                   10    CL11        CL13                  5          0.662742
```

```
                     9      CL10        drair_ge          6          0.673242
                     8      CL9         form_fil          7          0.638162
1                                               SAS                                9:39 TUESDAY, APRIL 2, 1991   2

                                  CENTROID HIERARCHICAL CLUSTER ANALYSIS

                 NUMBER                                FREQUENCY       NORMALIZED
                   OF                                   OF NEW          CENTROID
                CLUSTERS    CLUSTERS JOINED             CLUSTER         DISTANCE

                     7      CL8         CL15              9          0.722433
                     6      CL7         medical_         10          0.732175
                     5      CL6         language         11          0.783836
                     4      CL14        air_traf          3          0.799688
                     3      CL5         weather          12          0.825345
                     2      CL3         CL4              15          0.822499
                     1      CL2         console_         16          0.811065
1                                               SAS                                9:40 TUESDAY, APRIL 2, 1991   3

                                  CENTROID HIERARCHICAL CLUSTER ANALYSIS

                                        NAME OF OBSERVATION OR CLUSTER

             e     p     l     c     a     d     f     s     p     m     l           p           a     c
             q     r     e     a     c     r     o     w     r     e     a     w     i     s     i     o
             u     o     a     r     c     a     r     _     o     d     n     e     l     u     r     n
             i     g     d     g     o     i     m     d     t     i     g     a     o     r     _     s
             p     r     e     o     u     r     _     e     o     c     u     t     t     g     t     o
             _     a     r     _     n     _     f     s     c     a     a     h     _     e     r     l
             d     m     s     l     t     g     i     i     o     l     g     e     t     r     a     e
             i     _     h     o     i     e     l     g     l     _     e     r     r     y     f     _
        0.9 +
            |
            |
            |
            |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
        0.8 +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     .     XXXXXXXXXXXXX    .
D           |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     .     XXXXXXX     .     .
I           |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     .     .     XXXXXXX     .     .
S           |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     .     .     XXXXXXX     .     .
T           |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     .     .     .     XXXXXXX     .     .
A       0.7 +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     XXXXXXX     .     .     .     XXXXXXX     .     .
N           |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     XXXXXXX     .     .     .     XXXXXXX     .     .
C           |XXXXXX.     .XXXXXXXXXXXX     .XXXXXX     XXXXXXX     .     .     .     XXXXXXX     .     .
E           |.     .     .     .     .     .XXXXXX     XXXXXXX     .     .     .     XXXXXXX     .     .
            |.     .     .     .     .     .     .     XXXXXXX     .     .     .     XXXXXXX     .     .
B       0.6 +.     .     .     .     .     .     .     XXXXXXX     .     .           .     .     .     .
E           |.     .     .     .     .     .     .     XXXXXXX     .     .     .     .     .     .     .
T           |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
W           |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
E           |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
E       0.5 +.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
N           |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
            |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
C           |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
L           |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
U       0.4 +.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
S           |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
```

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      T         |.   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
      E         |.   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
      R         |.   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
            0.3 +.   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
      C         |.   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
      E         |.   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
      N         |.   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
      T         |.   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
      R     0.2 +.   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
      O         |.   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
      I         |.   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
      D         |.   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
      S         |.   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
            0.1 +.   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
                |.   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
                |.   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
                |.   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
                |.   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
              0 +.   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
1                                 Average scores for eight clusters                    9:40 TUESDAY, APRIL 2, 1991   4

------------------------------------------------------------ CLUSTER=1 ------------------------------------------------------------

   TASK              V1          V2          V3          V4          V5          V6          V7          V8          V9

   sw_desig           0           0           4           0           3           3           1           0           2
   protocol           2           1           4           0           4           2           2           0           3

   TASK             V10         V11         V12         V13         V14         V15         V16         V17         V18

   sw_desig           4           4           4           1           0           4           4           2           4
   protocol           0           4           4           1           0           4           4           1           4

   TASK             V19         V20         V21         V22      INPUTS     COMPLEX        TECH      INFORM       SOLVE

   sw_desig           4           2           0           1     0.90000     1.25000     1.50000     1.44444     2.08333
   protocol           3           3           0           1     1.70000     0.25000     2.00000     2.00000     2.16667

   TASK          RECALL    PERCEPT     ENVIRON      PSYCHE    PHYSICAL       PSYCH       EQUIP    COMMUNIC      DOMAIN

   sw_desig     2.40000           0           0           0           0     1.50000     1.33333     0.69231           1
   protocol     2.80000           0           0           0           0     2.50000     1.16667     1.61538           1


------------------------------------------------------------ CLUSTER=2 ------------------------------------------------------------

   TASK              V1          V2          V3          V4          V5          V6          V7          V8          V9

   pilot_tr           0           4           4           3           3           3           0           4           1
   surgery            0           4           4           1           2           3           0           3           2

   TASK             V10         V11         V12         V13         V14         V15         V16         V17         V18

   pilot_tr           3           4           0           3           0           0           4           4           3
   surgery            4           4           0           1           2           0           3           4           4

   TASK             V19         V20         V21         V22      INPUTS     COMPLEX        TECH      INFORM       SOLVE
```

```
   pilot_tr            0          2          3          1    2.30000    4.00000    2.00000   0.555556    2.41667
   surgery             0          1.         3          1    2.80000    2.50000    1.50000   0.888889    3.00000

   TASK           RECALL    PERCEPT    ENVIRON     PSYCHE   PHYSICAL      PSYCH      EQUIP   COMMUNIC     DOMAIN

   pilot_tr      2.40000    3.50000    1.83333    2.18182    2.60000    3.25000    1.66667    2.84615          3
   surgery       2.80000    1.50000    0.83333    3.09091    0.00000    2.00000    1.83333    2.00000          3
1                                     Average scores for eight clusters            9:40 TUESDAY, APRIL 2, 1991   5

 ------------------------------------------------- CLUSTER=3 --------------------------------------------------

   TASK               V1         V2         V3         V4         V5         V6         V7         V8         V9

   cargo_lo            0          4          4          0          2          1          4          1          0
   accounti            0          0          3          0          2          0          4          0          0
   program_            0          0          4          0          3          0          0          0          0
   leadersh            0          0          2          1          3          0          0          0          2
   equip_di            0          1          1          0          2          1          0          2          0
   drair_ge            1          0          2          1          1          0          1          1          4

   TASK              V10        V11        V12        V13        V14        V15        V16        V17        V18

   cargo_lo            3          4          0          3          0          0          3          4          2
   accounti            0          3          0          2          0          0          4          4          2
   program_            0          4          0          1          0          3          3          3          2
   leadersh            0          2          3          1          0          3          3          3          3
   equip_di            0          3          1          3          0          0          2          4          3
   drair_ge            0          2          0          3          0          0          4          3          1

   TASK              V19        V20        V21        V22     INPUTS    COMPLEX       TECH     INFORM      SOLVE

   cargo_lo            1          0          2          2    0.90000    0.75000    2.50000    1.66667    2.00000
   accounti            2          0          3          0    2.10000    0.75000    1.50000    2.44444    1.08333
   program_            0          0          0          3    1.50000    2.00000    2.00000    0.77778    1.91667
   leadersh            0          1          0          0    1.40000    0.50000    2.00000    0.88889    1.83333
   equip_di            1          0          0          1    1.60000    1.25000    2.50000    0.77778    0.91667
   drair_ge            3          3          0          0    1.30000    0.50000    2.50000    1.22222    1.91667

   TASK           RECALL    PERCEPT    ENVIRON     PSYCHE   PHYSICAL      PSYCH      EQUIP   COMMUNIC     DOMAIN

   cargo_lo      2.40000          0    1.00000   0.272727   0.400000    0.75000    0.66667    1.23077          1
   accounti      1.80000          0    0.00000   0.363636   0.000000    0.75000    1.16667    0.92308          1
   program_      2.40000          0    0.00000   0.000000   0.000000    0.50000    0.33333    1.76923          1
   leadersh      2.60000          0    0.00000   0.000000   0.000000    3.00000    0.66667    3.07692          1
   equip_di      1.60000          0    1.50000   0.818182   0.000000    0.25000    1.16667    0.30769          0
   drair_ge      1.80000          0    0.00000   0.000000   0.000000    1.50000    0.83333    1.23077          1


 ------------------------------------------------- CLUSTER=4 --------------------------------------------------

   TASK               V1         V2         V3         V4         V5         V6         V7         V8         V9

   form_fil            0          0          2          2          3          0          2          0          2

   TASK              V10        V11        V12        V13        V14        V15        V16        V17        V18

   form_fil            2          4          3          3          3          2          4          4          3
```

```
  TASK              V19         V20         V21         V22      INPUTS     COMPLEX        TECH      INFORM       SOLVE

  form_fil            3           3           0           2     1.20000    0.500000           2     1.11111     1.41667

  TASK           RECALL     PERCEPT     ENVIRON      PSYCHE    PHYSICAL       PSYCH       EQUIP    COMMUNIC      DOMAIN

  form_fil            2           0           0           0           0    0.500000     1.16667     1.61538           1
1                                          Average scores for eight clusters               9:40 TUESDAY, APRIL 2, 1991   6

--------------------------------------------------- CLUSTER=5 ---------------------------------------------------

  TASK               V1          V2          V3          V4          V5          V6          V7          V8          V9

  medical_            0           3           4           0           3           2           0           4           2

  TASK              V10         V11         V12         V13         V14         V15         V16         V17         V18

  medical_            1           2           0           2           1           4           4           2           3

  TASK              V19         V20         V21         V22      INPUTS     COMPLEX        TECH      INFORM       SOLVE

  medical_            0           2           2           2     2.40000           2           2     1.44444     2.08333

  TASK           RECALL     PERCEPT     ENVIRON      PSYCHE    PHYSICAL       PSYCH       EQUIP    COMMUNIC      DOMAIN

  medical_            3           0           0    0.909091           0     3.25000     1.33333     2.46154           1

--------------------------------------------------- CLUSTER=6 ---------------------------------------------------

  TASK               V1          V2          V3          V4          V5          V6          V7          V8          V9

  language            0           0           0           3           3           0           0           2           2

  TASK              V10         V11         V12         V13         V14         V15         V16         V17         V18

  language            1           4           1           1           2           2           4           0           4

  TASK              V19         V20         V21         V22      INPUTS     COMPLEX        TECH      INFORM       SOLVE

  language            4           3           1           0     1.40000     3.25000           2    0.888889     2.25000

  TASK           RECALL     PERCEPT     ENVIRON      PSYCHE    PHYSICAL       PSYCH       EQUIP    COMMUNIC      DOMAIN

  language      3.20000           0           0           0           0           3    0.333333     3.38462           1

--------------------------------------------------- CLUSTER=7 ---------------------------------------------------

  TASK               V1          V2          V3          V4          V5          V6          V7          V8          V9

  air_traf            0           4           4           0           1           1           0           0           0

  TASK              V10         V11         V12         V13         V14         V15         V16         V17         V18

  air_traf            4           4           0           2           1           0           2           0           4

  TASK              V19         V20         V21         V22      INPUTS     COMPLEX        TECH      INFORM       SOLVE
```

```
    air_traf            0            0            0            0      1.60000      3.25000            2      1.22222            2

    TASK           RECALL      PERCEPT      ENVIRON       PSYCHE     PHYSICAL        PSYCH        EQUIP     COMMUNIC       DOMAIN

    air_traf      2.40000            4      1.33333      2.81818     0.800000      2.25000      1.33333            2            2
1                                         Average scores for eight clusters                      9:40 TUESDAY, APRIL 2, 1991   7

 ---------------------------------------------------- CLUSTER=8 -----------------------------------------------------

    TASK               V1           V2           V3           V4           V5           V6           V7           V8           V9

    weather             1            4            4            0            0            4            2            0            3

    TASK              V10          V11          V12          V13          V14          V15          V16          V17          V18

    weather             0            3            0            2            0            0            4            3            0

    TASK              V19          V20          V21          V22       INPUTS      COMPLEX         TECH       INFORM        SOLVE

    weather             3            3            0            0      1.20000      3.25000            3      1.66667      2.33333

    TASK           RECALL      PERCEPT      ENVIRON       PSYCHE     PHYSICAL        PSYCH        EQUIP     COMMUNIC       DOMAIN

    weather       2.60000      1.50000            0            0            0     0.750000            1            0            1


 ---------------------------------------------------- CLUSTER=9 -----------------------------------------------------

    TASK               V1           V2           V3           V4           V5           V6           V7           V8           V9

    console_            0            0            4            0            3            2            3            4            1

    TASK              V10          V11          V12          V13          V14          V15          V16          V17          V18

    console_            0            1            0            2            3            0            2            4            2

    TASK              V19          V20          V21          V22       INPUTS      COMPLEX         TECH       INFORM        SOLVE

    console_            0            0            2            0      2.40000      2.75000            2      1.88889      2.83333

    TASK           RECALL      PERCEPT      ENVIRON       PSYCHE     PHYSICAL        PSYCH        EQUIP     COMMUNIC       DOMAIN

    console_      2.20000            4            1      1.81818      1.40000            2      1.66667      1.84615            2
1                                         Average scores for eight clusters                      9:40 TUESDAY, APRIL 2, 1991   8

       CLUSTER          V1           V2           V3           V4           V5           V6           V7           V8           V9

             1     1.00000      0.50000      4.00000      0.00000      3.50000      2.50000      1.50000      0.00000      2.50000
             2     0.00000      4.00000      4.00000      2.00000      2.50000      3.00000      0.00000      3.50000      1.50000
             3     0.16667      0.83333      2.66667      0.33333      2.16667      0.33333      1.50000      0.66667      1.00000
             4     0.00000      0.00000      2.00000      2.00000      3.00000      0.00000      2.00000      0.00000      2.00000
             5     0.00000      3.00000      4.00000      0.00000      3.00000      2.00000      0.00000      4.00000      2.00000
             6     0.00000      0.00000      0.00000      3.00000      3.00000      0.00000      0.00000      2.00000      2.00000
             7     0.00000      4.00000      4.00000      0.00000      1.00000      1.00000      0.00000      0.00000      0.00000
             8     1.00000      4.00000      4.00000      0.00000      0.00000      4.00000      2.00000      0.00000      3.00000
             9     0.00000      0.00000      4.00000      0.00000      3.00000      2.00000      3.00000      4.00000      1.00000
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```
      V10         V11         V12         V13         V14         V15         V16         V17         V18         V19

  2.00000           4     4.00000     1.00000           0           4     4.00000     1.50000     4.00000     3.50000
  3.50000           4     0.00000     2.00000           1           0     3.50000     4.00000     3.50000     0.00000
  0.50000           3     0.66667     2.16667           0           1     3.16667     3.50000     2.16667     1.16667
  2.00000           4     3.00000     3.00000           3           2     4.00000     4.00000     3.00000     3.00000
  1.00000           2     0.00000     2.00000           1           4     4.00000     2.00000     3.00000     0.00000
  1.00000           4     1.00000     1.00000           2           2     4.00000     0.00000     4.00000     4.00000
  4.00000           4     0.00000     2.00000           1           0     2.00000     0.00000     4.00000     0.00000
  0.00000           3     0.00000     2.00000           0           0     4.00000     3.00000     0.00000     3.00000
  0.00000           1     0.00000     2.00000           3           0     2.00000     4.00000     2.00000     0.00000

      V20         V21         V22      INPUTS     COMPLEX        TECH      INFORM       SOLVE      RECALL    PERCEPT

  2.50000     0.00000           1     1.30000     0.75000     1.75000     1.72222     2.12500     2.60000     0.00000
  1.50000     3.00000           1     2.55000     3.25000     1.75000     0.72222     2.70833     2.60000     2.50000
  0.66667     0.83333           1     1.46667     0.95833     2.16667     1.29630     1.61111     2.10000     0.00000
  3.00000     0.00000           2     1.20000     0.50000     2.00000     1.11111     1.41667     2.00000     0.00000
  2.00000     2.00000           2     2.40000     2.00000     2.00000     1.44444     2.08333     3.00000     0.00000
  3.00000     1.00000           0     1.40000     3.25000     2.00000     0.88889     2.25000     3.20000     0.00000
  0.00000     0.00000           0     1.60000     3.25000     2.00000     1.22222     2.00000     2.40000     4.00000
  3.00000     0.00000           0     1.20000     3.25000     3.00000     1.66667     2.33333     2.60000     1.50000
  0.00000     2.00000           0     2.40000     2.75000     2.00000     1.88889     2.83333     2.20000     4.00000

  ENVIRON          PSYCHE        PHYSICAL           PSYCH           EQUIP        COMMUNIC          DOMAIN

  0.00000         0.00000         0.00000         2.00000         1.25000         1.15385         1.00000
  1.33333         2.63636         1.30000         2.62500         1.75000         2.42308         3.00000
  0.41667         0.24242         0.06667         1.12500         0.80556         1.42308         0.83333
  0.00000         0.00000         0.00000         0.50000         1.16667         1.61538         1.00000
  0.00000         0.90909         0.00000         3.25000         1.33333         2.46154         1.00000
  0.00000         0.00000         0.00000         3.00000         0.33333         3.38462         1.00000
  1.33333         2.81818         0.80000         2.25000         1.33333         2.00000         2.00000
  0.00000         0.00000         0.00000         0.75000         1.00000         0.00000         1.00000
  1.00000         1.81818         1.40000         2.00000         1.66667         1.84615         2.00000
```

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                  CENTROID HIERARCHICAL CLUSTER ANALYSIS

                  EIGENVALUES OF THE COVARIANCE MATRIX

          EIGENVALUE      DIFFERENCE      PROPORTION      CUMULATIVE

 1          13.8941         6.26352        0.288797         0.28880
 2           7.6306         2.45736        0.158606         0.44740
 3           5.1732         0.57925        0.107529         0.55493
 4           4.5940         1.07205        0.095489         0.65042
 5           3.5219         0.42791        0.073205         0.72363
 6           3.0940         0.57024        0.064311         0.78794
 7           2.5238         0.77827        0.052458         0.84039
 8           1.7455         0.49820        0.036281         0.87668
 9           1.2473         0.03642        0.025926         0.90260
10           1.2109         0.12309        0.025169         0.92777
11           1.0878         0.14892        0.022610         0.95038
12           0.9389         0.30811        0.019515         0.96990
13           0.6308         0.12608        0.013111         0.98301
14           0.5047         0.19184        0.010490         0.99350
15           0.3128         0.31284        0.006503         1.00000
16           0.0000         0.00000        0.000000         1.00000
17           0.0000         0.00000        0.000000         1.00000
18           0.0000         0.00000        0.000000         1.00000
19           0.0000         0.00000        0.000000         1.00000
20           0.0000         0.00000        0.000000         1.00000
21           0.0000         0.00000        0.000000         1.00000
22           0.0000         0.00000        0.000000         1.00000
23           0.0000         0.00000        0.000000         1.00000
24           0.0000         0.00000        0.000000         1.00000
25           0.0000         0.00000        0.000000         1.00000
26           0.0000         0.00000        0.000000         1.00000
27           0.0000         0.00000        0.000000         1.00000
28          -0.0000         0.00000        -.000000         1.00000
29          -0.0000         0.00000        -.000000         1.00000
30          -0.0000         0.00000        -.000000         1.00000
31          -0.0000         0.00000        -.000000         1.00000
32          -0.0000         0.00000        -.000000         1.00000
33          -0.0000         0.00000        -.000000         1.00000
34          -0.0000         0.00000        -.000000         1.00000
35          -0.0000         0.00000        -.000000         1.00000
36          -0.0000          .             -.000000         1.00000

    ROOT-MEAN-SQUARE TOTAL-SAMPLE STANDARD DEVIATION =  1.15603
    ROOT-MEAN-SQUARE DISTANCE BETWEEN OBSERVATIONS   =   9.8092

     NUMBER                                 FREQUENCY     NORMALIZED
       OF                                    OF NEW        CENTROID
    CLUSTERS    CLUSTERS JOINED              CLUSTER       DISTANCE

        15      sw_desig    protocol            2          0.578896
        14      pilot_tr    surgery             2          0.622233
        13      cargo_lo    accounti            2          0.666616
        12      program_    leadersh            2          0.671527
        11      equip_di    CL12                3          0.663370
```

```
                     10    CL11        CL13              5         0.662742
                      9    CL10        drair_ge          6         0.673242
                      8    CL9         form_fil          7         0.638162
1                                            SAS                                  14:25 THURSDAY, JULY 11,
1991   2


                              CENTROID HIERARCHICAL CLUSTER ANALYSIS

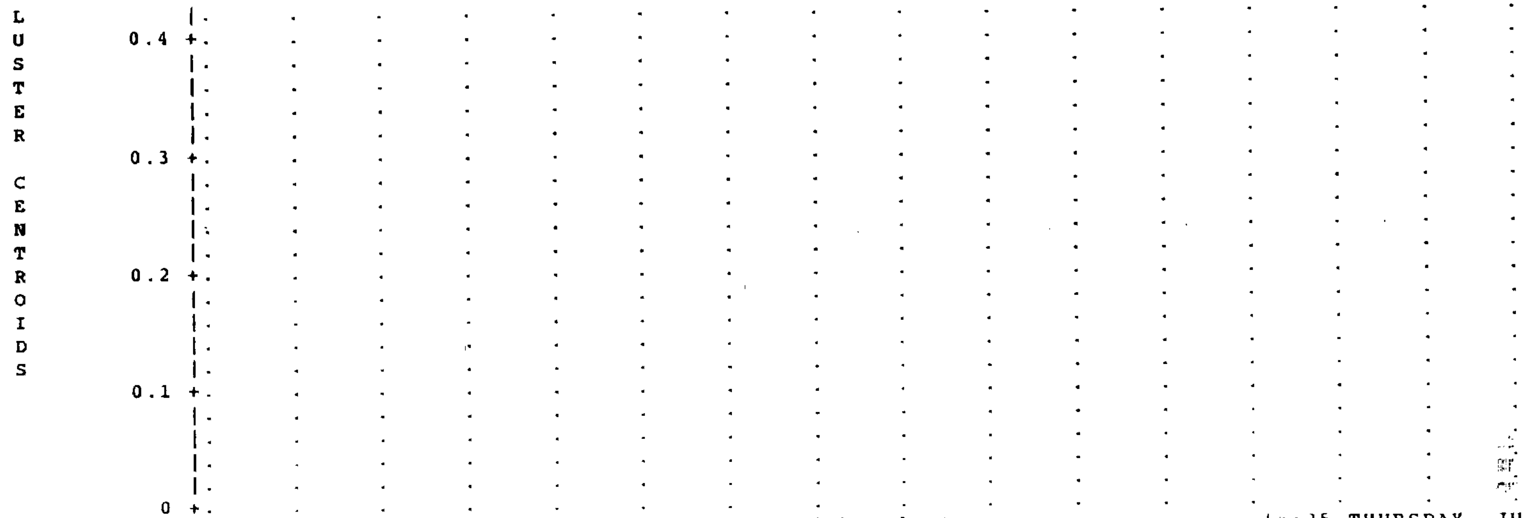
                NUMBER                                 FREQUENCY         NORMALIZED
                  OF                                    OF NEW            CENTROID
                CLUSTERS   CLUSTERS JOINED              CLUSTER           DISTANCE

                      7    CL8         CL15              9         0.722433
                      6    CL7         medical_         10         0.732175
                      5    CL6         language         11         0.783836
                      4    CL14        air_traf          3         0.799688
                      3    CL5         weather          12         0.825345
                      2    CL3         CL4              15         0.822499
                      1    CL2         console_         16         0.811065
1                                            SAS                                  14:25 THURSDAY, JULY 11,
1991   3


                              CENTROID HIERARCHICAL CLUSTER ANALYSIS

                                        NAME OF OBSERVATION OR CLUSTER

             e     p     l     c     a     d     f     s     p     m     l           p           a     c
             q     r     e     a     c     r     o     w     r     e     a     w     i     s     i     o
             u     o     a     r     c     a     r     _     o     d     n     e     l     u     r     n
             i     g     d     g     o     i     m     d     t     i     g     a     o     r     _     s
             p     r     e     o     u     r     _     e     o     c     u     t     t     g     t     o
             _     a     r     _     n     _     f     s     c     a     a     h     _     e     r     l
             d     m     s     l     t     g     i     i     o     l     g     e     t     r     a     e
             i     _     h     o     i     e     l     g     l     _     e     r     r     y     f     _
        0.9 +
            |
            |
            |
            |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
        0.8 +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     .     XXXXXXXXXXXXX     .
D           |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     .     XXXXXXX     .     .
I           |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     .     .     XXXXXXX     .     .
S           |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     .     .     XXXXXXX     .     .
T           |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     .     .     .     XXXXXXX     .     .
A       0.7 +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     XXXXXXX     .     .     .     XXXXXXX     .     .
N           |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     XXXXXXX     .     .     .     XXXXXXX     .     .
C           |XXXXXX.     .XXXXXXXXXXXX     .XXXXXX     XXXXXXX     .     .     .     XXXXXXX     .     .
E           |.     .     .     .     .     .XXXXXX     XXXXXXX     .     .     .     XXXXXXX     .     .
            |.     .     .     .     .     .     .     XXXXXXX     .     .     .     XXXXXXX     .     .
B       0.6 +.     .     .     .     .     .     .     XXXXXXX     .     .     .     .     .     .     .
E           |.     .     .     .     .     .     .     XXXXXXX     .     .     .     .     .     .     .
T           |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
W           |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
E           |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
E       0.5 +.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
N           |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
            |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
C           |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
```



```
                          Average scores for eight clusters               14:25 THURSDAY, JULY 11,
1
1991 4

 ------------------------------------------------------------ CLUSTER=1 --------------------------------------------------------
--------

     TASK          V1        V2        V3        V4        V5        V6        V7        V8
  V9

     sw_desig      0         0         4         0         3         3         1         0
   2
     protocol      2         1         4         0         4         2         2         0
   3
     cargo_lo      0         4         4         0         2         1         4         1
   0
     accounti      0         0         3         0         2         0         4         0
   0
     program_      0         0         4         0         3         0         0         0
   0
     leadersh      0         0         2         1         3         0         0         0
   2
     equip_di      0         1         1         0         2         1         0         2
   0
     drair_ge      1         0         2         1         1         0         1         1
   4
     form_fil      0         0         2         2         3         0         2         0
   2

     TASK          V10       V11       V12       V13       V14       V15       V16       V17
 V18

     sw_desig      4         4         4         1         0         4         4         2
   4
     protocol      0         4         4         1         0         4         4         1
   4
     cargo_lo      3         4         0         3         0         0         3         4
```

```
  2
     accounti          0          3          0          2          0          0          4          4
  2
     program_          0          4          0          1          0          3          3          3
  2
     leadersh          0          2          3          1          0          3          3          3
  3
     equip_di          0          3          1          3          0          0          2          4
  3
     drair_ge          0          2          0          3          0          0          4          3
  1
     form_fil          2          4          3          3          3          2          4          4
  3

     TASK            V19        V20        V21        V22     INPUTS    COMPLEX       TECH     INFORM         SO
LVE

     sw_desig          4          2          0          1    0.90000    1.25000    1.50000    1.44444       2.08
333
     protocol          3          3          0          1    1.70000    0.25000    2.00000    2.00000       2.16
667
     cargo_lo          1          0          2          2    0.90000    0.75000    2.50000    1.66667       2.00
000
     accounti          2          0          3          0    2.10000    0.75000    1.50000    2.44444       1.08
333
     program_          0          0          0          3    1.50000    2.00000    2.00000    0.77778       1.91
667
     leadersh          0          1          0          0    1.40000    0.50000    2.00000    0.88889       1.83
333
     equip_di          1          0          0          1    1.60000    1.25000    2.50000    0.77778       0.91
667
     drair_ge          3          3          0          0    1.30000    0.50000    2.50000    1.22222       1.91
667
     form_fil          3          3          0          2    1.20000    0.50000    2.00000    1.11111       1.41
667

     TASK         RECALL    PERCEPT    ENVIRON     PSYCHE   PHYSICAL      PSYCH      EQUIP   COMMUNIC        DOM
AIN

     sw_desig    2.40000          0    0.00000   0.000000   0.000000    1.50000    1.33333    0.69231
  1
     protocol    2.80000          0    0.00000   0.000000   0.000000    2.50000    1.16667    1.61538
  1
     cargo_lo    2.40000          0    1.00000   0.272727   0.400000    0.75000    0.66667    1.23077
  1
     accounti    1.80000          0    0.00000   0.363636   0.000000    0.75000    1.16667    0.92308
  1
     program_    2.40000          0    0.00000   0.000000   0.000000    0.50000    0.33333    1.76923
  1
     leadersh    2.60000          0    0.00000   0.000000   0.000000    3.00000    0.66667    3.07692
  1
     equip_di    1.60000          0    1.50000   0.818182   0.000000    0.25000    1.16667    0.30769
  0
     drair_ge    1.80000          0    0.00000   0.000000   0.000000    1.50000    0.83333    1.23077
  1
     form_fil    2.00000          0    0.00000   0.000000   0.000000    0.50000    1.16667    1.61538
  1
1                                               Average scores for eight clusters            14:25 THURSDAY, JULY 11,
```

```
1991  5
 ------------------------------------------------------------ CLUSTER=2 ------------------------------------------------------------
-------
    TASK               V1           V2           V3           V4           V5           V6           V7           V8
 V9
    pilot_tr            0            4            4            3            3            3            0            4
  1
    surgery             0            4            4            1            2            3            0            3
  2
    TASK              V10          V11          V12          V13          V14          V15          V16          V17
V18
    pilot_tr            3            4            0            3            0            0            4            4
  3
    surgery             4            4            0            1            2            0            3            4
  4
    TASK              V19          V20          V21          V22       INPUTS      COMPLEX         TECH       INFORM           SO
LVE
    pilot_tr            0            2            3            1      2.30000      4.00000      2.00000     0.555556         2.41
667
    surgery             0            1            3            1      2.80000      2.50000      1.50000     0.888889         3.00
000
    TASK           RECALL      PERCEPT      ENVIRON       PSYCHE     PHYSICAL        PSYCH        EQUIP     COMMUNIC          DOM
AIN
    pilot_tr      2.40000      3.50000      1.83333      2.18182      2.60000      3.25000      1.66667      2.84615
  3
    surgery       2.80000      1.50000      0.83333      3.09091      0.00000      2.00000      1.83333      2.00000
  3

 ------------------------------------------------------------ CLUSTER=3 ------------------------------------------------------------
-------
    TASK               V1           V2           V3           V4           V5           V6           V7           V8
 V9
    medical_            0            3            4            0            3            2            0            4
  2
    TASK              V10          V11          V12          V13          V14          V15          V16          V17
V18
    medical_            1            2            0            2            1            4            4            2
  3
    TASK              V19          V20          V21          V22       INPUTS      COMPLEX         TECH       INFORM           SO
LVE
    medical_            0            2            2            2      2.40000            2            2      1.44444         2.08
333
```

```
         TASK                RECALL       PERCEPT       ENVIRON        PSYCHE      PHYSICAL         PSYCH         EQUIP      COMMUNIC          DOM
AIN

         medical_                 3             0             0      0.909091             0       3.25000       1.33333       2.46154
  1
1                                                     Average scores for eight clusters                  14:25 THURSDAY, JULY 11,
1991   6

 ------------------------------------------------------------- CLUSTER=4 -------------------------------------------------------------
-------

         TASK                    V1            V2            V3            V4            V5            V6            V7            V8
  V9

         language                 0             0             0             3             3             0             0             2
  2

         TASK                   V10           V11           V12           V13           V14           V15           V16           V17
V18

         language                 1             4             1             1             2             2             4             0
  4

         TASK                   V19           V20           V21           V22        INPUTS       COMPLEX          TECH        INFORM           SO
LVE

         language                 4             3             1             0       1.40000       3.25000             2      0.888889         2.25
000

         TASK                RECALL       PERCEPT       ENVIRON        PSYCHE      PHYSICAL         PSYCH         EQUIP      COMMUNIC          DOM
AIN

         language           3.20000             0             0             0             0             3      0.333333       3.38462
  1


 ------------------------------------------------------------- CLUSTER=5 -------------------------------------------------------------
-------

         TASK                    V1            V2            V3            V4            V5            V6            V7            V8
  V9

         air_traf                 0             4             4             0             1             1             0             0
  0

         TASK                   V10           V11           V12           V13           V14           V15           V16           V17
V18

         air_traf                 4             4             0             2             1             0             2             0
  4

         TASK                   V19           V20           V21           V22        INPUTS       COMPLEX          TECH        INFORM           SO
LVE

         air_traf                 0             0             0             0       1.60000       3.25000             2       1.22222
  2
```

```
     TASK            RECALL     PERCEPT     ENVIRON      PSYCHE    PHYSICAL       PSYCH       EQUIP    COMMUNIC         DOM
AIN
     air_traf       2.40000           4     1.33333     2.81818    0.800000     2.25000     1.33333           2
  2

 ------------------------------------------------------------- CLUSTER=6 ---------------------------------------------------------
-------
     TASK                V1          V2          V3          V4          V5          V6          V7          V8
 V9
     weather              1           4           4           0           0           4           2           0
  3
     TASK               V10         V11         V12         V13         V14         V15         V16         V17
V18
     weather              0           3           0           2           0           0           4           3
  0
     TASK               V19         V20         V21         V22      INPUTS     COMPLEX        TECH      INFORM          SO
LVE
     weather              3           3           0           0     1.20000     3.25000           3     1.66667        2.33
333
     TASK            RECALL     PERCEPT     ENVIRON      PSYCHE    PHYSICAL       PSYCH       EQUIP    COMMUNIC         DOM
AIN
     weather        2.60000     1.50000           0           0           0    0.750000           1           0
  1
1                                                  Average scores for eight clusters              14:25 THURSDAY, JULY 11,
1991   7
 ------------------------------------------------------------- CLUSTER=7 ---------------------------------------------------------
-------
     TASK                V1          V2          V3          V4          V5          V6          V7          V8
 V9
     console_             0           0           4           0           3           2           3           4
  1
     TASK               V10         V11         V12         V13         V14         V15         V16         V17
V18
     console_             0           1           0           2           3           0           2           4
  2
     TASK               V19         V20         V21         V22      INPUTS     COMPLEX        TECH      INFORM          SO
LVE
     console_             0           0           2           0     2.40000     2.75000           2     1.88889        2.83
333
     TASK            RECALL     PERCEPT     ENVIRON      PSYCHE    PHYSICAL       PSYCH       EQUIP    COMMUNIC         DOM
```

```
AIN

     console_       2.20000          4           1       1.81818     1.40000           2       1.66667      1.84615
   2
1                                              Average scores for eight clusters               14:25 THURSDAY, JULY 11,
1991   8

         CLUSTER               V1           V2           V3           V4           V5           V6           V7           V8
   V9

               1          0.33333      0.66667      2.88889      0.44444      2.55556      0.77778      1.55556      0.44444      1.
44444
               2          0.00000      4.00000      4.00000      2.00000      2.50000      3.00000      0.00000      3.50000      1.
50000
               3          0.00000      3.00000      4.00000      0.00000      3.00000      2.00000      0.00000      4.00000      2.
00000
               4          0.00000      0.00000      0.00000      3.00000      3.00000      0.00000      0.00000      2.00000      2.
00000
               5          0.00000      4.00000      4.00000      0.00000      1.00000      1.00000      0.00000      0.00000      0.
00000
               6          1.00000      4.00000      4.00000      0.00000      0.00000      4.00000      2.00000      0.00000      3.
00000
               7          0.00000      0.00000      4.00000      0.00000      3.00000      2.00000      3.00000      4.00000      1.
00000

             V10              V11          V12          V13          V14          V15          V16          V17          V18
  V19

         1.00000          3.33333      1.66667            2      0.33333      1.77778      3.44444      3.11111      2.66667      1.
88889
         3.50000          4.00000      0.00000            2      1.00000      0.00000      3.50000      4.00000      3.50000      0.
00000
         1.00000          2.00000      0.00000            2      1.00000      4.00000      4.00000      2.00000      3.00000      0.
00000
         1.00000          4.00000      1.00000            1      2.00000      2.00000      4.00000      0.00000      4.00000      4.
00000
         4.00000          4.00000      0.00000            2      1.00000      0.00000      2.00000      0.00000      4.00000      0.
00000
         0.00000          3.00000      0.00000            2      0.00000      0.00000      4.00000      3.00000      0.00000      3.
00000
         0.00000          1.00000      0.00000            2      3.00000      0.00000      2.00000      4.00000      2.00000      0.
00000

             V20              V21          V22       INPUTS      COMPLEX         TECH       INFORM        SOLVE       RECALL      PE
RCEPT

         1.33333          0.55556      1.11111      1.40000      0.86111      2.05556      1.37037      1.70370      2.20000      0.
00000
         1.50000          3.00000      1.00000      2.55000      3.25000      1.75000      0.72222      2.70833      2.60000      2.
50000
         2.00000          2.00000      2.00000      2.40000      2.00000      2.00000      1.44444      2.08333      3.00000      0.
00000
         3.00000          1.00000      0.00000      1.40000      3.25000      2.00000      0.88889      2.25000      3.20000      0.
00000
         0.00000          0.00000      0.00000      1.60000      3.25000      2.00000      1.22222      2.00000      2.40000      4.
00000
         3.00000          0.00000      0.00000      1.20000      3.25000      3.00000      1.66667      2.33333      2.60000      1.
50000
```

```
             0.00000        2.00000        0.00000        2.40000        2.75000        2.00000        1.88889        2.83333        2.20000        4.
     00000

             ENVIRON          PSYCHE        PHYSICAL          PSYCH          EQUIP       COMMUNIC         DOMAIN

             0.27778         0.16162         0.04444        1.25000        0.94444        1.38462        0.88889
             1.33333         2.63636         1.30000        2.62500        1.75000        2.42308        3.00000
             0.00000         0.90909         0.00000        3.25000        1.33333        2.46154        1.00000
             0.00000         0.00000         0.00000        3.00000        0.33333        3.38462        1.00000
             1.33333         2.81818         0.80000        2.25000        1.33333        2.00000        2.00000
             0.00000         0.00000         0.00000        0.75000        1.00000        0.00000        1.00000
             1.00000         1.81818         1.40000        2.00000        1.66667        1.84615        2.00000
```

```
                    CENTROID HIERARCHICAL CLUSTER ANALYSIS

                     EIGENVALUES OF THE COVARIANCE MATRIX

            EIGENVALUE      DIFFERENCE      PROPORTION      CUMULATIVE

   1          13.8941         6.26352        0.288797         0.28880
   2           7.6306         2.45736        0.158606         0.44740
   3           5.1732         0.57925        0.107529         0.55493
   4           4.5940         1.07205        0.095489         0.65042
   5           3.5219         0.42791        0.073205         0.72363
   6           3.0940         0.57024        0.064311         0.78794
   7           2.5238         0.77827        0.052458         0.84039
   8           1.7455         0.49820        0.036281         0.87668
   9           1.2473         0.03642        0.025926         0.90260
  10           1.2109         0.12309        0.025169         0.92777
  11           1.0878         0.14892        0.022610         0.95038
  12           0.9389         0.30811        0.019515         0.96990
  13           0.6308         0.12608        0.013111         0.98301
  14           0.5047         0.19184        0.010490         0.99350
  15           0.3128         0.31284        0.006503         1.00000
  16           0.0000         0.00000        0.000000         1.00000
  17           0.0000         0.00000        0.000000         1.00000
  18           0.0000         0.00000        0.000000         1.00000
  19           0.0000         0.00000        0.000000         1.00000
  20           0.0000         0.00000        0.000000         1.00000
  21           0.0000         0.00000        0.000000         1.00000
  22           0.0000         0.00000        0.000000         1.00000
  23           0.0000         0.00000        0.000000         1.00000
  24           0.0000         0.00000        0.000000         1.00000
  25           0.0000         0.00000        0.000000         1.00000
  26           0.0000         0.00000        0.000000         1.00000
  27           0.0000         0.00000        0.000000         1.00000
  28          -0.0000         0.00000        -.000000         1.00000
  29          -0.0000         0.00000        -.000000         1.00000
  30          -0.0000         0.00000        -.000000         1.00000
  31          -0.0000         0.00000        -.000000         1.00000
  32          -0.0000         0.00000        -.000000         1.00000
  33          -0.0000         0.00000        -.000000         1.00000
  34          -0.0000         0.00000        -.000000         1.00000
  35          -0.0000         0.00000        -.000000         1.00000
  36          -0.0000          .             -.000000         1.00000

      ROOT-MEAN-SQUARE TOTAL-SAMPLE STANDARD DEVIATION =  1.15603
      ROOT-MEAN-SQUARE DISTANCE BETWEEN OBSERVATIONS   =   9.8092

       NUMBER                              FREQUENCY      NORMALIZED
         OF                                 OF NEW         CENTROID
      CLUSTERS     CLUSTERS JOINED          CLUSTER        DISTANCE

           15      sw_desig   protocol          2          0.578896
           14      pilot_tr   surgery           2          0.622233
           13      cargo_lo   accounti          2          0.666616
           12      program_   leadersh          2          0.671527
           11      equip_di   CL12              3          0.663370
```

```
                    10     CL11        CL13              5           0.662742
                     9     CL10        drair_ge          6           0.673242
                     8     CL9         form_fil          7           0.638162
                                              SAS                                    14:23 THURSDAY, JULY 11,
1
1991   2

                               CENTROID HIERARCHICAL CLUSTER ANALYSIS

                  NUMBER                                   FREQUENCY         NORMALIZED
                    OF                                      OF NEW            CENTROID
                 CLUSTERS      CLUSTERS JOINED              CLUSTER           DISTANCE

                     7     CL8         CL15                    9             0.722433
                     6     CL7         medical_               10             0.732175
                     5     CL6         language               11             0.783836
                     4     CL14        air_traf                3             0.799688
                     3     CL5         weather                12             0.825345
                     2     CL3         CL4                    15             0.822499
                     1     CL2         console_               16             0.811065
                                              SAS                                    14:23 THURSDAY, JULY 11,
1
1991   3

                               CENTROID HIERARCHICAL CLUSTER ANALYSIS

                                         NAME OF OBSERVATION OR CLUSTER

         e      p      l      c      a      d      f      s      p      m      l             p             a      c
         q      r      e      a      c      r      o      w      r      e      a      w      i      s      i      o
         u      o      a      r      c      a      r      _      o      d      n      e      l      u      r      n
         i      g      d      g      o      i      m      d      t      i      g      a      o      r      _      s
         p      r      e      o      u      r      _      e      o      c      u      t      t      g      t      o
         _      a      r      _      n      _      f      s      c      a      a      h      _      e      r      l
         d      m      s      l      t      g      i      i      o      l      g      e      t      r      a      e
         i      _      h      o      i      e      l      g      l      _      e      r      r      y      f      _
    0.9 +
        |
        |
        |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
        |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX      .      XXXXXXXXXXXXXXX      .
    0.8 +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX      .      XXXXXXXX      .      .
D       |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX      .      .      XXXXXXXX      .      .
I       |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX      .      .      XXXXXXXX      .      .
S       |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX      .      .      .      XXXXXXXX      .      .
T       |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX      .      .      .      XXXXXXXX      .      .
A   0.7 +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX      XXXXXXXX      .      .      .      XXXXXXXX      .      .
N       |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX      XXXXXXXX      .      .      .      XXXXXXXX      .      .
C       |XXXXXX.       .XXXXXXXXXXXXXX      .XXXXXXX      XXXXXXXX      .      .      .      XXXXXXXX      .      .
E       |.      .      .      .      .      .XXXXXXX      XXXXXXXX      .      .      .      XXXXXXXX      .      .
        |.      .      .      .      .      .      .      XXXXXXXX      .      .      .      .      .      .      .
B   0.6 +.      .      .      .      .      .      .      XXXXXXXX      .      .      .      .      .      .      .
E       |.      .      .      .      .      .      .      XXXXXXXX      .      .      .      .      .      .      .
T       |.      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
W       |.      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
E       |.      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
E   0.5 +.      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
N       |.      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
        |.      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
C       |.      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
```

```
    L          |.         .         .         .         .         .         .         .         .         .         .         .         .         .         .         .
    U    0.4 +.         .         .         .         .         .         .         .         .         .         .         .         .         .         .         .
    S          |.         .         .         .         .         .         .         .         .         .         .         .         .         .         .         .
    T          |.         .         .         .         .         .         .         .         .         .         .         .         .         .         .         .
    E          |.         .         .         .         .         .         .         .         .         .         .         .         .         .         .         .
    R          |.         .         .         .         .         .         .         .         .         .         .         .         .         .         .         .
         0.3 +.         .         .         .         .         .         .         .         .         .         .         .         .         .         .         .
    C          |.         .         .         .         .         .         .         .         .         .         .         .         .         .         .         .
    E          |.         .         .         .         .         .         .         .         .         .         .         .         .         .         .         .
    N          |.         .         .         .         .         .         .         .         .         .         .         .         .         .         .         .
    T          |.         .         .         .         .         .         .         .         .         .         .         .         .         .         .         .
    R    0.2 +.         .         .         .         .         .         .         .         .         .         .         .         .         .         .         .
    O          |.         .         .         .         .         .         .         .         .         .         .         .         .         .         .         .
    I          |.         .         .         .         .         .         .         .         .         .         .         .         .         .         .         .
    D          |.         .         .         .         .         .         .         .         .         .         .         .         .         .         .         .
    S          |.         .         .         .         .         .         .         .         .         .         .         .         .         .         .         .
         0.1 +.         .         .         .         .         .         .         .         .         .         .         .         .         .         .         .
               |.         .         .         .         .         .         .         .         .         .         .         .         .         .         .         .
               |.         .         .         .         .         .         .         .         .         .         .         .         .         .         .         .
               |.         .         .         .         .         .         .         .         .         .         .         .         .         .         .         .
               |.         .         .         .         .         .         .         .         .         .         .         .         .         .         .         .
           0 +.         .         .         .         .         .         .         .         .         .         .         .         .         .         .         .
1                                          Average scores for eight clusters                              14:23 THURSDAY, JULY 11,
1991   4

 ---------------------------------------------------------------- CLUSTER=1 ----------------------------------------------------------
-------

  TASK                  V1          V2          V3          V4          V5          V6          V7          V8
 V9

  sw_desig               0           0           4           0           3           3           1           0
  2
  protocol               2           1           4           0           4           2           2           0
  3

  TASK                 V10         V11         V12         V13         V14         V15         V16         V17
V18

  sw_desig               4           4           4           1           0           4           4           2
  4
  protocol               0           4           4           1           0           4           4           1
  4

  TASK                 V19         V20         V21         V22      INPUTS     COMPLEX        TECH      INFORM          SO
LVE

  sw_desig               4           2           0           1     0.90000     1.25000     1.50000     1.44444        2.08
333
  protocol               3           3           0           1     1.70000     0.25000     2.00000     2.00000        2.16
667

  TASK              RECALL     PERCEPT     ENVIRON      PSYCHE    PHYSICAL       PSYCH       EQUIP    COMMUNIC         DOM
AIN

  sw_desig         2.40000           0           0           0           0     1.50000     1.33333     0.69231
  1
  protocol         2.80000           0           0           0           0     2.50000     1.16667     1.61538
```

```
1

 ------------------------------------------------------------ CLUSTER=2 -----------------------------------------------------------
-------

    TASK            V1          V2          V3          V4          V5          V6          V7          V8
 V9

    pilot_tr         0           4           4           3           3           3           0           4
  1
    surgery          0           4           4           1           2           3           0           3
  2

    TASK           V10         V11         V12         V13         V14         V15         V16         V17
V18

    pilot_tr         3           4           0           3           0           0           4           4
  3
    surgery          4           4           0           1           2           0           3           4
  4

    TASK           V19         V20         V21         V22      INPUTS     COMPLEX        TECH      INFORM          SO
LVE

    pilot_tr         0           2           3           1     2.30000     4.00000     2.00000    0.555556        2.41
667
    surgery          0           1           3           1     2.80000     2.50000     1.50000    0.888889        3.00
000

    TASK        RECALL     PERCEPT     ENVIRON      PSYCHE    PHYSICAL       PSYCH       EQUIP    COMMUNIC         DOM
AIN

    pilot_tr   2.40000     3.50000     1.83333     2.18182     2.60000     3.25000     1.66667     2.84615
  3
    surgery    2.80000     1.50000     0.83333     3.09091     0.00000     2.00000     1.83333     2.00000
  3
1                                            Average scores for eight clusters             14:23 THURSDAY, JULY 11,
1991   5

 ------------------------------------------------------------ CLUSTER=3 -----------------------------------------------------------
-------

    TASK            V1          V2          V3          V4          V5          V6          V7          V8
 V9

    cargo_lo         0           4           4           0           2           1           4           1
  0
    accounti         0           0           3           0           2           0           4           0
  0
    program_         0           0           4           0           3           0           0           0
  0
    leadersh         0           0           2           1           3           0           0           0
  2
    equip_di         0           1           1           0           2           1           0           2
  0
    drair_ge         1           0           2           1           1           0           1           1
  4
```

```
     form_fil          0          0          2          2          3          0          2          0
  2
     TASK            V10        V11        V12        V13        V14        V15        V16        V17
V18
     cargo_lo          3          4          0          3          0          0          3          4
  2
     accounti          0          3          0          2          0          0          4          4
  2
     program_          0          4          0          1          0          3          3          3
  2
     leadersh          0          2          3          1          0          3          3          3
  3
     equip_di          0          3          1          3          0          0          2          4
  3
     drair_ge          0          2          0          3          0          0          4          3
  1
     form_fil          2          4          3          3          3          2          4          4
  3
     TASK            V19        V20        V21        V22     INPUTS    COMPLEX       TECH     INFORM         SO
LVE
     cargo_lo          1          0          2          2    0.90000    0.75000    2.50000    1.66667       2.00
000
     accounti          2          0          3          0    2.10000    0.75000    1.50000    2.44444       1.08
333
     program_          0          0          0          3    1.50000    2.00000    2.00000    0.77778       1.91
667
     leadersh          0          1          0          0    1.40000    0.50000    2.00000    0.88889       1.83
333
     equip_di          1          0          0          1    1.60000    1.25000    2.50000    0.77778       0.91
667
     drair_ge          3          3          0          0    1.30000    0.50000    2.50000    1.22222       1.91
667
     form_fil          3          3          0          2    1.20000    0.50000    2.00000    1.11111       1.41
667
     TASK         RECALL    PERCEPT    ENVIRON     PSYCHE   PHYSICAL      PSYCH      EQUIP   COMMUNIC        DOM
AIN
     cargo_lo    2.40000          0    1.00000   0.272727   0.400000    0.75000    0.66667    1.23077
  1
     accounti    1.80000          0    0.00000   0.363636   0.000000    0.75000    1.16667    0.92308
  1
     program_    2.40000          0    0.00000   0.000000   0.000000    0.50000    0.33333    1.76923
  1
     leadersh    2.60000          0    0.00000   0.000000   0.000000    3.00000    0.66667    3.07692
  1
     equip_di    1.60000          0    1.50000   0.818182   0.000000    0.25000    1.16667    0.30769
  0
     drair_ge    1.80000          0    0.00000   0.000000   0.000000    1.50000    0.83333    1.23077
  1
     form_fil    2.00000          0    0.00000   0.000000   0.000000    0.50000    1.16667    1.61538
  1
1                                 Average scores for eight clusters          14:23 THURSDAY, JULY 11,
1991   6
```

```
------------------------------------------------------------ CLUSTER=4 ------------------------------------------------------------
-------
   TASK             V1          V2          V3          V4          V5          V6          V7          V8
V9
   medical_          0           3           4           0           3           2           0           4
 2
   TASK            V10         V11         V12         V13         V14         V15         V16         V17
V18
   medical_          1           2           0           2           1           4           4           2
 3
   TASK            V19         V20         V21         V22      INPUTS     COMPLEX        TECH      INFORM          SO
LVE
   medical_          0           2           2           2     2.40000           2           2     1.44444        2.08
333
   TASK         RECALL     PERCEPT     ENVIRON      PSYCHE    PHYSICAL       PSYCH       EQUIP    COMMUNIC         DOM
AIN
   medical_          3           0           0    0.909091           0     3.25000     1.33333     2.46154
 1

------------------------------------------------------------ CLUSTER=5 ------------------------------------------------------------
-------
   TASK             V1          V2          V3          V4          V5          V6          V7          V8
V9
   language          0           0           0           3           3           0           0           2
 2
   TASK            V10         V11         V12         V13         V14         V15         V16         V17
V18
   language          1           4           1           1           2           2           4           0
 4
   TASK            V19         V20         V21         V22      INPUTS     COMPLEX        TECH      INFORM          SO
LVE
   language          4           3           1           0     1.40000     3.25000           2    0.888889        2.25
000
   TASK         RECALL     PERCEPT     ENVIRON      PSYCHE    PHYSICAL       PSYCH       EQUIP    COMMUNIC         DOM
AIN
   language    3.20000           0           0           0           0           3    0.333333     3.38462
 1

------------------------------------------------------------ CLUSTER=6 ------------------------------------------------------------
```

```
-------

 V9 TASK                V1          V2          V3          V4          V5          V6          V7          V8

     air_traf            0           4           4           0           1           1           0           0
   0

     TASK              V10         V11         V12         V13         V14         V15         V16         V17
V18

     air_traf            4           4           0           2           1           0           2           0
   4

     TASK              V19         V20         V21         V22      INPUTS     COMPLEX        TECH      INFORM          SO
LVE

     air_traf            0           0           0           0     1.60000     3.25000           2     1.22222
   2

     TASK           RECALL     PERCEPT     ENVIRON      PSYCHE    PHYSICAL       PSYCH       EQUIP    COMMUNIC         DOM
AIN

     air_traf      2.40000           4     1.33333     2.81818    0.800000     2.25000     1.33333           2
   2
1                                                    Average scores for eight clusters         14:23 THURSDAY, JULY 11,
1991   7

 ----------------------------------------------------------- CLUSTER=7 -----------------------------------------------
-------

     TASK               V1          V2          V3          V4          V5          V6          V7          V8
  V9

     weather             1           4           4           0           0           4           2           0
   3

     TASK              V10         V11         V12         V13         V14         V15         V16         V17
V18

     weather             0           3           0           2           0           0           4           3
   0

     TASK              V19         V20         V21         V22      INPUTS     COMPLEX        TECH      INFORM          SO
LVE

     weather             3           3           0           0     1.20000     3.25000           3     1.66667        2.33
333

     TASK           RECALL     PERCEPT     ENVIRON      PSYCHE    PHYSICAL       PSYCH       EQUIP    COMMUNIC         DOM
AIN

     weather       2.60000     1.50000           0           0           0    0.750000           1           0
   1

 ----------------------------------------------------------- CLUSTER=8 -----------------------------------------------
-------
```

```
V9  TASK               V1        V2        V3        V4        V5        V6        V7        V8

     console_           0         0         4         0         3         2         3         4
  1

     TASK              V10       V11       V12       V13       V14       V15       V16       V17
V18

     console_           0         1         0         2         3         0         2         4
  2

     TASK              V19       V20       V21       V22    INPUTS   COMPLEX      TECH    INFORM        SO
LVE

     console_           0         0         2         0   2.40000   2.75000         2   1.88889      2.83
333

     TASK           RECALL   PERCEPT   ENVIRON    PSYCHE  PHYSICAL     PSYCH     EQUIP  COMMUNIC       DOM
AIN

     console_      2.20000         4         1   1.81818   1.40000         2   1.66667   1.84615
  2
1                                         Average scores for eight clusters         14:23 THURSDAY, JULY 11,
1991   8

         CLUSTER          V1        V2        V3        V4        V5        V6        V7        V8
   V9

                1    1.00000   0.50000   4.00000   0.00000   3.50000   2.50000   1.50000   0.00000        2.
50000
                2    0.00000   4.00000   4.00000   2.00000   2.50000   3.00000   0.00000   3.50000        1.
50000
                3    0.14286   0.71429   2.57143   0.57143   2.28571   0.28571   1.57143   0.57143        1.
14286
                4    0.00000   3.00000   4.00000   0.00000   3.00000   2.00000   0.00000   4.00000        2.
00000
                5    0.00000   0.00000   0.00000   3.00000   3.00000   0.00000   0.00000   2.00000        2.
00000
                6    0.00000   4.00000   4.00000   0.00000   1.00000   1.00000   0.00000   0.00000        0.
00000
                7    1.00000   4.00000   4.00000   0.00000   0.00000   4.00000   2.00000   0.00000        3.
00000
                8    0.00000   0.00000   4.00000   0.00000   3.00000   2.00000   3.00000   4.00000        1.
00000

             V10       V11       V12       V13       V14       V15       V16       V17       V18
  V19

         2.00000   4.00000         4   1.00000   0.00000   4.00000   4.00000   1.50000   4.00000        3.
50000
         3.50000   4.00000         0   2.00000   1.00000   0.00000   3.50000   4.00000   3.50000        0.
00000
         0.71429   3.14286         1   2.28571   0.42857   1.14286   3.28571   3.57143   2.28571        1.
42857
         1.00000   2.00000         0   2.00000   1.00000   4.00000   4.00000   2.00000   3.00000        0.
00000
         1.00000   4.00000         1   1.00000   2.00000   2.00000   4.00000   0.00000   4.00000        4.
00000
```

```
          4.00000      4.00000          0      2.00000      1.00000      0.00000      2.00000      0.00000      4.00000      0.
00000
          0.00000      3.00000          0      2.00000      0.00000      0.00000      4.00000      3.00000      0.00000      3.
00000
          0.00000      1.00000          0      2.00000      3.00000      0.00000      2.00000      4.00000      2.00000      0.
00000
              V20          V21        V22       INPUTS      COMPLEX         TECH       INFORM        SOLVE       RECALL      PE
RCEPT
          2.50000      0.00000    1.00000      1.30000      0.75000      1.75000      1.72222      2.12500      2.60000      0.
00000
          1.50000      3.00000    1.00000      2.55000      3.25000      1.75000      0.72222      2.70833      2.60000      2.
50000
          1.00000      0.71429    1.14286      1.42857      0.89286      2.14286      1.26984      1.58333      2.08571      0.
00000
          2.00000      2.00000    2.00000      2.40000      2.00000      2.00000      1.44444      2.08333      3.00000      0.
00000
          3.00000      1.00000    0.00000      1.40000      3.25000      2.00000      0.88889      2.25000      3.20000      0.
00000
          0.00000      0.00000    0.00000      1.60000      3.25000      2.00000      1.22222      2.00000      2.40000      4.
00000
          3.00000      0.00000    0.00000      1.20000      3.25000      3.00000      1.66667      2.33333      2.60000      1.
50000
          0.00000      2.00000    0.00000      2.40000      2.75000      2.00000      1.88889      2.83333      2.20000      4.
00000
          ENVIRON          PSYCHE      PHYSICAL        PSYCH        EQUIP     COMMUNIC       DOMAIN
          0.00000         0.00000       0.00000      2.00000      1.25000      1.15385      1.00000
          1.33333         2.63636       1.30000      2.62500      1.75000      2.42308      3.00000
          0.35714         0.20779       0.05714      1.03571      0.85714      1.45055      0.85714
          0.00000         0.90909       0.00000      3.25000      1.33333      2.46154      1.00000
          0.00000         0.00000       0.00000      3.00000      0.33333      3.38462      1.00000
          1.33333         2.81818       0.80000      2.25000      1.33333      2.00000      2.00000
          0.00000         0.00000       0.00000      0.75000      1.00000      0.00000      1.00000
          1.00000         1.81818       1.40000      2.00000      1.66667      1.84615      2.00000
```

```
task_name1          |task_name2          |equal_count|similar_count
------------------------------------------------------------------
air_traffic         |form_fill_out       |         38|           69
pilot_training      |language_train      |         38|           64
air_traffic         |equip_diag          |         39|           67
program_mgmt        |pilot_training      |         39|           67
drair_gen           |surgery             |         40|           59
pilot_training      |leadership          |         41|           70
drair_gen           |air_traffic         |         41|           65
pilot_training      |form_fill_out       |         41|           70
air_traffic         |accounting          |         41|           66
program_mgmt        |console_ops         |         42|           71
air_traffic         |language_train      |         42|           69
air_traffic         |medical_diag        |         43|           72
pilot_training      |accounting          |         43|           65
program_mgmt        |surgery             |         43|           66
drair_gen           |pilot_training      |         43|           63
weather             |air_traffic         |         43|           71
equip_diag          |surgery             |         43|           73
console_ops         |leadership          |         43|           72
console_ops         |form_fill_out       |         44|           77
air_traffic         |leadership          |         44|           75
pilot_training      |sw_design           |         44|           73

task_name1          |task_name2          |equal_count|similar_count
------------------------------------------------------------------
pilot_training      |equip_diag          |         45|           76
console_ops         |language_train      |         45|           69
air_traffic         |cargo_loading       |         46|           80
pilot_training      |medical_diag        |         46|           71
air_traffic         |sw_design           |         46|           68
console_ops         |equip_diag          |         46|           80
console_ops         |accounting          |         46|           70
pilot_training      |cargo_loading       |         46|           80
cargo_loading       |surgery             |         47|           68
form_fill_out       |surgery             |         47|           68
program_mgmt        |air_traffic         |         47|           77
leadership          |surgery             |         47|           67
air_traffic         |protocol_des        |         47|           73
sw_design           |surgery             |         48|           70
surgery             |accounting          |         48|           62
pilot_training      |protocol_des        |         49|           73
console_ops         |protocol_des        |         49|           75
console_ops         |drair_gen           |         50|           76
weather             |surgery             |         50|           69
equip_diag          |language_train      |         50|           76
weather             |pilot_training      |         50|           74

task_name1          |task_name2          |equal_count|similar_count
------------------------------------------------------------------
program_mgmt        |equip_diag          |         51|           81
console_ops         |surgery             |         52|           74
program_mgmt        |weather             |         52|           76
console_ops         |sw_design           |         52|           72
language_train      |surgery             |         53|           77
surgery             |protocol_des        |         53|           74
console_ops         |cargo_loading       |         53|           74
```

```
program_mgmt         |medical_diag        |           53|          74
equip_diag           |leadership          |           55|          83
pilot_training       |surgery             |           55|          79
cargo_loading        |medical_diag        |           56|          73
weather              |equip_diag          |           56|          89
weather              |language_train      |           56|          79
equip_diag           |form_fill_out       |           56|          86
weather              |leadership          |           57|          85
medical_diag         |accounting          |           57|          73
drair_gen            |language_train      |           57|          75
console_ops          |pilot_training      |           58|          82
console_ops          |medical_diag        |           58|          82
language_train       |accounting          |           58|          80
form_fill_out        |medical_diag        |           58|          72

task_name1           |task_name2          |equal_count|similar_count
----------------------------------------------------------------------
drair_gen            |medical_diag        |           58|          69
weather              |cargo_loading       |           58|          82
air_traffic          |surgery             |           58|          88
weather              |console_ops         |           58|          88
leadership           |medical_diag        |           59|          81
sw_design            |medical_diag        |           60|          76
air_traffic          |pilot_training      |           60|          86
equip_diag           |medical_diag        |           60|          89
console_ops          |air_traffic         |           61|          77
surgery              |medical_diag        |           61|          82
equip_diag           |sw_design           |           62|          85
language_train       |cargo_loading       |           62|          90
weather              |form_fill_out       |           63|          83
equip_diag           |protocol_des        |           63|          84
language_train       |form_fill_out       |           63|          92
drair_gen            |equip_diag          |           63|          91
equip_diag           |accounting          |           64|          88
equip_diag           |cargo_loading       |           64|          91
drair_gen            |leadership          |           64|          83
weather              |protocol_des        |           64|          84
language_train       |medical_diag        |           65|          80

task_name1           |task_name2          |equal_count|similar_count
----------------------------------------------------------------------
leadership           |accounting          |           65|          85
language_train       |sw_design           |           65|          86
weather              |accounting          |           66|          88
weather              |drair_gen           |           67|          85
weather              |sw_design           |           67|          87
weather              |medical_diag        |           68|          92
medical_diag         |protocol_des        |           68|          83
language_train       |leadership          |           69|          91
form_fill_out        |leadership          |           69|          91
sw_design            |accounting          |           69|          91
program_mgmt         |leadership          |           69|          96
program_mgmt         |language_train      |           69|          93
sw_design            |cargo_loading       |           69|          87
program_mgmt         |drair_gen           |           70|          87
drair_gen            |cargo_loading       |           70|          89
 adership            |protocol_des        |           70|          96
 ogram_mgmt          |accounting          |           71|          90
```

```
form_fill_out    |cargo_loading   |         71|          92
cargo_loading    |leadership      |         71|          92
language_train   |protocol_des    |         71|          87
sw_design        |leadership      |         72|          97

task_name1       |task_name2      |equal_count|similar_count
-------------------------------------------------------------
program_mgmt     |sw_design       |         72|          96
form_fill_out    |protocol_des    |         73|         103
drair_gen        |sw_design       |         73|          90
cargo_loading    |protocol_des    |         73|          92
program_mgmt     |cargo_loading   |         74|         101
drair_gen        |protocol_des    |         74|          90
drair_gen        |form_fill_out   |         75|          97
form_fill_out    |accounting      |         75|          96
accounting       |protocol_des    |         75|          91
program_mgmt     |protocol_des    |         76|          98
drair_gen        |accounting      |         77|         100
cargo_loading    |accounting      |         79|          98
program_mgmt     |form_fill_out   |         80|         107
form_fill_out    |sw_design       |         81|         101
sw_design        |protocol_des    |         87|         107
```

```
task_name1           |task_name2          |equal_count|similar_count
------------------------------------------------------------------------
drair_gen            |surgery             |         40|           59
surgery              |accounting          |         48|           62
drair_gen            |pilot_training      |         43|           63
pilot_training       |language_train      |         38|           64
pilot_training       |accounting          |         43|           65
drair_gen            |air_traffic         |         41|           65
program_mgmt         |surgery             |         43|           66
air_traffic          |accounting          |         41|           66
leadership           |surgery             |         47|           67
program_mgmt         |pilot_training      |         39|           67
air_traffic          |equip_diag          |         39|           67
cargo_loading        |surgery             |         47|           68
air_traffic          |sw_design           |         46|           68
form_fill_out        |surgery             |         47|           68
drair_gen            |medical_diag        |         58|           69
air_traffic          |language_train      |         42|           69
console_ops          |language_train      |         45|           69
air_traffic          |form_fill_out       |         38|           69
weather              |surgery             |         50|           69
pilot_training       |leadership          |         41|           70
pilot_training       |form_fill_out       |         41|           70
task_name1           |task_name2          |equal_count|similar_count
------------------------------------------------------------------------
sw_design            |surgery             |         48|           70
console_ops          |accounting          |         46|           70
weather              |air_traffic         |         43|           71
pilot_training       |medical_diag        |         46|           71
program_mgmt         |console_ops         |         42|           71
console_ops          |leadership          |         43|           72
console_ops          |sw_design           |         52|           72
air_traffic          |medical_diag        |         43|           72
form_fill_out        |medical_diag        |         58|           72
air_traffic          |protocol_des        |         47|           73
medical_diag         |accounting          |         57|           73
pilot_training       |sw_design           |         44|           73
pilot_training       |protocol_des        |         49|           73
equip_diag           |surgery             |         43|           73
cargo_loading        |medical_diag        |         56|           73
program_mgmt         |medical_diag        |         53|           74
console_ops          |cargo_loading       |         53|           74
console_ops          |surgery             |         52|           74
surgery              |protocol_des        |         53|           74
weather              |pilot_training      |         50|           74
console_ops          |protocol_des        |         49|           75
task_name1           |task_name2          |equal_count|similar_count
------------------------------------------------------------------------
drair_gen            |language_train      |         57|           75
air_traffic          |leadership          |         44|           75
console_ops          |drair_gen           |         50|           76
program_mgmt         |weather             |         52|           76
pilot_training       |equip_diag          |         45|           76
 quip_diag           |language_train      |         50|           76
sw_design            |medical_diag        |         60|           76
```

```
language_train      |surgery             |         53|           77
program_mgmt        |air_traffic         |         47|           77
console_ops         |air_traffic         |         61|           77
console_ops         |form_fill_out       |         44|           77
pilot_training      |surgery             |         55|           79
weather             |language_train      |         56|           79
language_train      |medical_diag        |         65|           80
pilot_training      |cargo_loading       |         46|           80
language_train      |accounting          |         58|           80
console_ops         |equip_diag          |         46|           80
air_traffic         |cargo_loading       |         46|           80
leadership          |medical_diag        |         59|           81
program_mgmt        |equip_diag          |         51|           81
console_ops         |medical_diag        |         58|           82

task_name1          |task_name2          |equal_count|similar_count
-------------------------------------------------------------------
console_ops         |pilot_training      |         58|           82
surgery             |medical_diag        |         61|           82
weather             |cargo_loading       |         58|           82
drair_gen           |leadership          |         64|           83
weather             |form_fill_out       |         63|           83
medical_diag        |protocol_des        |         68|           83
equip_diag          |leadership          |         55|           83
weather             |protocol_des        |         64|           84
equip_diag          |protocol_des        |         63|           84
weather             |leadership          |         57|           85
weather             |drair_gen           |         67|           85
leadership          |accounting          |         65|           85
equip_diag          |sw_design           |         62|           85
equip_diag          |form_fill_out       |         56|           86
language_train      |sw_design           |         65|           86
air_traffic         |pilot_training      |         60|           86
weather             |sw_design           |         67|           87
sw_design           |cargo_loading       |         69|           87
language_train      |protocol_des        |         71|           87
program_mgmt        |drair_gen           |         70|           87
weather             |console_ops         |         58|           88

task_name1          |task_name2          |equal_count|similar_count
-------------------------------------------------------------------
air_traffic         |surgery             |         58|           88
weather             |accounting          |         66|           88
equip_diag          |accounting          |         64|           88
drair_gen           |cargo_loading       |         70|           89
weather             |equip_diag          |         56|           89
equip_diag          |medical_diag        |         60|           89
drair_gen           |protocol_des        |         74|           90
language_train      |cargo_loading       |         62|           90
drair_gen           |sw_design           |         73|           90
program_mgmt        |accounting          |         71|           90
drair_gen           |equip_diag          |         63|           91
equip_diag          |cargo_loading       |         64|           91
language_train      |leadership          |         69|           91
sw_design           |accounting          |         69|           91
form_fill_out       |leadership          |         69|           91
accounting          |protocol_des        |         75|           91
cargo_loading       |protocol_des        |         73|           92
```

```
language_train      |form_fill_out        |          63|          92
weather             |medical_diag         |          68|          92
form_fill_out       |cargo_loading        |          71|          92
cargo_loading       |leadership           |          71|          92

task_name1          |task_name2           |equal_count|similar_count
----------------------------------------------------------------------
program_mgmt        |language_train       |          69|          93
leadership          |protocol_des         |          70|          96
form_fill_out       |accounting           |          75|          96
program_mgmt        |sw_design            |          72|          96
program_mgmt        |leadership           |          69|          96
sw_design           |leadership           |          72|          97
drair_gen           |form_fill_out        |          75|          97
program_mgmt        |protocol_des         |          76|          98
cargo_loading       |accounting           |          79|          98
drair_gen           |accounting           |          77|         100
program_mgmt        |cargo_loading        |          74|         101
form_fill_out       |sw_design            |          81|         101
form_fill_out       |protocol_des         |          73|         103
program_mgmt        |form_fill_out        |          80|         107
sw_design           |protocol_des         |          87|         107
```

```
attrib_name          |zero_cnt|one_cnt|two_cnt|three_cnt|four_cnt
-----------------------------------------------------------------
facts                |       0|      0|      2|        5|       9
communicates         |       0|      4|      6|        0|       6
goal_vs_data         |       0|      9|      2|        5|       0
analyze              |       0|      5|      2|        3|       6
categorize           |       0|      3|      6|        3|       4
kr_hp                |       0|     12|      4|        0|       0
quant_qual           |       0|      2|      9|        5|       0
high_low_tech        |       0|      6|      2|        8|       0
compare              |       1|      3|      3|        3|       6
decompose            |       1|      1|      4|        3|       7
written              |       1|      1|      3|        2|       9
sub_goals            |       1|      0|      3|        5|       7
temporal             |       1|      2|      3|        5|       5
interpret            |       1|      3|      2|        6|       4
procedures           |       2|      4|      3|        0|       7
constraints          |       2|      2|      7|        3|       2
specialize           |       2|      1|      8|        5|       0
articulation         |       2|      6|      3|        2|       3
requests             |       2|      8|      3|        2|       1
notation             |       2|      1|      6|        4|       3
cases_examples       |       2|      6|      3|        4|       1

attrib_name          |zero_cnt|one_cnt|two_cnt|three_cnt|four_cnt
-----------------------------------------------------------------
answers              |       2|      2|      5|        1|       6
training             |       2|      5|      1|        1|       7
acq_and_pres         |       2|      2|      4|        3|       5
principles           |       2|      3|      3|        1|       7
propadeutics         |       2|      7|      2|        2|       3
verbal               |       2|      3|      2|        5|       4
branching            |       3|      1|      4|        3|       5
informs              |       3|      3|      2|        6|       2
form_proc_alg        |       3|      3|      2|        4|       4
case_based           |       3|      4|      5|        3|       1
education            |       3|      2|      2|        4|       5
choose               |       3|      1|      4|        5|       3
learn                |       4|      9|      2|        1|       0
itemize              |       4|      3|      5|        2|       2
ret_to_def           |       4|      1|      7|        3|       1
indicates            |       5|      6|      3|        2|       0
transmits            |       5|      5|      2|        2|       2
plan                 |       5|      2|      2|        2|       5
means_ends           |       5|      1|      3|        3|       4
uncertainty          |       5|      7|      1|        2|       1
estimate             |       5|      1|      5|        2|       3

attrib_name          |zero_cnt|one_cnt|two_cnt|three_cnt|four_cnt
-----------------------------------------------------------------
translate            |       5|      1|      3|        3|       4
advises              |       5|      3|      1|        3|       4
gen_and_test         |       6|      2|      2|        4|       2
model_based          |       6|      2|      3|        3|       2
visual               |       6|      2|      1|        0|       7
deduce               |       6|      2|      5|        2|       1
recombine            |       6|      2|      4|        2|       2
```

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```
deductive            |        6|      3|      2|        3|      2
calculate            |        7|      3|      3|        0|      3
historical           |        7|      2|      2|        3|      2
integrate            |        8|      2|      0|        3|      3
prob_of_success      |        8|      2|      1|        4|      1
id_obj_act_events    |        8|      1|      0|        3|      4
directs              |        8|      3|      0|        2|      3
computer             |        8|      1|      1|        2|      4
supervise            |        9|      2|      1|        2|      2
spatial              |        9|      2|      1|        1|      3
cover_and_diff       |        9|      3|      1|        2|      1
search_rec_info      |        9|      1|      2|        0|      4
dynamism             |        9|      0|      2|        2|      3
instrumentation      |       10|      0|      1|        1|      4

attrib_name          |zero_cnt|one_cnt|two_cnt|three_cnt|four_cnt
-----------------------------------------------------------------
monitor              |       10|      2|      1|        0|      3
databases            |       10|      2|      1|        1|      2
fine                 |       10|      2|      2|        0|      2
simple_disc          |       10|      1|      2|        0|      3
supervises           |       10|      2|      1|        1|      2
instruments          |       10|      0|      1|        2|      3
compute              |       10|      2|      1|        1|      2
mathematical         |       10|      1|      2|        1|      2
mm_interface         |       11|      0|      1|        0|      4
statistical          |       11|      2|      2|        0|      1
mental_strain        |       11|      2|      0|        3|      0
stress               |       11|      1|      1|        3|      0
interpolate          |       11|      1|      1|        2|      1
prop_and_ref         |       11|      2|      1|        2|      0
auditory             |       11|      1|      2|        1|      1
general_health       |       12|      0|      0|        4|      0
cog_attent           |       12|      0|      1|        0|      3
boredom              |       12|      1|      2|        1|      0
attention_span       |       12|      0|      1|        0|      3
age                  |       12|      4|      0|        0|      0
preciseness          |       12|      1|      1|        1|      1

attrib_name          |zero_cnt|one_cnt|two_cnt|three_cnt|four_cnt
-----------------------------------------------------------------
express_movement     |       12|      0|      3|        1|      0
tabulate             |       12|      2|      1|        0|      1
generalize           |       12|      2|      1|        1|      0
noise                |       12|      1|      1|        2|      0
inductive            |       13|      1|      2|        0|      0
kinesthetic          |       13|      0|      1|        1|      1
percep_speed         |       13|      0|      2|        0|      1
gross                |       13|      1|      2|        0|      0
contaminants         |       13|      0|      1|        1|      1
lighting             |       13|      1|      1|        1|      0
scan_display         |       13|      0|      0|        0|      3
repetitive           |       13|      1|      1|        1|      0
fatigue              |       13|      1|      0|        2|      0
negotiates           |       13|      0|      1|        1|      1
induce               |       13|      2|      1|        0|      0
'esponse_chaining    |       14|      0|      1|        1|      0
.ode                 |       14|      0|      0|        1|      1
```

```
intro_accuracy      |      14|       1|       0|         1|        0
schedule            |      14|       1|       0|         0|        1
phys_strain         |      14|       0|       1|         1|        0
instructs           |      14|       0|       1|         0|        1

attrib_name         |zero_cnt|one_cnt|two_cnt|three_cnt|four_cnt
-------------------------------------------------------------------
confinement         |      14|       1|       0|         0|        1
electricity         |      15|       0|       1|         0|        0
reflex              |      15|       1|       0|         0|        0
analogical          |      15|       0|       0|         1|        0
compound            |      15|       0|       0|         1|        0
complex_cont        |      15|       0|       0|         0|        1
interp_movement     |      15|       0|       1|         0|        0
weight              |      15|       1|       0|         0|        0
computerize         |      15|       0|       0|         0|        1
test_equip          |      15|       1|       0|         0|        0
analogs             |      15|       0|       1|         0|        0
acceleration        |      15|       0|       0|         1|        0
vehicles            |      15|       0|       0|         0|        1
height              |      16|       0|       0|         0|        0
gender              |      16|       0|       0|         0|        0
weapon_systems      |      16|       0|       0|         0|        0
sleep               |      16|       0|       0|         0|        0
magnetism           |      16|       0|       0|         0|        0
isolation           |      16|       0|       0|         0|        0
```

```
attrib_name         |zero_cnt|one_cnt|two_cnt|three_cnt|four_cnt
-----------------------------------------------------------------
interp_movement     |      15|      0|      1|        0|       0
express_movement    |      12|      0|      3|        1|       0
analogs             |      15|      0|      1|        0|       0
generalize          |      12|      2|      1|        1|       0
specialize          |       2|      1|      8|        1|       0
goal_vs_data        |       0|      9|      2|        5|       0
acceleration        |      15|      0|      0|        5|       0
high_low_tech       |       0|      6|      2|        1|       0
indicates           |       5|      6|      3|        8|       0
quant_qual          |       0|      2|      9|        2|       0
compound            |      15|      0|      0|        5|       0
reflex              |      15|      1|      0|        1|       0
gross               |      13|      1|      2|        0|       0
test_equip          |      15|      1|      0|        0|       0
repetitive          |      13|      1|      1|        0|       0
inductive           |      13|      1|      2|        1|       0
weapon_systems      |      16|      0|      0|        0|       0
isolation           |      16|      0|      0|        0|       0
learn               |       4|      9|      2|        0|       0
prop_and_ref        |      11|      2|      1|        1|       0
kr_hp               |       0|     12|      4|        2|       0
                                                   0|       0

attrib_name         |zero_cnt|one_cnt|two_cnt|three_cnt|four_cnt
-----------------------------------------------------------------
stress              |      11|      1|      1|        3|       0
induce              |      13|      2|      1|        0|       0
electricity         |      15|      0|      1|        0|       0
intro_accuracy      |      14|      1|      0|        1|       0
analogical          |      15|      0|      0|        1|       0
lighting            |      13|      1|      1|        1|       0
weight              |      15|      1|      0|        0|       0
height              |      16|      0|      0|        0|       0
gender              |      16|      0|      0|        0|       0
age                 |      12|      4|      0|        0|       0
general_health      |      12|      0|      0|        4|       0
boredom             |      12|      1|      2|        1|       0
magnetism           |      16|      0|      0|        0|       0
sleep               |      16|      0|      0|        0|       0
noise               |      12|      1|      1|        2|       0
response_chaining   |      14|      0|      1|        1|       0
fatigue             |      13|      1|      0|        2|       0
mental_strain       |      11|      2|      0|        3|       0
phys_strain         |      14|      0|      1|        1|       0
preciseness         |      12|      1|      1|        1|       1
interpolate         |      11|      1|      1|        2|       1

attrib_name         |zero_cnt|one_cnt|two_cnt|three_cnt|four_cnt
-----------------------------------------------------------------
tabulate            |      12|      2|      1|        0|       1
schedule            |      14|      1|      0|        0|       1
deduce              |       6|      2|      5|        2|       1
contaminants        |      13|      0|      1|        1|       1
prob_of_success     |       8|      2|      1|        4|       1
confinement         |      14|      1|      0|        0|       1
vehicles            |      15|      0|      0|        0|       1
```

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```
instructs         |      14|      0|      1|        0|       1
requests          |       2|      8|      3|        2|       1
negotiates        |      13|      0|      1|        1|       1
statistical       |      11|      2|      2|        0|       1
percep_speed      |      13|      0|      2|        0|       1
cover_and_diff    |       9|      3|      1|        2|       1
cases_examples    |       2|      6|      3|        4|       1
ret_to_def        |       4|      1|      7|        3|       1
case_based        |       3|      4|      5|        3|       1
auditory          |      11|      1|      2|        1|       1
kinesthetic       |      13|      0|      1|        1|       1
uncertainty       |       5|      7|      1|        2|       1
complex_cont      |      15|      0|      0|        0|       1
code              |      14|      0|      0|        1|       1

attrib_name       |zero_cnt|one_cnt|two_cnt|three_cnt|four_cnt
-----------------------------------------------------------------
computerize       |      15|      0|      0|        0|       1
fine              |      10|      2|      2|        0|       2
supervise         |       9|      2|      1|        2|       2
recombine         |       6|      2|      4|        2|       2
supervises        |      10|      2|      1|        1|       2
transmits         |       5|      5|      2|        2|       2
model_based       |       6|      2|      3|        3|       2
deductive         |       6|      3|      2|        3|       2
informs           |       3|      3|      2|        6|       2
gen_and_test      |       6|      2|      2|        4|       2
itemize           |       4|      3|      5|        2|       2
compute           |      10|      2|      1|        1|       2
mathematical      |      10|      1|      2|        1|       2
constraints       |       2|      2|      7|        3|       2
historical        |       7|      2|      2|        3|       2
databases         |      10|      2|      1|        1|       2
articulation      |       2|      6|      3|        2|       3
simple_disc       |      10|      1|      2|        0|       3
integrate         |       8|      2|      0|        3|       3
spatial           |       9|      2|      1|        1|       3
attention_span    |      12|      0|      1|        0|       3

attrib_name       |zero_cnt|one_cnt|two_cnt|three_cnt|four_cnt
-----------------------------------------------------------------
cog_attent        |      12|      0|      1|        0|       3
directs           |       8|      3|      0|        2|       3
scan_display      |      13|      0|      0|        0|       3
estimate          |       5|      1|      5|        2|       3
monitor           |      10|      2|      1|        0|       3
calculate         |       7|      3|      3|        0|       3
dynamism          |       9|      0|      2|        2|       3
propadeutics      |       2|      7|      2|        2|       3
instruments       |      10|      0|      1|        2|       3
notation          |       2|      1|      6|        4|       3
choose            |       3|      1|      4|        5|       3
interpret         |       1|      3|      2|        6|       4
mm_interface      |      11|      0|      1|        0|       4
verbal            |       2|      3|      2|        5|       4
computer          |       8|      1|      1|        2|       4
categorize        |       0|      3|      6|        3|       4
instrumentation   |      10|      0|      1|        1|       4
```

```
translate           |        5|       1|       3|         3|        4
search_rec_info     |        9|       1|       2|         0|        4
means_ends          |        5|       1|       3|         3|        4
advises             |        5|       3|       1|         3|        4

attrib_name         |zero_cnt|one_cnt|two_cnt|three_cnt|four_cnt
--------------------------------------------------------------------------
id_obj_act_events   |        8|       1|       0|         3|        4
form_proc_alg       |        3|       3|       2|         4|        4
education           |        3|       2|       2|         4|        5
plan                |        5|       2|       2|         2|        5
branching           |        3|       1|       4|         3|        5
acq_and_pres        |        2|       2|       4|         3|        5
temporal            |        1|       2|       3|         5|        5
answers             |        2|       2|       5|         1|        6
communicates        |        0|       4|       6|         0|        6
compare             |        1|       3|       3|         3|        6
analyze             |        0|       5|       2|         3|        6
sub_goals           |        1|       0|       3|         5|        7
decompose           |        1|       1|       4|         3|        7
visual              |        6|       2|       1|         0|        7
procedures          |        2|       4|       3|         0|        7
principles          |        2|       3|       3|         1|        7
training            |        2|       5|       1|         1|        7
facts               |        0|       0|       2|         5|        9
written             |        1|       1|       3|         2|        9
```

```
name: program_mgmt
statistical
spacial
analogical
model-based
deductive
cover-and-diff
form-proc-alg
recombine
visual
auditory
kinesthetic
instrumentation
mm-interface
branching
dynamism
complex-cont
compound
reflex
simple-disc
fine
gross
repetitive
code
computerize
interpolate
tabulate
translate
deduce
compute
integrate
monitor
analogs
percep-speed
search-rec-info
id-ob-act-events
scan-display
acceleration
confinement
isolation
contaminants
electricity
lighting
magnetism
noise
fatigue
mental-strain
stress
phys-strain
preciseness
cog_attent
response chaining
attention span
sleep
schedule
boredom
```

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general health
age
gender
height
weight
intro accuracy
prob of success
vehicles
weapon systems
instruments
notation
test equip
advises
indicates
instructs
transmits
express movement
interp movement


name: weather
analogical
inductive
means_ends
prop-and-ref
generalize
verbal
auditory
kinesthetic
complex-cont
compound
reflex
simple-disc
fine
gross
repetitive
calculate
code
computerize
induce
plan
supervise
analogs
percep-speed
scan-display
acceleration
confinement
isolation
contaminants
electricity
lighting
magnetism
noise
fatigue
mental-strain
stress
phys-strain
preciseness
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cog_attent
response chaining
attention span
sleep
schedule
boredom
general health
age
gender
height
weight
intro accuracy
vehicles
weapon systems
test equip
directs
instructs
requests
transmits
supervises
negotiates
express movement
interp movement


name: console_ops
statistical
analogical
mathematical
inductive
means_ends
gen-and-test
prop-and-ref
recombine
generalize
auditory
kinesthetic
instrumentation
databases
historical
complex-cont
compound
reflex
gross
code
computerize
itemize
tabulate
induce
compute
analogs
acceleration
confinement
isolation
contaminants
electricity
magnetism
phys-strain
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preciseness
response chaining
sleep
gender
height
weight
intro accuracy
vehicles
weapon systems
instruments
test equip
directs
instructs
negotiates
express movement
interp movement


name: drair_gen
spacial
analogical
case-based
model-based
inductive
means_ends
gen-and-test
cover-and-diff
prop-and-ref
specialize
ret-to-def
visual
auditory
kinesthetic
instrumentation
mm-interface
branching
dynamism
constraints
uncertainity
complex-cont
compound
reflex
simple-disc
fine
gross
repetitive
code
computerize
itemize
induce
choose
integrate
plan
supervise
monitor
principles
procedures
analogs
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percep-speed
search-rec-info
id-ob-act-events
scan-display
acceleration
confinement
isolation
contaminants
electricity
lighting
magnetism
noise
fatigue
mental-strain
stress
phys-strain
preciseness
cog_attent
response chaining
attention span
sleep
schedule
boredom
general health
age
gender
height
weight
intro accuracy
prob of success
vehicles
weapon systems
instruments
notation
test equip
directs
indicates
instructs
supervises
negotiates
express movement
interp movement


name: air_traffic
statistical
analogical
case-based
mathematical
deductive
gen-and-test
cover-and-diff
prop-and-ref
recombine
generalize
ret-to-def
auditory
kinesthetic
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historical
propadeutics
complex-cont
compound
reflex
gross
repetitive
code
computerize
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learn
tabulate
deduce
compare
integrate
analogs
cases-examples
acceleration
isolation
contaminants
electricity
magnetism
phys-strain
sleep
boredom
gender
height
weight
education
intro accuracy
vehicles
weapon systems
test equip
answers
instructs
negotiates
express movement
interp movement


name: pilot_training
statistical
analogical
mathematical
deductive
inductive
gen-and-test
cover-and-diff
prop-and-ref
generalize
specialize
ret-to-def
databases
historical
uncertainity
complex-cont
compound
calculate
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code
computerize
learn
tabulate
translate
deduce
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compute
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lighting
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phys-strain
sleep
schedule
gender
height
education
intro accuracy
computer
weapon systems
test equip
advises
directs
instructs
supervises
negotiates
express movement
interp movement


name: equip_diag
analogical
case-based
mathematical
inductive
means_ends
prop-and-ref
generalize
kinesthetic
mm-interface
databases
dynamism
complex-cont
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response chaining
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general health
age
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height
weight
education
intro accuracy
prob of success
articulation
computer
vehicles
weapon systems
directs
instructs
supervises
negotiates
express movement
interp movement


name: language_train
statistical
spacial
model-based
mathematical
prop-and-ref
acq-and-present
kinesthetic
instrumentation
mm-interface
databases
complex-cont
compound
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repetitive
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preciseness
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sleep
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boredom
general health
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computer
vehicles
weapon systems
instruments
test equip
transmits
negotiates
interp movement


name: form_fill_out
statistical
spacial
temporal
analogical
model-based
mathematical
inductive
gen-and-test
cover-and-diff
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recombine
generalize
visual
auditory
kinesthetic
instrumentation
mm-interface
dynamism
complex-cont
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principles
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id-ob-act-events
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phys-strain
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boredom
general health
age
gender
height
weight
intro accuracy
prob of success
vehicles
weapon systems
instruments
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test equip
advises
directs
instructs
supervises
express movement
interp movement


name: sw_design
statistical
spacial
analogical
deductive
inductive
cover-and-diff
generalize
visual
auditory
kinesthetic
instrumentation
mm-interface
databases
historical
dynamism
constraints
complex-cont
compound
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simple-disc
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induce
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supervise
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procedures
analogs
percep-speed
search-rec-info
id-ob-act-events
scan-display
acceleration
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mental-strain
stress
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phys-strain
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response chaining
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boredom
general health
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gender
height
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training
intro accuracy
prob of success
vehicles
weapon systems
instruments
test equip
answers
directs
indicates
informs
instructs
transmits
supervises
negotiates
express movement
interp movement

name: cargo_loading
statistical
analogical
inductive
cover-and-diff
prop-and-ref
generalize
auditory
kinesthetic
instrumentation
mm-interface
databases
historical
dynamism
uncertainity
complex-cont
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induce
monitor
interpret
analogs
cases-examples
percep-speed
search-rec-info
id-ob-act-events
scan-display
acceleration
confinement
isolation
contaminants
electricity
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boredom
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height
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intro accuracy
prob of success
articulation
computer
vehicles
weapon systems
instruments
test equip
advises
informs
instructs
negotiates
express movement
interp movement


name: leadership
statistical
spacial
analogical
mathematical
deductive
inductive
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form-proc-alg
ret-to-def
auditory
kinesthetic
instrumentation
mm-interface
databases
historical
propadeutics
dynamism
complex-cont
compound
reflex
simple-disc
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induce
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supervise
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analogs
percep-speed
search-rec-info
id-ob-act-events
scan-display
acceleration
confinement
isolation
contaminants
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fatigue
mental-strain
stress
phys-strain
preciseness
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response chaining
attention span
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general health
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gender
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weight
computer
vehicles
weapon systems
instruments
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test equip
indicates
instructs
supervises


name: surgery
statistical
analogical
mathematical
inductive
gen-and-test
prop-and-ref
acq-and-present
recombine
generalize
written
mm-interface
databases
historical
reflex
repetitive
calculate
code
computerize
interpolate
learn
tabulate
translate
induce
compute
estimate
integrate
analogs
percep-speed
scan-display
acceleration
confinement
isolation
electricity
magnetism
noise
response chaining
sleep
schedule
boredom
gender
height
weight
intro accuracy
computer
vehicles
weapon systems
test equip
instructs
transmits
negotiates
interp movement
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name: medical_diag
spacial
analogical
mathematical
inductive
means_ends
sub-goals
prop-and-ref
decompose
recombine
generalize
mm-interface
databases
complex-cont
compound
reflex
gross
repetitive
calculate
code
computerize
interpolate
tabulate
induce
compute
monitor
analogs
percep-speed
scan-display
acceleration
confinement
isolation
electricity
lighting
magnetism
noise
fatigue
phys-strain
preciseness
cog_attent
response chaining
attention span
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boredom
general health
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gender
height
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intro accuracy
computer
vehicles
weapon systems
test equip
supervises
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negotiates
interp movement


name: accounting
statistical
spacial
analogical
model-based
inductive
cover-and-diff
prop-and-ref
generalize
visual
verbal
auditory
kinesthetic
instrumentation
branching
dynamism
uncertainity
complex-cont
compound
reflex
simple-disc
fine
gross
repetitive
computerize
interpolate
translate
induce
choose
integrate
plan
supervise
monitor
analogs
percep-speed
scan-display
acceleration
confinement
isolation
contaminants
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lighting
magnetism
noise
fatigue
mental-strain
stress
phys-strain
preciseness
cog_attent
response chaining
attention span
sleep
schedule
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boredom
general health
age
gender
height
weight
intro accuracy
prob of success
vehicles
weapon systems
instruments
test equip
advises
directs
instructs
supervises
negotiates
express movement
interp movement


name: protocol_des
spacial
analogical
model-based
mathematical
deductive
inductive
cover-and-diff
form-proc-alg
generalize
visual
auditory
kinesthetic
instrumentation
mm-interface
databases
dynamism
uncertainity
complex-cont
compound
reflex
simple-disc
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gross
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calculate
code
computerize
interpolate
itemize
tabulate
deduce
induce
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integrate
supervise
monitor
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analogs
percep-speed
search-rec-info
id-ob-act-events
scan-display
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contaminants
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magnetism
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mental-strain
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phys-strain
preciseness
cog_attent
response chaining
attention span
sleep
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boredom
general health
age
gender
height
weight
training
intro accuracy
prob of success
computer
vehicles
weapon systems
instruments
test equip
indicates
informs
instructs
requests
supervises
negotiates
express movement
interp movement
```

```
name: program_mgmt
answers
communicates
supervises


name: weather
temporal
model-based
acq-and-present
decompose
visual
written
mm-interface
branching
uncertainity
categorize
interpolate
analyze
compare
estimate
integrate
interpret
facts
principles
id-ob-act-events
training
computer
notation
advises
informs


name: console_ops
temporal
visual
mm-interface
dynamism
constraints
simple-disc
fine
analyze
compare
monitor
interpret
facts
principles
procedures
percep-speed
search-rec-info
id-ob-act-events
scan-display
cog_attent
attention span
training
computer
```

```
notation
communicates


name: drair_gen
deductive
acq-and-present
databases
historical
calculate
analyze
compare
facts
answers
transmits


name: air_traffic
spacial
temporal
means_ends
sub-goals
decompose
visual
verbal
instrumentation
mm-interface
dynamism
constraints
estimate
plan
monitor
procedures
search-rec-info
scan-display
cog_attent
attention span
schedule
training
prob of success
computer
instruments
communicates
directs


name: pilot_training
spacial
visual
kinesthetic
instrumentation
mm-interface
branching
dynamism
simple-disc
integrate
plan
monitor
```

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interpret
facts
principles
procedures
search-rec-info
scan-display
confinement
training
vehicles
instruments


name: equip_diag
gen-and-test
form-proc-alg
ret-to-def
visual
written
analyze
deduce
facts
procedures


name: language_train
sub-goals
decompose
recombine
verbal
auditory
written
translate
choose
compare
supervise
facts
education
training
articulation
answers
communicates
instructs


name: form_fill_out
acq-and-present
form-proc-alg
written
propadeutics
translate
interpret
answers
transmits


name: sw_design
temporal
means_ends
```

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sub-goals
gen-and-test
acq-and-present
decompose
recombine
written
propadeutics
branching
code
computerize
translate
analyze
integrate
principles
computer


name: cargo_loading
mathematical
form-proc-alg
calculate
compute
estimate
facts


name: leadership
case-based
sub-goals
acq-and-present
decompose
verbal
written
itemize
analyze
articulation
advises
communicates
negotiates


name: surgery
spacial
model-based
means_ends
sub-goals
decompose
visual
instrumentation
propadeutics
complex-cont
simple-disc
fine
categorize
choose
plan
supervise
facts
```

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principles
procedures
search-rec-info
id-ob-act-events
contaminants
preciseness
cog_attent
attention span
education
training
instruments
advises
answers
directs
requests
supervises


name: medical_diag
temporal
deductive
cover-and-diff
visual
verbal
written
instrumentation
historical
branching
categorize
choose
compare
plan
facts
principles
procedures
id-ob-act-events
education
training
articulation
advises
answers
communicates
directs
informs


name: accounting
mathematical
sub-goals
form-proc-alg
decompose
written
databases
categorize
calculate
itemize
tabulate
compare
```

```
compute
procedures
education
notation


name: protocol_des
statistical
means_ends
sub-goals
written
branching
translate
plan
principles
cases-examples
education
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                                                        SAS                             10:29 THURSDAY, JULY 11,
1
1991  1

 INITIAL FACTOR METHOD: PRINCIPAL COMPONENTS

                                              PRIOR COMMUNALITY ESTIMATES: ONE

                                 EIGENVALUES OF THE CORRELATION MATRIX:  TOTAL =        36   AVERAGE =          1

                          1          2          3          4          5          6          7          8          9         10         11
      12
 EIGENVALUE        9.617646   4.988310   4.711803   3.693210   2.925432   2.417242   1.520797   1.371233   1.091349   0.899565   0.861062  0
.673311
 DIFFERENCE        4.629336   0.276507   1.018593   0.767778   0.508190   0.896445   0.149564   0.279884   0.191784   0.038503   0.187750  0
.116727
 PROPORTION          0.2672     0.1386     0.1309     0.1026     0.0813     0.0671     0.0422     0.0381     0.0303     0.0250     0.0239
 0.0187
 CUMULATIVE          0.2672     0.4057     0.5366     0.6392     0.7205     0.7876     0.8298     0.8679     0.8983     0.9232     0.9472
 0.9659

                         13         14         15         16         17         18         19         20         21         22         23
      24
 EIGENVALUE        0.556585   0.436890   0.235567   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000  0
.000000
 DIFFERENCE        0.119695   0.201323   0.235567   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000  0
.000000
 PROPORTION          0 0155     0.0121     0.0065     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
 0.0000
 CUMULATIVE          0.9813     0.9935     1.0000     1.0000     1.0000     1.0000     1.0000     1.0000     1.0000     1.0000     1.0000
 1.0000

                         25         26         27         28         29         30         31         32         33         34         35
      36
 EIGENVALUE        0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000  0
.000000
 DIFFERENCE        0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000
 PROPORTION          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
 0.0000
 CUMULATIVE          1.0000     1.0000     1.0000     1.0000     1.0000     1.0000     1.0000     1.0000     1.0000     1.0000     1.0000
 1.0000

                                           3 FACTORS WILL BE RETAINED BY THE NFACTOR CRITERION
                                                        SAS                             10:29 THURSDAY, JULY 11,
1
1991  2

 INITIAL FACTOR METHOD: PRINCIPAL COMPONENTS

                                                      FACTOR PATTERN

                                                    FACTOR1   FACTOR2   FACTOR3

                                           V1       -0.10992  -0.37229   0.19889
                                           V2        0.79963   0.18055  -0.47424
                                           V3        0.43339   0.24648   0.37934
                                           V4       -0.04173   0.37413   0.49575
                                           V5       -0.32641   0.36362   0.51651
                                           V6        0.76174  -0.25723  -0.03079
                                           V7       -0.46743  -0.41143  -0.31061
```

```
                                 V8          0.11742  -0.76308   0.29772
                                 V9         -0.10678   0.52321   0.34057
                                 V10        -0.06867   0.79410  -0.27549
                                 V11        -0.30244   0.69378  -0.30752
                                 V12        -0.35806  -0.22827   0.37920
                                 V13         0.27021  -0.75703   0.04142
                                 V14         0.56944  -0.33047   0.71624
                                 V15        -0.55791   0.27648   0.05587
                                 V16        -0.56262  -0.13935  -0.06938
                                 V17         0.11202  -0.22004  -0.52748
                                 V18         0.01511   0.44216  -0.33579
                                 V19        -0.28547   0.12366   0.05299
                                 V20        -0.31312   0.30821   0.43738
                                 V21         0.22520  -0.03442   0.12403
                                 V22         0.09533  -0.45801   0.35984
                                 INPUTS      0.73434  -0.12936   0.09583
                                 COMPLEX     0.88211   0.13318   0.17860
                                 TECH        0.31606  -0.11731   0.30677
                                 INFORM     -0.26132  -0.34782  -0.06739
                                 SOLVE       0.75982   0.00519   0.28989
                                 RECALL      0.75994  -0.00247   0.41733
                                 PERCEPT     0.89607   0.03397  -0.23900
                                 ENVIRON     0.66407   0.01200  -0.44085
                                 PSYCHE      0.81357   0.29907  -0.34481
                                 PHYSICAL    0.77210   0.33064  -0.44444
                                 PSYCH       0.65707   0.29248   0.45892
                                 EQUIP       0.71017  -0.12855  -0.28133
                                 COMMUNIC    0.51370   0.30002   0.46156
                                 DOMAIN     -0.04690   0.56915   0.67331

                                   VARIANCE EXPLAINED BY EACH FACTOR

                                       FACTOR1    FACTOR2    FACTOR3
                                       9.617646   4.988310   4.711803

                             FINAL COMMUNALITY ESTIMATES: TOTAL =  19.317759

              V1        V2        V3        V4        V5        V6        V7        V8        V9       V10       V11        V1
2
        0.190240  0.896920  0.392475  0.387490  0.505542  0.647356  0.484246  0.684708  0.401139  0.711212  0.667376  0.32410
2

             V13       V14       V15       V16       V17       V18       V19       V20       V21       V22    INPUTS    COMPLE
X
        0.647822  0.946478  0.390830  0.340772  0.339201  0.308487  0.099593  0.384339  0.067282  0.348349  0.565171  0.82775
7
1                                                             SAS                                 10:29 THURSDAY, JULY 11.
1991  3

 INITIAL FACTOR METHOD: PRINCIPAL COMPONENTS

            TECH    INFORM     SOLVE    RECALL   PERCEPT   ENVIRON    PSYCHE  PHYSICAL     PSYCH     EQUIP  COMMUNIC     DOMAI
N
        0.207762  0.193813  0.661386  0.751682  0.861208  0.635477  0.870237  0.902986  0.727900  0.600010  0.566939  0.77947
3
1                                                             SAS                                 10:29 THURSDAY, JULY 11,
1991  4
```

```
ROTATION METHOD: VARIMAX

                    ORTHOGONAL TRANSFORMATION MATRIX

                              1           2           3

                1       0.90252    -0.43052     0.01021
                2       0.20344     0.44714     0.87102
                3       0.37955     0.78404    -0.49114

                        ROTATED FACTOR PATTERN

                          FACTOR1     FACTOR2     FACTOR3

          V1             -0.09945     0.03680    -0.42308
          V2              0.57842    -0.63535     0.39835
          V3              0.58527     0.22104     0.03280
          V4              0.22661     0.57395     0.08197
          V5             -0.02458     0.70808     0.05971
          V6              0.62347    -0.46710    -0.20116
          V7             -0.62346    -0.22626    -0.21058
          V8              0.06373    -0.15833    -0.80968
          V9              0.13934     0.54694     0.28737
          V10            -0.00499     0.16864     0.82629
          V11            -0.24854     0.19932     0.75225
          V12            -0.22567     0.34939    -0.38872
          V13             0.10558    -0.42235    -0.67698
          V14             0.71855     0.16864    -0.63381
          V15            -0.42608     0.40762     0.20768
          V16            -0.56246     0.12551    -0.09304
          V17            -0.14387    -0.56018     0.06855
          V18            -0.02386    -0.07207     0.55020
          V19            -0.21238     0.21974     0.07877
          V20            -0.05389     0.61554     0.05045
          V21             0.24332    -0.01510    -0.08859
          V22             0.12944     0.03630    -0.57470
          INPUTS          0.67281    -0.29885    -0.15225
          COMPLEX         0.89101    -0.18018     0.03729
          TECH            0.37782     0.05200    -0.24962
          INFORM         -0.33219    -0.09586    -0.27253
          SOLVE           0.79684    -0.09751    -0.13010
          RECALL          0.84376    -0.00107    -0.19937
          PERCEPT         0.72492    -0.55797     0.15611
          ENVIRON         0.43446    -0.62617     0.23375
          PSYCHE          0.66424    -0.48688     0.43815
          PHYSICAL        0.59542    -0.53302     0.51415
          PSYCH           0.82671     0.20771     0.03607
          EQUIP           0.50801    -0.58379     0.03345
          COMMUNIC        0.69985     0.27488     0.03987
          DOMAIN          0.32902     0.80258     0.16457

                   VARIANCE EXPLAINED BY EACH FACTOR

                      FACTOR1    FACTOR2    FACTOR3
                      8.719305   5.676360   4.922094
```

```
ROTATION METHOD: VARIMAX

                                   FINAL COMMUNALITY ESTIMATES: TOTAL =  19.317759

               V1        V2        V3        V4        V5        V6        V7        V8        V9       V10       V11        V1
2
         0.190240  0.896920  0.392475  0.387490  0.505542  0.647356  0.484246  0.684708  0.401139  0.711212  0.667376  0.32410
2

              V13       V14       V15       V16       V17       V18       V19       V20       V21       V22    INPUTS    COMPLE
X
         0.647822  0.946478  0.390830  0.340772  0.339201  0.308487  0.099593  0.384339  0.067282  0.348349  0.565171  0.82775
7

             TECH    INFORM     SOLVE    RECALL   PERCEPT   ENVIRON    PSYCHE  PHYSICAL     PSYCH     EQUIP  COMMUNIC     DOMAI
N
         0.207762  0.193813  0.661386  0.751682  0.861208  0.635477  0.870237  0.902986  0.727900  0.600010  0.566939  0.77947
3
```

8 CLUSTER SOLUTION

```
                         CENTROID HIERARCHICAL CLUSTER ANALYSIS

                          EIGENVALUES OF THE COVARIANCE MATRIX

                 EIGENVALUE      DIFFERENCE      PROPORTION      CUMULATIVE

      1            10.6128         2.60119        0.246740         0.24674
      2             8.0116         2.13421        0.186264         0.43300
      3             5.8774         1.84754        0.136645         0.56965
      4             4.0299         0.70215        0.093691         0.66334
      5             3.3277         0.27633        0.077367         0.74071
      6             3.0514         1.35031        0.070942         0.81165
      7             1.7011         0.18551        0.039549         0.85120
      8             1.5156         0.29187        0.035236         0.88643
      9             1.2237         0.17295        0.028450         0.91488
     10             1.0507         0.18234        0.024429         0.93931
     11             0.8684         0.22584        0.020190         0.95950
     12             0.6426         0.12845        0.014939         0.97444
     13             0.5141         0.13462        0.011953         0.98639
     14             0.3795         0.17373        0.008823         0.99522
     15             0.2058         0.20576        0.004784         1.00000
     16             0.0000         0.00000        0.000000         1.00000
     17             0.0000         0.00000        0.000000         1.00000
     18             0.0000         0.00000        0.000000         1.00000
     19             0.0000         0.00000        0.000000         1.00000
     20             0.0000         0.00000        0.000000         1.00000
     21             0.0000         0.00000        0.000000         1.00000
     22             0.0000         0.00000        0.000000         1.00000
     23             0.0000         0.00000        0.000000         1.00000
     24             0.0000         0.00000        0.000000         1.00000
     25             0.0000         0.00000        0.000000         1.00000
     26             0.0000         0.00000        0.000000         1.00000
     27            -0.0000         0.00000        -.000000         1.00000
     28            -0.0000         0.00000        -.000000         1.00000
     29            -0.0000         0.00000        -.000000         1.00000
     30            -0.0000         0.00000        -.000000         1.00000
     31            -0.0000         0.00000        -.000000         1.00000
     32            -0.0000         0.00000        -.000000         1.00000
     33            -0.0000         0.00000        -.000000         1.00000
     34            -0.0000         0.00000        -.000000         1.00000
     35            -0.0000         0.00000        -.000000         1.00000
     36            -0.0000            .           -.000000         1.00000

         ROOT-MEAN-SQUARE TOTAL-SAMPLE STANDARD DEVIATION =   1.09306
         ROOT-MEAN-SQUARE DISTANCE BETWEEN OBSERVATIONS   =   9.27493

         NUMBER                               FREQUENCY       NORMALIZED
           OF                                  OF NEW          CENTROID
         CLUSTERS    CLUSTERS JOINED           CLUSTER         DISTANCE

             15      sw_desig    leadersh         2            0.564206
             14      air_traf    surgery          2            0.610276
             13      CL14        pilot_tr         3            0.582182
             12      cargo_lo    accounti         2            0.623189
             11      program_    form_fil         2            0.672973
```

```
                   10     CL11        CL12              4           0.677967
                    9     CL10        drair_ge          5           0.658739
                    8     console_    medical_          2           0.698351
```

```
                                  CENTROID HIERARCHICAL CLUSTER ANALYSIS

                 NUMBER                                    FREQUENCY        NORMALIZED
                   OF                                       OF NEW           CENTROID
                CLUSTERS      CLUSTERS JOINED               CLUSTER          DISTANCE

                    7     CL9         CL15              7           0.705751
                    6     CL7         protocol          8           0.733092
                    5     weather     CL8               3           0.749222
                    4     CL5         equip_di          4           0.787431
                    3     CL6         CL4              12           0.739529
                    2     CL3         CL13             15           0.762808
                    1     CL2         language         16           0.787522
```

```
                                  CENTROID HIERARCHICAL CLUSTER ANALYSIS

                                        NAME OF OBSERVATION OR CLUSTER

             p     f     c     a     d     s     l     p           c     m     e     a           p     l
             r     o     a     c     r     w     e     r     w     o     e     q     i     s     i     a
             o     r     r     c     a     _     a     o     e     n     d     u     r     u     l     n
             g     m     g     o     i     d     d     t     a     s     i     i     _     r     o     g
             r     _     o     u     r     e     e     o     t     o     c     p     t     g     t     u
             a     f     _     n     _     s     r     c     h     l     a     _     r     e     _     a
             m     i     l     t     g     i     s     o     e     e     l     d     a     r     t     g
             _     l     o     i     e     g     h     l     r     _     _     i     f     y     r     e
        0.8 +
            |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
            |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     .XXXXXXXXXXXXXXXXXX     .
D           |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     .     XXXXXXXXXXXXX     .
I           |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     .     .     XXXXXXX     .     XXXXXXXXXXXXX     .
S       0.7 +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     .     .     XXXXXXX     .     XXXXXXXXXXXXX     .
T           |XXXXXXXXXXXXXXXXXXXXXXXXX     XXXXXXX     .     .     .     .     .     XXXXXXXXXXXXX     .
A           |.     .     XXXXXXXXXXXXX     XXXXXXX     .     .     .     .     .     XXXXXXXXXXXXX     .
N           |.     .     XXXXXXX     .     XXXXXXX     .     .     .     .     .     XXXXXXXXXXXXX     .
C           |.     .     XXXXXXX     .     XXXXXXX     .     .     .     .     .     XXXXXXXXXXXXX     .
E       0.6 +.     .     .     .     .     XXXXXXX     .     .     .     .     .     .     .XXXXXX     .
            |.     .     .     .     .     XXXXXXX     .     .     .     .     .     .     .XXXXXX     .
B           |.     .     .     .     .     XXXXXXX     .     .     .     .     .     .     .     .     .
E           |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
T           |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
W       0.5 +.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
E           |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
E           |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
N           |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
            |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
C       0.4 +.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
L           |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
U           |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
S           |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
```

```
          T          |.   .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .
          E      0.3 +.   .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .
          R          |.   .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .
                     |.   .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .
          C          |.   .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .
          E          |.   .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .
          N      0.2 +.   .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .
          T          |.   .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .
          R          |.   .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .
          O          |.   .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .
          I          |.   .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .
          D      0.1 +.   .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .
          S          |.   .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .
                     |.   .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .
                     |.   .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .
                     |.   .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .
                   0 +.   .    .    .    .    .    .  1 .    .    .    .    .    .    .    .    .    .
1
1991  4                                  Average scores for eight clusters                    12:48 THURSDAY, JULY 11,

 ------------------------------------------------------------ CLUSTER=1 -----------------------------------------------------
-------

    TASK                  V1            V2            V3            V4            V5            V6            V7            V8
V9

    sw_desig               0             0             4             0             3             2             2             0
  0
    leadersh               0             0             3             0             4             1             0             0
  0

    TASK                 V10           V11           V12           V13           V14           V15           V16           V17
V18

    sw_desig               4             4             4             1             0             3             4             1
  4
    leadersh               3             4             3             1             1             1             4             0
  4

    TASK                 V19           V20           V21           V22        INPUTS       COMPLEX          TECH        INFORM          SO
LVE

    sw_desig               4             0             2             1       1.10000       1.25000       2.50000       2.00000        1.41
667
    leadersh               2             1             2             0       0.90000       1.50000       2.00000       1.11111        1.58
333

    TASK              RECALL       PERCEPT       ENVIRON        PSYCHE      PHYSICAL         PSYCH         EQUIP      COMMUNIC          DOM
AIN

    sw_desig         1.80000             0             0      0.000000             0       1.00000       1.16667       0.38462
  1
    leadersh         1.60000             0             0      0.181818             0       2.60000       0.50000       1.84615
  1

 ------------------------------------------------------------ CLUSTER=2 -----------------------------------------------------
-------
```

```
    TASK            V1         V2         V3         V4         V5         V6         V7         V8
V9
    air_traf         0          4          4          0          0          1          0          0
 1
    surgery          0          4          2          0          1          4          0          1
 0
    pilot_tr         0          4          3          0          1          3          0          0
 0
    TASK           V10        V11        V12        V13        V14        V15        V16        V17
V18
    air_traf         4          4          0          2          0          0          2          3
 4
    surgery          4          4          0          1          1          0          0          3
 4
    pilot_tr         3          3          0          1          0          0          2          3
 3
    TASK           V19        V20        V21        V22     INPUTS    COMPLEX       TECH     INFORM        SO
LVE
    air_traf         0          0          3          0    1.90000    3.00000    1.50000   0.888889      2.00
000
    surgery          0          0          3          2    1.90000    2.50000    3.00000   0.777778      1.75
000
    pilot_tr         3          0          0          0    2.40000    2.50000    2.00000   0.555556      2.00
000
    TASK        RECALL    PERCEPT    ENVIRON     PSYCHE   PHYSICAL      PSYCH      EQUIP   COMMUNIC       DOM
AIN
    air_traf   1.80000    3.25000    0.83333    2.36364    0.80000    2.20000    1.66667    1.53846
  2
    surgery    2.60000    2.00000    1.00000    2.18182    0.80000    2.40000    1.00000    2.38462
  2
    pilot_tr   2.60000    3.25000    1.66667    1.18182    1.00000    1.40000    1.00000    1.00000
  2
1                                      Average scores for eight clusters           12:48 THURSDAY, JULY 11,
1991   5

 ----------------------------------------------------- CLUSTER=3 --------------------------------------------------------
-------
    TASK            V1         V2         V3         V4         V5         V6         V7         V8
 V9
    cargo_lo         0          1          2          0          1          2  [illegible]          1
  0
    accounti         0          0          2          0          1          0          4          3
  0
    program_         0          0          3          0          3          0          1          0
  2
    form_fil         0          0          0          0          3          0          0          1
  0
    drair_ge         1          0          1          0          0          0          3          4
```

```
   0

     TASK              V10         V11         V12         V13         V14         V15         V16         V17
V18

     cargo_lo            2           2           1           3           0           0           1           4
   2
     accounti            2           4           3           1           0           0           3           4
   4
     program_            1           3           1           1           0           1           3           0
   2
     form_fil            2           3           0           1           0           2           4           4
   3
     drair_ge            0           3           0           3           0           0           4           2
   2

     TASK              V19         V20         V21         V22      INPUTS     COMPLEX        TECH      INFORM          SO
LVE

     cargo_lo            2           0           2           2     0.60000     1.00000           1     1.11111        1.66
667
     accounti            2           0           2           2     1.50000     0.75000           2     2.22222        1.25
000
     program_            0           1           1           2     1.00000     0.75000           2     0.66667        1.16
667
     form_fil            0           0           2           2     1.50000     1.25000           2     1.22222        1.16
667
     drair_ge            2           2           0           0     1.30000     0.00000           2     1.33333        1.58
333

     TASK           RECALL     PERCEPT     ENVIRON      PSYCHE    PHYSICAL       PSYCH       EQUIP    COMMUNIC         DOM
AIN

     cargo_lo      1.60000    0.000000           0           0           0     0.80000     0.33333     0.76923
   1
     accounti      1.60000    0.500000           0           0           0     1.20000     1.16667     0.61538
   1
     program_      1.60000    0.000000           0           0           0     1.20000     0.16667     1.46154
   1
     form_fil      1.40000    0.000000           0           0           0     1.20000     0.50000     1.46154
   1
     drair_ge      1.00000    0.000000           0           0           0     1.00000     0.50000     1.23077
   1


 ------------------------------------------------------------ CLUSTER=4 -------------------------------------------------------------
-------

     TASK               V1          V2          V3          V4          V5          V6          V7          V8
  V9

     console_            0           2           4           0           2           3           0           2
   0
     medical_            1           0           4           0           2           3           0           4
   0

     TASK              V10         V11         V12         V13         V14         V15         V16         V17
V18
```

```
    console_         0          2          0          3          3          0          1          1
  2
    medical_         0          0          3          3          4          0          2          1
  0

    TASK           V19        V20        V21        V22     INPUTS    COMPLEX       TECH     INFORM       SO
LVE

    console_         0          0          2          3    1.40000    3.25000    2.50000    1.55556      2.00
000
    medical_         0          0          2          2    2.60000    2.75000    2.50000    1.00000      2.16
667

    TASK        RECALL    PERCEPT    ENVIRON     PSYCHE   PHYSICAL      PSYCH      EQUIP   COMMUNIC       DOM
AIN

    console_   2.80000    4.00000   0.500000    1.45455   0.800000    1.80000    1.33333    1.53846
  2
    medical_   3.00000    1.50000   0.333333    0.54545   0.000000    3.00000    1.00000    2.30769
  1
1                                              Average scores for eight clusters             12:48 THURSDAY. JULY 11,
1991   6

 ------------------------------------------------------------ CLUSTER=5 -------------------------------------------------------
-------

    TASK            V1         V2         V3         V4         V5         V6         V7         V8
 V9

  0 protocol         4          0          3          0          2          0          0          0
    TASK           V10        V11        V12        V13        V14        V15        V16        V17
V18

    protocol         4          4          3          1          0          3          3          0
  1

    TASK           V19        V20        V21        V22     INPUTS    COMPLEX       TECH     INFORM       SO
LVE

    protocol         1          0          3          2    1.10000    1.50000    2.50000   0.777778      1.33
333

    TASK        RECALL    PERCEPT    ENVIRON     PSYCHE   PHYSICAL      PSYCH      EQUIP   COMMUNIC       DOM
AIN

    protocol   2.20000          0          0          0          0    1.20000   0.333333   0.692308
  1


 ------------------------------------------------------------ CLUSTER=6 -------------------------------------------------------
-------

    TASK            V1         V2         V3         V4         V5         V6         V7         V8
 V9

    weather          2          3          4          0          2          4          2          3
```

```
  0

    TASK             V10         V11         V12         V13         V14         V15         V16         V17
V18

    weather            0           3           2           2           3           0           4           2
  4

    TASK             V19         V20         V21         V22      INPUTS     COMPLEX        TECH      INFORM        SO
LVE

    weather            3           0           3           3           2     3.25000     2.50000     1.66667      2.33
333

    TASK          RECALL     PERCEPT     ENVIRON      PSYCHE    PHYSICAL       PSYCH       EQUIP    COMMUNIC       DOM
AIN

    weather      2.20000     1.50000           0           0           0           2     1.66667     1.07692
  1


 ---------------------------------------------------------- CLUSTER=7 ----------------------------------------------------------
-------

    TASK              V1          V2          V3          V4          V5          V6          V7          V8
 V9

    equip_di           2           1           1           0           0           2           0           3
  0

    TASK             V10         V11         V12         V13         V14         V15         V16         V17
V18

    equip_di           0           2           4           3           1           0           2           4
  3

    TASK             V19         V20         V21         V22      INPUTS     COMPLEX        TECH      INFORM        SO
LVE

    equip_di           1           0           3           4     1.80000           1     2.50000    0.888889      1.25
000

    TASK          RECALL     PERCEPT     ENVIRON      PSYCHE    PHYSICAL       PSYCH       EQUIP    COMMUNIC       DOM
AIN

    equip_di     1.20000    0.750000     1.33333    0.363636           0    0.200000     1.16667    0.538462
  1
1                                                  Average scores for eight clusters            12:48 THURSDAY, JULY 11,
1991   7

 ---------------------------------------------------------- CLUSTER=8 ----------------------------------------------------------
-------

    TASK              V1          V2          V3          V4          V5          V6          V7          V8
 V9

    language           0           0           3           3           2           0           0           2
  2
```

```
    TASK            V10        V11        V12        V13        V14        V15        V16        V17
V18

    language          3          4          2          1          2          0          0          3
  4

    TASK            V19        V20        V21        V22     INPUTS    COMPLEX       TECH     INFORM        SO
LVE

    language          4          3          2          3    1.60000    1.75000          2   0.888889
  2

    TASK         RECALL    PERCEPT    ENVIRON     PSYCHE   PHYSICAL      PSYCH      EQUIP   COMMUNIC       DOM
AIN

    language    2.60000          0          0          0          0    2.80000   0.333333    1.84615
  1
1                                          Average scores for eight clusters            12:48 THURSDAY, JULY 11,
1991  8

       CLUSTER           V1         V2         V3         V4         V5         V6         V7         V8
  V9

             1      0.00000    0.00000    3.50000          0    3.50000    1.50000    1.00000    0.00000        0.
00000
33333        2      0.00000    4.00000    3.00000          0    0.66667    2.66667    0.00000    0.33333        0.
             3      0.20000    0.20000    1.60000          0    1.60000    0.40000    2.40000    1.80000        0.
10000
             4      0.50000    1.00000    4.00000          0    2.00000    3.00000    0.00000    3.00000        0
00000
             5      4.00000    0.00000    3.00000          0    2.00000    0.00000    0.00000    0.00000        0.
00000
             6      2.00000    3.00000    4.00000          0    2.00000    4.00000    2.00000    3.00000        0.
00000
             7      2.00000    1.00000    1.00000          0    0.00000    2.00000    0.00000    3.00000        0.
00000
             8      0.00000    0.00000    3.00000          3    2.00000    0.00000    0.00000    2.00000        2.
00000

           V10        V11        V12        V13        V14        V15        V16        V17        V18
  V19

       3.50000    4.00000    3.50000    1.00000    0.50000    2.00000    4.00000    0.50000    4.00000        3.
00000
       3.66667    3.66667    0.00000    1.33333    0.33333    0.00000    1.33333    3.00000    3.66667        1.
00000
       1.40000    3.00000    1.00000    1.80000    0.00000    0.60000    3.00000    2.80000    2.60000        1.
20000
       0.00000    1.00000    1.50000    3.00000    3.50000    0.00000    1.50000    1.00000    1.00000        0.
00000
       4.00000    4.00000    3.00000    1.00000    0.00000    3.00000    3.00000    0.00000    1.00000        1.
00000
       0.00000    3.00000    2.00000    2.00000    3.00000    0.00000    4.00000    2.00000    4.00000        3.
00000
       0.00000    2.00000    4.00000    3.00000    1.00000    0.00000    2.00000    4.00000    3.00000        1.
00000
       3.00000    4.00000    2.00000    1.00000    2.00000    0.00000    0.00000    3.00000    4.00000        4.
```

```
00000

            V20         V21         V22      INPUTS     COMPLEX        TECH      INFORM       SOLVE      RECALL       PE
RCEPT

        0.50000     2.00000     0.50000     1.00000     1.37500     2.25000     1.55556     1.50000     1.70000       0.
00000
        0.00000     2.00000     0.66667     2.06667     2.66667     2.16667     0.74074     1.91667     2.33333       2.
83333
        0.60000     1.40000     1.60000     1.18000     0.75000     1.80000     1.31111     1.36667     1.44000       0.
10000
        0.00000     2.00000     2.50000     2.00000     3.00000     2.50000     1.27778     2.08333     2.90000       2.
75000
        0.00000     3.00000     2.00000     1.10000     1.50000     2.50000     0.77778     1.33333     2.20000       0.
00000
        0.00000     3.00000     3.00000     2.00000     3.25000     2.50000     1.66667     2.33333     2.20000       1.
50000
        0.00000     3.00000     4.00000     1.80000     1.00000     2.50000     0.88889     1.25000     2.20000       0.
75000
        3.00000     2.00000     3.00000     1.60000     1.75000     2.00000     0.88889     2.00000     2.60000       0.
00000
        ENVIRON        PSYCHE      PHYSICAL         PSYCH        EQUIP     COMMUNIC        DOMAIN

        0.00000       0.09091      0.000000       1.80000      0.83333      1.11538       1.00000
        1.16667       1.90909      0.866667       2.00000      1.22222      1.64103       2.00000
        0.00000       0.00000      0.000000       1.08000      0.53333      1.10769       1.00000
        0.41667       1.00000      0.400000       2.40000      1.16667      1.92308       1.50000
        0.00000       0.00000      0.000000       1.20000      0.33333      0.69231       1.00000
        0.00000       0.00000      0.000000       2.00000      1.66667      1.07692       1.00000
        1.33333       0.36364      0.000000       0.20000      1.16667      0.53846       1.00000
        0.00000       0.00000      0.000000       2.80000      0.33333      1.84615       1.00000
```

7 CLUSTER SOLUTION

```
                  CENTROID HIERARCHICAL CLUSTER ANALYSIS

                  EIGENVALUES OF THE COVARIANCE MATRIX

          EIGENVALUE      DIFFERENCE      PROPORTION      CUMULATIVE

  1        10.6128         2.60119         0.246740         0.24674
  2         8.0116         2.13421         0.186264         0.43300
  3         5.8774         1.84754         0.136645         0.56965
  4         4.0299         0.70215         0.093691         0.66334
  5         3.3277         0.27633         0.077367         0.74071
  6         3.0514         1.35031         0.070942         0.81165
  7         1.7011         0.18551         0.039549         0.85120
  8         1.5156         0.29187         0.035236         0.88643
  9         1.2237         0.17295         0.028450         0.91488
 10         1.0507         0.18234         0.024429         0.93931
 11         0.8684         0.22584         0.020190         0.95950
 12         0.6426         0.12845         0.014939         0.97444
 13         0.5141         0.13462         0.011953         0.98639
 14         0.3795         0.17373         0.008823         0.99522
 15         0.2058         0.20576         0.004784         1.00000
 16         0.0000         0.00000         0.000000         1.00000
 17         0.0000         0.00000         0.000000         1.00000
 18         0.0000         0.00000         0.000000         1.00000
 19         0.0000         0.00000         0.000000         1.00000
 20         0.0000         0.00000         0.000000         1.00000
 21         0.0000         0.00000         0.000000         1.00000
 22         0.0000         0.00000         0.000000         1.00000
 23         0.0000         0.00000         0.000000         1.00000
 24         0.0000         0.00000         0.000000         1.00000
 25         0.0000         0.00000         0.000000         1.00000
 26         0.0000         0.00000         0.000000         1.00000
 27        -0.0000         0.00000         -.000000         1.00000
 28        -0.0000         0.00000         -.000000         1.00000
 29        -0.0000         0.00000         -.000000         1.00000
 30        -0.0000         0.00000         -.000000         1.00000
 31        -0.0000         0.00000         -.000000         1.00000
 32        -0.0000         0.00000         -.000000         1.00000
 33        -0.0000         0.00000         -.000000         1.00000
 34        -0.0000         0.00000         -.000000         1.00000
 35        -0.0000         0.00000         -.000000         1.00000
 36        -0.0000            .            -.000000         1.00000

    ROOT-MEAN-SQUARE TOTAL-SAMPLE STANDARD DEVIATION =   1.09306
    ROOT-MEAN-SQUARE DISTANCE BETWEEN OBSERVATIONS   =   9.27493

     NUMBER                               FREQUENCY      NORMALIZED
       OF                                  OF NEW         CENTROID
    CLUSTERS   CLUSTERS JOINED             CLUSTER        DISTANCE

         15    sw_desig    leadersh              2        0.564206
         14    air_traf    surgery               2        0.610276
         13    CL14        pilot_tr              3        0.582182
         12    cargo_lo    accounti              2        0.623189
         11    program_    form_fil              2        0.672973
```

```
                        10     CL11        CL12             4         0.677967
                         9     CL10        drair_ge         5         0.658739
                         8     console_    medical_         2         0.698351
                                                 SAS                                  12:46 THURSDAY, JULY 11,
1
1991   2


                               CENTROID HIERARCHICAL CLUSTER ANALYSIS

                     NUMBER                                 FREQUENCY        NORMALIZED
                       OF                                    OF NEW           CENTROID
                    CLUSTERS    CLUSTERS JOINED              CLUSTER          DISTANCE

                         7     CL9         CL15             7         0.705751
                         6     CL7         protocol         8         0.733092
                         5     weather     CL8              3         0.749222
                         4     CL5         equip_di         4         0.787431
                         3     CL6         CL4             12         0.739529
                         2     CL3         CL13            15         0.762808
                         1     CL2         language        16         0.787522
                                                 SAS                                  12:46 THURSDAY, JULY 11,
1
1991   3


                               CENTROID HIERARCHICAL CLUSTER ANALYSIS

                                               NAME OF OBSERVATION OR CLUSTER

         p     f     c     a     d     s     l     p           c     m     e     a           p     l
         r     o     a     c     r     w     e     r     w     o     e     q     i     s     i     a
         o     r     r     c     a     _     a     o     e     n     d     u     r     u     l     n
         g     m     g     o     i     d     d     t     a     s     i     i     _     r     o     g
         r     _     o     u     r     e     e     o     t     o     c     p     t     g     t     u
         a     f     _     n     _     s     r     c     h     l     a     _     r     e     _     a
         m     i     l     t     g     i     s     o     e     e     l     d     a     r     t     g
         _     l     o     i     e     g     h     l     r     _     _     i     f     y     r     e
    0.8 +
        |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
        |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     .XXXXXXXXXXXXXXXXXX     .
D       |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     .     XXXXXXXXXXXXX     .
I       |XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     .     .     XXXXXXX     .     XXXXXXXXXXXXX     .
S   0.7 +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     .     .     XXXXXXX     .     XXXXXXXXXXXXX     .
T       |XXXXXXXXXXXXXXXXXXXXXXXXX     XXXXXXX     .     .     .     .     .     XXXXXXXXXXXXX     .
A       |.     .     XXXXXXXXXXXXX     XXXXXXX     .     .     .     .     .     XXXXXXXXXXXXX     .
N       |.     .     XXXXXXX     .     XXXXXXX     .     .     .     .     .     XXXXXXXXXXXXX     .
C       |.     .     XXXXXXX     .     XXXXXXX     .     .     .     .     .     XXXXXXXXXXXXX     .
E   0.6 +.     .     .     .     .     XXXXXXX     .     .     .     .     .     .     .XXXXXX     .
        |.     .     .     .     .     XXXXXXX     .     .     .     .     .     .     .XXXXXX     .
B       |.     .     .     .     .     XXXXXXX     .     .     .     .     .     .     .     .     .
E       |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
T       |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
W   0.5 +.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
E       |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
E       |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
N       |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
        |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
C   0.4 +.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
L       |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
U       |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
S       |.     .     .     .     .     .     .     .     .     .     .     .     .     .     .     .
```

```
                  T          |.      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
                  E    0.3 +.      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
                  R          |.      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
                             |.      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
                  C          |.      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
                  E          |.      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
                  N    0.2 +.      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
                  T          |.      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
                  R          |.      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
                  O          |.      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
                  I          |.      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
                  D    0.1 +.      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
                  S          |.      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
                             |.      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
                             |.      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
                             |.      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
                         0 +.      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
1                                    Average scores for eight clusters              12:46 THURSDAY, JULY 11,
1991   4

 ---------------------------------------------------------- CLUSTER=1 ----------------------------------------------------------
-------

    TASK              V1          V2          V3          V4          V5          V6          V7          V8
 V9

    sw_desig           0           0           4           0           3           2           2           0
  0
    leadersh           0           0           3           0           4           1           0           0
  0
    cargo_lo           0           1           2           0           1           2           4           1
  0
    accounti           0           0           2           0           1           0           4           3
  0
    program_           0           0           3           0           3           0           1           0
  2
    form_fil           0           0           0           0           3           0           0           1
  0
    drair_ge           1           0           1           0           0           0           3           4
  0

    TASK             V10         V11         V12         V13         V14         V15         V16         V17
V18

    sw_desig           4           4           4           1           0           3           4           1
  4
    leadersh           3           4           3           1           1           1           4           0
  4
    cargo_lo           2           2           1           3           0           0           1           4
  2
    accounti           2           4           3           1           0           0           3           4
  4
    program_           1           3           1           1           0           1           3           0
  2
    form_fil           2           3           0           1           0           2           4           4
  3
    drair_ge           0           3           0           3           0           0           4           2
  2
```

```
      TASK            V19         V20         V21         V22      INPUTS     COMPLEX        TECH      INFORM          SO
LVE

      sw_desig          4           0           2           1     1.10000     1.25000     2.50000     2.00000     1.41
667   leadersh          2           1           2           0     0.90000     1.50000     2.00000     1.11111     1.58
333   cargo_lo          2           0           2           2     0.60000     1.00000     1.00000     1.11111     1.66
667   accounti          2           0           2           2     1.50000     0.75000     2.00000     2.22222     1.25
000   program_          0           1           1           2     1.00000     0.75000     2.00000     0.66667     1.16
667   form_fil          0           0           2           2     1.50000     1.25000     2.00000     1.22222     1.16
667   drair_ge          2           2           0           0     1.30000     0.00000     2.00000     1.33333     1.58
333
      TASK         RECALL     PERCEPT     ENVIRON      PSYCHE    PHYSICAL       PSYCH       EQUIP    COMMUNIC         DOM
AIN

      sw_desig    1.80000    0.000000           0    0.000000           0     1.00000     1.16667     0.38462
  1   leadersh    1.60000    0.000000           0    0.181818           0     2.60000     0.50000     1.84615
  1   cargo_lo    1.60000    0.000000           0    0.000000           0     0.80000     0.33333     0.76923
  1   accounti    1.60000    0.500000           0    0.000000           0     1.20000     1.16667     0.61538
  1   program_    1.60000    0.000000           0    0.000000           0     1.20000     0.16667     1.46154
  1   form_fil    1.40000    0.000000           0    0.000000           0     1.20000     0.50000     1.46154
  1   drair_ge    1.00000    0.000000           0    0.000000           0     1.00000     0.50000     1.23077
  1                                        Average scores for eight clusters              12:46 THURSDAY, JULY 11,
1
1991   5

 ------------------------------------------------------------ CLUSTER=2 ------------------------------------------------------------
-------

      TASK             V1          V2          V3          V4          V5          V6          V7          V8
 V9

      air_traf          0           4           4           0           0           1           0           0
  1   surgery           0           4           2           0           1           4           0           1
  0   pilot_tr          0           4           3           0           1           3           0           0
  0
      TASK            V10         V11         V12         V13         V14         V15         V16         V17
V18

      air_traf          4           4           0           2           0           0           2           3
  4   surgery           4           4           0           1           1           0           0           3
```

```
     4
       pilot_tr          3         3         0         1         0         0         2         3
     3

       TASK            V19       V20       V21       V22    INPUTS   COMPLEX      TECH    INFORM     SO
  LVE

       air_traf          0         0         3         0   1.90000   3.00000   1.50000  0.888889   2.00
  000
       surgery           0         0         3         2   1.90000   2.50000   3.00000  0.777778   1.75
  000
       pilot_tr          3         0         0         0   2.40000   2.50000   2.00000  0.555556   2.00
  000

       TASK         RECALL   PERCEPT   ENVIRON    PSYCHE  PHYSICAL     PSYCH     EQUIP  COMMUNIC    DOM
  AIN

       air_traf    1.80000   3.25000   0.83333   2.36364   0.80000   2.20000   1.66667   1.53846
     2
       surgery     2.60000   2.00000   1.00000   2.18182   0.80000   2.40000   1.00000   2.38462
     2
       pilot_tr    2.60000   3.25000   1.66667   1.18182   1.00000   1.40000   1.00000   1.00000
     2

   ------------------------------------------------------------ CLUSTER=3 ---------------------------------------------------------
  -------

       TASK             V1        V2        V3        V4        V5        V6        V7        V8
   V9

       console_          0         2         4         0         2         3         0         2
     0
       medical_          1         0         4         0         2         3         0         4
     0

       TASK            V10       V11       V12       V13       V14       V15       V16       V17
  V18

       console_          0         2         0         3         3         0         1         1
     2
       medical_          0         0         3         3         4         0         2         1
     0

       TASK            V19       V20       V21       V22    INPUTS   COMPLEX      TECH    INFORM     SO
  LVE

       console_          0         0         2         3   1.10000   3.25000   2.50000   1.55556   2.00
  000
       medical_          0         0         2         2   2.60000   2.75000   2.50000   1.00000   2.16
  667

       TASK         RECALL   PERCEPT   ENVIRON    PSYCHE  PHYSICAL     PSYCH     EQUIP  COMMUNIC    DOM
  AIN

       console_    2.80000   4.00000  0.500000   1.45455  0.800000   1.80000   1.33333   1.53846
     2
       medical_    3.00000   1.50000  0.333333   0.54545  0.000000   3.00000   1.00000   2.30769
```

```
 ------------------------------------------------------------- CLUSTER=4 -------------------------------------------------------
-------

    TASK              V1          V2          V3          V4          V5          V6          V7          V8
 V9

    protocol           4           0           3           0           2           0           0           0
  0

    TASK             V10         V11         V12         V13         V14         V15         V16         V17
V18

    protocol           4           4           3           1           0           3           3           0
  1

    TASK             V19         V20         V21         V22      INPUTS     COMPLEX        TECH      INFORM          SO
LVE

    protocol           1           0           3           2     1.10000     1.50000     2.50000    0.777778        1.33
333

    TASK          RECALL     PERCEPT     ENVIRON      PSYCHE    PHYSICAL       PSYCH       EQUIP    COMMUNIC         DOM
AIN

    protocol     2.20000           0           0           0           0     1.20000    0.333333    0.692308
  1


 ------------------------------------------------------------- CLUSTER=5 -------------------------------------------------------
-------

    TASK              V1          V2          V3          V4          V5          V6          V7          V8
 V9

    weather            2           3           4           0           2           4           2           3
  0

    TASK             V10         V11         V12         V13         V14         V15         V16         V17
V18

    weather            0           3           2           2           3           0           4           2
  4

    TASK             V19         V20         V21         V22      INPUTS     COMPLEX        TECH      INFORM          SO
LVE

    weather            3           0           3           3           2     3.25000     2.50000     1.66667        2.33
333

    TASK          RECALL     PERCEPT     ENVIRON      PSYCHE    PHYSICAL       PSYCH       EQUIP    COMMUNIC         DOM
AIN

    weather      2.20000     1.50000           0           0           0           2     1.66667     1.07692
  1
```

```
 ---------------------------------------------------------- CLUSTER=6 ---------------------------------------------------------
-------

   TASK              V1          V2          V3          V4          V5          V6          V7          V8
 V9

   equip_di           2           1           1           0           0           2           0           3
  0

   TASK             V10         V11         V12         V13         V14         V15         V16         V17
V18

   equip_di           0           2           4           3           1           0           2           4
  3

   TASK             V19         V20         V21         V22      INPUTS     COMPLEX        TECH      INFORM          SO
LVE

   equip_di           1           0           3           4     1.80000           1     2.50000    0.888889        1.25
000

   TASK          RECALL     PERCEPT     ENVIRON      PSYCHE    PHYSICAL       PSYCH       EQUIP    COMMUNIC         DOM
AIN

   equip_di     2.20000    0.750000     1.33333    0.363636           0    0.200000     1.16667    0.538462
  1
1                                                Average scores for eight clusters            12:46 THURSDAY, JULY 11,
1991   7

 ---------------------------------------------------------- CLUSTER=7 ---------------------------------------------------------
-------

   TASK              V1          V2          V3          V4          V5          V6          V7          V8
 V9

   language           0           0           3           3           2           0           0           2
  2

   TASK             V10         V11         V12         V13         V14         V15         V16         V17
V18

   language           3           4           2           1           2           0           0           3
  4

   TASK             V19         V20         V21         V22      INPUTS     COMPLEX        TECH      INFORM          SO
LVE

   language           4           3           2           3     1.60000     1.75000           2    0.888889
  2

   TASK          RECALL     PERCEPT     ENVIRON      PSYCHE    PHYSICAL       PSYCH       EQUIP    COMMUNIC         DOM
AIN

   language     2.60000           0           0           0           0     2.80000    0.333333     1.84615
  1
1                                                Average scores for eight clusters            12:46 THURSDAY, JULY 11,
```

```
1991  8
        CLUSTER         V1          V2          V3          V4          V5          V6          V7          V8
  V9

              1    0.14286     0.14286     2.14286           0     2.14286     0.71429           2     1.28571     0.
28571
33333         2    0.00000     4.00000     3.00000           0     0.66667     2.66667           0     0.33333     0.
              3    0.50000     1.00000     4.00000           0     2.00000     3.00000           0     3.00000     0.
00000
              4    4.00000     0.00000     3.00000           0     2.00000     0.00000           0     0.00000     0.
00000
              5    2.00000     3.00000     4.00000           0     2.00000     4.00000           2     3.00000     0.
00000
              6    2.00000     1.00000     1.00000           0     0.00000     2.00000           0     3.00000     0.
00000
              7    0.00000     0.00000     3.00000           3     2.00000     0.00000           0     2.00000     2.
00000

            V10         V11         V12         V13         V14         V15         V16         V17         V18
  V19

        2.00000     3.28571     1.71429     1.57143     0.14286           1     3.28571     2.14286     3.00000     1.
71429
        3.66667     3.66667     0.00000     1.33333     0.33333           0     1.33333     3.00000     3.66667     1.
00000
        0.00000     1.00000     1.50000     3.00000     3.50000           0     1.50000     1.00000     1.00000     0.
00000
        4.00000     1.00000     3.00000     1.00000     0.00000           3     3.00000     0.00000     1.00000     1.
00000
        0.00000     3.00000     2.00000     2.00000     3.00000           0     4.00000     2.00000     4.00000     3.
00000
        0.00000     2.00000     4.00000     3.00000     1.00000           0     2.00000     4.00000     3.00000     1.
00000
        3.00000     4.00000     2.00000     1.00000     2.00000           0     0.00000     3.00000     4.00000     4.
00000

            V20         V21         V22      INPUTS     COMPLEX        TECH      INFORM       SOLVE      RECALL     PE
RCEPT

        0.57143     1.57143     1.28571     1.12857     0.92857     1.92857     1.38095     1.40476     1.51429     0.
07143
        0.00000     2.00000     0.66667     2.06667     2.66667     2.16667     0.74074     1.91667     2.33333     2.
83333
        0.00000     2.00000     2.50000     2.00000     3.00000     2.50000     1.27778     2.08333     2.90000     2.
75000
        0.00000     3.00000     2.00000     1.10000     1.50000     2.50000     0.77778     1.33333     2.20000     0.
00000
        0.00000     3.00000     3.00000     2.00000     3.25000     2.50000     1.66667     2.33333     2.20000     1.
50000
        0.00000     3.00000     4.00000     1.80000     1.00000     2.50000     0.88889     1.25000     2.20000     0.
75000
        3.00000     2.00000     3.00000     1.60000     1.75000     2.00000     0.88889     2.00000     2.60000     0.
00000

        ENVIRON          PSYCHE       PHYSICAL          PSYCH         EQUIP       COMMUNIC        DOMAIN

        0.00000         0.02597       0.000000        1.28571       0.61905        1.10989       1.00000
```

```
1.16667     1.90909     0.866667     2.00000     1.22222     1.64103     2.00000
0.41667     1.00000     0.400000     2.40000     1.16667     1.92308     1.50000
0.00000     0.00000     0.000000     1.20000     0.33333     0.69231     1.00000
0.00000     0.00000     0.000000     2.00000     1.66667     1.07692     1.00000
1.33333     0.36364     0.000000     0.20000     1.16667     0.53846     1.00000
0.00000     0.00000     0.000000     2.80000     0.33333     1.84615     1.00000
```

APPENDIX O
FINAL LIST OF CHARACTERISTICS

1. Representational Techniques - characteristics related to the use of information to perform the task

   statistical
   spatial
   temporal
   analogical
   case-based
   modelling
   mathematical

2. Search Strategies - methods of finding a solution in the problem space

   means-ends analysis
   forming sub-goals
   generate-and-test
   goal-directed heuristic search
   data-drive heuristic search
   cover & differentiate
   propose & refine
   acquire & present
   formula/procedure/algorithm
   decomposing
   recombining
   generalizing
   specialization
   return to definition

3. Inputs - information input to the task

   qualitative
   quantitative
   visual
   verbal
   auditory
   kinesthetic
   written material
   sensor readings/test results
   interface to machine/console/device
   databases

4. Task Complexity - characteristics of the data array and problem solving space that influence the task

   branching factor
   dynamism
   physical constraints
   time constraints
   uncertainity in inputs
   uncertainity in interpretation/evaluation

5. Technical Component - the degree to which the task requires a technical background or skill

   technical/engineering
   non-technical

6. Motor Processes - physical manipulation during the task

   Complex-continuous
   compound
   reflex
   simple-discrete
   fine
   gross
   repetitive

7. Information Processing - characteristics of the way data is manipulated

   categorize
   calculate
   code
   computerize
   interpolate
   itemize
   tabulate
   translate
   analyze
   deduce
   induce
   choose
   compare
   compute
   estimate
   integrate
   monitor
   interpret

8. Recall - the role of memory in the task

   facts
   principles
   procedures
   analogs
   cases
   models

9. Perceptual - use of the visual input during task performance

  perceptual speed
  searching for and receiving information
  identifying objects, actions, and events
  scanning a display

10. Environment - physical and psychological characteristics of the environment in which the task is performed

  10.1 Physical

    acceleration
    confinement
    isolation
    contaminants
    lighting
    magnetism
    noise

  10.2 Psychological

    fatigue
    mental strain
    stress
    physical strain
    precision
    attention/automaticity
    response chaining
    amount of sleep
    work schedule
    boredom

11. Physical Characteristics - characteristics of the problem solver

  age
  gender
  height
  weight

12. Background - type of learning situation encountered by problem solver

  education
  training

13. Type of Domain

  knowledge-rich
  high performance

14. Hardware/Equipment/Tools Involved - items or devices used during the task

computer
vehicles/aircraft
weapon system
instruments
notation
tools
test equipment

15. Communication Processes - communication during task performance

15.1 Verbal

negotiates
supervises
transmits
requests
instructs
informs
indicates
directs
communicates
answers
advises

15.2 Nonverbal

interpretive movement
expressive movement

TABLE 19

Human's taxonomy

- 1 Environment
  - 1.1 Type
    - 1.1.1 Laboratory
    - 1.1.2 Office
    - 1.1.3 Outer space
  - 1.2 Attributes
    - 1.2.1 Acceleration
    - 1.2.2 Confinement
    - 1.2.3 Contaminants/toxicants
    - 1.2.4 Day/night cycles
    - 1.2.5 Electricity
    - 1.2.6 Isolation
    - 1.2.7 Lighting
      - 1.2.7.1 Type
        - 1.2.7.1.1 Fluorescent
        - 1.2.7.1.2 Incandescent
        - 1.2.7.1.3 Sunlight
      - 1.2.7.2 Attributes
        - 1.2.7.2.1 Luminance in foot lamberts
    - 1.2.8 Magnetism
    - 1.2.9 Noise
      - 1.2.9.1 Duration
        - 1.2.9.1.1 Continuous
        - 1.2.9.1.2 Impulsive
        - 1.2.9.1.3 Intermittent
        - 1.2.9.1.4 Single
      - 1.2.9.2 Frequency
        - 1.2.9.2.1 Constant
        - 1.2.9.2.2 Variable
      - 1.2.9.3 Intensity
        - 1.2.9.3.1 Constant
        - 1.2.9.3.2 Variable
      - 1.2.9.4 Medium
        - 1.2.9.4.1 Atmosphere
        - 1.2.9.4.2 Communication
        - 1.2.9.4.3 Hydrosphere
      - 1.2.9.5 Range
        - 1.2.9.5.1 Infrasonic
        - 1.2.9.5.2 Sonic
        - 1.2.9.5.3 Ultrasonic
      - 1.2.9.6 Spectrum
        - 1.2.9.6.1 Broad band
        - 1.2.9.6.2 Narrow band
        - 1.2.9.6.3 Pure
    - 1.2.10 Pressure
      - 1.2.10.1 Ambient vapor pressure in MB
      - 1.2.10.2 Gravity
    - 1.2.11 Radiation
      - 1.2.11.1 Infrared
      - 1.2.11.2 Microwave
      - 1.2.11.3 Radio frequency
      - 1.2.11.4 Ultraviolet
      - 1.2.11.5 Visible
      - 1.2.11.6 X-Ray
    - 1.2.12 Reduced/zero gravity
    - 1.2.13 Terrain
    - 1.2.14 Thermal
      - 1.2.14.1 Ambient dry bulb temperature in degrees celsius
      - 1.2.14.2 Humidity
    - 1.2.15 Vibration

- 2 Subject
  - 2.1 Physical characteristics
    - 2.1.1 Age
    - 2.1.2 Effector
      - 2.1.2.1 Feet
        - 2.1.2.1.1 Agility
        - 2.1.2.1.2 Dominance
        - 2.1.2.1.3 Lift strength
      - 2.1.2.2 Hands
        - 2.1.2.2.1 Dominance
        - 2.1.2.2.2 Flexibility
        - 2.1.2.2.3 Grip strength
      - 2.1.2.3 Voice
    - 2.1.3 Fatigue
    - 2.1.4 Gender
      - 2.1.4.1 Female
      - 2.1.4.2 Male
    - 2.1.5 Height in cm
    - 2.1.6 Limbs
      - 2.1.6.1 Legs
        - 2.1.6.1.1 Endurance
        - 2.1.6.1.2 Strength
      - 2.1.6.2 Arms
        - 2.1.6.2.1 Length
    - 2.1.7 Weight in Kg
  - 2.2 Mental state
    - 2.2.1 Attention span
    - 2.2.2 Drugs
      - 2.2.2.1 Type
      - 2.2.2.2 Attributes
        - 2.2.2.2.1 Dosage
        - 2.2.2.2.2 Number of days since last taken
        - 2.2.2.2.3 Number of days taken
    - 2.2.3 Memory
      - 2.2.3.1 Long term
        - 2.2.3.1.1 Number of times has done task before
      - 2.2.3.2 Short term
        - 2.2.3.2.1 Number of items stored
    - 2.2.4 Personality trait
      - 2.2.4.1 Perceived probability of success
    - 2.2.5 Sleep in hours
    - 2.2.6 Work schedule
      - 2.2.6.1 Days on duty
      - 2.2.6.2 Rest periods
        - 2.2.6.2.1 Duration
        - 2.2.6.2.2 Frequency
  - 2.3 Senses
    - 2.3.1 Auditory
      - 2.3.1.1 Acuity
      - 2.3.1.2 Biaural
      - 2.3.1.3 Monaural
      - 2.3.1.4 Tone perception
    - 2.3.2 Olfactory
    - 2.3.3 Tactual
    - 2.3.4 Vision
      - 2.3.4.1 Accommodation
      - 2.3.4.2 Acuity
      - 2.3.4.3 Binocular
      - 2.3.4.4 Color perception
      - 2.3.4.5 Convergence
      - 2.3.4.6 Monocular

- 3 Task
  - 3.1 Control device
    - 3.1.1 Type
      - 3.1.1.1 Knob
      - 3.1.1.2 Lever
      - 3.1.1.3 Pedal
      - 3.1.1.4 Pushbutton
      - 3.1.1.5 Switch
        - 3.1.1.5.1 Rocker
        - 3.1.1.5.2 Rotary selector
        - 3.1.1.5.3 Toggle
      - 3.1.1.6 Track ball
      - 3.1.1.7 Touch device
        - 3.1.1.7.1 Keyboard
          - 3.1.1.7.1.1 Membrane
          - 3.1.1.7.1.2 Teletype
        - 3.1.1.7.2 Light pen
        - 3.1.1.7.3 Pointer
        - 3.1.1.7.4 Touch panel
        - 3.1.1.7.5 Touch screen
      - 3.1.1.8 Voice activated
      - 3.1.1.9 Wheels
        - 3.1.1.9.1 Steering wheels
        - 3.1.1.9.2 Thumb wheels
    - 3.1.2 Attributes
      - 3.1.2.1 Number of positions
      - 3.1.2.2 Size
      - 3.1.2.3 Type damping
      - 3.1.2.4 Type feedback
  - 3.2 Display device
    - 3.2.1 Type
      - 3.2.1.1 Auditory displays
        - 3.2.1.1.1 Electromechanical
          - 3.2.1.1.1.1 Bells
          - 3.2.1.1.1.2 Buzzers
          - 3.2.1.1.1.3 Horns
          - 3.2.1.1.1.4 Sirens
        - 3.2.1.1.2 Electronic
          - 3.2.1.1.2.1 Electronic tones and signals
          - 3.2.1.1.2.2 Recorded signals directions
      - 3.2.1.2 Visual
        - 3.2.1.2.1 CRT alphanumeric-pictorial displays
          - 3.2.1.2.1.1 Computer output displays
          - 3.2.1.2.1.2 Infrared sensor displays
          - 3.2.1.2.1.3 Low-light-level TV displays
          - 3.2.1.2.1.4 Television output displays
        - 3.2.1.2.2 CRT electronic parameter displays
          - 3.2.1.2.2.1 Analog computer output displays
          - 3.2.1.2.2.2 Bargraph displays
          - 3.2.1.2.2.3 Waveform displays
        - 3.2.1.2.3 CRT spatial relation displays
          - 3.2.1.2.3.1 Radar displays
          - 3.2.1.2.3.2 Sonar displays
        - 3.2.1.2.4 Hard copy readout displays
          - 3.2.1.2.4.1 Plotters
          - 3.2.1.2.4.2 Printers
          - 3.2.1.2.4.3 Recorders
        - 3.2.1.2.5 Indicator lights (transilluminated)
          - 3.2.1.2.5.1 Lighted pushbutton displays
          - 3.2.1.2.5.2 Multiple status
          - 3.2.1.2.5.3 Single status

- 3.2.1.2.6 Light Emitting Diode (LED)
- 3.2.1.2.7 Liquid Crystal Displays (LCD)
- 3.2.1.2.8 Mechanical
- 3.2.1.2.9 Projection
- 3.2.1.2.10 Random-access digital readouts
  - 3.2.1.2.10.1 Back-lighted belt displays
  - 3.2.1.2.10.2 Cold cathode tubes
  - 3.2.1.2.10.3 Edge-lighted plates
  - 3.2.1.2.10.4 Light-Emitting Diode displays
  - 3.2.1.2.10.5 Projection readouts
  - 3.2.1.2.10.6 Segmented matrices
- 3.2.1.2.11 Scalar displays
  - 3.2.1.2.11.1 Fixed pointer, moving scale
  - 3.2.1.2.11.2 Moving pointer, fixed scale
- 3.2.1.2.12 Sequential-access digital readouts
  - 3.2.1.2.12.1 Electromechanical drum counters
  - 3.2.1.2.12.2 Flag counters
- 3.2.1.2.13 Status displays
  - 3.2.1.2.13.1 Large screen displays
  - 3.2.1.2.13.2 Map displays
  - 3.2.1.2.13.3 Matrix boards
  - 3.2.1.2.13.4 Plot boards
  - 3.2.1.2.13.5 Projected displays

- 3.2.2 Attributes
  - 3.2.2.1 Size
    - 3.2.2.1.1 Diameter in cm
    - 3.2.2.1.2 Height in cm
    - 3.2.2.1.3 Width in cm
  - 3.2.2.2 Viewing conditions
    - 3.2.2.2.1 Collimation
    - 3.2.2.2.2 Distance of operator to display in cm
    - 3.2.2.2.3 Magnification
    - 3.2.2.2.4 Ocular design
      - 3.2.2.2.4.1 Binocular
      - 3.2.2.2.4.2 Dichoptic
      - 3.2.2.2.4.3 Monocular left eye
      - 3.2.2.2.4.4 Monocular right eye
    - 3.2.2.2.5 Resolution
    - 3.2.2.2.6 Visual angle/field of view in degrees

- 3.3 Machine
  - 3.3.1 Computer
    - 3.3.1.1 Mainframe
    - 3.3.1.2 Personal
  - 3.3.2 Vehicles
    - 3.3.2.1 Aircraft
      - 3.3.2.1.1 Helicopter
      - 3.3.2.1.2 Jet
      - 3.3.2.1.3 Propeller
    - 3.3.2.2 Motorized ground vehicle
      - 3.3.2.2.1 Car
      - 3.3.2.2.2 Half track
      - 3.3.2.2.3 Jeep
      - 3.3.2.2.4 Tank
      - 3.3.2.2.5 Truck
    - 3.3.2.3 Ship
      - 3.3.2.3.1 Aircraft carrier
      - 3.3.2.3.2 Destroyer
      - 3.3.2.3.3 Submarine
    - 3.3.2.4 Spacecraft
  - 3.3.3 Weapon

- 3.4 Stimulus
  - 3.4.1 Type
    - 3.4.1.1 Auditory
    - 3.4.1.2 Kinesthetic
    - 3.4.1.3 Visual
      - 3.4.1.3.1 Alphanumeric
      - 3.4.1.3.2 Graph
  - 3.4.2 Attributes
    - 3.4.2.1 Background
      - 3.4.2.1.1 Complexity
      - 3.4.2.1.2 Contrast
      - 3.4.2.1.3 Number of background characters
    - 3.4.2.2 Characteristics
      - 3.4.2.2.1 Alphanumerics
      - 3.4.2.2.2 Changing/moving stimulus
      - 3.4.2.2.3 Coded stimulus
      - 3.4.2.2.4 Conspicuity
      - 3.4.2.2.5 Raw stimulus
      - 3.4.2.2.6 Static stimulus
    - 3.4.2.3 Color
    - 3.4.2.4 Duration
      - 3.4.2.4.1 Continuous
      - 3.4.2.4.2 Intermittent
        - 3.4.2.4.2.1 Probability
        - 3.4.2.4.2.2 Rate
      - 3.4.2.4.3 Single
    - 3.4.2.5 Information presented
      - 3.4.2.5.1 Content
      - 3.4.2.5.2 Qualitative
      - 3.4.2.5.3 Quantitative
    - 3.4.2.6 Location on display
      - 3.4.2.6.1 Center
      - 3.4.2.6.2 Lower left
      - 3.4.2.6.3 Lower middle
      - 3.4.2.6.4 Lower right
      - 3.4.2.6.5 Middle left
      - 3.4.2.6.6 Middle right
      - 3.4.2.6.7 Upper left
      - 3.4.2.6.8 Upper middle
      - 3.4.2.6.9 Upper right
      - 3.4.2.6.10 Predictability of location
    - 3.4.2.7 Mechanism
      - 3.4.2.7.1 Directly viewed event
      - 3.4.2.7.2 Display
      - 3.4.2.7.3 Written material
    - 3.4.2.8 Number
      - 3.4.2.8.1 Multiple
      - 3.4.2.8.2 Single
    - 3.4.2.9 Range of values
    - 3.4.2.10 Relative movement
      - 3.4.2.10.1 Observer and target at rest
      - 3.4.2.10.2 Observer and target in motion
      - 3.4.2.10.3 Observer in motion, target at rest
      - 3.4.2.10.4 Observer at rest, target in motion
    - 3.4.2.11 Relative position of observer
      - 3.4.2.11.1 Horizontal range in Km
      - 3.4.2.11.2 Offset in Km
      - 3.4.2.11.3 Positions
        - 3.4.2.11.3.1 Air-to-air
        - 3.4.2.11.3.2 Air-to-ground
        - 3.4.2.11.3.3 At a display
        - 3.4.2.11.3.4 Ground-to-air
        - 3.4.2.11.3.5 Ground-to-ground
    - 3.4.2.12 Size/amplitude
      - 3.4.2.12.1 Signal-to-noise ratio

- 3.5 Task
  - 3.5.1 Type
    - 3.5.1.1 Communication
      - 3.5.1.1.1 Type
        - 3.5.1.1.1.1 Advise
        - 3.5.1.1.1.2 Answer
        - 3.5.1.1.1.3 Communicate
          - 3.5.1.1.1.3.1 Job-related
          - 3.5.1.1.1.3.2 Public-related
        - 3.5.1.1.1.4 Comprehend
        - 3.5.1.1.1.5 Coordinate
        - 3.5.1.1.1.6 Direct
        - 3.5.1.1.1.7 Indicate
        - 3.5.1.1.1.8 Inform
        - 3.5.1.1.1.9 Instruct
        - 3.5.1.1.1.10 Request
        - 3.5.1.1.1.11 Supervise
        - 3.5.1.1.1.12 Transmit
      - 3.5.1.1.2 Attributes
        - 3.5.1.1.2.1 Oral
        - 3.5.1.1.2.2 Written
    - 3.5.1.2 Meditation
      - 3.5.1.2.1 Type
        - 3.5.1.2.1.1 Information processing
          - 3.5.1.2.1.1.1 Categorize
          - 3.5.1.2.1.1.2 Calculate
          - 3.5.1.2.1.1.3 Code
          - 3.5.1.2.1.1.4 Compute
          - 3.5.1.2.1.1.5 Interpolate
          - 3.5.1.2.1.1.6 Itemize
          - 3.5.1.2.1.1.7 Learn
          - 3.5.1.2.1.1.8 Tabulate
          - 3.5.1.2.1.1.9 Translate
        - 3.5.1.2.1.2 Problem solving and decision making
          - 3.5.1.2.1.2.1 Analyse
          - 3.5.1.2.1.2.2 Deduce
          - 3.5.1.2.1.2.3 Induce
          - 3.5.1.2.1.2.4 Calculate
          - 3.5.1.2.1.2.5 Choose
            - 3.5.1.2.1.2.5.1 Choose from known alternatives
            - 3.5.1.2.1.2.5.2 Choose from unknown alternatives
            - 3.5.1.2.1.2.5.3 Choose from unspecified alternatives
          - 3.5.1.2.1.2.6 Compare
            - 3.5.1.2.1.2.6.1 Order
          - 3.5.1.2.1.2.7 Compute
          - 3.5.1.2.1.2.8 Estimate
          - 3.5.1.2.1.2.9 Integrate
          - 3.5.1.2.1.2.10 Plan
          - 3.5.1.2.1.2.11 Supervise
        - 3.5.1.2.1.3 Recall
          - 3.5.1.2.1.3.1 Recall facts
          - 3.5.1.2.1.3.2 Recall principles
          - 3.5.1.2.1.3.3 Recall procedures
          - 3.5.1.2.1.3.4 Timeshare
      - 3.5.1.2.2 Attributes
        - 3.5.1.2.2.1 Complexity
        - 3.5.1.2.2.2 Difficulty

- 3.5.1.3 Motor processes
  - 3.5.1.3.1 Type
    - 3.5.1.3.1.1 Complex-continuous
      - 3.5.1.3.1.1.1 Adjust
      - 3.5.1.3.1.1.2 Align
      - 3.5.1.3.1.1.3 Insert object
      - 3.5.1.3.1.1.4 Regulate
      - 3.5.1.3.1.1.5 Remove object
      - 3.5.1.3.1.1.6 Synchronize
      - 3.5.1.3.1.1.7 Track
        - 3.5.1.3.1.1.7.1 Visual tracking only
        - 3.5.1.3.1.1.7.2 Visual tracking plus position plotting
      - 3.5.1.3.1.1.8 Type message on keyboard
      - 3.5.1.3.1.1.9 Write
    - 3.5.1.3.1.2 Compound
    - 3.5.1.3.1.3 Reflex
      - 3.5.1.3.1.3.1 Intersegmental
      - 3.5.1.3.1.3.2 Segmental
      - 3.5.1.3.1.3.3 Suprasegmental
    - 3.5.1.3.1.4 Simple-discrete
      - 3.5.1.3.1.4.1 Activate
      - 3.5.1.3.1.4.2 Close
      - 3.5.1.3.1.4.3 Connect
      - 3.5.1.3.1.4.4 Disconnect
      - 3.5.1.3.1.4.5 Join
      - 3.5.1.3.1.4.6 Move
      - 3.5.1.3.1.4.7 Press
      - 3.5.1.3.1.4.8 Set
      - 3.5.1.3.1.4.9 Turn single rotary control
  - 3.5.1.3.2 Attributes
    - 3.5.1.3.2.1 Ballistic
    - 3.5.1.3.2.2 Continuous
    - 3.5.1.3.2.3 Coordinated
    - 3.5.1.3.2.4 Fine
    - 3.5.1.3.2.5 Gross
    - 3.5.1.3.2.6 Repetitive
    - 3.5.1.3.2.7 Serial
    - 3.5.1.3.2.8 Static
- 3.5.1.4 Perceptual processing
  - 3.5.1.4.1 Searching for and receiving information
    - 3.5.1.4.1.1 Detect
      - 3.5.1.4.1.1.1 Detect non-verbal cues
      - 3.5.1.4.1.1.2 Detect verbal cues
    - 3.5.1.4.1.2 Inspect
    - 3.5.1.4.1.3 Observe
    - 3.5.1.4.1.4 Read
    - 3.5.1.4.1.5 Receive
    - 3.5.1.4.1.6 Scan
    - 3.5.1.4.1.7 Survey
  - 3.5.1.4.2 Identifying objects, actions, events
    - 3.5.1.4.2.1 Discriminate
      - 3.5.1.4.2.1.1 Discriminate auditory cues
      - 3.5.1.4.2.1.2 Discriminate kinetic cues
      - 3.5.1.4.2.1.3 Discriminate non-verbal cues
      - 3.5.1.4.2.1.4 Discriminate tactile cues
      - 3.5.1.4.2.1.5 Discriminate verbal cues
      - 3.5.1.4.2.1.6 Discriminate visual cues
    - 3.5.1.4.2.2 Identify
      - 3.5.1.4.2.2.1 Identify non-verbal cues
      - 3.5.1.4.2.2.2 Identify verbal cues
    - 3.5.1.4.2.3 Recognize
      - 3.5.1.4.2.3.1 Recognize non-verbal cues
      - 3.5.1.4.2.3.2 Recognize verbal cues
- 3.5.2 Attributes
  - 3.5.2.1 Amount of labor required
  - 3.5.2.2 Complexity
  - 3.5.2.3 Degree of response chaining
  - 3.5.2.4 Difficulty
  - 3.5.2.5 Knowledge of results
  - 3.5.2.6 Output
  - 3.5.2.7 Pacing
  - 3.5.2.8 Precision
  - 3.5.2.9 Repetitiveness
  - 3.5.2.10 Skill demands
  - 3.5.2.11 Simultaneity of responses
  - 3.5.2.12 Task autonomy