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An information processing model of pharmacists' cognition: Research on typicality biases in performance

Slack, Marion Kimball, Ph.D.

The University of Arizona, 1989

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AN INFORMATION PROCESSING MODEL OF PHARMACISTS' COGNITION:
RESEARCH ON TYPICALITY BIASES IN PERFORMANCE

by
Marion Kimball Slack

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A dissertation Submitted to the Faculty of the
DEPARTMENT OF PHARMACY PRACTICE
In Partial Fulfillment of the Requirements
For the Degree of
DOCTOR OF PHILOSOPHY
In the Graduate College
THE UNIVERSITY OF ARIZONA

1989
As members of the Final Examination Committee, we certify that we have read the dissertation prepared by Marion Kimball Slack entitled An Information Processing Model of Pharmacists' Cognition: Research on Typicality Biases in Performance

and recommend that it be accepted as fulfilling the dissertation requirement for the Degree of Doctor of Philosophy.

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SIGNED: Maxine Kendall Slack
ACKNOWLEDGEMENTS

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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIST OF ILLUSTRATIONS</td>
<td>7</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>8</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>9</td>
</tr>
<tr>
<td>1. INTRODUCTION</td>
<td>11</td>
</tr>
<tr>
<td>Problem Statement</td>
<td>12</td>
</tr>
<tr>
<td>Significance</td>
<td>15</td>
</tr>
<tr>
<td>Objectives</td>
<td>18</td>
</tr>
<tr>
<td>Cognitive Process Model</td>
<td>19</td>
</tr>
<tr>
<td>Hypotheses</td>
<td>29</td>
</tr>
<tr>
<td>Definitions</td>
<td>35</td>
</tr>
<tr>
<td>2. LITERATURE REVIEW</td>
<td>38</td>
</tr>
<tr>
<td>Information Processing Theory</td>
<td>38</td>
</tr>
<tr>
<td>Typicality Studies</td>
<td>45</td>
</tr>
<tr>
<td>Typicality Studies in the Health Sciences</td>
<td>54</td>
</tr>
<tr>
<td>Studies of Dispensing Errors in Pharmacy</td>
<td>83</td>
</tr>
<tr>
<td>3. METHODOLOGY</td>
<td>89</td>
</tr>
<tr>
<td>Development of Materials</td>
<td>90</td>
</tr>
<tr>
<td>Subjects</td>
<td>104</td>
</tr>
<tr>
<td>Research Design</td>
<td>106</td>
</tr>
<tr>
<td>Data Collection</td>
<td>106</td>
</tr>
<tr>
<td>Statistical Analysis</td>
<td>109</td>
</tr>
<tr>
<td>Hypotheses</td>
<td>111</td>
</tr>
<tr>
<td>Limitations</td>
<td>119</td>
</tr>
<tr>
<td>Pilot Test</td>
<td>120</td>
</tr>
<tr>
<td>4. RESULTS</td>
<td>127</td>
</tr>
<tr>
<td>Demographic Data</td>
<td>127</td>
</tr>
<tr>
<td>Hypothesis #1</td>
<td>132</td>
</tr>
<tr>
<td>Hypothesis #2</td>
<td>132</td>
</tr>
<tr>
<td>Hypothesis #3</td>
<td>133</td>
</tr>
<tr>
<td>Hypothesis #4</td>
<td>133</td>
</tr>
<tr>
<td>Hypothesis #5</td>
<td>134</td>
</tr>
<tr>
<td>Hypothesis #6</td>
<td>135</td>
</tr>
<tr>
<td>Hypothesis #7</td>
<td>135</td>
</tr>
</tbody>
</table>
# Table of Contents, continued.

Hypothesis #8. ...................................................... 136
Hypothesis #9. ...................................................... 136
Hypothesis #10. ...................................................... 137
Hypothesis #11 and #12. ......................................... 141
Hypothesis #13. ...................................................... 141
Hypothesis #14. ...................................................... 141
Hypothesis #15. ...................................................... 142
Hypothesis #16. ...................................................... 142
Hypothesis #17. ...................................................... 142
Hypothesis #18. ...................................................... 143
Hypothesis #19. ...................................................... 143
Hypothesis #20. ...................................................... 144
Hypothesis #21. ...................................................... 144

5. DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS. ........ 150

Discussion ........................................................... 150
Conclusions ......................................................... 160
Recommendations ................................................... 162

APPENDIX 3.1, DRUG NAME PAIRS SELECTED FOR USE AS STIMULI. ................. 171

APPENDIX 3.2, PATIENT DESCRIPTIONS. .................................... 172

APPENDIX 3.3, PHARMACIST QUESTIONNAIRE. .............................. 180

APPENDIX 3.4, EXAMPLE STIMULUS-RESPONSE PAIRS FOR THE RECOGNITION TASK. .... 194

APPENDIX 3.5, EXAMPLE STIMULUS-RESPONSE DISPLAYS FOR THE JUDGMENT TASK. .... 195

APPENDIX 3.6, EXAMPLE STIMULUS-RESPONSE DISPLAYS FOR THE DECISION TASK. .... 196

APPENDIX 3.7, KNOWLEDGE TEST. ....................................... 197

APPENDIX 3.8, COMPUTER PROGRAM. .................................... 198

REFERENCES .......................................................... 241
# LIST OF ILLUSTRATIONS

<table>
<thead>
<tr>
<th>FIGURE</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Cognitive Processing Model.</td>
<td>20</td>
</tr>
<tr>
<td>3.1</td>
<td>Outline of Test Program.</td>
<td>97</td>
</tr>
<tr>
<td>3.2</td>
<td>Time Line for Test Procedure.</td>
<td>99</td>
</tr>
<tr>
<td>3.3</td>
<td>Types of Response Variance.</td>
<td>101</td>
</tr>
<tr>
<td>3.4</td>
<td>Research Design.</td>
<td>107</td>
</tr>
<tr>
<td>3.5</td>
<td>Statistical Analysis: A $(2 \times 3) \times 3$ ANOVA for Measuring the Influence of Typicality on Cognitive Tasks across Three Levels of Experience.</td>
<td>110</td>
</tr>
</tbody>
</table>
LIST OF TABLES

TABLE 3.1, Mean Response Scores for Pharmacists on the Pilot Test .......... 122
TABLE 3.2, Mean Reaction Times for Pharmacists on the Pilot Test .......... 124
TABLE 4.1, Demographic Characteristics of Subjects .......... 128
TABLE 4.2, Mean Scores by Group for the Knowledge Test .......... 130
TABLE 4.3, Mean Scores for the Choice Dependent Variable on Typical and Atypical Stimuli .. 138
TABLE 4.4, Mean Reaction Times on Typical and Atypical Stimuli .......... 140
TABLE 4.5, Mean Difference between Typical and Atypical on the Response Choice Dependent Variable .......... 146
TABLE 4.6, Mean Difference between Typical and Atypical on the Reaction Time Dependent Variable .......... 147
TABLE 4.7, Typicality Effects on Statistics for Three Groups of Subjects .......... 149
ABSTRACT

An information processing model was developed to describe how information used by pharmacists in providing pharmacy services is processed. The process is hypothesized to be sequential and to consist of perception, recognition, judgment, decision making and response control components which continuously interact and are influenced by memory, particularly long term memory. Information in long term memory was hypothesized to be organized according to the perceived typicality of the stimulus.

A laboratory methodology using a microcomputer was developed to test the effect of typicality on three of the process components, recognition, judgment and decision making. Three groups of ten subjects were tested, practicing pharmacists, pharmacy technicians and fourth year PharmD students. For the recognition task, subjects were shown a drug name on the computer screen then asked to indicate which of two drug names, one typical and one atypical, was shown. Pharmacists' responses were most likely to be biased toward the typical drug, technicians' responses were less likely to be biased and students' responses were least likely to be biased. For the judgment task, subjects were shown a drug name and a brief description of a typical or atypical patient; subjects were
asked to indicate whether the drug was likely to be appropriate therapy for the patient. Pharmacists' responses were most likely to be biased by the perceived typicality of the patient, technicians, less likely and students, least likely. The decision task was identical to the judgment task except subjects were asked to indicate whether they would dispense the prescription as written or whether they would contact the prescriber. Pharmacists' choices were most likely to be influenced by the perceived typicality of the patient, and technicians were less likely to be influenced by typicality. Students' responses appeared not to be influenced at all. When between groups comparisons were made on difference scores, only the comparison between pharmacists and students on the decision task was significant. No statistically significant differences were found on the reaction time dependent variable for any of the subject groups.
CHAPTER 1

INTRODUCTION

Problem Description:

A pharmacist is presented with a prescription for amoxicillin needed by a three-year-old girl for the treatment of otitis media. Consultation with the girl's mother reveals that the child has had an allergic reaction to penicillin in the past. The pharmacist determines that amoxicillin therapy is inappropriate and decides to consult with the child's physician before dispensing the drug.

This brief description of a pharmacist providing pharmacy services to a patient illustrates that the pharmacist must use some type of thinking process to make decisions about prescriptions. The pharmacist must determine what drug is being used to treat the patient, determine if the drug is appropriate for this patient and make a decision about whether to dispense the prescription as written. After these decisions are made, the pharmacist can then perform the physical actions needed to dispense the drug to the patient.
Problem Statement:

In the scenario described above, the pharmacist used information from several sources; information was used from the prescription, from the patient's mother and from memory to make the judgment that the prescription was inappropriate and subsequently to make the decision that the physician should be consulted before the prescription is dispensed. Therefore it seems that information and its use by the pharmacist is central to the performance of professional duties. Given the centrality of information processing to the performance of professional functions, it seems likely that the cognitive processes used to manipulate the information related to the professional task can produce differential performance by practitioners.

The importance of information processing in the performance of tasks related to the distribution of drugs is illustrated by a study of the unit dose system at the University of Kentucky. Technicians were shown to spend only one-third of their time physically handling or filling drug cabinets, the remainder of their time was spent in information handling (Hynniman, Conrad, Urch, Rudnick & Parker, 1970). The authors also concluded that a portion of all medication errors (1% to 6.9%) at the hospitals studied could be attributed to discrepancies in information sources. They attribute the success of unit dose systems
in reducing error to the system's handling of information; the pharmacist interprets the original physician order and checks each dose, prepared by a technician, before the dose is sent to the nurse. The nurse can then check her information against the information received from pharmacy.

As discussed above, a pharmacist's primary function is to process information and to make decisions related to providing pharmacy services to patients. The pharmacist must interpret the original drug order and use other patient related information to make diagnoses related to the appropriateness of therapy, significant drug interaction problems and determine how to counsel the patient. Some pharmacists, particularly when technicians are used to physically handle the drug products, spend nearly all their time performing these information processing activities.

The thinking or cognitive processes that pharmacists or other professionals use to process information and make decisions is poorly understood and the relationship between information processing and actual performance is unknown.

Differential performance among practitioners is usually attributed to some characteristic of the individual practitioner; when the concern is degraded performance, the practitioner is said to 'lack motivation' or is 'not paying attention' (Wertheimer, Ritchko & Dougherty, 1973; Fink &
D'Alessandro, 1980). Differential performance is also evident in situations where motivation and lack of attention would seem to be irrelevant issues; Schroeder et al. (1973) found a seventeen fold variation in the mean cost of laboratory tests and a four fold variation in the mean cost of drugs ordered by physicians in a clinic, even though the physicians were treating patients with similar medical conditions.

Although exactly how information processing may influence performance is unknown, the effects of poor information processing on performance in several professional groups such as physicians, pilots and nuclear plant technicians (Nisbett & Ross, 1980; Wickens, 1984) is well documented. Nisbett and Ross (1980) contend that many phenomena generally regarded as motivational can be better understood as products of neutral information processing operations rather than outcomes of an emotional process. Rolfe (1977) also reflects this approach when he advocates that the system be altered so that attention will be directed appropriately rather than blaming the individual for failing to pay attention.

The purpose of this research was to propose a model that describes how cognitive processes and memory interact to handle the information which health professionals use in their practice and to test the model by observing the
performance of pharmacists while they are processing information about drugs. Studies in psychology suggest that human memory is structured according to typicality; this study attempted to show that pharmacists' memory is also structured as hypothesized by typicality theory and that this type of memory structure influences the outcomes of cognitive processes related to providing pharmacy services to patients.

**Significance:**

Since the provision of professional services appears to be heavily dependent on information and the processing of information, increased understanding of these processes should also provide valuable information for systems designers so that performance of the human component of health care systems can be maximized. Related to the system design issue is the appropriate assignment of tasks to professionals and technicians so that the performance of each can be enhanced and health care services provided as efficiently and effectively as possible.

This research represents basic research about how professionals process information and make decisions related to their professional services. Basic research provides benefits through increased understanding; the increased understanding can then be applied to specific
problems related to information processing. Although the benefits of basic research can be difficult to anticipate, basic research generally has a greater potential for benefit than does applied research (Fuchs, 1986). Basic research on information processing should benefit a number of areas in health care such as undergraduate education, continuing education, improving professionals' performance on current patient care activities and training professionals to provide new services designed to improve patient care.

The problems that can result from a poor understanding of cognitive processes became evident during World War II when pilots were being trained for combat duty. Even though the men were carefully chosen for pilot training and then trained extensively, aircraft systems were not functioning as expected; aircraft were being flown into the ground or enemy radar contacts were missed by radar operators (Wickens, 1984). A similar situation exists in health care; persons wishing to become health care professionals must meet rigorous criteria for admission into training programs and training is prolonged yet, as shown above, the performance of health care personnel varies considerably.

With respect to pharmacy, pharmacists receive five to six years of education and at least a year of practical
training and must pass a licensure exam, yet pharmacists function at only a 90 to 95% level of accuracy when dispensing prescriptions (Guernsey et al., 1983; McGhan, Smith & Adams, 1983 & Wertheimer, Ritchko & Dougherty, 1973.) and seem to function at even lower levels when such tasks as drug interaction monitoring or patient consultation are considered. Kirking, Ascione, Thomas and Boyd (1984) found a two to three fold variation in pharmacist reported encounters of drug related problems which included drug interactions and diagnosis of noncompliance. In fact, Smith and Knapp (1987) identify the pharmacist’s failure to counsel patients as a leading issue in the delivery of quality pharmacy care.

Research on the cognitive processing of information should lead to the development of educational programs which are more effective and efficient and which will produce practitioners more likely to perform at optimal levels. Current educational programs consist of a period of didactic instruction and a period of practical experience; students are left to integrate the two types of knowledge themselves. Increased understanding of cognitive processes could produce educational programs which assist and direct the student’s integration of knowledge and experience.

The development of systems which will complement and
enhance performance rather than degrading performance should also be possible. There are two aspects of system design which could be affected by an understanding of cognitive processes, the interaction of the professional with the technical portions of the system and the assignment of tasks to professionals or technicians. Of particular interest in this research is the allocation of tasks to professionals or technicians; technicians have been shown to function as well as pharmacists in performing the physical actions needed to dispense drugs (McGhan, Smith & Adams, 1983). However as described above, the pharmacist must also make decisions related to drug therapy; the relative performance of the pharmacist and the technician on decision tasks is not known.

Objectives:

Specifically, the objectives of this research were to:

(1) Propose a model of the cognitive processes used by a health professional when performing the information processing necessary for professional functions.

(2) Propose an experimental procedure for testing the model in the laboratory.

(3) Test the model by measuring how pharmacist performance is influenced by the typicality structure of memory on three different intellectual tasks, recognition,
judgment and decision making.

The Cognitive Process Model:

The primary purpose of the cognitive model is to identify the types of cognitive processes needed to process the information related to the prescription. Therefore development of the cognitive model requires several assumptions about cognitive processes: (1) that more than one cognitive process is required to perform the task and (2) that these processes are qualitatively different and can be described taxonomically. These assumptions, in turn, presuppose that cognitive processing must occur in a sequence with the results of one cognitive process serving as the basis for a subsequent cognitive process.

The model must explain important characteristics of task performance, particularly the experienced performer's ability to execute a response without conscious control and an experienced performer's propensity to commit certain types of errors. The model should also be able to explain the differences between practitioner and student performance and the difference between practitioner (professional) and technician performance.

The proposed model is pictured in Figure 1.1 and is hypothesized to contain three major process phases, perceptual, intellectual and response (Bailey, 1982 and
COGNITIVE PROCESSING MODEL

PHASE PERCEPTUAL INTELLECTUAL RESPONSE

Processing Components

Perception ⇒ Recognition ⇒ Judgment ⇒ Decision ⇒ Response Control

Memory

Working Memory

Long-Term Memory

Figure 1.1
Wickens, 1984). Cognitive processing occurs within a goal attainment framework; that is, the purpose of cognitive processing is to permit a person to reach a goal (Card, Moran and Newell, 1983). For the pharmacist, the goal of cognitive process could be to optimize drug therapy, to provide pharmacy services and so on.

Perception begins the cognitive process and is hypothesized to use high capacity, parallel processing to obtain information about the world (Norman, 1986). The perceptual process is directed by a schema or a concept which has been developed through previous experience and represents expectations about the content of the world. Thus perception relies on both sensory information and information from memory. The pharmacist must obtain sensory information from the prescription and/or the patient; what and how the information is gathered will depend on which schema is activated in memory.

The second major phase of cognitive processing consists of intellectual processes which act on the perceived information to determine its semantic content, that is, determine its meaning, and determine the implications of the content for attaining a goal. Different types of cognitive processes link the perception to the response and determine the nature of the response (Bailey, 1983).
The first portion of the intellectual process functions to recognize the stimulus as belonging to a class of similar objects or ideas and, in this manner, establishes the semantic content of the stimulus. The classification process is biased by the schema used to perceive the stimulus; stimuli will be assigned to classes which provide information consistent with the schema. Many theorists regard the perception and recognition process as the most crucial process mediating behavior (Nisbett and Ross, 1980) and, as represented in this model, these processes do assume major importance as subsequent intellectual processes will be based on the outcome of these processes. For the pharmacist, this stage of the process would be primarily concerned with interpretation of the prescription; such as assigning meaning to the drug name.

The semantic content from each stimulus or portion of the stimulus formed during the recognition process is then combined to permit the classification of the stimuli on a more global scale, that is, a judgment is made. Classic examples of the judgment process are the physician’s diagnosis of disease and the biologist’s classification of a plant or an animal as belonging to a particular species. Inasmuch as the judgment is based on the recognition process, the class membership of the stimuli will bias the
judgment so that the judgment is consistent with the semantic content of the stimuli. A pharmacist would judge whether the drug therapy was appropriate or inappropriate for the patient during this process.

The third portion of the intellectual process is decision making or planning a response based on the results of the judgment process. The purpose of this process is to decide what to do next; thus the decision may be to use a previously learned procedure to execute a response, it may be to further clarify the judgment through seeking additional information, it may be to not respond and so on.

This model explicitly differentiates between judgment and decision making; many models or studies of human cognition will not make this differentiation and will use the terms interchangeably. Schwartz and Griffin (1986) do differentiate between judgment and decision making; they define judgment as making an inference from data and decision making as selecting between two or more actions. This is the type of distinction being made in the proposed model; judgment is describing a situation through the process of categorization, decision making is a process of selecting an action. Judgment is passive and does not directly denote which response action is appropriate. Decisions are active and directly indicate the appropriate action.
The information required for judgment is different than the information required for decisions. Judgment requires stimulus data or data which describes different world states. Decisions require information about actions and their effects. The different information requirements imply that a person could have the information to perform one process and not the other. Indeed such a situation may exist with respect to pharmacy and medicine; pharmacists will not dispute a physician's diagnosis of disease (judgment) but they may not agree with the drug therapy that the physician has selected for treating the patient (decision).

The third and last cognitive process phase identified in the model is that of response control and implies the constant monitoring of the response to insure that the execution of the response is occurring as planned (Bailey, 1982 and Wickens, 1984).

Feedback is hypothesized to occur continuously through the interaction of the cognitive processes and long term memory as shown by the arrows pointing in both direction in Figure 1. This is a different conception of feedback; feedback is usually denoted as a separate loop which re-initiates the cognitive process (Wickens, 1984). A separate feedback loop means that feedback would affect the process at only one point rather than at many points and
would itself be a discrete process.

The remaining portion of the model delineates the characteristics of memory and the relationship between memory and the cognitive processes. Memory is conceived to be divided into two parts, long term memory and working memory. Long term memory contains stored information about the world; it is high capacity and is subconscious. Long term memory interacts with the world via high capacity, parallel processing at a subconscious level. Working memory is used to act on information currently held in consciousness. Working memory interacts with long term memory via low capacity, sequential processing; working memory does not interact directly with the world, rather it uses information from long term memory to guide interactions.

Memory is hypothesized to underlie all the cognitive processes and to interact with them; thus, the outcome of each cognitive process component is dependent upon the previous cognitive process and upon its interaction with memory. The manner in which the cognitive processes interact with memory is conceived to be the factor which produces the important characteristics of task performance outlined above.

The predominant relationship between memory and the cognitive process components is envisioned as subconscious.
The cognitive processes operate automatically and subconsciously from information stored in long term memory. When this information is not adequate for task performance, cognitive processing is forced into working or conscious memory.

The experienced performer is able to execute many tasks automatically, without conscious attention, because of the availability of information in long term memory. Rich information structures are available in long term memory that can interact directly with the cognitive process components and working memory is not needed. The information structures are formed from repeated exposure to the same or similar stimuli so that the experienced practitioner may perform many different tasks, some of which might be quite complex, automatically. The information structures are also characterized by a context orientation; that is, information is stored in schemas determined by situations that the practitioner has experienced.

The characteristics of information stored in long term memory produce the biases and the propensity of the experienced practitioner to commit certain types of errors. The first two portions of the intellectual process are hypothesized to require classification. Classification refers to the organization of information into classes or
groups and these classes have been shown to have a structure characterized by typicality (Rosch, 1975). Items in a class are organized so that typical, usually common, members of the class are centrally located and easy to access while atypical, usually less common, items are located on the periphery and are more difficult to access. Therefore the errors made by experienced practitioners would be expected to show a typicality bias such that items which are typical and easy to access are substituted for items which are atypical and more difficult to access.

Since the student would be expected to have little information stored in long term memory related to the task, cognitive processing is forced into working memory and becomes slow, labored and distinctly sequential. The student should make errors related to lack of information in long term memory or related to lack of capacity in working memory. The student would not be expected to show the effects of bias that characterize errors made by experienced practitioners. Further, information for the student is structured around subject or content schemas rather than context or situation schemas and the content schemas are unlikely to be related to real world practice situations.

Technicians would be expected to have long term memory structures that are determined entirely by experience and
should lack information related to understanding drug therapy problems and they should lack procedural knowledge related to making judgments or decisions about drug therapy problems. For example, the technician would be expected to be able to read a prescription and recognize the drug name but would not be able to make a judgment as to whether the drug therapy was appropriate or inappropriate. A technician's judgment categorization would be related to whether the drug was available for dispensing, not with appropriateness.

Further study of the concepts that pharmacists use to interpret a prescription may help clarify how experience and context contribute to differential performance. The organization of memory into concept classes has been shown to affect the performance of people on tasks related to the classification of everyday objects. An apple is considered a typical example of a class of food called fruit and a tomato is considered an atypical example; people can react rapidly to the apple as an example of a fruit but are much slower to react to a tomato as an example of a fruit (Anderson, 1980). Typical examples of a category or class seem to be much easier for people to recognize (Rosch, 1975).

Typicality may affect the performance of health care personnel in a similar manner. Rosenhan (1973) describes
an incident in which a group of experimenters had themselves admitted to several different psychiatric wards by complaining, falsely, that they were hearing voices. The experimenters then had great difficulty convincing hospital personnel that there was nothing wrong with them; hospital personnel considered their behavior to be typical of mental patients and would not believe their assertion that they were researchers.

Several studies have documented the effect of typicality on the psychiatric diagnoses that physicians make (Cantor, French, Smith & Mezzich, 1980 & Horowitz, Wright, Lowenstein & Parad, 1981). These authors found that psychiatrists do appear to have memory structures organized around typicality and that the perceived typicality of the patient influences both diagnostic accuracy and the time required to make a diagnosis. Therefore it seems likely that typicality may be affecting the ability of pharmacists to interpret prescriptions and make decisions related to patient care.

Hypotheses:

The above description of the cognitive processes and their relationship to memory suggest several hypotheses for testing the intellectual components of the model, recognition, judgment and decision making, on information
processing tasks from pharmacy practice. Performance on the three intellectual tasks is expected to vary depending on the experience that the subject has had; that is, pharmacists' memory is expected to be structured differently than technicians' memory and students' memory is expected to be structured differently than either of the other groups. Typicality is hypothesized to be the characteristic which differentiates each group's memory from the other groups. Specifically, each group is hypothesized to differ on the typicality dimension as follows:

Experienced pharmacists will:

(1) Recognize more typical drug names correctly than atypical drug names.

(2) Judge more drugs as appropriate for typical patients than for atypical patients.

(3) Decide to dispense prescriptions to typical patients more frequently than to atypical patients.

(4) React to typical drug names or patients faster than to atypical drug names and patients on the recognition, judgment and decision making tasks.

These hypotheses concern how the structure of the pharmacist's memory influence the performance accuracy and reaction time of three different intellectual processes. According to typicality theory, memory should be organized
such that stimuli considered to be typical can be processed quickly and accurately therefore pharmacists should perform more accurately and react faster to typical stimuli.

Technicians will:

(5) Recognize more typical drug names correctly than atypical drug names.

(6) Make drug therapy judgments and dispensing decisions that are not different for typical and atypical drugs or patients.

(7) React to typical drug names faster than to atypical drug names on the recognition task.

(8) React to typical and atypical patients so that reaction times will not be different on the judgment and decision tasks.

Hypotheses five through eight concern the memory structure of technicians and how that will influence their performance accuracy and reaction time. The typicality structure of memory should influence the accuracy and reaction time of technicians on the drug name recognition task but not on the diagnosis and decision tasks. The diagnosis and decision tasks are hypothesized to require knowledge about patients and the effects of drugs on people as well as knowledge about drug names. Because this type of knowledge is usually acquired through academic training combined with experience making these decisions in
practice, technicians would not be expected to have memory structures which would support these tasks.

Pharmacy students will:

(9) Perform equally well on typical and atypical drug names in the recognition task, the judgment task and the decision task.

(10) React equally fast to typical and atypical drug names on the recognition task, the judgment task and the decision task.

A student's memory should be organized around the formal drug therapy knowledge that they have received in the classroom thus students should not have access to patient related information that is acquired through experience or have structured their memory according to context. Students are not expected to react to the stimuli in a differential manner according to the typicality of the stimulus.

The performance of each group, pharmacists, technicians and students is also expected to be different from the other groups on some of the tasks.

When the performance of technicians and pharmacists is compared on the recognition task, technicians will:

(11) Recognize as many drug names correctly as will pharmacists.

Pharmacists and technicians are both expected to have
developed memory structures based on typicality with respect to the drugs they have encountered in their practice. Since recognition is not dependent on knowledge to make judgments or decisions, pharmacists and technicians should perform equally well on the recognition task. Technicians will:

(12) React as fast to drug names as will pharmacists.

When the performance of technicians and pharmacists is compared on the judgment task, pharmacists will:

(13) more likely be affected by typicality so that the difference in performance on the typical and atypical tasks will be larger for pharmacists than for technicians.

Judgment about the appropriateness of a drug for a patient is hypothesized to depend on knowledge about using drugs to treat disease and knowledge about the patient; since technicians have not been trained to perform these functions, they should not have developed memory structures based on typicality and should not react differently to typical and atypical stimuli. Pharmacists' performance should be affected to greater extent than technicians so that the difference in performance on the typical and atypical stimuli will be greater for the pharmacist on both dependent variables.

(14) The difference in reaction times will be greater for pharmacists than for technicians on the judgment task.
When the performance of technicians and pharmacists are compared on the decision task, pharmacists will:

(15) Decide to dispense more prescriptions as written for typical patients than for atypical patients, thus the difference in performance on the typical and atypical stimuli will be larger for pharmacists than for technicians.

(16) Make dispensing decisions in less time for typical patients than for atypical patients which will make the difference in reaction time greater for pharmacists than for technicians.

When the performance of pharmacy students is compared to pharmacists and technicians on the recognition task, pharmacists and technicians will:

(17) Recognize more drug names correctly for typical patients than for atypical patients so that the difference in performance on the two types of stimuli will be greater for pharmacists and technicians than for pharmacy students.

(18) React to typical drug names faster than to atypical drug names so that the difference in reaction times will be greater for pharmacists and technicians than for pharmacy students.

The hypotheses comparing the performance of pharmacy students on the recognition task reflect the hypothesis that both pharmacists and technicians will have developed
memory structures related to their practice while students will not have had this opportunity.

When the performance of pharmacy students is compared to pharmacists and technicians on the judgment and decision tasks, pharmacy students will:

(19) Perform similarly to technicians on the typical and atypical stimuli; that is, the difference in performance on the typical and atypical stimuli will approach zero and will be less than the difference in performance for pharmacists.

(20) React similarly to technicians on typical and atypical stimuli; that is, the difference in reaction times on the typical and atypical stimuli will approach zero and will be less than the difference in reaction times for pharmacists.

The hypotheses comparing students to pharmacists and technicians is based on the theory that neither technicians nor students have developed the memory structures which cause pharmacists to react differently to typical and atypical stimuli on the judgment and decision tasks.

**Definitions**

Definition of terms relevant to this research are provided below.

**Accuracy**, in the context of pharmacy practice, refers to
the dispensing of a drug to the patient or his/her representative in accordance with the physician’s directions.

**Appropriate drug therapy** is drug therapy that is suitable for a particular patient as determined by current medical practice.

**Category** or **class** refers to objects, events or ideas which are grouped together according to their similarity. **Concepts** are abstract representations of objects, events or people which contain information about classes of objects, events or people.

**Correct response** refers to a response consistent with the semantic content of the word.

**Decision**, as defined by the model, is the selection of a response or the selection of a course of action. **Dispensing** refers to the transfer of a drug from a pharmacist to a patient or the patient’s representative on a prescription order. **Dispensing error** is the dispensing of a drug to the patient or his/her representative that deviates from the physician’s order.

**Error**, in the context of the experimental procedure, refers to the random error of measurement. **Judgment**, as defined by the model, is a process of describing a situation through categorization.
Incorrect response refers to a response which is not consistent with the semantic content of the word.

Prototype refers to a very typical instance of a category.

Reaction time is used as a synonym for response time.

Recognition, in the context of the model, refers to the process of establishing the semantic content of a stimulus.

Recognition task is any form of multiple choice test of memory.

Response time is the length of time between the display of the response screen on a CRT monitor and the subject’s response.

Schema is a complex body of knowledge similar to a prototype but without all the features specified.

Semantic refers to the meaning of a word.

Syntactic describes the structure of verbal communication, such as the grammatical characteristics of a sentence.

Typicality refers to the extent to which members of a category share properties with other members of the category.
CHAPTER 2

LITERATURE REVIEW

Introduction:

The literature relevant to the proposed research can be divided into several distinct areas; the literature related to models of information processing, the errors that humans make in information processing and their importance, typicality theory and the empirical evidence supporting this theory in psychology and in the health sciences, and finally the empirical evidence in the literature related to pharmacist error which might suggest that information processing could be important to pharmacists when providing pharmacy services.

Information Processing Theory:

The model proposed by Wickens (1984) probably resembles the information processing model described in chapter one, more than any other model. Each operation in his model is conceptualized as a functional transformation of the data (information) which requires some time for processing.

The model is generally sequential and proceeds left to
right beginning with the perception process and ending with
the response. Attention is visualized as a separate,
limited resource which is allocated to the various
cognitive processes, including working memory. The
intellectual processes are lumped together in one process
called decision and response selection; this process
requires attention and interacts directly with working
memory but does not interact directly with long term
memory. Perception is shown to interact directly with long
term memory but not with working memory; the implication of
this construction is that working memory cannot directly
control perception and that long term memory cannot
directly control decision and response selection.

The initial model components concern the short-term
sensory store and perception. The short-term sensory store
holds the sensory information until perceptual encoding can
occur. Perception transforms the sensory stimuli by
assigning the stimuli to a single perceptual category.
Recognition, identification and categorization occur as
part of the perceptual process. The process that is
performed depends on the complexity of the stimuli;
multidimensional stimuli will require pattern recognition
for their categorization.

Decision or decision making is used as a generic term
throughout the model and can refer to perceptual decisions,
recognition decisions, judgment decisions and response decisions. Response decisions occur after categorization and represent the process of selecting a response; this decision is a critical juncture in information processing. Decisions made at this point in the process involve a large degree of choice and have heavy potential costs and benefits.

Response execution is separated from the selection of the response and includes the series of steps required to call up and control the response. A separate feedback loop is shown which enables the person to monitor the progress of the response. The feedback information comes through the visual, auditory, proprioceptive, and tactile sensory systems.

Wickens contends that the processes can operate in reverse order and that the reversal in order accounts for the differences in bottom up (data driven) processing and top-down processing.

The information processing model proposed by Bailey (1982) is a three stage model consisting of perceptual, intellectual and movement control stages. Each stage has access to memory and the entire process is influenced by motivation although he does not describe the relationship between motivation and other components. The process is considered to be continuous and stages are artificial
segments in the process. The intellectual stage includes reasoning, problem-solving, decision making and creative thinking processes.

Cognitive processing can be either automatic or conscious; automatic processing occurs at a subconscious level and performance controlled by automatic processing is usually not remembered. Conscious processing relies more on peripheral sensory feedback and can usually be recalled.

Errors in human performance can be attributed to a processing error in one of the information processing stages; thus errors can be due to faulty perception, inappropriate decisions or to faulty movement control. Different types of errors also occur when the processing is automatic as opposed to conscious.

Norman (1984) uses a four stage model to describe the human-computer interaction. The stages are an intention stage, an action selection stage, action execution stage, and a stage in which the outcome is evaluated. The stages are not discrete; humans use highly parallel processes and multiple factors continually interact to shape activity.

The process of forming the intention then selecting and carrying out the intention is controlled by schemas. The process of activating and using the schema can lead to several types of errors. Errors related to the intention are mistakes and errors related to carrying out the
intention are slips (Norman, 1983). Mistakes are due to a misclassification of the situation and the consequent activation of an inappropriate schema to control the response. Mistakes are diagnostic errors and are very difficult to detect because the human is biased toward obtaining only confirming evidence and will accept partial explanations (Norman, 1986).

Slips occur in the faulty activation or triggering of schemas used to control the response (Norman, 1983). Faulty activation occurs when the procedure being performed is very similar to another better learned procedure and the better learned procedure 'captures' control. The components of the procedure can be misordered so that steps are skipped or omitted. Faulty triggering occurs when a schema is triggered prematurely or blends are formed between schemas.

The consideration of errors is important to anyone studying psychological processes because any theory of cognitive processing in humans must be able to explain why humans make errors and understanding the cause of errors is essential to designing systems which will enhance rather than degrade human performance (Norman 1983, & 1986).

A five-step model has been used to describe the diagnostic process used by radiologists (Kundel, 1978 & Schwartz & Griffin, 1986). The steps include orientation,
search, recognition, decision making and interpretation. The clinical history provides the radiologist with an orientation to the case which appears to direct the search strategy. Eye movement studies have shown that an expert uses a circumferential scan and a novice uses a localized central scan. Experienced radiologists appear to compare the observed pattern to patterns held in memory and are able to identify abnormalities almost instantaneously.

Based on this model, three types of errors are possible, errors from faulty search, errors from faulty recognition and errors from faulty decisions. Decisions refer to diagnostic decisions in this model.

Schwartz and Griffin (1986) hypothesize that schemas are used to direct the perception process and that these schemas are formed through experience. The anticipatory schema allows the radiologist to disregard the normal and concentrate on the abnormal. The schema concept also explains why obvious abnormalities are sometimes missed; the possible abnormality is not contained in the schema so that attention is not directed toward the perception of relevant visual information.

The information processing models discussed above have in common a stage or step-wise approach to information transformation. Each model tends to focus on somewhat different aspects of the process; Norman's (1983) four
stage model describing the human-computer interaction tends
to focus on intentions and responses with little emphasis
on the perceptual or recognition process. The five step
model used to describe radiologists' thinking focuses on
the perceptual and recognition portions of the process and
does not consider the response portion. Wicken's model
seems to emphasize the beginning perceptual aspects of the
process and the ending response aspects but does not
clearly delineate the components of the intellectual
process. None of the models describe how memory is
structured or describe how memory structure might influence
the cognitive processes. In contrast, the primary
objective of the model proposed in chapter one, is to
delineate how memory structure may influence the
intellectual processes. The remaining literature to be
reviewed will be concerned with the empirical evidence for
certain memory structures and the influence these
structures appear to have on performance.

Typicality Studies:

Typicality is a theory which proposes that memory is
structured according to the representativeness of the
category examples encountered through experience. The
literature related to typicality includes some of the
studies in psychology which describe typicality and its
influence on performance.

Objects occurring naturally display their attributes in correlated sets rather than as random combinations of attributes (Mervis and Rosch, 1981). Humans have developed concept categories to describe and cope with their environment by grouping objects which share correlated attributes into classes then treating these objects as though they are equivalent. This allows the human to react to unique stimulus situations on the basis of past learning and categorization. Thus the cognitive categories that people use to deal with the world are not arbitrary but reflect the structure of the real world.

Classical concepts differ from the naturally formed concepts described above in that any example can represent the concept category equally well. For example, an equilateral triangle is considered as good an example of the classical concept 'triangle' as an isosceles triangle. The examples of a naturally formed category, instead, vary as to how well they represent a category; that is, examples of natural categories exhibit gradients of representativeness with a very good example considered prototypical of its category and a poor example considered atypical of its category. The non-equivalence of category examples has been shown to affect virtually all the dependent variables used as measures in psychological
research (Mervis & Rosch, 1981). These include speed of processing, order and probability of exemplar production, accuracy of response, natural languages, asymmetry in similarity ratings, and learning and development.

The literature reviewed in this section will demonstrate how the representativeness of category instances has been operationalized in psychology and then the effect that representativeness has on task performance will be examined. The following section will review the literature related to how concept categorization is used by health professionals, principally physicians, to make a diagnosis and how their performance appears to be affected by the same typicality biases that affect performance in the everyday world.

That subjects can reliably rate examples as being representative or not representative of a category was shown by Rosch (1975). Subjects (209 undergraduate students) were asked to rate examples of concrete noun categories (fruit, bird, vehicle, vegetable, sport, tool, toy, furniture, weapon, & clothing) on a seven point scale (1 = very good example, 7 = very poor example).

Correlations were calculated for each instance between split halves of the sample of subjects divided at random (r = 0.97) demonstrating that subjects are able to rate how well an example represents its category and the subjects
agree on the ratings. Thus semantic categories appear to be structured along a typicality dimension.

The family resemblance structure of categories was examined by Rosch and Mervis (1975). They hypothesized that prototypicality ratings and degree of family resemblance would be positively correlated. Family resemblance was defined as the number of features that a specific member of a category shares with other members of that category.

The test stimuli were first rated for typicality on a 1-20 scale by a group of 32 undergraduate students; the stimuli came from six different noun categories: car, truck, airplane, chair, table, and lamp. A second sample of 150 students then listed the attributes for each of the 20 stimulus items in each category. Family resemblance was scored by counting the number of items in the category which shared that attribute; a family resemblance score of 20 would indicate that the attribute was listed for all 20 items. Natural logs were taken for these scores and summed to obtain the family resemblance score for each attribute. These scores were ranked from 1 to 20 and compared to the typicality ranks obtained in group 1 with a Spearman rank-order correlation coefficient. The Spearman correlation coefficient ranged from 0.69 for lamp to 0.94 for car. Thus the more prototypical members are those which have the
largest number of attributes in common with other members of the category.

The internal structure of categories as described by typicality theory was studied by Rosch, Simpson and Miller (1976). Typicality effects could be attributed to frequency effects; that is, the most typical item is the item most frequently associated with the category name or the most familiar item. Alternatively, categories could be structured so that the prototype provides the maximum amount of information about the category; thus a prototype would be an item which shares the largest number of features with other items in the category.

Rosch et al. used artificial categories to examine these alternative explanations because previous experience with exemplars of natural categories cannot be controlled. They used three types of category structure, Gestalt configurations, mean values of attributes and family resemblance structures. Dot patterns were used for Gestalt configurations; members of a category were dot patterns which were variants of the prototype. Stick figures were used for the mean values of attributes structure in which the prototype possessed mean values on the attributes by which the members were identified. Letter and number strings were used for the family resemblance structure; family resemblance was the number of letters or numbers
that member strings shared with other members.

The subjects were 102 undergraduate psychology students and paid volunteers; 32 subjects learned the dot patterns, 30, the stick figures and 40, the letter-number strings. The subjects in each group were shown the stimuli until they could correctly categorize each member of the category then data was collected on the next 15 stimulus displays for reaction time, typicality ratings, and rate of learning. Reaction time was measured on the last stimulus set display for all subjects and rate of learning was measured by the total number of errors that subjects made when classifying an item.

The category members were grouped into high, medium and low typicality levels according to the rules used to structure the category and these groups were used for the statistical analysis. Frequency of item exposure was controlled so that each subject was exposed to the same number of items in each typicality level. The ANOVA performed for each dependent variable revealed there was significant variation in performance associated with each level of typicality even though the subject was exposed to the same number of items at each level. F values ranged from 5.61 to 7.66 and all p values were less than 0.05.

The second experiment altered the number of item exposures so that less typical items were presented more
than typical items, otherwise the experimental procedures were the same. Again, statistical analysis with ANOVA revealed that performance differed significantly across the levels of typicality on the number of errors, the reaction time and the typicality ratings. $F$ values ranged from 6.21 to 9.46 and all $p$ values were less than 0.05. Thus typicality effects due to structure persist even under conditions in which the frequency of item exposure is inversely related to structure.

The authors concluded that the results do not support a frequency of presentation explanation for variable performance across levels of typicality. In fact, the belief that typicality is related to frequency may itself be an effect of typicality. However frequency effects can be associated with category attributes within the structure of the category.

Mayer and Bower (1986) have extended the study of typicality to complex personality schemas. They wanted to establish whether people can learn complex personality schemas and if so, the effect that schema knowledge has on people's judgments and memory for the characteristics of group members.

Arbitrary personality prototypes were developed by randomly designating a feature from each of 16 dimensions as positive (typical) or negative (atypical) of a specific
personality. An example belonged to a class if it contained 9 or more features of that class that had a positive value, positive features occurred about 75% of the time and negative features about 12%.

Experiment 1 was designed to show how accurately subjects could classify new examples.

The subjects were 32 undergraduates and the experiment used a within subjects design. Each subject was presented with 30 category examples and 30 non-examples. The first 40 examples served as learning trials and the last 20 as test trials. The subjects also filled out a questionnaire asking them to estimate the relative frequency with which features occurred for both category members and non-members. Subjects answered questions indicating whether a feature was a clue to class membership on a four point scale (1 = yes, definitely a clue, 4 = not a clue).

Learning was demonstrated by responses considerably above chance on the last 20 examples (t = 11.55, p < 0.0001) and the probability of correct classification was related to the number of positive features contained in the exemplar.

Subjects estimated the frequencies of positive and negative features as 65% and 36% respectively. Positive clues were recognized as "definitely a clue" by at least 24 subjects for each dimension. Thus subjects are able to
learn complex personality schemas and to recognize which attributes are positive (typical) and which are negative (atypical).

The second experiment addressed the effects that the personality schema might have on recognition memory. The subjects for this experiment were 32 undergraduates and a within subjects design was used.

As above, the subjects learned a group prototype from a series of person descriptions, half of which were descriptions of group members and half of which were not. The first 40 cases served as learning examples and the last 20 cases as test examples to determine how well subjects had learned the prototype. The subjects classified 77% of the last 20 cases correctly (t(32) = 13.62, \( p < 0.0001 \)).

Recognition memory was tested on four new person descriptions each of which contained 8 positive features (thus the person did not belong to any category according to the earlier definition). Subjects studied the four person descriptions and indicated which group the person belonged to then they answered recognition questions about the person's personality by circling the feature on a feature dimension which they thought the person exhibited. Each subject answered 16 recognition questions for each test case.

Subjects recognized the personality attributes much
better than chance; 52% of the positive features were correctly identified and 42% of the negative features. When group membership was considered, subjects recognized positive features for 42% of the cases classified as group members and for 35% of the cases classified as non-members; thus, the subjects had a bias toward recognizing the positive features associated with group members.

Subjects could also make errors by attributing positive features or an incorrect negative feature to the example when the correct feature was negative. By chance, subjects should have chosen each alternative 33.3% of the time; the results showed that they chose the positive feature at a rate of 48%, incorrect negatives, at 26% and correct negatives at 26%. The bias was also greater in group members (0.13 versus .05). The authors concluded that there was a bias toward recognizing positive (typical) features for all cases and that this bias was greater for category members as opposed to non-members.

Typicality Studies in the Health Sciences:

Cantor, Smith, French and Mezzich (1980) studied psychiatric diagnosis to establish whether diagnosis is better represented by the classical view of categorization or the prototypic view. They examined the content and structure of diagnostic categories then looked at the
problems of reliability of clinical diagnoses and clinician confidence in the diagnosis.

The authors investigated the content and structure of the diagnostic categories to determine if the categories used by clinicians resembled those of classical categorization or those of prototype categorization. Prototype categorization is characterized by categories that have correlated features rather than necessary features and categories which are not completely nested. In a completely nested category, members of the subordinate categories would have all the features of the superordinate categories above them in the hierarchy. Prototypic categories also exhibit a characteristic structure with basic level categories being much richer information sources than superordinate or subordinate categories.

The correlated features characteristic was examined empirically by having 13 psychiatrists list the clinical features for each of nine diagnostic categories. The results showed that there were some unique features, a substantial number of features that were listed by two to four clinicians and very few features that were listed by all 13 clinicians. Thus each feature could not be necessary for category membership as is required by classical categorization.

The imperfect nesting assumption was tested by
identifying all the features shared by the subordinate categories of the two major categories of disease, schizophrenia and affective disorders. Eleven of the features appeared in all subordinate categories of schizophrenia while one feature of affective disorders appeared in all the subordinate categories. Hence there was incomplete nesting between the superordinate categories and subordinate categories as was predicted from prototype theory.

The richness of the information stored in each category level was examined by having clinicians list features for categories at each level. The mean number of features listed for basic level categories was 15.5, for superordinate categories, 6.33 and for subordinate categories, 11.6.

Differences in the reliability and accuracy of diagnostic judgment are also characteristic of prototypic categories; judgments are more reliable and more accurate for typical instances of a category than for atypical instances. This hypothesis was tested by having nine clinicians diagnose 12 patients as having one of four different psychiatric diseases, based on an unedited case history. The diagnosis given the patient by the hospital was designated as the correct diagnosis and the patient histories were selected so that there was one prototypic
patient, one medium typical patient and one atypical patient in each category. The patient typicality was
determined by the number of features the patient shared
with the prototype for each category; a prototypic patient
had 8-13 features, a medium typical patient, 5-8 features
and an atypical patient, 4 features. After the clinicians
had made their diagnosis, they were asked to give a rating
of how typical this patient was of the diagnostic category
they had selected.

The effect size for the difference in typicality
ratings was .643 and the effect size for the difference in
the number of correct diagnoses was 1.976. Thus typicality
had a large effect on the accuracy of the diagnosis and the
number of features present had an effect on how typical the
patient was perceived to be of the chosen diagnosis.

Blashfield, Sprock, Pinkston and Hodgin (1985)
identified prototypes of psychiatric diagnostic categories
by measuring interclinician agreement and the length of
time that it took a clinician to make a diagnosis.

The subjects for this study were 20 clinicians
affiliated with the University of Florida. Five clinicians
were psychiatrists, five were psychiatric residents, five
were clinical psychologists, and five were interns in
clinical psychology. Each subject was presented with a
summary of a case history 11 to 24 lines in length which
was displayed on the CRT screen of a microcomputer. The program software measured reaction time and the subject selected a diagnosis from a list by entering a number from the keyboard. A case was considered prototypical if 80% of the clinicians agreed on the diagnosis and if the z transformed mean reaction time was less than zero.

Ten case studies fit the prototypic criteria, supporting the authors' hypothesis that clinicians do use a prototypic concept structure to make diagnoses. Prototypic cases were identified for 8 of the possible 11 diagnostic categories.

The performance of the different groups of clinicians was also compared on the dimensions of professional identity and experience. A comparison of the mean number of clinicians in each group who made a diagnosis that did not match the source diagnosis showed that the same number of psychiatrists disagreed as psychologists. There was a small difference when the rate of disagreement was compared between faculty and resident clinicians (2.10 versus 2.26) but the difference was not statistically significant. A 2 X 2 ANOVA performed on the reaction times was significant; F = 49.95, p < .0001 for the experience dimension. Thus experienced clinicians appear to be able to make a diagnosis much faster than residents or interns.

The authors concluded that experience or profession
(psychiatrist or psychologist) had little effect on how humans make decisions; they conclude this from the insignificance obtained when the rates of incorrect diagnoses were compared. They did not provide full statistical information though, so the reader cannot determine if the failure to find significance was due to lack of power or no difference. However the sample size was very small, ten experienced clinicians versus ten inexperienced clinicians, so the lack of power argument could well apply especially since the difference in reaction time was very large (the effect size was 1.62).

A method for deriving prototypes of problem children is described by Horowitz, Wright, Lowenstein and Parad (1981). They then traced the development of the prototypes through a cross-sectional study of students and practitioners of child psychology.

The features of a prototypic child were established by having experts (staff members of Wedico Children’s Services with advanced degrees and 3 to 14 years of experience) identify the three basic categories of problem child and then list the feelings, thoughts and behaviors characteristic of the children in each group. Three judges were asked to count and tabulate the features. Features with a probability of .29 or higher were used to form the final prototype. The prototypic features were organized
semantically by asking students in psychology to judge which features went together. A correlation matrix was computed and features were clustered with a hierarchical technique.

The second portion of the study focused on how the prototype becomes refined through experience. The influence of experience was traced by asking two additional groups of subjects to provide lists of features for the three categories of problem children. One group was college students who had assisted in the program previously and the other group was students who had not assisted in the program before. The number of features listed was quite stable for each of these groups, returning students listed a mean of 12 features and new students, 9 features (SD = 1.53 - 2.08). The new students also listed some idiosyncratic features which were not listed by either the returnees or the experts. The effect size for the expert-returnee comparison was 5.75 and for the returnee-new students, 1.28.

A second study by Horowitz, Post, French, Wallis and Siegelman (1981) investigated the number of features shared by a person and the depressive prototype and the effect the shared features would have on the likelihood that the person would be categorized as depressive. In addition, they hypothesized that subjects would perceive a person
with many features from the depressive prototype as being more depressed.

The depressive prototype was developed in the manner described above by having 35 students in psychology list the feelings, thoughts and behaviors exhibited by depressed people. All features which occurred with a probability of 0.20 or higher were included in the prototype. From these features, descriptions were developed of people with one prototypic feature, people with 4-9 prototypic features and 17-20 prototypic features. These descriptions were then presented to 24 other students who were asked to rate the people on a five point scale on several dimensions, one of which was depression. The mean depression ratings (1 = not depressed and 5 = very depressed) were 2.71 for one prototypic feature, 3.58 for 4-9 prototypic features and 4.88 for 17-20 prototypic features. The person was also described as depressed by 4%, 20% and 69% of the subjects for each group.

The second study was an attempt to describe interjudge agreement in terms of stimulus characteristics rather than in the terms of judge behavior. The subjects for this experiment were 24 clinicians with an average of 4 years experience. Each clinician was shown a videotape interview of a patient seeking psychiatric treatment; four patients were assigned to each of three different levels of
severity, in level 1 depression was less salient than in levels 2 and 3. The clinicians were asked to identify the features of depression from a list of symptoms which contained the 37 features of the prototype. The mean number of features identified was 13.9, 17.1 and 25.6 for each of the levels respectively. The subjects also rated the severity of the person's depression; the mean ratings on a five point scale (1 = not depressed, 5 = very depressed) were 2.8, 3.3 and 4.1. The correlation of the number of depressive features identified with the ratings was .903. The intraclass correlation coefficients (calculated according to Shrout and Fleiss) were .00, .74 and .94. Thus patients from level 3 were judged as depressed more reliably than were patients from level 2 and level 1.

The third experiment studied the role of irrelevant features on clinicians' ability to assign a diagnostic label to each of 26 patients as described by their case summaries. The case summaries contained both relevant and irrelevant features. The cases were divided into three groups (low, medium and high) depending on the proportion of agreement among the clinicians. Psychology students were asked to rate whether the features, both relevant and irrelevant, were definitely present or definitely absent. Statistical analysis showed that the proportion of relevant
features could be related to low, medium and high levels of diagnostic consensus \( (F(2,14) = 12.97, p < .001) \) but not to irrelevant features \( (F(2,14) = 1.54, p > .20) \). Therefore relevant features seem to be much more discriminating than irrelevant features for experienced clinicians.

Murphy and Wright (1985) expanded the study of Horowitz et al. (1981) to include a group of novices who were undergraduates in a beginning psychology class. They hypothesized that experts should have concept categories that are more differentiated; that is, experts can assign a specific diagnosis to a patient from a general group of patients who appear very similar to a less experienced clinicians.

The authors hypothesized that if experts' category structure is more differentiated than novices then experts should list more distinctive features and fewer overlapping features for each category than should novices. This hypothesis was tested in two experimental studies, an attribute listing study and an attribute rating study.

The subjects were the same groups of subjects from the study by Horowitz et al. (1981) plus a group of novices who were students in an introductory psychology class. There was 12 subjects in the expert group, 21 in the experienced group, 24 in the beginning group, and 20 in the novice group.
Each group was asked to list features characteristic of three categories of children; aggressive, depressive, and disorganized. The category labels were provided to the groups. The feature lists were then coded by a panel of three judges and a final feature list was compiled that represented a consensus of the three judges and which included features which were listed in at least 25% of individual lists.

The results showed that the total number of features increased systematically with experience. The mean number of features listed was 23.7 for experts, 17.7 for experienced counselors, 16.7 for beginning counselors and 12.7 for novices.

Experts should also share more consensual features; that is, experts should list more features which are listed by other experts than should be true in the less experienced groups. Analysis of the data showed that 41% of the experts' features were listed by other experts, experienced counselors shared 25% of the features, beginning counselors, 24% and novices, 22%; F(3, 284) = 30.9, p < .001.

The analysis to determine the relative number of distinctive features listed by experts for each category and which were not shared with other categories versus less experienced subjects revealed that less experienced
subjects tended to list more distinctive features. The percentage of distinctive features was 94% for novices, 88% for beginners, 81% for experienced counselors, and 76% for experts. Thus the hypothesis that experts should have a more differentiated category structure was not supported.

Distinctiveness was also examined by asking novice and experienced subjects to rate the how distinctive they perceived each feature to be. The subjects for this study were 30 undergraduate students and 15 experienced staff members who had degrees in psychology or social work and at least 1.5 years of experience. Each subject rated the category features obtained in the previous study on how well the feature described members of the category and on how well the feature described members of the other categories. The ratings were subtracted to obtain a distinctiveness score. Novices' features were rated as more distinctive than the experts' features; \( t(69) = 3.84, p < .001 \) for the comparison between the means for the two groups. The ratings of both groups of subjects were very similar and apparently were combined for the statistical analysis.

A separate group of subjects, 15 undergraduate psychology students, also rated the semantic similarity between the category label and the features provided in the lists by the groups of practitioners. A comparison between
the novice and expert groups revealed that novice features were rated as semantically similar to category labels while experts' features were not; \( t(86) = 4.34, p < .01. \)

The authors suggest that the failure to support the distinctiveness hypothesis could be related to an experts' ability to use patterns of features rather than single distinctive features; this issue will be discussed in relation to another study below.

The failure to support their hypothesis could also be related to the manner that the concept of distinctiveness was operationalized. The original statement implied that experts could make a specific diagnosis, that is, assign a specific category label, in situations in which a novice could assign only a general label. This implies that when presented with a problem child, an expert could categorize the child specifically as depressive, aggressive or disorganized while a novice could not. A task similar to this in which the subject was asked to supply a category label might have produced results which were consistent with the differentiation hypothesis. Instead, differentiation was operationalized by supplying the category labels and asking subjects to list features characteristic of the category; it is not clear how this task is related to the subjects' ability to assign a specific category label.
The heterogeneity of a group of patients with borderline personality disorder (BPD) and the diagnostic efficiency of features or sets of features used in a differential diagnosis task was studied by Clarkin, Widiger, Frances, Hurt and Gilmore (1983). Diagnostic efficiency was defined as the hit rate within a diagnostic category divided by the hit rate outside the category for each feature.

The subjects on which the psychiatric diagnosis was made were 76 psychiatric outpatients (18-45 years old) who intake interviewers identified as fulfilling the criteria for a DSM-III diagnosis on an Axis II personality disorder. Subsequently patients were given a one hour interview by one to three raters who assessed whether a feature necessary for BPD diagnosis was present or absent. Raters also tested for other relevant features if they deemed it necessary. After this interview, a separate group of raters administered the Diagnostic Interview for Borderline Patients (DIB).

Patients were given a diagnosis of BPD (borderline personality disorder) or other psychiatric disorder (OPD) by two different methods. The less restrictive method (LR method) assigned a BPD diagnosis if the mean number of features required by DSM-III was greater than or equal to 4.6. The DSM-III guidelines require the presence of five
of eight features considered diagnostic of BPD. The more restrictive method (MR method) assigned a diagnosis of BPD if 67% of the raters agreed that five or more of the eight features were present.

The MR method resulted in 20 patients being classified as BPD and 56 as OPD. The LR method resulted in 26 patients being classified as BPD and 50 as OPD.

Examination of the MR group of BPD patients revealed that the group was heterogenous; 10% of the patients had all 8 features, 25% had 7 features, 40% had 6 features, and 25% had 5 features. For the LR classification, 8% of the patients exhibited a mean number of 7.6 to 8 features, 8% had 7.5 to 6.6 features, 42% had 6.5 to 5.6 features, and 42% had 5.5 to 4.6 features. Five of the six patients classified by the LR method but not by the MR method as having BPD were classified by the DIB inventory as having BPD.

Analysis of the patterns of features associated with a diagnosis of BPD under the MR criteria showed that of the 56 possible combinations of the five different features, 65% of the patients had one combination of four features. The next most common set of features differed from the previous set by only one feature. Under the LR criteria, the one combination was found in 46% of the patients.

Diagnostic efficiency was calculated to be between .38
and .69 for the MR group and .56 and .73 for the LR group. High efficiency was evident for the combination of four features since this combination occurred in only nine of the OPD patients.

The authors concluded that the results demonstrate the heterogeneity of patients diagnosed as having a borderline personality disorder. The calculation of diagnostic efficiency focused on the covariation of symptoms which may be important to identifying the presence or absence of a disorder. They point out, however, that the results of their study may have limited generalizability because the diagnostic efficiency of features is dependent on the incidence of the feature in both the criterion and the comparison group; the incidence may vary in both groups depending on the health care setting.

The structure of medical knowledge in the memories of medical students and general practitioners was examined by Bordage and Zacks (1984). They were interested in showing whether prototypes can be used to describe the knowledge that physicians and medical students have about disease. Compared to the studies in psychiatry, this study is notable because it focuses on disease knowledge rather than on patient knowledge.

The subjects for this study were third year medical students who had not begun their clerkships and physicians
who were general practitioners. A population of students was identified then assigned randomly to each of the four experiments. The physicians were recruited from a professional society for the first and third experiments and from physicians attending two different seminars for the second and fourth experiments.

The first experiment was a normative study to describe the content of the physicians' and the students' disease categories. The disease categories were selected from the International Classification of Health Problems and from standard medical references. The subjects were presented with the category names and then asked to list all the disorders they could recall which belonged to that category. For example, pneumonia could be listed for the respiratory disorders category. Students listed an average of 11.5 items per category and physicians, 13.1 items per category for an effect size of .332. The authors commented that the content appeared very similar for both groups.

The second experiment sought to obtain typicality ratings for the disorders in each category. Subjects rated the disorders on a seven point scale that ranged from 'not a member of the category' to 'excellent example'. A Spearman correlation coefficient for the mean ratings was .90, indicating a high correlation between the ratings. The physicians had a wider range of ratings than did the
students, the physician range was 3.11 and the student range, 2.36.

Experiment three examined the family resemblance structure of the categories. It was expected that subjects could list more features for highly typical examples of a disease category than for atypical examples. Subjects were asked to list all the features that they could recall for each disorder; they were allowed 1.5 minutes per disorder. The mean number of features listed by students was 8.1 and by physicians, 9.2 for an effect size of .15. Thus there appeared to be only minor differences between students and physicians on this task.

The speed of access to information was the subject of the fourth experiment. The students and physicians were presented with a list of 56 statements like 'Diabetes mellitus is a kind of endocrine disorder.' and asked to indicate whether the statement was true or false. The results indicated a substantial difference in the speed of access to information about atypical items between the student and physician group, the effect size was 1.045. The difference was less for the typical items, .768. In general, the physicians could judge the truth of the statement faster than the students but the difference was much greater for the atypical items.

The authors also attempted to determine whether
experience was affecting the ability of physicians to list
diseases for a particular category by looking at the
frequency of responses for the ten most commonly
encountered diseases in practice. However there was no
difference between the student and physician groups ($X^2 < 1.46$).

The influence of contextual information related to the
patient on the generation of initial diagnostic hypotheses
by medical students and experienced physicians was examined
in a study by Hobus, Schmidt, Boshuizen and Patel (1987). They utilized the script theory proposed by Feltovich and
Barrows (1984) that hypothesizes that doctors use illness
scripts to construct a cognitive representation of the
patient's problem. The illness script provides a pattern
of features associated with the illness such as age, sex,
whether the patient smokes, abuses alcohol and so on. The
initial diagnostic hypotheses are then promulgated within
the framework of this illness script.

The subjects for this study were 18 family doctors and
17 new graduates or senior medical students. The average
age of the doctors was 38.2 years ($SD = 9.1$) and they had
an average of 11.1 years ($SD = 7.7$) of experience. The
student group consisted of 12 senior medical students and 5
doctors who had graduated within the last month. Their
average age was 25.5 years ($SD = 3.3$).
Subjects were presented with three different slides for each patient; one slide was a portrait of the patient, one slide provided chart information such as the patient's age, sex, profession, previous disease and so on. The third slide contained a statement about the patient's presenting complaint in lay terms. The portrait was shown for 4 seconds, the patient's chart for 3 to 42 seconds, depending on the number of lines of text, and the presenting complaint for 3 to 9 seconds depending on the length of the statement. The mean presentation time was 32 seconds per case. A blank slide was shown for 15 seconds and during this time the subject was asked to state the most likely diagnosis. The cases were presented in two series of 16 cases each. After each series was completed, the diagnosis with the presenting complaint was read back to the subject and the subject was asked to recall information related to the diagnosis. The responses were audiotaped.

Two judges compared the subject's diagnosis to the actual diagnosis; if the subject agreed with the actual diagnosis then the response was scored as correct, otherwise the response was considered incorrect.

The recall information was scored by segmenting the chart information into information units each of which contained a single fact or idea. Recall was scored
according to whether the information recalled was literal, inferred or summary information. Two judges scored 20% of the recall material then one judge scored the remaining material.

The results of the data analysis indicated that the experienced physicians (M = 12.11, SD = 2.52) made significantly more correct diagnoses than did students (M = 8.88, SD = 2.12). The effect size for the difference was 1.28.

Experienced physicians also recalled more information (M = 216.05, SD = 52.84) than did the students (M = 163.35, SD = 48.56) but the difference was much larger for relevant information (effect size = 1.08) than for irrelevant information (effect size = 0.59). The correlations between the number of correct diagnoses and the recall score showed a significant correlation for experienced physicians (r = 0.54) but not for students (r = 0.12). The authors concluded that experienced physicians use contextual knowledge about illness as well as factual knowledge about disease to make a diagnosis.

The authors did not explicitly consider the internal structure of the scripts that they hypothesized are used to structure the cognitive representation of the patient by the physician. Scripts are stereotypic knowledge structures (Anderson, 1980); thus, scripts should also have
an internal structure based on prototypes.

The two studies comparing the differences between medical students and experienced physicians indicates that experience has much greater effects on the use of contextual information related to patients than it has on factual information related to disease. Each study used a recall measure to examine differences; the effect size for the differences in recall for the disease study was 0.15 and the effect size for the differences in recall for the patient context study was 0.997. Thus learning additional factual information from experience appears to contribute very little to the experienced physician's ability to make an accurate diagnosis.

The prototype structure as a structure of disease knowledge was specifically rejected in a study done by Feltovich, Johnson, Moller and Swanson (1984). They focused on disease knowledge rather than patient knowledge and stated that a disease model better describes the knowledge associated with a disease state. A disease model contains information about the pathophysiology of disease and its clinical manifestations; disease models are formal representations of disease derived by analysis rather than the informal representation that a physician might construct in the process of treating patients.

Feltovich et al. (1984) used four case studies from
pediatric cardiology to study the reasoning processes used by four medical students who had just completed a six week rotation in pediatric cardiology, four residents in pediatric cardiology and four experts in pediatric cardiology. The students had seen 25-30 patients in pediatric cardiology and the residents, about 150 patients. Experts were either fellows in pediatric cardiology or faculty members. Fellows estimated that they had seen about 400 patients and the faculty members had seen at least 5,000 patients over a 20 year period.

A logical competitor set (LCS) concept was used to develop the case studies. The LCS is composed of a set of alternative diseases which are similar to the case diagnosis and are likely to be confused with it. These sets were developed with a faculty member in pediatric cardiology and by reference to standard textbooks. The cases were then constructed so that symptoms which would discriminate among the diseases would appear at various points in the case history.

Each subject was asked to diagnose all four cases; the subjects read case information and thought aloud as they did so. At the end of the list, the subject was asked for a primary diagnosis. The subjects' responses were taped then submitted to protocol analysis.

The purpose of the first case was to investigate
subjects' differentiation of a disease into subtypes. Generally the results of the protocol analysis showed that as expertise increased, the subjects were able to consider more alternatives from the LCS and that the two faculty members were able to utilize nonclassical variants of the disease as hypotheses. The explanation offered for this was that experts form a kind of category which is an interconnected memory unit and activation of the category makes all category information available for use.

Three of the subjects made the correct diagnosis on the first case, the two faculty members and one of the residents. The case was described as an uncommon variant of valvular aortic stenosis, known as subvalvular aortic stenosis. When the diagnostic errors were examined, six subjects had never considered the correct diagnosis. This failure did not appear to be related to lack of knowledge; subjects demonstrated knowledge of the disease in post-experiment interviews.

The purpose of the second case was to investigate the aggregation by subjects of a set of physiologically similar diseases into a memory grouping or category. The LCS for this case included four diseases and the correct diagnosis was total anomalous pulmonary venous connection. Four subjects diagnosed this case correctly, the two faculty experts and two of the residents. One of the residents did
not select the correct diagnosis because she thought the disease did not occur in children as old as the child in the case study. Two of the students provided multiple diagnoses to account for the clinical findings. The case did demonstrate that experts form their own disease groupings; the three incorrect diagnoses are usually considered as acyanotic heart disease while the correct diagnosis is considered as cyanotic heart disease. The experts did not use this textbook style grouping but instead grouped all four diseases together and considered them simultaneously.

The third case study was designed to test the robustness of expert grouping of hypotheses when there is no negative evidence. The correct diagnosis was patent ductus arteriosus and all subjects made the correct diagnosis.

The fourth case study was similar to case 2 in that it was used to determine experts aggregation of similar diseases. Four subjects made the correct diagnosis, however, one of the faculty experts also missed the diagnosis.

The authors concluded that experts know more defining characteristics of a disease and that they have more knowledge that is accessible in a task situation; therefore the structure of the knowledge base is important to its
This study was largely descriptive; subjects were asked to think aloud while they made a diagnosis on a sample patient. The study supposedly related a physician's knowledge to the script knowledge that has been proposed as a guide to human behavior. However the authors did not specify the content of the script and they did not seem to reach any conclusion about whether doctors use scripts when making a diagnosis. Since scripts seem to share prototype structure, an examination of the prototype structure of disease categories may have been more informative.

The effects that typicality and correlation of category features may have on the subject's ability to make a diagnosis has also been examined.

Psychiatrists are able to differentiate features of diagnostic categories along the typicality dimension. Livesley (1986) developed a survey instrument describing the traits and behaviors associated with the 11 diagnostic categories of DSM-III. A total of 22 different questionnaires were developed each describing either traits or behaviors associated with a specific diagnostic category. Each responding psychiatrist was asked to indicate on a scale (1 = low typicality and 7 = high typicality) how typical this trait or behavior was of the diagnostic category. The questionnaire was sent to 2960
psychiatrists in the U.S. and Canada; 938 were returned. Analysis of the results indicated that psychiatrists do differentiate the attributes of psychiatric disorders on the typicality dimension; the mean rating for the attributes ranged from 2 to 6.7. The authors concluded that concepts of personality disorders possess an internal structure based on prototypicality.

Correlation of symptoms and typicality was examined by Medin, Alton, Edelson, and Freka (1982) in a simulated medical classification task. They conducted three experiments on a diagnostic task for a fictitious disease, burlosis, and one experiment on a differential diagnostic task for two fictitious diseases, terrigitis and midosis.

The subjects for experiment 1 were 48 undergraduate psychology students who were randomly assigned to one of two groups. Group 1 subjects were presented with 9 sample cases to study that had from 1 to 4 symptoms of burlosis and 2 of the symptoms were perfectly correlated. Group 2 subjects were presented with 9 sample cases in which there was no correlation between the symptoms. All subjects were then presented with pairs of cases and asked to indicated which case was most likely to be a case of burlosis. Subjects were also asked to describe a typical case of burlosis and to list the strategy they used to make a diagnosis. The results indicated that group 1 subjects
were more likely to diagnose cases which contained correlated symptoms as having burlosis \( t(46) = 2.26, p < .05 \). However when asked to describe how they made a diagnosis, subjects in both groups would report using correlations that didn’t exist.

Experiment 2 repeated the procedure of experiment 1 except that the correlated symptoms were either 2 typical symptoms or 2 atypical symptoms; typicality was determined by the number of times the symptom appeared in the sample cases. The results of the comparison between the two groups showed that symptom correlation increased the likelihood that the subject would make a diagnosis of burlosis \( F(1,46) = 19.29 \) but the effect size was much larger, 0.65 versus 0.33 for experiment 1.

For experiment 3, five symptom dimensions were used and the typicality and correlation was controlled on each dimension. The probability that each case would be identified as most likely to be a case of burlosis was calculated from the typicality and correlation characteristics of the symptoms. Generally cases containing a larger number of typical symptoms should be selected in preference to cases with fewer typical symptoms, however if correlation is also introduced, subjects should select the case which preserves the correlation even if it has fewer typical symptoms.
The subjects for this experiment were 30 students attending the University of Illinois who were paid for their participation. This experiment used one group of subjects and compared their performance on four cases which differed on the typicality dimension and five cases which differed on the correlation dimension; the five cases having a pair of correlated symptoms would also have fewer typical symptoms than the comparison cases. A t test comparing the performance on the first four cases with the last five cases was 3.87, $p < .01$ indicating that the difference was statistically reliable. The effect size was 0.71.

The task for the fourth experiment was a differential diagnosis task in which subjects were asked to indicate whether a patient had one of two fictitious diseases, terrigitis or midosis. The symptoms used for the cases were designed so that the first two symptom dimensions varied on typicality and the third and fourth dimensions on correlation; thus if correlation is critical to differential diagnosis then all cases with correlated symptoms should be diagnosed correctly without regard to the typicality of the other symptoms.

The subjects for this experiment were 32 students in an introductory psychology course. The subjects were given 8 cases to study then presented with 32 test cases and
asked to indicate which disease the patient had. The results indicated that subjects were influenced by the typicality on the first two dimensions; they were 12 to 16 percent more accurate in their diagnosis if both symptoms were typical of the disease as opposed to when one symptom was atypical. When correlated symptoms were added to the model, subjects used both correlation and typicality to make the differential diagnosis. The authors were able to develop a model to predict the proportion of test cases categorized as each disease based on their typicality and correlated features; their model accounted for 98% of the variance.

The authors concluded that configural information plays an important role in subjects' category judgments and that the diagnostic process cannot be described by weighted sums of independent attributes.

**Studies of Dispensing Errors in Pharmacy:**

Studies have not been conducted in pharmacy to describe how pharmacists make judgments or decisions from the information available to them. Pharmacists do make errors, as do all other humans; examination of the errors made by pharmacists may give some indication as to how pharmacists use information in a professional setting.

There are few studies of dispensing errors made by
pharmacists in an outpatient or community pharmacy setting. The single report of dispensing errors made in community pharmacies was made by Wertheimer, Ritchko and Dougherty (1973) by having physicians make carbon copies of prescriptions they wrote during one to four week periods. Patients were contacted by telephone three to seven days after their physician visit and asked to read their prescription label and to describe their medication. The results of the interview were compared to the carbon copy of the prescription. Data was collected on 233 prescriptions; 29(12.9%) were identified as containing an error of some kind. Seven of the errors involved the omission of the drug name when it had been requested by the prescriber. The other errors involved the instructions(17) or the dispensing of the wrong drug or wrong drug strength(5). The authors concluded that the errors appeared in a random fashion regardless of characteristics of the metropolitan area and characteristics of the patient. The authors comment that an error rate of approximately 10% is unacceptable and attributed the high error rate to "...pharmacists becoming lax in their professional obligations...".

The performance of pharmacists and technicians in an outpatient hospital pharmacy was compared in a study by McGhan, Smith and Adams (1983). The purpose of the study
was to determine if technicians could dispense prescriptions as accurately as pharmacists and if so, pharmacy technicians could then be employed for dispensing duties. Since State Board regulations prohibited technicians from performing dispensing functions, special permission was obtained for the study and pharmacy clerks were given a training program which lasted for four weeks to teach them how to dispense. Prescriptions were randomly assigned to pharmacists or technicians and then checked for accuracy by a pharmacist not involved in the dispensing process. The error rates were found to be similar between the two groups; the percent of prescriptions containing an error was 5.17% for pharmacists and 4.17% for technicians. The difference was non-significant when a chi-square test was done on actual frequencies ($X^2$, df=1, $p=NS$). The authors did find that pharmacists spent substantially more time counseling patients ($t=10.24, df=488, p<.001$) than they did prior to the utilization of technicians for dispensing.

The dispensing errors made in an outpatient pharmacy of a Public Health Service Hospital are described by Johnson (1978). This study identified errors by reviewing all the new prescriptions filled at the end of the day for proper drug, quantity dispensed and changes in dosage. Refilled prescriptions were not reviewed. The procedure used to fill prescriptions was described as being an
assembly line; typists prepared the label and then the prescription was filled by either a pharmacist or a technician. If a technician filled, the prescription was checked by a pharmacist; if a pharmacist filled no second check was performed. Over an eight month period, 65 errors were identified; 21 were wrong drug errors and eight were wrong strength errors, the remaining errors were made in the instructions for use, dosage form, drug name, failure to include the prescription in the bag and dispensing the incorrect quantity. There was a substantial difference in the number of errors attributed to pharmacists and to technicians; pharmacists made seventeen wrong drug errors and five wrong strength errors compared to four wrong drug errors and three wrong strength errors for technicians. However it must be remembered that all technician dispensed prescriptions were checked by a pharmacist so the reported errors for technicians really represent the errors that the pharmacist did not identify when checking, thus the true technician error rate cannot be established from this information. The author attributes control of dispensing errors to proper motivation and rational counseling.

Taylor and Gaucher (1986) studied the dispensing errors made by technicians in filling unit dose carts. They identified five error categories: incorrect medication, incorrect dosage, incorrect dosage form,
omitted medication and extra medication. The total error rate was 1.7% of all orders filled (442 errors for 26,532 orders) and the average daily rate was 31 errors. The most frequently made error was errors of dosage (42% of all errors); omitted medication was the second most frequently made error (30%) and incorrect medication was the third most frequently made error (17%). The authors studied the incorrect medication errors in further detail; they divided the incorrect medication into subcategories according to how far away from the correct medication box the incorrect medication was located on the supply shelves. They found that the most frequent incorrect medication error involved a medication that was three or more boxes away from the correct medication box (70%) seeming to suggest that the technician did not just 'miss' the correct medication box.

The authors found that the number of errors did not seem to be related to the time of day but did vary between wards. The variation between wards was not tested for significance. The authors thought the difference between wards could have been due to the variation in experience among the technicians or to the complexity of the medication lists but these factors were not addressed in the study.

The studies reviewed above related to pharmacist and technician error seem to indicate that site of practice,
type of patient or chance does not adequately explain why the errors were made. The default hypothesis in these studies seems to be that the pharmacist was inadequately motivated or non-professional. Information processing theory provides an alternative method for examining errors and their causes; that is, errors may result from defaults in the cognitive processing of information.

The studies reviewed above indicate that humans seem to structure their categorical memory around prototypes and that this type of structure affects performance on a number of dependent variables in psychology. The effects have been demonstrated in psychiatry; the manner in which a psychiatrist or psychologist structure their memory for patients affects their ability to make a diagnosis. The effects have been demonstrated to a lesser effect in medicine; studies in medicine focus on physician’s memory for disease concepts rather than on patient related concepts. Thus, the effects of memory structure seem likely to affect pharmacist performance as well.

The differences in memory or performance between a professional, who has a great deal of formal training as well as experience, and technicians, who have experience but little formal training, was not addressed by the studies discussed above. Since memory structures related to categories seem to be developed from experience with
objects in a category, technicians may also have memory structures characterized by typicality. If so, the performance of technicians should also be affected by the typicality of the stimulus.
CHAPTER 3

METHODOLOGY

Introduction:

The purpose of this research was to examine the relationship between performance on recognition, judgment and decision tasks and the organization of information in memory as described by typicality theory. According to this theory, information is organized so that subjects are biased toward selecting the response for which they consider the stimulus to be more typical. Subjects can usually respond to typical stimuli faster than to atypical stimuli, thus reaction times should be less for typical stimuli than for atypical stimuli. The organization of memory according to typicality is hypothesized to occur through the subject's experience with stimuli, therefore less experienced subjects do not display bias in their responses to typical and atypical stimuli.

Typicality effects can be studied by having subjects respond to stimuli which vary in typicality such as drug names and examples of drug therapy. The subjects' responses and reaction times to typical and atypical stimuli can then be compared to determine the effects of
typicality bias on performance. To determine the effects of experience, the performance of three different groups of subjects were compared, the performance of experienced pharmacists, technicians and students.

The research was conducted by displaying the three types of stimuli on the liquid crystal display of a computer then asking the subjects to respond by pressing one of two keys on the keyboard. A mixed design was used to measure the effects of typicality on response selection and response time for each of the three tasks, recognition, judgment, and decision and then to compare the differences in responses across the three groups.

Development of Materials:

Materials development can be divided into two parts, a portion in which the drug names and patient descriptions which served as stimuli were developed and a portion in which the test procedure was developed.

(1) Development of the stimuli:

Three sets of stimuli were needed, one set for each cognitive task. Generally, developing the stimuli required collecting the typical-atypical pairs of drug names and a patient description to accompany each drug name. The typicality characteristics were established for each drug name or patient; then, based on the typicality
characteristics, each stimulus-response set was constructed.

The typicality characteristics of the drug names were established for a list of 32 drugs constructed from reports of dispensing errors; two reports were modified so that both drugs in the report did not involve drugs from the same therapeutic category. The list of drugs is shown in Appendix 3.1. This list of drugs was presented to two pharmacists who practiced in the HMO where the data would be collected; these pharmacists served as judges of typicality. The pharmacists were presented with a pair of drug names and asked to indicate which drug name they were more likely to come across in their practice. The pharmacists answered by marking a seven point scale anchored on each end by a drug name. The stimulus drug names selected for the test procedure were the pairs on which both pharmacists agreed that they were much more likely to come across one drug name than the other.

A similar procedure was followed for the accompanying patient descriptions except that a clinical pharmacist at the College of Pharmacy was asked to provide patient descriptions of patients typical of each drug therapy. The patient description contained information about the age, gender, diagnosis and one or two other pertinent characteristics of the patient such as whether the patient
smoked, was obese or was taking other drugs. The instrument used to collect this data is shown in Appendix 3.2.

These descriptions were presented to the two pharmacists; they were asked to indicate how typical they thought each patient was of the specified drug therapy on a seven point scale, anchored on the upper end by 'very typical' and on the lower end by 'not at all typical'. A different drug name was used in each instance of drug therapy but a patient description could appear twice, once as a patient thought to be typical of the specified therapy and once as a patient thought to be an atypical patient. The diagnosis was omitted from the patient description to avoid the possibility that the subjects could respond based on their knowledge of diseases and treatments. The questionnaire used to collect the typicality data is shown in Appendix 3.3.

The set of recognition stimuli required eight drug name pairs containing one typical and one atypical drug. The stimulus-response sets were constructed from each pair of typical-atypical drug names. The pair of drugs formed the response alternatives for each stimulus drug name in turn so that the same drug name appeared once as a stimulus and twice as a possible response. A random number program was used to determine the display order for the 16 drug names and to determine whether the matching response choice
was listed as response choice number 1 or response choice number 2. Example displays for the recognition task are shown in Appendix 3.4.

The set of stimuli for the judgment and decision tasks required a total of thirty-two drug names with an associated patient description. Patient descriptions could appear twice; once as a patient considered typical of the specified drug therapy and once as a patient considered atypical; however each drug-patient combination appeared only once. Eight drug name pairs were identical to the pairs used for the recognition task; eight pairs were new drug names. The items for the judgment task and for the decision task were selected from a randomly ordered list. A random number program was also used to establish the display order and to determine whether the first response choice was a typical or an atypical patient. Example stimulus-response displays for the judgment task and the decision task are shown in Appendices 3.5 and 3.6.

The drug names used for the recognition task were either a trade name or a generic name. The information presented for the judgment and decision tasks included both names; a trade name was presented with the generic name in parentheses or vice versa.

A Pearson's r calculated on the typicality ratings by the two pharmacist judges for the drug names was .95; the
Pearson's $r$ calculated for the drug names combined with the patient description was .945.

A knowledge test was administered to each test subject at the end of the test procedure. The knowledge test was designed to determine if the subjects had basic knowledge about the generic and trade names for the drugs included in the test procedure and if they knew the typical therapeutic use of each test drug. The knowledge test contained two sections; a section in which the subject was asked to select the correct trade or generic name for the drug presented and a section in which the subject was asked to indicate for which of two diseases the drug represented a typical treatment. The diagnoses provided by the clinical pharmacist when the patient descriptions were developed were used in the treatment questions. Each section contained ten items, the items were chosen from the drugs used as stimuli using a random number program. The knowledge test is shown in Appendix 3.7.

(2) Development of the test procedure:

The test procedure was conducted in a laboratory setting by having the subjects respond to drug name stimuli shown on a liquid crystal display (LCD) screen of a portable microcomputer. The subjects selected one of two response choices by pressing one of two keys on the keyboard. The dependent variables were the number of
correct responses and the time the subject required to make a response.

To conduct this type of test procedure, one must consider the hardware, the software, and the experimental procedure used to collect the data.

The hardware for conducting the experiment consisted of a Zenith-180 Series Laptop computer which is IBM compatible. This computer operates on rechargeable batteries so that a power outlet is not needed for operation. The screen is a liquid crystal display screen (LCD) rather than a cathode ray tube (CRT). A LCD screen operates by blocking light rather than by producing light as does a CRT screen. The display is a standard 80 characters wide and 25 characters high. Each character on the screen is created in a matrix 8 pixels wide and 8 pixels deep. The light characteristics of the LCD screen make it possible to use the display under all lighting conditions.

The program software for operation is stored on a 3 1/4 inch disk. The hardware will support software timing functions to a microsecond.

The software for operating the experimental procedure is programmed in Turbo Basic; this language was selected because it contains timing functions which will control display time to a millisecond and collect reaction time
data to microsecond precision. The language also allows programming by non-experts. The computer program used for the test procedure is shown in Appendix 3.8.

The experimental procedure is divided into six parts, (1) the introduction, including demographic information, (2) the recognition test, (3) the judgment test, (4) the decision test, (5) the knowledge test and (6) the sign off procedure. An outline of the test procedure with a brief description of each section is provided in Figure 3.1.

Display of a stimulus for a specified time and the collection of response times requires that the test procedure be carefully timed. The intervals between the fixation letters, the stimulus display, the display of the response choices and the collection of response time must be compatible with the testing procedure.

Calfee (1975) discusses experimental procedures which use reaction time as a dependent variable and which use some type of timed stimulus display. When the stimulus is preceded by fixation letters, the interstimulus intervals, that is the time between stimulus displays, should be between 250 and 500 milliseconds and the intervals should not vary in length. Based on Calfee’s (1975) recommendation, the interstimulus intervals were set at 400 milliseconds and all intervals are the same length. The stimulus sequence, the time intervals and the display
Outline of Test Program

1. Introduction
   * brief description of test program
   * collect demographic data
   * thank subject for participating

2. Recognition test
   * introduction to recognition test
   * trial displays
   * test displays
   * indicate to subject that recognition test is completed and new test will begin

3. Judgment test
   * introduction to judgment test
   * trial displays
   * test displays
   * indicate to subject that judgment test is completed and a new test will begin

4. Decision test
   * introduction to decision test
   * trial displays
   * test displays
   * indicate to subject that decision test is completed and a knowledge test will follow

5. Knowledge test
   * introduction to knowledge test
   * trial question
   * test questions
   * indicate to subject that knowledge test is completed

6. Sign off
   * thank subject for participating

Figure 3.1
content are shown in Figure 3.2.

The time line was modified for each task. The stimulus display time for the recognition task was set at 36 msec (S.D. = .00346). The time was established through testing so that subjects would be able to only partially read the drug name and hence would have to select the drug name that they thought was most likely.

The subject was allowed to pace the display of the drug therapy examples used for the judgment and decision tasks. The stimulus was displayed on the screen and erased when the subject made a response. For these two tasks, the subject needed to be able to completely read the words.

Several types of error are associated with an experimental procedure asking subjects to respond to a stimulus. There is the error due to individual variability and the error that results when subjects are not allowed a warm-up period. The error variability due to individual differences can be reduced by using a repeated measures design and warm-up error eliminated by allowing subjects a few practice trials before beginning the test procedure (Calfee, 1975). These problems were addressed in this research by allowing subjects four trial stimulus displays for each task and by using a repeated measures design. Other possible errors that the subject can make during the testing procedure include the subject responding before
### Time Line for Test Procedure

<table>
<thead>
<tr>
<th>Timing intervals for stimulus displays</th>
<th>Display content/subject response</th>
</tr>
</thead>
<tbody>
<tr>
<td>* 500 msec</td>
<td>--- Fixation letters</td>
</tr>
<tr>
<td>* 400 msec(^a)</td>
<td>--- Clear screen</td>
</tr>
<tr>
<td>* 125 msec(^b)</td>
<td>--- Display stimulus(^c)</td>
</tr>
<tr>
<td>* 400 msec</td>
<td>--- Clear screen</td>
</tr>
<tr>
<td>Reaction time</td>
<td>--- Display response question</td>
</tr>
<tr>
<td>* 400 msec</td>
<td>--- Subject responds</td>
</tr>
<tr>
<td>Variable time</td>
<td>--- Clear screen</td>
</tr>
<tr>
<td>* 400 msec</td>
<td>--- Initiate new sequence?</td>
</tr>
<tr>
<td>* --- Subject initiates new sequence</td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) interstimulus interval, the interval between one stimulus and the next stimulus

\(^b\) stimulus display time was set for the recognition task; for judgment and decision tasks, the stimulus was displayed until the subject responded.

\(^c\) stimulus content varies according to the type of task

Figure 3.2.
the stimulus is displayed, displaying the stimulus before the subject is ready and the subject selecting the wrong response (Calfee, 1975). Errors due to premature subject response were identified by examining the response times; tests of the software had shown that the computer takes approximately 500 microseconds to process the program lines, send the response display to the screen and read the keyboard. Response times of about 500 microseconds indicated that the subject has pressed a key before the response display appeared on the screen. Displaying the stimulus before the subject was ready was prevented by allowing subjects to indicate when they were ready for the next stimulus.

The remaining subject error, selecting the wrong response, is designated as incorrect responses for the recognition task and is the variance which is the principal interest for that task. The hypothesis is that typicality bias will affect the number of incorrect responses made by a subject; that is, typicality will affect the variance due to bias.

Brown (1976) divides response variance into three parts, the variance due to a specified variable, the variance due to bias and the variance due to random error. The relationship is shown in Figure 3.3.

The portion of variance due to typicality bias is
Types of Response Variance

\[ s_{v}^{2} \quad s_{i}^{2} \quad s_{e}^{2} \]

- \( s_{v}^{2} \) is variance due to a specified variable
- \( s_{i}^{2} \) is variance due to bias
- \( s_{e}^{2} \) is random variance and represents measurement error

Figure 3.3.
expected to vary depending on the typicality of the stimulus items making up the test. A test composed of typical items would be expected to elicit better performance than a test composed of atypical items because the variance due to bias would increase the number of correct responses and thus increase performance scores. Conversely, performance scores on atypical items would be decreased because more incorrect responses would be made on atypical items.

As stated above in the description of stimuli development, test items were used from each end of the typicality scale, that is, very typical items and very atypical items, so that typicality bias was maximized and the performance on each type of item can be measured.

Reliability, in the context of the experimental procedure, refers to any measurement error and would be expected to be related to how reliably the computer controls the stimulus exposure interval and how reliably the computer collects reaction time data. The reliability of the stimulus exposure interval can be tested by setting the microtimer to measure the interval between the command to display the stimulus and the command to clear the screen.

Testing indicated that the computer measures the reaction time to within one millisecond. If a subject
presses a key before the response display is written to the screen, the microtimer indicates that about 500 microseconds or half a millisecond have elapsed so that the subject's response time would be measured within a millisecond. Since the reaction times are expected to be at least one or two seconds, this level of precision should be acceptable.

Internal validity, as it is related to this experimental procedure, would be related to either the content or the construct validity. External validity is related to generalizability and is discussed under 'Limitations'.

Construct validity concerns whether the dependent variables are measuring the effects of typicality or the effects of some other construct. Three alternative hypotheses appear to be pertinent to the validity of the experimental procedure. (1) The difference in performance could be attributed to experience with computers. This should not affect performance on the test; subjects were expected to press one of two keys to respond, a response that does not require any experience with computers. Further, pharmacists, technicians and students are all familiar with typewriters and typewriter keyboards and computer keyboards have similar layouts. (2) The difference in performance could be attributed to knowledge
about drugs. To control for this effect, a knowledge test about the drugs used in the experimental procedure was administered at the end of the test procedure so that differences in knowledge could be examined. (3) The difference in performance could be attributed to experience with the drugs. In an attempt to use drug names with which all the subjects are familiar, the drug name stimuli were developed on the same sample of subjects who performed the test procedure (see discussion under development of materials). Experience was also an independent variable when pharmacist performance is compared to technician and student performance.

Content validity, in the context of this experimental procedure, refers to whether the drug names and patient examples represent a part of pharmacy practice. The drug names were taken from reports in the literature so that they can be assumed to represent drug names encountered by pharmacists. The patient examples were developed by having a pharmacist who currently practices pharmacy provide brief patient descriptions. Thus the content of the experimental procedure would appear to be valid.

Subjects:

The research focus was on the structure of knowledge in experienced practitioners, that is, in pharmacists who
are currently practicing pharmacy and who have had some experience. For the purposes of this research, a practicing pharmacist was someone who has a B.S. degree in pharmacy and has practiced at least one year after licensure and who is currently practicing at least ten hours a week.

Since the drug name stimuli were derived from reports of wrong drug substitutions in the literature, the subject pharmacists must be exposed to these drugs in their practice. Most of the wrong drug substitutions identified in the literature as appropriate for this experiment seem to involve drugs that would be dispensed to an outpatient or to a patron of a community pharmacy, so the subjects must come from these practice sites. Therefore a group of pharmacists and technicians who could serve as subjects was identified at a local health maintenance organization. Two pharmacists from this group served as judges of typicality and participated in the development of the stimuli for the test procedure.

Student subjects were recruited from fourth year pharmacy students in a Doctor of Pharmacy (PharmD) program who had just begun their clerkship rotations. These students have completed all their coursework including their therapeutics classes so that their knowledge should be characterized by a content organization rather than a
context organization.

**Research Design:**

The research design is a mixed design for three groups of subjects. The subject groups represent samples of three distinct populations, pharmacists, pharmacy students, and pharmacy technicians. The design is illustrated in Figure 3.4.

**Data Collection:**

All subjects were tested individually. Student subjects were tested in a conference room in the pharmacy college. Pharmacist or technician subjects were tested in an office or conference room which could be closed off from other activities taking place at the site.

Subjects were seated at a table or a desk with the portable microcomputer placed before them. The subjects could adjust the location of the keyboard so that they could rest the heel of their hand on the table surface and position two fingers on the keys needed for responding to the stimulus displays.

At the beginning of the test procedure, subjects provided relevant demographic data. Subjects were presented with questions asking them to indicate their primary work site, the number of hours worked per week,
Research Design

Group 1: \( X_1 O_1 O_2 X_2 O_3 O_4 X_3 O_5 O_6 \)
Group 2: \( X_1 O_1 O_2 X_2 O_3 O_4 X_3 O_5 O_6 \)
Group 3: \( X_1 O_1 O_2 X_2 O_3 O_4 X_3 O_5 O_6 \)

Group 1 = practicing pharmacists
Group 2 = pharmacy technicians
Group 3 = pharmacy students

\( X_1 \) is the recognition task
\( O_1 \) is the number of correct responses
\( O_2 \) is the response time
\( X_2 \) is the judgment task
\( O_3 \) is the number of correct responses
\( O_4 \) is the response time
\( X_3 \) is the decision task
\( O_5 \) is the number of correct responses
\( O_6 \) is the response time

Figure 3.4.
number of years experience as a licensed pharmacist and the percentage of patients that they counseled about their drugs. The subject's gender was noted by the experimenter at the time the data collection procedure was performed.

Subjects were told that the purpose of the experiment was to present drug names and patient descriptions to several groups of people, pharmacists, technicians or pharmacy students, to determine if the different groups reacted differently to the examples.

A scoring procedure was developed for each dependent variable. A subject's choices on the recognition task were scored by counting the number of responses which matched the stimulus drug name on the typical and atypical portions of the task. There were eight typical drug names and eight atypical drug names; thus, the subject could obtain a high score of eight on each section. For the judgment task, subjects received a score of one for each response indicating that the drug was appropriate for the patient; again the subject could receive a high score of eight for the typical or the atypical section. Since only appropriate choices were scored, no adjustment needed to be made for responses made before the stimulus was displayed on the screen since these responses were recorded as zeros. The decision task was scored in a manner identical to the judgment task except that subjects received a score of one
for each response in which they indicated that they would dispense the prescription as written.

The reaction time dependent variable was scored by calculating the median reaction time for each subject on each section of the test. Thus a subject's reaction time on typical recognition stimuli would be the median of the subject's eight reaction times to those stimuli and so on for each portion of the three tasks. Responses in which the subject pressed a key before the stimulus was displayed were omitted from the calculations.

The knowledge test was scored by giving one point for each correct answer; there were 20 possible points.

**Statistical Analysis:**

The statistical analysis was conducted as planned comparisons subsequent to an ANOVA analysis. The ANOVA served as basis for the design and as a source of error terms for the calculation of the planned comparisons. The comparisons were planned so that each comparison provided information relevant to a particular hypothesis. All comparisons were conducted using two-tailed t tests even though some of the hypotheses were directional in nature as recommended by Keppel (1982). The statistical significance level was set at .05 for all tests. The ANOVA design is shown in Figure 3.5 and will be referred
Statistical Analysis: A (2 X 3) X 3 ANOVA for Measuring the Influence of Typicality on Cognitive Tasks across Three Levels of Experience

<table>
<thead>
<tr>
<th></th>
<th>B₁</th>
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<th>B₁</th>
<th>B₂</th>
<th>B₁</th>
<th>B₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>A₁</td>
<td></td>
<td></td>
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<tr>
<td>A₂</td>
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</tr>
<tr>
<td>A₃</td>
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</tr>
</tbody>
</table>

A = Experience dimension:
A(1) = pharmacists
A(2) = pharmacy technicians
A(3) = pharmacy students

B = Typicality dimension:
B(1) = typical
B(2) = atypical

C = Task dimension:
C(1) = recognition task
C(2) = judgment task
C(3) = decision task

Figure 3.5.
to as necessary to describe the comparisons. The design in Figure 3.5 is for one dependent variable, the same design was replicated for the second dependent variable.

Hypotheses 1 through 4 concern the effect of typicality on pharmacists' performance and were the principal hypotheses of the experiment. The level of probability was set at .05 to evaluate the results of the t test.

**Hypothesis #1**: Experienced pharmacists recognize more typical drug names correctly than atypical drug names.

This hypothesis was a comparison of the means of cells A1B1 and A1B2 from task C1 on the number of response choice dependent variable.

**Hypothesis #2**: Experienced pharmacists judge more drugs as appropriate therapy for typical patients than for atypical patients.

Experienced pharmacists are the subject of this hypothesis so the comparisons were done within condition A(1). Cell A1B1 was compared to A1B2 on task C2 comparing the number of drugs judged to be appropriate for typical patients versus the number of drugs judged to be appropriate for atypical patients.

**Hypothesis #3**: Experienced pharmacists are more likely to decide to dispense prescriptions as written for typical patients than for atypical patients.
Cell AIB1 was compared to AIB2 for task C3 on the number of drugs dispensed for typical patients versus the number of drugs dispensed for atypical patients.

Hypothesis #4: Pharmacists react to typical drug names or patients faster than to atypical drug names or patients on the recognition, judgment and decision tasks.

This hypothesis predicts that response times will be different on typical and atypical stimuli for all three tasks; therefore three different t tests were required, one for each task condition. The comparison was made between cell AIB1 and cell AIB2 for C1, C2 and C3 on the response time dependent variable.

Hypotheses 5 through 8 concern the effect that typicality has on the performance of technicians.

Hypothesis #5: Technicians recognize more typical drug names correctly than atypical drug names. Cell A2B1 was compared to cell A2B2 for condition C1.

Hypothesis #6: Technicians make drug therapy judgments and dispensing decisions which are not significantly different for typical and atypical patients.

The number of drugs judged as appropriate for typical patients and atypical patients was compared for the A2B1 and A2B2 cells within the C2 task condition for the judgment task. The number of drugs dispensed for typical patients and atypical patients was compared for the A2B1
and A2B2 cells within the C3 task condition for the decision task.

Hypothesis #7: Technicians react to typical drug names faster than to atypical drug names on the recognition task. Within condition C1, cell A2B1 was compared to cell A2B2 on the reaction time dependent variable.

Hypothesis #8: Technicians react equally fast to typical and atypical patients so that reaction times will not be different on the judgment and decision tasks.

The reaction times were compared for cells A2B1 and A2B2 for tasks C2 and C3.

Hypotheses #9 and #10: These hypotheses concern pharmacy students and the hypotheses predict that typicality will not affect the performance of the students on the three tasks, on both dependent variables, therefore the null hypothesis of no difference would be accepted. Calculation of an effect size was done to establish whether the effect was small but positive or likely to be negative or zero; effect sizes less than .3 are considered small (Cohen, 1977).

All comparisons were made within the A3 level between the A3B1 and A3B2 cells for each dependent variable.

Hypotheses 11 through 16 compare the performance of technicians and pharmacists on the three tasks for both dependent variables. The primary distinction between
pharmacists and technicians is expected to be reflected in the differences in performance on typical versus atypical stimuli. Therefore the dependent variable used for this portion of the experiment was a difference score calculated by subtracting the typical score from the atypical score. These groups are independent, consequently a t test for independent groups was used for the comparisons.

**Hypothesis #11:** Pharmacists and technicians recognize an equal number of drug names correctly for typical and atypical drugs on the recognition task; thus the mean of the difference scores for each group is expected to be equal. This hypothesis was tested with a two-tailed t test for the difference scores from the A1C1 cell and the A2C1 cell with the expectation that p would be at least 0.20.

**Hypothesis #12:** Pharmacists and technicians react to drug names equally fast therefore the mean difference in reaction times on the typical and atypical drug names is expected to be equal. The reaction time differences calculated from the A1C1 cell and the A2C1 cell were compared with the expectation that p would be greater than 0.05 for a two-tailed t test.

**Hypothesis #13:** Pharmacists are more likely than technicians to be affected by the typicality of the patient when judging whether drug therapy is appropriate therefore the mean of the difference scores was hypothesized to be
larger for pharmacists than for technicians.

A two-tailed t test on the difference scores for pharmacists calculated from cell A1C2 and for technicians calculated from cell A2C2 indicates whether pharmacists and technicians perform differently on the judgment task when the dependent variable is the number of drugs judged to be appropriate therapy.

**Hypothesis #14:** Pharmacists are more likely to be affected by typicality when making drug therapy judgments so that the mean difference in reaction times for typical and atypical patients is greater for pharmacists than for technicians.

A two-tailed t test between the differences in reaction times calculated from the A1C2 and A2C2 cells indicated whether pharmacists and technicians performed as predicted on the judgment task for the response time dependent variable.

**Hypothesis #15:** Pharmacists are more likely than technicians to be affected by the typicality of the patient when deciding whether to dispense the prescription as written or whether to contact the physician or patient, therefore the mean of the difference scores was hypothesized to be larger for pharmacists than for technicians.

A two-tailed t test which compares the means of the
difference scores from cell A1C3 and cell A2C3 on the number of correct responses dependent variable was used to test this hypothesis.

Hypothesis #16: Pharmacists are more likely to be affected by the typicality of the patient when making dispensing decisions so that the mean difference in reaction time for typical and atypical patients is greater for pharmacists than for technicians.

A t test which compares the mean difference in reaction times calculated for cell A1C3 and cell A2C3 was used to test this hypothesis.

Hypotheses 17 through 20 concern comparisons of student performance to pharmacist and technician performance for both dependent variables on the three tasks.

Hypothesis #17: Pharmacists or technicians are more likely to be affected by the typicality of the drug name stimuli than are students, therefore mean difference scores on the recognition task for pharmacists and technicians are greater than those for students.

Two t tests were needed; one test comparing the mean differences from cells A1C1 and A3C1 for the pharmacist-student comparison and one test comparing the mean differences from cells A2C1 and A3C1 for the technician-student comparison.

Hypothesis #18: Pharmacists or technicians are more
likely to be affected by the typicality of the drug name when reacting to the drug names, therefore, the mean difference in reaction time is greater for pharmacists or technicians than for students.

Two t tests were needed; one test comparing the mean reaction time differences from cells A1C1 and A3C1 for the pharmacist-student comparison and one test comparing the mean reaction time differences from cells A2C1 and A3C1 for the technician-student comparison.

Hypothesis #19: Pharmacists are more likely to be affected by the typicality of the patient when making judgments or decisions about drug therapy than are students, therefore, the mean difference scores for pharmacists on the judgment and decision tasks are greater than those for students.

Two t tests for mean score difference were needed to test this hypothesis.

(1) A t test for the difference scores from cells A1C2 and A3C2 to compare student and pharmacist performance on the judgment task.

(2) A t test for the difference scores from cells A1C3 and A3C3 to compare student and pharmacist performance on the decision task.

Hypothesis #20: Technicians and students are affected by the typicality of the patient equally when making
judgments or decisions about drug therapy, therefore, the mean difference scores for technicians on the judgment and decision tasks are equal to those for students.

Two t tests are required to test this hypothesis.

(1) A t test for difference scores from cells A3C2 and A2C2 to compare student and technician performance on the judgment task.

(2) A t test for difference scores from cells A2C3 and A3C3 to compare student and technician performance on the decision task.

Hypothesis #21: Pharmacy students and technicians are less likely to be affected by the typicality of the patient when making judgments or decisions about drug therapy than are pharmacists, therefore, the mean difference in reaction time is greater for pharmacists than for students and equal for technicians and students.

Four t tests on the response time dependent variable were needed to test this hypothesis.

(1) A t test comparing the mean difference in reaction time from cell A1C2 and cell A3C2 for the pharmacist-student comparison on the judgment task.

(2) A t test comparing the mean difference in reaction time from cell A1C3 and cell A3C3 for the pharmacist-student comparison on the decision task.

(3) A t test comparing the mean difference in
reaction time from cell A2C2 and cell A3C2 for the technician-student comparison on the judgment task.

(4) A t test comparing the mean difference in reaction time from cell A2C3 and cell A3C3 for the technician-student comparison on the decision task.

Limitations:

The principal limitations of this research are related to the method used to select the sample of pharmacy practitioners and the method of collecting data. The data was collected in a laboratory setting; the limitations of collecting data in a laboratory must be considered in the context of basic versus applied research. A laboratory procedure permits exploration of the factors which may be causing differences which would not be possible in a real world setting. This laboratory procedure is expected to serve the same function in research on practitioner cognition that an animal model serves in research on disease. The research is generalizable to the extent that the theory is adequate to include both laboratory and real world settings; that is, a recognition task should be the same regardless of setting.

The other aspect of the research concerned with generalizability, selection of the practitioner sample, is relevant to trying to generalize the results of the
research to the entire population of pharmacists. Theoretically, the results on specific stimuli can be generalized only to pharmacists whose practice is similar to the practice of the sample pharmacists. The general cognitive bias demonstrated by the subjects should be characteristic of all pharmacists and even other health care practitioners.

Another limitation associated with the research is the problem with using comparison groups which are not the result of random assignment. The student comparison group was selected as characteristic of inexperienced pharmacists but the experience of the two groups was not controlled. Therefore the difference between the groups could be caused by some factor associated with typicality.

Pilot Test:

A pilot test was conducted with four practicing pharmacists as subjects; one subject was tested in an office in the College of Pharmacy and the other subjects were tested at their practice site which was a community pharmacy. Three of the four subjects were male and one female; they had practiced an average of 13.25 years (S.D. = 9.878), they worked an average of 45 hours per week (S.D. = 5.774) and they counseled an average of 46.25 percent (S.D. = 24.96) of the patients seen in their
practices.

The results of the pilot test for the response choice dependent variable are summarized in Table 3.1. Results on two of the three tasks, judgment and decision, were in the direction predicted; that is, the score means were higher for the stimuli considered typical than for the stimuli considered atypical. The results on the recognition task were in the opposite direction; that is, the score mean was higher for the atypical stimuli than for the typical stimuli. Examination of the individual responses showed that most of the difference was due to the three subjects in the community pharmacy responding in an opposite manner on the Inderal-Isordil drug name pair. The judges from the HMO indicated that Inderal was a more common drug name than was Isordil; the pilot test subjects responded as though Isordil was a more common drug name than Inderal.

As stated above, the means were in the predicted direction for the judgment and decision tasks however the small effect size for the decision task indicated that there was a problem with the operationalization of the task. The decision task also had a standard deviation twice that of the recognition and judgment tasks. Comments made by the subjects indicated that the response alternatives were not clear on the decision task; subjects could select either 'dispense the prescription as written'
TABLE 3.1
MEAN RESPONSE SCORES FOR PHARMACISTS ON THE PILOT TEST

<table>
<thead>
<tr>
<th>Task</th>
<th>Typical&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Atypical&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Effect Size</th>
<th>Samplea Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recognition&lt;sup&gt;c&lt;/sup&gt;</td>
<td>6.5</td>
<td>7.3</td>
<td>-0.596&lt;sup&gt;d&lt;/sup&gt;</td>
<td>15</td>
</tr>
<tr>
<td>Judgment&lt;sup&gt;e&lt;/sup&gt;</td>
<td>6.5</td>
<td>4.5</td>
<td>1.225</td>
<td>5</td>
</tr>
<tr>
<td>Decision&lt;sup&gt;f&lt;/sup&gt;</td>
<td>4.2</td>
<td>3.5</td>
<td>0.273</td>
<td>68</td>
</tr>
</tbody>
</table>

<sup>a</sup>Sample size was calculated using tables from Cohen (1977) and using an r of 0.6.

<sup>b</sup>There was a possible score of eight for each subject on the typical or the atypical portions of each task.

<sup>c</sup>Scores were obtained by giving one point for each drug name correctly identified.

<sup>d</sup>The direction of difference between the means was opposite to that predicted.

<sup>e</sup>Scores were obtained by giving one point for each response indicating that the drug therapy was appropriate.

<sup>f</sup>Scores were obtained by giving one point for each response indicating that the prescription would be dispensed as written.
or 'verify the therapeutic intent before dispensing'. Subsequent to the pilot test the wording for the second choice was changed to 'check with the patient or the doctor about the use of the drug before dispensing'.

The results for the reaction time dependent variable are shown in Table 3.2. Generally, the mean reaction times were expected to be less for the typical stimuli than for the atypical stimuli. Again, the direction of the means on the recognition task were opposite to the predicted direction, though the difference was very small. The means for the judgment and decision task were in the predicted direction however it seemed that the sequence of the test procedure limited the variability of the reaction times. Subjects were presented with the drug name and patient description for a limited time then the screen was cleared and the response choices displayed; subjects could not respond quickly to the stimuli since they would have to wait until the response question was displayed. Subsequent to the pilot test the response sequence was changed so that subjects could respond quickly if they liked.

The pilot test provided mixed information as to the size of sample needed to obtain statistical significance. Information from the recognition task was difficult to interpret given that the direction of the means was opposite to the predicted direction. The difference
TABLE 3.2
MEAN REACTION TIMES FOR PHARMACISTS
ON THE PILOT TEST

<table>
<thead>
<tr>
<th>Task</th>
<th>Typical</th>
<th>Atypical</th>
<th>Effect Size</th>
<th>Samplea Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recognition</td>
<td>1.471b</td>
<td>1.435</td>
<td>-0.141</td>
<td>250</td>
</tr>
<tr>
<td>Judgment</td>
<td>1.677</td>
<td>2.044</td>
<td>0.532</td>
<td>12</td>
</tr>
<tr>
<td>Decision</td>
<td>1.123</td>
<td>2.255</td>
<td>0.774</td>
<td>10</td>
</tr>
</tbody>
</table>

*aSample size was calculated using tables from Cohen (1977) and using an r of 0.6.
bReaction times are given in seconds.
between the means was almost significant for the judgment task with four subjects and the reaction times for the judgment and decision tasks required ten to twelve subjects to obtain significance. A second problem with estimating sample size was the problem with estimating the correlation between scores on the typical and atypical stimuli. A correlation of 0.6 was used for the sample size calculations although correlations performed on the judgment and decision task data indicated that the score correlations were about 0.7. Given these problems with estimating sample size, a sample size of ten subjects in each group, total sample size of 30, was selected for the experiment. Ten pharmacists and ten technicians should be available to participate in the experiment from a local HMO and ten students could be recruited from PharmD students doing their clerkships in the Tucson area.

No pilot data was collected for the other two test groups, pharmacy technicians or students, therefore estimates could not be made for the sample size needed to demonstrate statistical significance between groups. Further, the hypotheses concerning the effects of typicality within groups were the hypotheses of primary interest; the hypotheses concerning group differences were of secondary interest.

The performance of the pilot test subjects on the
knowledge test was quite uniform; the mean score was 18.5 (S.D. = 0.58) on the 20 point test. Reaction times were also collected for the knowledge test; the mean reaction time was 2.79 seconds (S.D. = 0.427).
CHAPTER 4

RESULTS

Demographic Data:

A total of 30 subjects participated in the experiment; 10 subjects were pharmacists, 10 were pharmacy technicians and 10 were fourth year PharmD students. All the pharmacists and the technicians were employees of an HMO with clinics in Tucson and Phoenix. Three pharmacists and two technicians were tested at clinic sites in Phoenix, the remaining pharmacists and technicians were tested at clinic sites in Tucson. The two pharmacists serving as judges of typicality in the materials development phase were also practicing in Tucson. The students were fourth year PharmD students who were just beginning their clinical rotations in Tucson; no students were tested from clerkship sites outside Tucson. The majority of the subjects were female, 6 of the 10 pharmacists, 7 of the 10 students and all of the technicians were female. The demographic characteristics are summarized in Table 4.1.

All subjects were given a knowledge test at the end of the experimental procedure; usable data was obtained from
TABLE 4.1
DEMOGRAPHIC CHARACTERISTICS OF SUBJECTS

<table>
<thead>
<tr>
<th></th>
<th>Mean years (hours) of Experience</th>
<th>Mean hours worked per week</th>
<th>Mean % of patients counseled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pharmacists</td>
<td>13.3 (6.2)\textsuperscript{a,b}</td>
<td>40.0 (0.0)</td>
<td>29.0 (34.1)</td>
</tr>
<tr>
<td>Technicians</td>
<td>5.6 (2.4)\textsuperscript{a,c}</td>
<td>39.7 (0.7)</td>
<td>34.4 (24.9)</td>
</tr>
<tr>
<td>Students</td>
<td>1544.4 (632.7)\textsuperscript{d}</td>
<td>17.0 (13.6)</td>
<td>28.9 (36.9)</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Experience is given in mean years for pharmacists and technicians.
\textsuperscript{b} Figures in parentheses are standard deviations.
\textsuperscript{c} The difference in experience between pharmacists and technicians is significant, t = 3.24, p = 0.006.
\textsuperscript{d} Experience is given in mean number of internship hours for students.
all except one subject. One technician pressed the answer key prematurely and all responses were recorded as zeros, therefore data is included for only nine technicians. The scores are shown by group and by test section in Table 4.2. Technicians' scores were significantly lower than either pharmacists' or students' scores on part one of the test; post hoc Tukey tests were used to test for significance at the 0.05 level. This portion of the test asked subjects to indicate which of two names was the correct generic or trade name for a specified drug. There were no significant differences between the groups on the second part of the test concerned with the therapeutic uses of drugs. When the test scores were totaled for both parts of the test, pharmacists again scored significantly better than technicians but not significantly different than students.

Reaction times were also collected on all subjects on the knowledge test; no significant differences were found within the groups between the sections of the test or between the groups on the sections of the test or on the test as a whole. Thus group membership did not seem to affect reaction times.

The time each subject required to complete the experimental procedure was collected. The mean time required was 21.315 minutes (S.D. = 3.161) with a range of 14.333 minutes to 29.917 minutes. There was no significant
<table>
<thead>
<tr>
<th>Group</th>
<th>Mean Score (Part 1(^a))</th>
<th>Mean Score (Part 2(^b))</th>
<th>Mean Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pharmacist</td>
<td>9.6 (0.699)(^c)</td>
<td>8.2 (0.632)</td>
<td>17.8 (1.033)</td>
</tr>
<tr>
<td>Technician</td>
<td>7.778 (1.202)(^d)</td>
<td>7.444 (1.333)</td>
<td>15.222 (2.167)</td>
</tr>
<tr>
<td>Student</td>
<td>9.3 (1.160)</td>
<td>7.6 (1.776)</td>
<td>16.9 (2.331)</td>
</tr>
</tbody>
</table>

\(^a\)Part 1 contained 10 questions on trade and generic drug names.

\(^b\)Part 2 contained 10 questions on therapeutic use.

\(^c\)Figures in parentheses are standard deviations.

\(^d\)Technicians scored significantly lower than either pharmacists or students at the 0.05 level.

\(^e\)Technicians scored significantly lower than pharmacists at the 0.05 level.
difference between the groups on the total time needed to complete the experimental procedure.

**Hypothesis testing:**

All hypotheses were tested as planned comparisons. An ANOVA analysis for a mixed design was performed then the comparisons were made using information from the ANOVA analysis. All statistical analyses were conducted using the Systat statistical program for microcomputers. The basic analysis was a mixed measures analysis with six trials on the repeated factor and three groups on the independent factor; each trial represented a column from the design shown in Figure 3.5. When comparisons are being made between cells, Systat recalculates the error term so that only the columns with cells in the comparison contribute to the error term. Therefore the error term for the cell comparisons has 27 degrees of freedom because the error term is calculated across the groups. This procedure is recommended by Keppel (1982).

Response choices or reaction times for responses made by the subject before the response question was displayed were not included in the analysis. On the recognition task, seven of 480 responses were made prematurely (1.46%); four of the judgment responses were premature (0.83%) and two of the decision responses (0.42%).

The hypotheses of primary interest in the experiment
concerned the effect that typicality may have on pharmacists' performance on the three different cognitive tasks, recognition, judgment and decision. The hypotheses were that the typicality of the stimulus would affect pharmacists' performance on each task so that pharmacists' performance would be biased toward the typical rather than the atypical. All relevant comparisons were performed comparing the responses on the typical versus the atypical stimuli within the pharmacist group.

Hypothesis #1: This hypothesis concerned the recognition task and the effect that typicality might have on the pharmacist's ability to correctly recognize a drug name. Typicality should bias the pharmacist's performance so that the pharmacist is more likely to correctly identify a drug name which is considered typical than a drug name which is considered atypical. The mean score for pharmacists on the typical recognition stimuli was compared to the mean score for pharmacists on the atypical recognition stimuli. This comparison was not significant at the 0.05 level, $F(1,27) = 3.135$, $p = 0.088$, indicating that a typicality effect may be present but was smaller than expected on the recognition task.

Hypothesis #2: The second hypothesis concerned the effect that typicality might have on pharmacists' judgment of appropriateness of drug therapy for a patient. The
 dependent variable was the number of examples judged to be appropriate for typical patients versus the number judged appropriate for atypical patients. This comparison was significant, $F(1,27) = 8.472, p = 0.007$, indicating that typicality had a substantial effect on the pharmacist’s judgment of appropriateness.

**Hypothesis #3:** The third hypothesis concerned the effect that typicality might have on a pharmacist’s decision to dispense a prescription as written or to contact the patient or prescriber before dispensing. The dependent variable was the number of example prescriptions that the subject indicated would be dispensed as written for typical patients compared to the number dispensed as written for atypical patients. This comparison was also significant, $F(1,27) = 5.863, p = 0.022$, providing evidence that the typicality of the stimulus influences the decisions that pharmacists make about dispensing drugs.

**Hypothesis #4:** Pharmacists’ reaction times on typical versus atypical stimuli was the question in this hypothesis. Generally, people seem to be able to react faster to typical stimuli than to atypical stimuli. Therefore, pharmacists were expected to have shorter reaction times for typical stimuli than for atypical stimuli. The mean reaction time was 1.731 seconds ($SD = 0.413$) for typical stimuli and 1.982 seconds ($SD = 1.090$)
for atypical stimuli on the recognition task. The mean reaction time was 7.429 seconds (SD = 2.559) for typical stimuli and 7.758 seconds (SD = 2.773) for atypical stimuli on the judgment task. The mean reaction time was 5.569 seconds (SD = 2.095) for typical stimuli and 6.234 seconds (SD = 1.260) for atypical stimuli on the decision task. When the reaction times were compared for the typical and atypical stimuli, none of the comparisons were significantly different for any of the three tasks. The direction of the difference was as predicted for the reaction times on all three tasks with the mean reaction time for typical stimuli less than for atypical stimuli.

Hypotheses 5 through 8 concern the effect that typicality might have on the performance of technicians on the three tasks. The effect of typicality was expected to be uneven across the tasks for technicians; they should perform in a manner similar to pharmacists on the recognition task but differently on the judgment and decision tasks. The judgment and decision tasks were thought to require knowledge about drug therapy as well as experience dispensing drugs, thus technicians were not expected to display differences in performance on the judgment and decision tasks.

**Hypothesis #5:** Technicians were hypothesized to recognize more typical drug names correctly than atypical
drug names. The mean number of typical drug names identified correctly was compared to the mean number of atypical drug names identified correctly within the technician group. This comparison was not significant at the 0.05 level, \( F(1,27) = 0.576, p = 0.455 \).

**Hypothesis #6:** Patient typicality was hypothesized not to influence judgments made by technicians about the appropriateness of drug therapy. The dependent variable was the number of drugs judged to be appropriate for typical versus atypical patients. The difference in performance on the typical and atypical stimuli was significant, \( F(1,27) = 4.221, p = 0.050 \), indicating that typicality does influence the performance of technicians on a judgment task.

Patient typicality was hypothesized not to influence decisions made by technicians about dispensing. The comparison was the mean number of prescriptions that subjects indicated they would dispense as written for typical versus atypical patients. The difference in performance was not significant at the 0.05 level, \( F(1,27) = 1.466, p = 0.237 \), indicating that the effect was not as powerful as the effect for the judgment task but that a small effect due to typicality could be present.

**Hypothesis #7:** Technicians react to typical drug names faster than to atypical drug names. This hypothesis
compared the mean reaction time on typical drug names to
the mean reaction time on atypical drug names for the
recognition task. The difference in reaction times was not
significantly different for technicians, $F(1,27) = 2.351$, $p = 0.137$. The direction of the means and the p-value could
indicate that an effect was present but was too small to be
significant in this experiment.

**Hypothesis #8**: This hypothesis concerned the reaction
times of technicians on the judgment and decision tasks and
was a hypothesis of no difference; that is, typicality was
not expected to affect technicians' reaction times on
typical and atypical stimuli. The difference in reaction
times was not significantly different for technicians on
the two tasks, for the judgment task, $F(1,27) = 1.056$, $p = 0.313$ and for the decision task, $F(1,27) = 1.417$ and $p = .244$.

**Hypothesis #9**: This hypothesis predicts that
typicality will not affect the performance of students as
they perform the three different tasks. Students were
expected to correctly identify as many typical drug names
as atypical drug names; to indicate drug therapy is
appropriate for as many atypical as typical patients and to
indicate that they would dispense prescriptions as written
to as many atypical as typical patients. The means on the
recognition task were equal for the typical (mean = 7.0)
and atypical (mean = 7.0) drug names indicating that technicians did perform equally well on the two types of stimuli. There was a small difference on the judgment task, $F(1,27) = 1.055$ and $p = 0.313$. The difference was small and in the opposite direction on the decision task; that is, students indicated that they would dispense prescriptions as written slightly more often to atypical patients than to typical patients, $F(1,27) = 0.194$ and $p = 0.663$. The effect size was small and the p-value large for the decision task, evidence that responses were a variation around zero and did not represent a real effect.

**Hypothesis #10:** Students were expected to react equally fast to typical and atypical stimuli on all three tasks so that there should be no significant differences between mean reaction times for typical and atypical stimuli on any of the three tasks. As expected, there were no significant differences. Effect sizes were small on all the tasks, the recognition effect size was 0.36, the judgment effect size was -0.157 and the decision effect size was 0.323. The direction of the difference for the judgment task was also in the opposite direction, indicating that students were reacting slightly faster to atypical stimuli than to typical stimuli.

The results of the within groups comparisons on the response dependent variable are summarized in Table 4.3.
<table>
<thead>
<tr>
<th>Task/Group</th>
<th>Mean Typical</th>
<th>Mean Atypical</th>
<th>Effect Size</th>
<th>p&lt;sup&gt;b&lt;/sup&gt;</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recognition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pharmacist</td>
<td>6.9&lt;sup&gt;c&lt;/sup&gt;</td>
<td>6.2</td>
<td>0.447</td>
<td>3.135</td>
<td>0.088</td>
</tr>
<tr>
<td></td>
<td>(1.449)&lt;sup&gt;d&lt;/sup&gt;</td>
<td>(2.044)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technician</td>
<td>6.6</td>
<td>6.3</td>
<td>0.240</td>
<td>0.576</td>
<td>0.455</td>
</tr>
<tr>
<td></td>
<td>(1.174)</td>
<td>(1.252)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>7.0</td>
<td>7.0</td>
<td>0.000</td>
<td>0.000</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>(1.414)</td>
<td>(1.491)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judgment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pharmacist</td>
<td>6.6</td>
<td>4.9</td>
<td>0.962</td>
<td>8.472</td>
<td>0.007</td>
</tr>
<tr>
<td></td>
<td>(1.265)</td>
<td>(1.853)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technician</td>
<td>5.5</td>
<td>4.3</td>
<td>0.603</td>
<td>4.221</td>
<td>0.050</td>
</tr>
<tr>
<td></td>
<td>(0.972)</td>
<td>(1.889)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>5.7</td>
<td>5.1</td>
<td>0.338</td>
<td>1.055</td>
<td>0.313</td>
</tr>
<tr>
<td></td>
<td>(1.418)</td>
<td>(1.287)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decision</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pharmacist</td>
<td>5.8</td>
<td>3.6</td>
<td>0.575</td>
<td>5.863</td>
<td>0.022</td>
</tr>
<tr>
<td></td>
<td>(1.989)</td>
<td>(2.413)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technician</td>
<td>5.6</td>
<td>4.5</td>
<td>0.472</td>
<td>1.466</td>
<td>0.237</td>
</tr>
<tr>
<td></td>
<td>(1.430)</td>
<td>(2.415)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>4.3</td>
<td>4.7</td>
<td>-0.184</td>
<td>0.194</td>
<td>0.663</td>
</tr>
<tr>
<td></td>
<td>(1.252)</td>
<td>(2.263)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>There were 10 subjects in each group.

<sup>b</sup>df = 1,27; the error term used for each comparison was pooled across groups since the variance across groups was homogenous.

<sup>c</sup>The scores could range from 0 - 8 for each subject on each type of stimulus, typical or atypical.

<sup>d</sup>Figures in parentheses are standard deviations.
The typicality of the stimulus produced a consistent effect across the three cognitive tasks. Pharmacists consistently displayed the largest effect on scores between typical and atypical stimuli; technicians displayed a smaller effect. Students displayed no effect at all on the recognition task, an effect favoring typical stimuli on the judgment task and an effect favoring atypical stimuli on the decision task. The small and variable effect for the students suggests that their responses were varying around zero.

The results of the within groups comparisons for the reaction time dependent variable are summarized in Table 4.4. As shown in the table and discussed above, there were no significant differences for any of the groups on the typical and atypical stimuli. However the differences were in the predicted direction for pharmacists and technicians; they consistently required more time to react to atypical stimuli than to typical stimuli. Students were not as consistent with the effect being reversed for them on the judgment task; they required longer to react to typical stimuli than to atypical stimuli.

Hypotheses 11 through 16 compare the performance of pharmacists and technicians on the typical and atypical stimuli across the three tasks. The dependent variable for these comparisons was a difference score calculated by
TABLE 4.4
MEAN REACTION TIMES ON TYPICAL AND ATYPICAL STIMULI

<table>
<thead>
<tr>
<th>Task/Groupa</th>
<th>Mean Typical</th>
<th>Mean Atypical</th>
<th>Effect Size</th>
<th>Fb</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recognition</td>
<td>Pharmacist</td>
<td>1.731&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.982</td>
<td>0.407</td>
<td>2.016</td>
</tr>
<tr>
<td></td>
<td>(0.413)&lt;sup&gt;d&lt;/sup&gt;</td>
<td>(1.090)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Technician</td>
<td>1.584</td>
<td>1.854</td>
<td>0.499</td>
<td>2.351</td>
</tr>
<tr>
<td></td>
<td>(0.514)</td>
<td>(0.567)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Student</td>
<td>1.419</td>
<td>1.573</td>
<td>0.360</td>
<td>0.758</td>
</tr>
<tr>
<td></td>
<td>(0.398)</td>
<td>(0.457)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judgment</td>
<td>Pharmacist</td>
<td>7.429</td>
<td>7.758</td>
<td>0.123</td>
<td>0.682</td>
</tr>
<tr>
<td></td>
<td>(2.559)</td>
<td>(2.773)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Technician</td>
<td>6.028</td>
<td>7.052</td>
<td>0.277</td>
<td>1.056</td>
</tr>
<tr>
<td></td>
<td>(1.682)</td>
<td>(5.815)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Student</td>
<td>8.110</td>
<td>7.671</td>
<td>0.157</td>
<td>0.195</td>
</tr>
<tr>
<td></td>
<td>(2.867)</td>
<td>(2.741)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decision</td>
<td>Pharmacist</td>
<td>5.569</td>
<td>6.234</td>
<td>0.396</td>
<td>1.432</td>
</tr>
<tr>
<td></td>
<td>(2.095)</td>
<td>(1.260)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Technician</td>
<td>5.219</td>
<td>5.881</td>
<td>0.291</td>
<td>1.417</td>
</tr>
<tr>
<td></td>
<td>(2.037)</td>
<td>(2.518)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Student</td>
<td>6.402</td>
<td>7.283</td>
<td>0.323</td>
<td>2.510</td>
</tr>
<tr>
<td></td>
<td>(2.518)</td>
<td>(2.939)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>There were 10 subjects in each group.

<sup>b</sup>df = 1,27; the error term used for each comparison was pooled across groups since the groups had homogenous variance.

<sup>c</sup>Reaction times are given in seconds.

<sup>d</sup>Figures in parentheses represent standard deviations.
subtracting the typical score from the atypical score.

**Hypothesis #11 and #12:** The mean difference scores for pharmacists and technicians were expected to be equal on the recognition task, the mean difference for pharmacists was 0.700 (SD = 1.567) and for technicians, the mean difference was 0.300 (SD = 1.252). When they were compared with an independent groups t test, the mean differences were not statistically different and the effect size was small (0.24). When compared with an independent groups t test, the differences in reaction times were not statistically significant either, indicating that the difference in reaction times on typical versus atypical stimuli was not different for pharmacists (mean = -0.251, SD = 0.765) than for technicians (mean = -0.271, SD = 0.481) on the recognition task.

**Hypothesis #13:** The mean difference between typical and atypical scores on the response choice dependent variable for judgment task was expected to be larger for pharmacists than for technicians since typicality was expected to bias the pharmacists’ responses but not the technicians’ responses. However an independent groups t test for this hypothesis indicated that there was no statistical difference between the scores, F(1,27) = 0.366, p = 0.55.

**Hypothesis #14:** This hypothesis compared the mean
difference in reaction times for pharmacists and technicians on the judgment task; no significant difference between the group means was found with an independent groups t test. The mean difference in reaction time for pharmacists was -0.329 (SD = 1.743) and -1.023 (SD = 4.639) for technicians.

Hypothesis #15: A comparison between the mean difference scores of pharmacists and technicians on the response choice dependent variable for the decision task was the subject of this hypothesis. The mean difference for the pharmacists was 2.200 (SD = 3.824) and for the technicians was 1.100 (SD = 2.331). The independent groups t test indicated that there was no statistical difference between the groups; $F(1,27) = 0.733$ and $p = 0.399$.

Hypothesis #16: This hypothesis compared the mean difference in reaction times for pharmacists and technicians on the decision task with an independent groups t test. The mean difference for pharmacists was -0.665 (SD = 1.780) and for technicians was -0.662 (SD = 1.051). The difference was not statistically significant.

Hypotheses 17 through 21 concern comparisons, on both dependent variables, of student performance on the three tasks to pharmacist and technician performance on the three tasks.

Hypothesis #17: This hypothesis stated that
pharmacists and technicians were more likely to be affected by typicality on the drug name recognition task than were students. The t test comparing pharmacists (mean = 0.700, SD = 1.567) and students (mean = 0.000, SD = 0.816) on the difference scores was not significant, F(1,27) = 1.568, p = 0.221 nor was the t test used to examine the difference scores for technicians (mean = 0.300, SD = 1.252) and students (mean = 0.000, SD = 0.816), F(1,27) = 0.512, p = 0.48.

**Hypothesis #18:** This hypothesis compared the difference in reaction times for pharmacists and technicians to the difference in reaction times for students on the recognition task. The t test for the pharmacist-student comparison was not significant; the mean difference in reaction times for pharmacists was -0.251 (SD = 0.765) and for students was -0.154 (SD = 0.345). When students (mean = -0.154, SD = 0.345) were compared with technicians (mean = 0.271, SD = 0.481), the t test was not significant.

**Hypothesis #19:** The difference scores on the response choice dependent variable for pharmacists on the judgment and decision tasks were compared to the difference scores for students in this hypothesis. Pharmacists did not perform significantly different on the judgment task than did students, F(1,27) = 1.774, p = 0.194. Pharmacists may
have differed from students on the decision task, \( F(1,27) = 4.094, p = 0.053 \).

**Hypothesis #20:** This hypothesis concerns the mean difference scores on the choice dependent variable for technicians and students on the judgment and decision tasks; the mean difference scores for students and technicians were expected to be equal on these two tasks. Neither t test was significant, for the judgment task, \( F(1,27) = 0.528, p = 0.474 \) and for the decision task, \( F(1,27) = 1.363, p = 0.253 \).

**Hypothesis #21:** The mean difference in reaction times on the judgment and decision tasks for pharmacists, technicians and students was the subject of this hypothesis. The mean difference was expected to be larger for pharmacists than for students. When pharmacists (mean = \(-0.329, SD = 1.743\)) were compared to students (mean = \(0.439, SD = 2.240\)), there was no statistically significant difference on the judgment task. When pharmacists (mean = \(-0.665, SD = 1.780\)) were compared to students (mean = \(-0.880, SD = 2.234\)), there was no statistically significant difference on the decision task. When technicians (mean = \(-1.023, SD = 4.639\)) and students (mean = \(0.439, SD = 2.240\)) were compared on the judgment task, there was no statistically significant difference. When technicians (mean = \(-0.662, SD = 1.051\)) were compared to students (mean
= -0.880, SD = 2.234) on the decision task, there was no statistically significant difference.

The results comparing the groups on the response choice dependent variable are summarized in Table 4.5. The differences were largest when pharmacists were being compared with students and this difference was consistent across the three different cognitive tasks.

The results comparing the groups on the reaction time dependent variable are summarized in Table 4.6. The differences between the groups was less consistent on this dependent variable. Pharmacists and technicians consistently displayed a difference in the direction predicted with reaction times less for typical stimuli than for atypical stimuli however, the difference was not always greater than the difference for students and none of the between groups comparisons were statistically significant.

Typicality affects other statistics in addition to the mean; variance and range are also influenced by the typicality of the stimulus. While means are expected to be less for atypical stimuli than for typical stimuli, the variance and range are expected to be greater for the atypical stimuli than for the typical stimuli. For the pharmacist and technician groups, all variance and range statistics were in the direction predicted except the range for pharmacists on the decision task. For the student
### TABLE 4.5
MEAN DIFFERENCE BETWEEN TYPICAL AND ATYPICAL ON THE RESPONSE CHOICE DEPENDENT VARIABLE

<table>
<thead>
<tr>
<th>Group</th>
<th>Recognition</th>
<th>Judgment</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pharmacist</td>
<td>0.700&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.700</td>
<td>2.200&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(1.567)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>(1.767)</td>
<td>(3.824)</td>
</tr>
<tr>
<td>Technician</td>
<td>0.300</td>
<td>1.200</td>
<td>1.100</td>
</tr>
<tr>
<td></td>
<td>(1.252)</td>
<td>(1.989)</td>
<td>(2.331)</td>
</tr>
<tr>
<td>Student</td>
<td>0.000</td>
<td>0.600</td>
<td>-0.400</td>
</tr>
<tr>
<td></td>
<td>(0.816)</td>
<td>(1.776)</td>
<td>(2.171)</td>
</tr>
</tbody>
</table>

<sup>a</sup> Atypical scores were subtracted from typical scores to obtain a difference score.

<sup>b</sup> Figures in parentheses represent standard deviations.

<sup>c</sup> The comparison between pharmacists and students was F(1,27)=4.094, p=0.053.
### TABLE 4.6
MEAN DIFFERENCE BETWEEN TYPICAL AND ATYPICAL ON THE REACTION TIME DEPENDENT VARIABLE

Means

<table>
<thead>
<tr>
<th>Group</th>
<th>Recognition</th>
<th>Judgment</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pharmacist(^a)</td>
<td>-0.251(^b)</td>
<td>-0.329</td>
<td>-0.665</td>
</tr>
<tr>
<td></td>
<td>(0.765)(^c)</td>
<td>(1.743)</td>
<td>(1.780)</td>
</tr>
<tr>
<td>Technician(^d)</td>
<td>-0.271</td>
<td>-1.023</td>
<td>-0.662</td>
</tr>
<tr>
<td></td>
<td>(0.481)</td>
<td>(4.639)</td>
<td>(1.051)</td>
</tr>
<tr>
<td>Student</td>
<td>-0.154</td>
<td>0.439</td>
<td>-0.880</td>
</tr>
<tr>
<td></td>
<td>(0.345)</td>
<td>(2.240)</td>
<td>(2.234)</td>
</tr>
</tbody>
</table>

\(^a\) Pharmacists were compared to technicians and students; neither comparison was significant at the 0.05 level.

\(^b\) Atypical reaction times were subtracted from typical reaction times to obtain the difference score.

\(^c\) Figures in parentheses represent standard deviations.

\(^d\) The technicians-student comparison was not significant at the 0.05 level.
group, the direction of the difference was in the opposite direction for four of the nine statistics. The results are summarized in Table 4.7.
### TABLE 4.7

TYPICALITY EFFECTS ON STATISTICS FOR THREE GROUPS OF SUBJECTS

<table>
<thead>
<tr>
<th>Task/Statistic</th>
<th>Pharmacist</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Technician</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Student</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Typ&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Atyp&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Typ</td>
<td></td>
<td></td>
<td>Typ</td>
<td></td>
<td>Atyp</td>
<td></td>
<td></td>
<td>Typ</td>
<td></td>
<td></td>
<td>Atyp</td>
<td></td>
</tr>
<tr>
<td><strong>Recognition</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean&lt;sup&gt;c&lt;/sup&gt;</td>
<td>6.9</td>
<td>6.2</td>
<td>6.6</td>
<td></td>
<td>6.3</td>
<td></td>
<td>7.0</td>
<td></td>
<td>7.0&lt;sup&gt;e&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variance&lt;sup&gt;d&lt;/sup&gt;</td>
<td>2.1</td>
<td>4.18</td>
<td>1.38</td>
<td></td>
<td>1.57</td>
<td></td>
<td>2.0</td>
<td></td>
<td>2.22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range&lt;sup&gt;d&lt;/sup&gt;</td>
<td>4.0</td>
<td>7.0</td>
<td>3.0</td>
<td></td>
<td>4.0</td>
<td></td>
<td>4.0</td>
<td></td>
<td>4.0&lt;sup&gt;e&lt;/sup&gt;</td>
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<tr>
<td><strong>Judgment</strong></td>
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<td></td>
</tr>
<tr>
<td>Mean</td>
<td>6.6</td>
<td>4.9</td>
<td>5.5</td>
<td></td>
<td>4.3</td>
<td></td>
<td>5.7</td>
<td></td>
<td>5.1</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Variance</td>
<td>1.6</td>
<td>3.43</td>
<td>0.94</td>
<td></td>
<td>3.57</td>
<td></td>
<td>2.01</td>
<td></td>
<td>1.66&lt;sup&gt;e&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>3.0</td>
<td>6.0</td>
<td>3.0</td>
<td></td>
<td>7.0</td>
<td></td>
<td>4.0</td>
<td></td>
<td>3.0&lt;sup&gt;e&lt;/sup&gt;</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Decision</strong></td>
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<td></td>
</tr>
<tr>
<td>Mean</td>
<td>5.8</td>
<td>3.6</td>
<td>5.6</td>
<td></td>
<td>4.5</td>
<td></td>
<td>4.3</td>
<td></td>
<td>4.7&lt;sup&gt;e&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variance</td>
<td>3.96</td>
<td>5.82</td>
<td>2.04</td>
<td></td>
<td>5.83</td>
<td></td>
<td>1.57</td>
<td></td>
<td>5.12</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>7.0</td>
<td>6.0&lt;sup&gt;e&lt;/sup&gt;</td>
<td>5.0</td>
<td></td>
<td>7.0</td>
<td></td>
<td>4.0</td>
<td></td>
<td>8.0</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>Typ = typical stimuli.

<sup>b</sup>Atyp = atypical stimuli.

<sup>c</sup>Means are expected to be greater for typical stimuli than for atypical stimuli.

<sup>d</sup>Variance and range are expected to be less for typical stimuli than for atypical stimuli.

<sup>e</sup>The direction of the difference for the statistic is opposite to that expected from typicality.
CHAPTER 5

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

Introduction:

The following discussion will begin by considering the implications of the results on the theoretical formulation of the model. The results will be related to the model primarily by focusing on the size of the effects produced by the typicality of the stimulus so that statistically insignificant results will not be ignored. The methodology will be evaluated by considering the effects that reliability could have on the power of the experiment. Finally, the implications that the results might have on issues in pharmacy practice and suggestions for future research will be discussed.

Discussion:

The hypotheses of greatest interest in this experiment were those concerned with the effects of typicality on the responses selected by pharmacists on the recognition, judgment and decision tasks. Pharmacists consistently preferred the typical drug name or patient to the atypical drug name or patient when asked to select a drug name or to
make a judgment or decision about example patients. Thus perceptions of typicality do appear to influence performance on recognition, judgment and decision tasks.

The effect of typicality on recognition was not as large as that for judgments or decisions; the effect size for the recognition task was 0.447 compared to 0.962 for the judgment task and 0.575 for the decision task. This smaller effect size explains why the t test did not reach significance on this task.

The accuracy of recognition appears to be reduced for experienced practitioners for atypical drug names; that is, an atypical drug name displayed by itself can be misread and the misreading is apparently dependent upon the drug name's perceived typicality. That is, if a pharmacist is more likely to come across the drug name, Tagamet, than the drug name, Tegretol, then the pharmacist will tend to make reading errors so that Tegretol is misread as Tagamet. Thus, under circumstances in which the pharmacist is not able to clearly perceive a drug name, the pharmacist will be inclined to make reading errors biased toward the typical.

The 'correctness' of the judgment or the decision that the pharmacist made could not be determined from the information obtained in this experiment. Although, technically, all the atypical examples were examples of
inappropriate drug therapy that should not be dispensed to the patient, in reality, the patient might be expected to be receiving such a drug. Subjects were not provided with a diagnosis therefore they merely determined if the drug was likely to be appropriate or if the prescription was likely to be safe for dispensing. Thus pharmacists made a probabilistic determination rather than an absolute determination.

The pharmacists who participated in the experiment, generally reacted favorably to the experimental procedure; most pharmacists seemed pleased that a university researcher was trying to measure something outside of book-learning. One pharmacist said that the experiment seemed to be measuring the sixth sense that he used when dispensing prescriptions.

Technicians also displayed an effect on performance due to the typicality of the stimulus but the effect was not as large as the effect for pharmacists. Consequently, only one t test was statistically significant and that was on the judgment task. The original hypotheses stated that technicians would display a bias toward selecting typical responses on only the recognition task. The judgment and decision tasks were thought to require content specific knowledge about drugs such as would be learned in an academic environment. The results of this experiment
suggest that people do learn to make judgments and decisions from experience and that the judgments and decisions they make will resemble those made by people who also have content specific knowledge. That specific knowledge is not required, is evident from the scores on the knowledge test; technicians scored significantly lower than pharmacists on the knowledge test.

Technicians also reacted favorably to the experimental procedure. Several technicians expressed some doubt about their ability to perform but after completing the experimental procedure, they commented that the task was not difficult. One technician stated that she answered the questions by determining if the patient and his/her current drug therapy 'went together with' the new drug therapy.

The similarity of the responses by the pharmacists and technicians indicates that experience is a powerful factor in determining the organization of memory. Pharmacists demonstrated a larger typicality effect on performance than technicians. The larger typicality effect could be due to the additional experience that the pharmacists had; this explanation would imply that experience continues to develop perceptions of typicality. The larger typicality effect for pharmacists could also be due to the effects of education; this explanation would imply that education augments the effects of experience.
Students displayed no effect or a small effect of typicality on the response choice dependent variable. This lack of bias produced a high level of accuracy for students on the recognition task; students recognized, on the average, 7 of the 8 drug names regardless of whether the name was typical or atypical. Thus the students were very accurate on the recognition task.

Students displayed some typicality effect on the judgment task (effect size = 0.338); that is, they were slightly more likely to identify drug therapy for a typical patient as appropriate than for an atypical patient. Students could be beginning to develop typicality structures about appropriate drug therapy. However, the variance and range of students' responses were not consistent with those expected from typicality. Hence, the differences in responses on the judgment task for students appears to be random variation.

Students displayed a negative effect in their performance on the decision task; however the effect size was very small (effect size = 0.184) indicating that there was no true typicality effect and that the students' performance was varying around zero. Therefore, students would be likely to make false negative decisions for typical patients and false positive decisions for atypical patients when dispensing prescriptions.
Several students made statements about the lack of information provided for the examples in the judgment and decision tasks and several students commented that they thought the test was difficult. Only one pharmacist made a similar comment and this was a pharmacist who participated in the pilot study and had limited experience in pharmacy practice, 3 years, whereas all the pharmacists who participated in the experiment had at least 6 years of experience. The students had a mean of 9 months experience, considerably less than any of the pharmacists.

In general, the performance of the pharmacists, technicians and students was consistent across the three tasks. Pharmacists always demonstrated the greatest difference in performance due to typicality, technicians always demonstrated a smaller difference and students always demonstrated the least difference. This consistency persisted even though only one of the between groups comparisons, the comparison between pharmacists and students, was statistically significant.

The consistency in responses across the three tasks implies that the lack of significance in the comparisons between groups is due to lack of power rather than to lack of a true effect. Several aspects of the experimental procedure could contribute to the lack of power in addition to the small sample size. There were only eight test items
in each cell; that is, there were eight typical test items and eight atypical test items for each task. Calfee (1975) recommends a minimum of 20 items per cell to assure a reliable score. In addition, the response choices were dichotomous and dichotomous responses tend to be less reliable than responses with a larger number of possible choices (Rosenthal, 1987).

There may have also been a problem with the operationalization of some of the concepts, particularly the decision task concept. The variance for the decision task is much larger than the variance for the judgment task and comments from several subjects suggest that the response choices may not have been worded well.

A third factor related to the power issue is the mix of subjects used. The pharmacists and technicians who participated in the experiment were from an HMO with clinics in Phoenix and Tucson; although the clinics are part of the same HMO and they appeared to serve similar patient populations, substantial variability in responses was added after the Phoenix subjects were included in the respondent pool. Two factors may have contributed to this problem; one was the manner in which the test materials were developed. The test materials were developed in cooperation with the pharmacists at the Tucson sites; two of the pharmacists at Tucson served as judges of typicality.
for the stimulus items. Typicality may have been perceived differently at the Phoenix clinics than in Tucson. The recognition task in particular seemed to be sensitive to the effects of location. Pharmacists on the pilot test scored opposite to the predicted direction on the recognition task; examination of the responses showed that most of the variation was due to one item which concerned Inderal and Isordil. The HMO pharmacists indicated that Inderal was more typical than Isordil; the pilot test pharmacists responded as though the opposite were true at their practice site. The pilot test pharmacy did serve a different population of patients; a large portion of their patients were nursing home patients and Isordil is a drug commonly used to treat elderly people.

A second factor which could have contributed to the variability when the Phoenix subjects were added was the circumstances surrounding the testing in Phoenix. Arrangements had been made for the experimenter to be in Phoenix on a Wednesday when all of the pharmacists and technicians who were potential subjects would be available. However, upon arrival in Phoenix, one or two subjects were not available as planned and the pharmacies were using some technician help from a temporary service. Consequently, fewer subjects were available and there was some difficulty in working the test procedure into the work schedules as
well as finding a suitable location for testing.

Typicality affects other statistics in addition to the mean; variance and range are also influenced by the typicality of the stimulus. While means are expected to be less for atypical stimuli than for typical stimuli, the variance and range are expected to be greater for the atypical stimuli than for the typical stimuli. For the pharmacist and technician groups, all variance and range statistics were in the direction predicted except the range for pharmacists on the decision task. For the student group, the direction of the difference was in the opposite direction for four of the nine statistics. The results are summarized in Table 5.1.

The results on the reaction time dependent variable were less clear. Pharmacists and technicians always demonstrated a difference in reaction time consistent with their performance on the response choice dependent variable, that is, the mean reaction times for the typical stimuli was always less than the reaction times for the atypical stimuli. None of the differences were significant and the effect sizes calculated for each task were medium to small with a range of 0.499 to 0.123. The smallest effect size was for pharmacists on the judgment task, 0.123, even though the largest effect size for the response choice dependent variable, 0.962, was for pharmacists on
this task.

The results varied for students on the reaction time dependent variable and the results were not consistent with their performance on the response choice dependent variable. There was a moderate effect on the recognition and decision tasks (the effect size for recognition was 0.360 and for decision, 0.323) even though there was no demonstrated effect of typicality on the response choices for the recognition task and the effect on the response choice dependent variable on the decision task was in the opposite direction. The result was opposite on the judgment task as well; on the response choice dependent variable there was a moderate effect (effect size = 0.338) favoring the typical stimulus while on the reaction time dependent variable there was a small effect (effect size = 0.157) favoring a smaller reaction time for atypical stimuli than for typical stimuli.

The variable results for students on the reaction time dependent variable could be considered to be variation around zero but this interpretation is difficult to make when some of the effect sizes were larger for students than for pharmacists or technicians.

Given the lack of significance and lack of stability in the reaction time dependent variable, the results are difficult to interpret. Studies in psychology have
consistently demonstrated differences in reaction time for typical and atypical stimuli, indicating that the lack of stability in the reaction time dependent variable could be related to how reaction times were collected or to some other aspect of the experimental procedure. The use of a dichotomous response variable could have adversely affected reaction times; similar studies in psychology that measured reaction time used more than two response choices. The best interpretation for the reaction time dependent variable seems to be to suspend judgment until the experiment has been replicated.

Conclusions:

The objectives of the research was to (1) develop a model to describe the cognitive processes used by pharmacists when providing pharmacy services, (2) develop an experimental procedure for testing the model in the laboratory and (3) test the model by measuring pharmacists' performance on different information processing tasks.

The model itself can be judged by several different criteria; if the purpose of the research is to develop a mathematical equation to predict future behavior then a model could be judged by the percentage of variance explained. However, if the purpose of the model is to increase the understanding of a phenomenon, then better
evidence for the success of the model can be obtained by examining the hypotheses derived from the model and whether the hypotheses can be tested. The model did lead to the formulation of specific hypotheses about how pharmacists, technicians or students would perform on different information processing tasks and the hypotheses were tested in the laboratory. Thus the first two objectives were realized.

The third objective was to test the model by measuring the performance of three different groups of subjects on tasks requiring the use of the three cognitive processes; subjects' performance was tested and results obtained that generally supported the hypotheses. Thus the model did provide a framework for studying the cognitive processes required for the performance of information processing tasks.

Perceptions of typicality do appear to influence the performance of pharmacists and technicians on the recognition, judgment and decision tasks. The effect was not as large for technicians but was consistent across the three tasks while students did not display a reliable effect related to the typicality of the stimulus. These results seem to indicate that performance on cognitive tasks similar to the recognition, judgment and decision tasks in this experiment are primarily based on experience
rather than on knowledge acquired in an academic setting.

Typicality did not appear to affect subjects' reaction times however replication of the experiment is needed to determine if the lack of influence was due to an inadequate experimental procedure or whether an effect observed in experimental psychology does not apply to pharmacists.

Recommendations:

There are other testable hypotheses related to the model which might be tested. The experiment described above examined only the relationship between memory and performance on the information processing tasks; the experiment did not examine the relationships between the processing components. The model hypothesizes that the processing components operate sequentially but this relationship was not tested in the present experiment. Comments made by several pharmacists and performance on the judgment and decision tasks suggest that decisions are usually made about dispensing drugs without considering whether the therapy is appropriate. One older pharmacist who participated in the pilot test said that older pharmacists were not accustomed to making judgments about the appropriateness of the drug therapy. This statement implies that pharmacists are making some other judgment before deciding if a prescription should be dispensed.
Exactly what judgments are made could be the subject of future experiments. The above discussion also implies that if pharmacists are expected to make new types of judgments, such as judgments of appropriateness, then the judgment will need to be explicitly built into the dispensing procedure or the new task is not likely to be performed.

Another hypothesis concerns the information needed to perform each task; typicality was shown to affect subjects' performance on the three tasks but the experiment did not address the issue of whether the same information is used for each task. Additional experiments could attempt to determine if different information is required to perform each task.

Another researchable hypothesis concerns the development of cognitive structures over time. Pharmacists displayed a more pronounced typicality effect than did technicians; the experiment did not collect data that would indicate whether the typicality structure continues to change as the practitioner becomes more experienced or whether the change levels off after a period of time. Related to this hypothesis, is the question of what happens to perceptions of typicality and its effect on performance as practitioners age.

Probably the most important finding in this experiment was that the memory structures used in practice are
determined by experience rather than by formal learning of content such as is encountered in an academic setting. This finding has implications for both undergraduate education and continuing education for practitioners. As mentioned earlier, education is usually separated into didactic and experience components and the student is expected to integrate the two components themselves. These results indicate that didactic learning would be more effective if the student could incorporate this information into a knowledge structure similar to that which will be used in practice. Further, continuing education designed to provide new information for practitioners is likely to be much more effective if it is structured so that the information can be incorporated into the knowledge structures the practitioner is already using to process information.

The results also have implications for changing practitioner behavior such as changing behavior to include more patient counseling. If a practitioner is to counsel patients, then the practitioner must have the information that is needed for counseling. The likelihood that a pharmacist will perform a specific task should be increased if the information is readily available; procedures or systems which increase access to this information would be expected to positively affect task performance.
The effects that typicality have on performance also suggest that this factor must be considered if the objective of an intervention is to improve certain aspects of practice such as dispensing accuracy. System changes or procedures designed to improve accuracy are unlikely to be successful if they do not account for the effect that typicality has on performance. In fact, procedures or systems which are changed without consideration of the effects of typicality may actually produce elevated error rates or produce systems which are inefficient.

The information processing theory used to develop this model and experimental procedure represents a different approach to the problem of assuring quality health care. Earlier research has attempted to relate such things as accuracy to motivational or emotional processes (Nisbett and Ross, 1980) or to personality traits (Barker, 1968). Personality traits or motivational processes are secondary factors within an information processing framework; within this framework, providing the information in a form that can be utilized by the individual is believed to affect the performance of all individuals regardless of personality or emotional processes.

Providing the individual with the information in a manner which will facilitate performance of a task tends to optimize the performance of current practitioners rather
than improve performance by selecting only those individuals who perform at high levels. As mentioned in the introduction, careful selection does not assure performance even if a large pool of candidates were available from which to select. Given the current shortage of personnel in some areas of health care, such as nursing, the most profitable strategy would appear to be optimizing the performance of current practitioners rather than trying to replace them with other personnel identified through a highly selective process.

Information processing theory seems to be applicable to many tasks within health care; typicality was shown to affect three different types of tasks, recognition, judgment and decision making. In contrast, personality traits or aptitudes appear to be related to a single type of task (Barker et al., 1968) so that a person could be selected to perform well in one dimension of nursing but may not perform well in another dimension of nursing. Improving performance based on information processing theory should increase performance on the dimensions the individual performs poorly without decreasing performance on the dimensions that the individual performs well.

Information processing theory should also apply to a large number of personnel within the health professions as well as to personnel in other areas of human performance
such as pilots, operators of nuclear power plants and so on. This is advantageous in that research done in one area can be applied to problems in other areas.

The methodology developed in this research project might have application in several areas. One of these areas could be competence testing. If the competent practitioner is defined as one who has developed information structures characterized by typicality, then a testing procedure could be developed to determine whether the practitioner has indeed developed those structures.

A second application could be the testing of new drug names. Currently, new drug names are tested through an informal procedure in which the names are published and comments sought from interested parties. The methodology used in this experiment could be adapted to empirically test the names before the drug was marketed.

Based on the results of this experiment, several changes in the methodology can be recommended. The test procedure would be more likely to produce reliable results if only one task were tested at a time so that the number of stimuli could be increased and the total test time kept low. The number of responses to the questions could also be changed so that a range of responses would be available rather than a dichotomous response. Offering a range of responses may increase the precision of the reaction times
so that reaction time could become a reliable dependent variable.

The results of this experiment also have implications for other research in the social and behavioral sciences. Examples, scenarios and case studies are widely used in social sciences research as well as in testing. The performance of experienced practitioners was shown to be affected by the typicality characteristics of the examples. Research or testing procedures which do not control the typicality of the examples could be introducing bias; the test would be biased in favor of subjects for whom the examples were typical and biased against subjects for whom the examples were atypical. The typicality characteristics of the examples could also introduce additional variability; performance on atypical examples is more variable so that standard deviations would be expected to be larger and the probability of finding significance reduced.

Summary:

An information processing model was developed to describe how information used by pharmacists in providing pharmacy services is processed. The model hypothesizes a sequence of cognitive processes, perception, recognition, judgment, decision making and response control, which
continuously interact and are influenced by the content and structure of memory, particularly long term memory. Information in long term memory was hypothesized to be organized according to the perceived typicality of the stimulus.

A laboratory methodology using a laptop microcomputer was developed to test the effect of typicality on three of the cognitive processes, recognition, judgment and decision making. Three groups of subjects were tested, practicing pharmacists, pharmacy technicians and fourth year PharmD students. For the recognition task, subjects were shown a drug name then asked to indicate which of two drug names, one typical and one atypical, was shown. For the judgment task, subjects were shown a drug name and a brief description of a typical or atypical patient; subjects were asked to indicate whether the drug was likely to be appropriate therapy for the patient. For the decision task, subjects were presented with a drug name and a brief description of a typical or atypical patient then asked to indicate whether they would dispense the prescription as written or contact the prescriber before dispensing. Pharmacists' responses were consistently most biased toward the typical drug name or typical patient, technician responses were less biased and student responses the least biased. Reaction times were also collected. Pharmacists
and technicians consistently required more time to respond to atypical items than to typical items on the three different tasks while students' reaction times varied across the three tasks.

Further, the results appear to be to memory structures rather than to knowledge. Pharmacists and students scored equally well on the knowledge test but pharmacists' performance was significantly affected by typicality while students' performance was not. Technicians' performance was biased much like that of pharmacists but technicians scored significantly lower on the knowledge test than did pharmacists.
APPENDIX 3.1
DRUG NAME PAIRS SELECTED FOR USE AS STIMULI

Typicality ratings were obtained on 32 drug names (16 pairs) so that drug name pairs could be selected which differed most on the typicality scale.

1. Terbutaline  2. Tolbutamide
3. Atarax  4. Apresoline
5. Seldane  6. Feldene
7. Tegretol  8. Tagamet
11. Tetracycline\textsuperscript{a}  12. Thorazine
15. Diamox  16. Diabinese
17. Nitroglycerin  18. Nortriptyline
19. Antabuse  20. Anturane
21. Trihexyphenidyl HCl  22. Triamcinolone
25. Diltiazem  26. Dilantin
27. Seconal  28. Demerol
29. Inderal  30. Isordil
31. Cyclosporine  32. Cyclospasmol

\textsuperscript{a}The original drug was thioridazine which is in the same therapeutic category as Thorazine.
\textsuperscript{b}The original drug was Norpramin which is in the same therapeutic category as Nortriptyline.
APPENDIX 3.2

PATIENT DESCRIPTIONS

A study is currently being conducted at the University of Arizona College of Pharmacy on how practicing pharmacists think about the drugs and the patients that they encounter in their practice. As part of this study, descriptions of patients characteristic of different types of drug therapy are needed.

A list of drug names is provided on the following pages; please provide a description of a patient that you think is very typical of that type of therapy. The description should include characteristics of the patient or patients you think is most typical of the patients encountered in your practice who have prescriptions for that drug. An outline of the information needed on each patient is provided to assist you.

An example is provided below which will demonstrate how to proceed.

EXAMPLE:

Drug therapy: Keflex

A typical patient:

Sex: __________ Age: ______________

Diagnosis: ____________________________

Other characteristics: ___________________________________________

(including concurrent drug therapy)

For the 'other characteristics' include one or two pertinent items of information such as obesity, smoker, past history of drug abuse, past history of by-pass surgery and so on. Include concurrent drug therapy if the drug therapy is typical of the patients taking the designated drug.

Please proceed to the next page.
Drug names and patient information blanks are provided below. Fill out the patient information blanks for each drug as described on the front page.

1. Drug therapy: Terbutaline
   A typical patient:
   - Sex: ____________  Age: ______________
   - Diagnosis: ______________________________
   - Other characteristics: ____________________

2. Drug therapy: Dilantin
   A typical patient:
   - Sex: ____________  Age: ______________
   - Diagnosis: ______________________________
   - Other characteristics: ____________________

3. Drug therapy: Antabuse
   A typical patient:
   - Sex: ____________  Age: ______________
   - Diagnosis: ______________________________
   - Other characteristics: ____________________

4. Drug therapy: Atarax
   A typical patient:
   - Sex: ____________  Age: ______________
   - Diagnosis: ______________________________
   - Other characteristics: ____________________
Fill out the patient descriptions as indicated on page :.

5. Drug therapy: Seldane
   A typical patient:
   Sex: _____________  Age: __________________
   Diagnosis: ________________________________
   Other characteristics: ________________________

6. Drug therapy: Tegretol
   A typical patient:
   Sex: _____________  Age: __________________
   Diagnosis: ________________________________
   Other characteristics: ________________________

7. Drug therapy: Tolbutamide
   A typical patient:
   Sex: _____________  Age: __________________
   Diagnosis: ________________________________
   Other characteristics: ________________________

8. Drug therapy: Apresoline
   A typical patient:
   Sex: _____________  Age: __________________
   Diagnosis: ________________________________
   Other characteristics: ________________________
Fill out the patient descriptions as indicated on page 1.

9. Drug therapy: Feldane

A typical patient:

Sex: ___________ Age: ______________

Diagnosis: ____________________________

Other characteristics: ____________________________

10. Drug therapy: Tagamet

A typical patient:

Sex: ___________ Age: ______________

Diagnosis: ____________________________

Other characteristics: ____________________________

11. Drug therapy: Florinef

A typical patient:

Sex: ___________ Age: ______________

Diagnosis: ____________________________

Other characteristics: ____________________________

12. Drug therapy: Tetracycline

A typical patient:

Sex: ___________ Age: ______________

Diagnosis: ____________________________

Other characteristics: ____________________________
Fill out the patient descriptions as indicated on page 1.

13. Drug therapy: Dibinese
   A typical patient:
   Sex: __________  Age: __________
   Diagnosis: ____________________________________________
   Other characteristics: __________________________________

14. Drug therapy: Inderal
   A typical patient:
   Sex: __________  Age: __________
   Diagnosis: ____________________________________________
   Other characteristics: __________________________________

15. Drug therapy: Triamcinolone
   A typical patient:
   Sex: __________  Age: __________
   Diagnosis: ____________________________________________
   Other characteristics: _________________________________

16. Drug therapy: Anturane
   A typical patient:
   Sex: __________  Age: __________
   Diagnosis: ____________________________________________
   Other characteristics: _________________________________
Fill out the patient descriptions as indicated on page 17.

17. Drug therapy: Acetohexamide
   A typical patient:
   Sex: ___________ Age: ___________
   Diagnosis: __________________________________________
   Other characteristics: ____________________________________________

18. Drug therapy: Diltiazem
   A typical patient:
   Sex: ___________ Age: ___________
   Diagnosis: __________________________________________
   Other characteristics: ____________________________________________

19. Drug therapy: Seconal
   A typical patient:
   Sex: ___________ Age: ___________
   Diagnosis: __________________________________________
   Other characteristics: ____________________________________________

20. Drug therapy: Cyclospasmol
   A typical patient:
   Sex: ___________ Age: ___________
   Diagnosis: __________________________________________
   Other characteristics: ____________________________________________
Fill out the patient descriptions as indicated on page 1.

21. Drug therapy: Isordil

A typical patient:

Sex: ___________ Age: _______________

Diagnosis: ____________________________________________

Other characteristics: __________________________________

22. Drug therapy: Nortriptyline

A typical patient:

Sex: ___________ Age: _______________

Diagnosis: ____________________________________________

Other characteristics: __________________________________

23. Drug therapy: Diamox

A typical patient:

Sex: ___________ Age: _______________

Diagnosis: ____________________________________________

Other characteristics: __________________________________

24. Drug therapy: Delalutin

A typical patient:

Sex: ___________ Age: _______________

Diagnosis: ____________________________________________

Other characteristics: __________________________________

Fill out the patient descriptions as indicated on page 1.

25. Drug therapy: Fiorinal

A typical patient:

Sex: ___________  Age: ___________

Diagnosis: ________________________________

Other characteristics: ________________________________

26. Drug therapy: Trihexyphenidyl HCl

A typical patient:

Sex: ___________  Age: ___________

Diagnosis: ________________________________

Other characteristics: ________________________________

27. Drug therapy: Cyclosporin

A typical patient:

Sex: ___________  Age: ___________

Diagnosis: ________________________________

Other characteristics: ________________________________

28. Drug therapy: Demerol

A typical patient:

Sex: ___________  Age: ___________

Diagnosis: ________________________________

Other characteristics: ________________________________
APPENDIX 3.3

PHARMACIST QUESTIONNAIRE

You are being asked to fill out the following questionnaire as part of a study being conducted at the University of Arizona, College of Pharmacy on how practicing pharmacists think about the drugs that they encounter in their practice.

The first section of this questionnaire is concerned with drug names and with whether one drug name is more likely to occur in your practice than a second drug name. The second section is concerned with whether you consider an example patient to be typical of patients on a specific drug.

Please answer the following questions about your practice before you begin the questionnaire.

1. Which of the following best describes your primary practice site? (Circle one.)
   (a) Acute care hospital
   (c) Independent pharmacy
   (e) HMO pharmacy
   (b) Long term care facility
   (d) Chain pharmacy
   (f) Other

2. How many years have you been practicing pharmacy? _____

3. How many hours do you work as a pharmacist per week? (Use average per week for past year)_____________________

4. What percentage of the patients that you see in your practice do you counsel? ___________%

PLEASE PROCEED TO THE NEXT PAGE
DIRECTIONS:

The purpose of the questions in this section is to determine whether one drug name is more likely to occur in your practice than a second drug name. Two different drug names will be presented simultaneously, you are to determine which of the two drug names that you are most likely to come across in your practice.

Several examples are provided below to illustrate how the drug names will be presented and how you can select an answer.

EXAMPLE:

Of the pairs of drug names listed below, which drug name are you more likely to come across in your practice? If you are much more likely to come across one drug name than the other, place an 'X' in the box closest to that drug name; if you are just as likely to come across one drug name as the other then place an 'X' in the center box and so on.

(1) Compazine :____:____:____:____:____:____:____: Cimetidine
Both are equally likely

(2) Ativan :____:____:____:____:____:____:____: Adapin
Both are equally likely

The 'X' in the box next to Cimetidine indicates that you are much more likely to come across the drug name 'Cimetidine' than the drug name 'Compazine' in your practice. The 'X' in the third box from Ativan indicates that you are slightly more likely to come across the drug name 'Ativan' than the drug name 'Adapin' in your practice.

Proceed through the drug name pairs as quickly as you can. Select each answer using your first impression of whether you are more likely to come across one drug name than another.

PLEASE PROCEED TO THE NEXT PAGE
For each drug name pair listed below, indicate which drug name you are most likely to come across in your practice.

1. Terbutaline: ___:___:___:___:___:___: Tolbutamide
   Both are equally likely

2. Atarax: ___:___:___:___:___:___: Apresoline
   Both are equally likely

3. Seldane: ___:___:___:___:___:___: Feldene
   Both are equally likely

4. Tegretol: ___:___:___:___:___:___: Tagamet
   Both are equally likely

5. Florinef: ___:___:___:___:___:___: Fiorinal
   Both are equally likely

6. Tetracycline: ___:___:___:___:___:___: Thorazine
   Both are equally likely

7. Diflunisal: ___:___:___:___:___:___: Dilantin
   Both are equally likely

8. Diamox: ___:___:___:___:___:___: Diabinese
   Both are equally likely

PLEASE PROCEED TO THE NEXT PAGE
For each drug name pair listed below, indicate which drug name that you are most likely to come across in your practice.

9. Nitroglycerin: ______:_____:_____:_____:_____:_____: Nortriptiline
   Both are equally likely

10. Antabuse: ______:_____:_____:_____:_____: Anturane
    Both are equally likely

11. Triamcinolone: ______:_____:_____:_____:_____: Trihexyphenidyl
    Both are equally likely

12. Acetohexamide: ______:_____:_____:_____:_____: Acetazolamide
    Both are equally likely

13. Diltiazem: ______:_____:_____:_____:_____: Dilantin
    Both are equally likely

14. Seconal: ______:_____:_____:_____:_____: Demerol
    Both are equally likely

15. Inderal: ______:_____:_____:_____:_____: Isordil
    Both are equally likely

16. Cyclosporine: ______:_____:_____:_____:_____: Cyclospasmol
    Both are equally likely

PLEASE PROCEED TO THE NEXT PAGE
DIRECTIONS:

The questions in this section are to find out whether you think a particular patient is typical of patients on a specific drug. A specific drug will be named, then a brief description of two different patients will be provided. You are to indicate, based on your experience, how typical you consider each patient to be of the patients who take the specified drug.

An example is provided below to demonstrate how the information will be presented and how you should answer the questions.

EXAMPLE:

Indicate on the scale provided how typical you consider this patient to be of patients taking the specified drug. If you consider the patient to be very typical, place an 'X' in the box next to 'Very typical'; if the patient is not at all typical, place an 'X' in the box next to 'Not at all typical'.

1. Of patients on Lanoxin(Digoxin), how typical is:

(A) A 64 year old male on Hydrodiuril.

Not at all :____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:____:___
Indicate on the scale provided how typical you consider each patient to be of patients taking the specified drug.

1. Of patients on *Nortriptyline* (Aventyl), how typical is:
   (A) A 32 year old female with a recent 20 pound weight loss.
       Not at all : ___ : ___ : ___ : ___ : ___ : Very typical
typical
   (B) A 69 year old male on Cardizem.
       Not at all : ___ : ___ : ___ : ___ : ___ : Very typical
typical

2. Of patients on *Antabuse* (disulfiram), how typical is:
   (A) A 54 year old male on Colchicine.
       Not at all : ___ : ___ : ___ : ___ : ___ : Very typical
typical
   (B) A 38 year old male who smokes, is a Vietnam veteran and has a
       history of drug abuse.
       Not at all : ___ : ___ : ___ : ___ : ___ : Very typical
typical

3. Of patients on *Tagamet* (Cimetidine), how typical is:
   (A) A 17 year old female who has previously taken phenytoin and
       phenobarbital.
       Not at all : ___ : ___ : ___ : ___ : ___ : Very typical
typical
   (B) A 42 year old male who smokes and takes antacids.
       Not at all : ___ : ___ : ___ : ___ : ___ : Very typical
typical

PLEASE PROCEED TO THE NEXT PAGE
4. Of patients on Diamox (Acetazolamide), how typical is:

(A) A 49 year old obese male on Nadolol and Nitroglycerin.

Not at all: ______:____:____:____:____:____: Very typical

(B) A 76 year old female using pilocarpine, epinephrine and timolol ophthalmic solutions.

Not at all: ______:____:____:____:____:____: Very typical

5. Of patients on Apresoline (Hydralazine), how typical is:

(A) A 54 year old female on Inderal, Lanoxin and Lasix.

Not at all: ______:____:____:____:____:____: Very typical

(B) A 10 year old female who uses Cortaid cream.

Not at all: ______:____:____:____:____:____: Very typical

6. Of patients on Feldene (Piroxicam), how typical is:

(A) A 28 year old female who has been using Visine eye drops.

Not at all: ______:____:____:____:____:____: Very typical

(B) A 68 year old female on Calcium supplements and antacids.

Not at all: ______:____:____:____:____:____: Very typical

7. Of patients on Thorazine (Chlorpromazine), how typical is:

(A) A 14 year old male who uses Retin A and benzoyl peroxide.

Not at all: ______:____:____:____:____:____: Very typical

(B) A 28 year old single, unemployed male on Prolinxin.

Not at all: ______:____:____:____:____:____: Very typical
8. Of patients on Cyclospasmol (Cyclandelate), how typical is:

(A) An 18 year old male on prednisone.

Not at all: ______:____:____:____:____:____: Very typical

(B) A 64 year old female who smokes.

Not at all: ______:____:____:____:____:____: Very typical

9. Of patients on Terbutaline (Brethine), how typical is:

(A) A 62 year old female on theophylline and a past history of smoking.

Not at all: ______:____:____:____:____:____: Very typical

(B) A 78 year old obese female who has had multiple refills on her Monistat prescription.

Not at all: ______:____:____:____:____:____: Very typical

10. Of patients on Fiorinal, how typical is

(A) A 28 year old female who smokes.

Not at all: ______:____:____:____:____:____: Very typical

(B) An 83 year old female.

Not at all: ______:____:____:____:____:____: Very typical

11. Of patients on Inderal (Propranolol), how typical is:

(A) A 50 year old black female on Hydrochlorothiazide.

Not at all: ______:____:____:____:____:____: Very typical

(B) A 69 year old obese male on Nifedipine who smokes.

Not at all: ______:____:____:____:____:____: Very typical
12. Of patients on **Diltiazem** (*Cardizem*), how typical is:

(A) A 22 year old male without other drug therapy.

Not at all: ___:___:___:___:___:___:___:___: Very typical
typical

(B) A 69 year old obese male on **Nitroglycerin** who smokes.

Not at all: ___:___:___:___:___:___:___: Very typical
typical

13. Of patients on **Acetazolamide** (*Diamox*), how typical is:

(A) A 60 year old obese female on Hydrodiuril and Aldomet.

Not at all: ___:___:___:___:___:___:___: Very typical
typical

(B) A 76 year old female who uses pilocarpine, epinephrine and 
timolol ophthalmic solutions.

Not at all: ___:___:___:___:___:___:___: Very typical
typical

14. Of patients on **Diflunisal** (*Dolobid*), how typical is:

(A) An 8 year old male on phenobarbital.

Not at all: ___:___:___:___:___:___:___: Very typical
typical

(B) A 34 year old male weekend sportsman.

Not at all: ___:___:___:___:___:___:___: Very typical
typical

15. Of patients on **Trihexyphenidyl HCl** (*Artane*), how typical is:

(A) A 62 year old male on *amantadine*.

Not at all: ___:___:___:___:___:___:___: Very typical
typical

(B) A 29 year old female using a coal tar ointment.

Not at all: ___:___:___:___:___:___:___: Very typical
typical
16. Of patients on Dilantin(Phenytoin), how typical is:
   (A) A 34 year old male weekend sportsman.
      Not at all :____:____:____:____:____:____: Very typical
   (B) An 8 year old male on phenobarbital.
      Not at all :____:____:____:____:____:____: Very typical

17. Of patients on Anturane(Sulfinpyrazone), how typical is:
   (A) A 54 year old male on colchicine.
      Not at all :____:____:____:____:____:____: Very typical
   (B) A 38 year old male who smokes, is a Vietnam veteran and has a history of drug abuse.
      Not at all :____:____:____:____:____:____: Very typical

18. Of patients on oral Triamcinolone(Aristocort), how typical is:
   (A) A 62 year old male on amantadine.
      Not at all :____:____:____:____:____:____: Very typical
   (B) A 29 year old female using a coal tar ointment.
      Not at all :____:____:____:____:____:____: Very typical

19. Of patients on Tetracycline, how typical is:
   (A) A 28 year old single, unemployed male on Prolixin.
      Not at all :____:____:____:____:____:____: Very typical
   (B) A 14 year old male who uses Retin A and benzoyl peroxide.
      Not at all :____:____:____:____:____:____: Very typical
20. Of patients on Acetohexamide (Dymelor), how typical is:

(A) A 59 year old male who uses pilocarpine, epinephrine and timolol ophthalmic solutions.

Not at all: _____:_____:_____:_____:_____:_____: Very typical

(B) A 60 year old obese female on Hydrodiuril and Aldomet.

Not at all: _____:_____:_____:_____:_____:_____: Very typical

21. Of patients on Florinef (Fludrocortisone acetate), how typical is:

(A) A 28 year old female who smokes.

Not at all: _____:_____:_____:_____:_____:_____: Very typical

(B) An 83 year old female.

Not at all: _____:_____:_____:_____:_____:_____: Very typical

22. Of patients on Isordil (Isosorbide dinitrate), how typical is:

(A) A 50 year old black female on Hydrochlorothiazide.

Not at all: _____:_____:_____:_____:_____:_____: Very typical

(B) A 69 year old obese male on Nifedipine who smokes.

Not at all: _____:_____:_____:_____:_____:_____: Very typical

23. Of patients on Tolbutamide (Orinase), how typical is:

(A) A 62 year old female on Theophylline and with a past history of smoking.

Not at all: _____:_____:_____:_____:_____:_____: Very typical

(B) A 78 year old obese female with multiple refills on her Monistat prescription.

Not at all: _____:_____:_____:_____:_____:_____: Very typical
24. Of patients on Seconal, how typical is:

(A) A 54 year old male.

Not at all : ______: ______: ______: ______: ______: ______: Very typical

typical

(B) A 24 year old male.

Not at all : ______: ______: ______: ______: ______: ______: Very typical
typical

25. Of patients on Atarax (Hydroxyzine HCl), how typical is:

(A) A 54 year old female on Inderal, Lanoxin and Lasix.

Not at all : ______: ______: ______: ______: ______: ______: Very typical
typical

(B) A 10 year old female using Cortaid cream.

Not at all : ______: ______: ______: ______: ______: ______: Very typical
typical

26. Of patients on Seldane (Terfenadine), how typical is:

(A) A 28 year old female who has been using Visine eye drops.

Not at all : ______: ______: ______: ______: ______: ______: Very typical
typical

(B) A 68 year old female on Calcium supplements and antacids.

Not at all : ______: ______: ______: ______: ______: ______: Very typical
typical

27. Of patients on Tegretol (Carbamazepine), how typical is:

(A) A 17 year old female who had previously taken phenytoin and
phenobarbital.

Not at all : ______: ______: ______: ______: ______: ______: Very typical
typical

(B) A 42 year old male who smokes and takes antacids.

Not at all : ______: ______: ______: ______: ______: ______: Very typical
typical
28. Of patients on Diabinese (Chlorpropamide), how typical is:
   (A) A 49 year old obese male on Nadolol and Nitroglycerin.
      Not at all:____:____:____:____:____:____: Very typical
      (B) A 76 year old female using pilocarpine, epinephrine and timolol ophthalmic solutions.
      Not at all:____:____:____:____:____:____: Very typical

29. Of patients on Nitroglycerin, how typical is:
   (A) A 69 year old obese male on Cardizem.
      Not at all:____:____:____:____:____:____: Very typical
   (B) A 32 year old female with a recent 20 pound weight loss.
      Not at all:____:____:____:____:____:____: Very typical

30. Of patients on Demerol (Meperidine), how typical is:
   (A) A 54 year old male.
      Not at all:____:____:____:____:____:____: Very typical
   (B) A 24 year old male.
      Not at all:____:____:____:____:____:____: Very typical

31. Of patients on Dilantin (Phenytoin), how typical is:
   (A) A 22 year old male without other drug therapy.
      Not at all:____:____:____:____:____:____: Very typical
   (B) A 69 year old obese male on Nitroglycerin who smokes.
      Not at all:____:____:____:____:____:____: Very typical
32. Of patients on Cyclosporine(Sandimmune), how typical is:

(A) An 18 year old male on prednisone.

Not at all :___:___:___:___:___:___: Very typical

typical

(B) A 64 year old female who smokes.

Not at all :___:___:___:___:___:___: Very typical

typical

The End

THANK YOU FOR PARTICIPATING!
APPENDIX 3.4
EXAMPLE STIMULUS-RESPONSE DISPLAYS
FOR THE RECOGNITION TASK

The recognition stimuli were developed with pairs of drug names; each pair consisted of one typical and one atypical drug name. For example, Diabinese-Diamox represent a pair of drugs in which Diabinese was rated as a typical drug and Diamox as an atypical drug. From these two drug names two stimulus displays and two response displays were formed as shown below. The order of the drug names in the response display was established by using a computer random number program.

Stimulus Display #1:

Diabinese

Response Display #1: Which drug name is identical to the name just shown?

1. Diamox
2. Diabinese

Stimulus Display #2:

Diamox

Response Display #2: Which drug name is identical to the name just shown?

1. Diamox
2. Diabinese
APPENDIX 3.5

EXAMPLE STIMULUS-RESPONSE DISPLAYS FOR

THE JUDGMENT TASK

The displays for the judgment task were developed from the list of drug and from the patient descriptions. Each stimulus display contained a specified drug and a patient description; the patient was rated by the two pharmacist-judges as typical or atypical. The drug and patient description served as the stimulus for the judgment task; subjects responded by indicating whether the drug therapy was likely to be appropriate or inappropriate for the patient.

The display order for the stimuli was determined using a random number program on a microcomputer.

The dependent variable for this task was the number of responses indicating that the drug was likely to be appropriate for typical versus atypical patients.

The question was displayed first, the screen was cleared and the drug name with the patient description was displayed. The possible response choices were shown at the bottom of the screen so that the subject could respond as soon as they had finished reading the display information.

Stimulus Display:

Diabinese (chlorpropamide) for a 49 year old male on Nadolol and Nitroglycerin.

Response Display:

The specified drug therapy is likely to be

______________ for the patient described.

1. appropriate
2. inappropriate
APPENDIX 3.6

EXAMPLE STIMULUS-RESPONSE DISPLAYS FOR

THE DECISION TASK

The displays for the decision task were developed from the list of drugs and from the patient descriptions. Each stimulus display contained a specified drug and a patient description; the patient was rated by the two pharmacist-judges as typical or atypical. The drug and patient description served as the stimulus for the decision task; subjects responded by indicating whether they would dispense the prescription as written or whether they would contact the patient or prescriber before dispensing. The stimulus displays for the decision task were similar to the stimulus displays for the judgment task but no two displays contained an identical drug-patient combination.

The display order for the stimuli was determined using a random number program on a microcomputer.

The response choice dependent variable was calculated by counting the number of response indicating that the prescription was suitable to dispensed as written for the typical versus atypical patients.

The question was displayed first, the screen was cleared and the drug name with the patient description was displayed. The possible response choices were shown at the bottom of the screen so that the subject could respond as soon as they had finished reading the display information.

Stimulus Display:

Nitroglycerin (Nitrostat) for a 69 year old male on Cardizem.

Response Display:

Which of the two actions described below would be a suitable response for the drug therapy just described?

(1) Dispense the prescription as written.
(2) Check with the patient or the doctor about the use of the drug before dispensing.
APPENDIX 3.7

KNOWLEDGE TEST

The knowledge test was constructed in two parts; the first part tested for knowledge of drug names and the second part tested for knowledge about the therapeutic use of the drugs. The content of the test items was chosen using a random number program on a microcomputer; ten drugs were chosen for the drug name portion of the test and ten drugs were chosen for the therapeutic use portion of the test. Each item contained a stem and two answer choices in a multiple choice format.

The questions were designed to correspond to the content of the stimuli used in the experimental procedure. For the drug name portion, a drug name was provided (e.g., Acetohexamide) and the two possible answers were Diamox or Diabinese; the alternatives that appeared in the recognition section of the experimental procedure. For the therapeutic use portion, a drug name was provided and the two possible answers were diagnoses provided by the clinical pharmacist during the materials development phase. Thus knowledge was tested that was directly relevant to the experimental task.

The knowledge test was administered at the end of the experimental procedure on the microcomputer. The subjects could answer each question by pressing one of two keys on the keyboard. Example questions are shown below.

Drug name question:

The generic name for Diamox is:

1. acetohexamide
2. acetazolamide

Therapeutic use question:

A typical therapeutic indication for Diamox (acetazolamide) is:

1. Glaucoma.
APPENDIX 3.8
COMPUTER PROGRAM

'the introduction to the experimental procedure

CLS
TIME$ = "0:00:00"
TIMER ON
'screen #1
LOCATE (6),(14)
PRINT "You are being asked to participate in the following"
LOCATE (8),(10)
PRINT "experiment as part of a study being conducted at the"
LOCATE (10),(10)
PRINT "University of Arizona, College of Pharmacy on how practicing"
LOCATE (12),(10)
PRINT "pharmacists, pharmacy technicians and pharmacy students think"
LOCATE (14),(10)
PRINT "about the drugs and the patients that they encounter in their"
LOCATE (16),(10)
PRINT "practice."
LOCATE (22),(15)

CALL CHANGE
'screen #2
CLS
LOCATE (6),(14)
PRINT "The purpose of this experiment is to study different parts"
LOCATE (8),(10)
PRINT "of the thinking process needed to interpret and dispense a"
LOCATE (10),(10)
PRINT "prescription. Therefore you will be presented with different"
LOCATE (12),(10)
PRINT "segments of prescription information and then asked questions"
LOCATE (14),(10)
PRINT "about each segment."
LOCATE (16),(14)
PRINT "There are no right or wrong answers to the questions thus"
LOCATE (18),(10)
PRINT "you need not be concerned about passing or failing."
LOCATE (21),(14)
CALL CHANGE

'screen # 3
CLS
LOCATE (6),(14)
PRINT "Studying how pharmacists, technicians and students think"
LOCATE (8),(10)
PRINT "about the drugs and the patients encountered in their practice"
LOCATE (10),(10)
PRINT "is important to developing instruction in pharmacy or for"
LOCATE (12),(10)
PRINT "developing new pharmacy systems."
LOCATE (15),(14)
CALL CHANGE

'screen #4
CLS
LOCATE (6),(14)
PRINT "The first section of the experiment will contain some"
LOCATE (8),(10)
PRINT "questions asking you to describe your practice or the"
LOCATE (10),(10)
PRINT "experience you’ve had working in a pharmacy."
LOCATE (12),(14)
PRINT "The next three sections of the experiment will contain the"
LOCATE (14),(10)
PRINT "questions about drug therapy. The final section will"
LOCATE (16),(10)
PRINT "contain some knowledge questions about drugs and diseases."
LOCATE (19),(15)
CALL CHANGE

'screen #5
CLS
The three sections concerning drug therapy ask different types of questions. In the first part, you will be presented with a drug name then asked to indicate which of two drug names you saw. In the second part, you will be shown a drug name and a patient description and asked to determine whether the drug is appropriate for the patient. In the third part, you will be shown a patient description and a drug name. You will be asked to indicate which of two actions you would consider suitable.

All your answers are confidential. If you are not sure how to answer, please answer using your best guess. Answer all the questions as quickly and accurately as you can.

Your participation in this experiment is greatly appreciated.
'if this is first subject, must open data file
OPEN "SUBANS%.DAT" FOR APPEND AS #19
CLOSE #19

OPEN "SUBANS%.DAT" FOR INPUT AS #20

' read through the file and count number of records
S%=0 'counter variable

DO WHILE NOT EOF(20)
   LINE INPUT #20, TEMP$
   S%=S% + 1
LOOP

' assign current subject number
SUBJNO% = S% + 1
CLOSE #20

' begin test procedure
A = SUBJNO%

'dimension arrays for storing demographic data
DIM DEMO% (SUBJNO%:SUBJNO%,1:6):'array is set
   for 5 questions + 1 FOR S
' store subject no in array
A = SUBJNO%
DEMO%(A,1) = A

'screen #6--collect demographic data
CLS
LOCATE (6),(14)
PRINT "Several questions about your practice will now be displayed."
LOCATE (8),(10)
PRINT "Please answer the questions by pressing the number on the "
LOCATE (10),(10)
PRINT "keyboard which corresponds to your selection."
LOCATE (13),(14)
PRINT "Please indicate whether you are a practicing pharmacist, "
LOCATE (15),(10)
PRINT "a pharmacy technician or a pharmacy student."
LOCATE (17),(10)
PRINT "(1) Practicing pharmacist
   (2) Pharmacy technician "
LOCATE (19),(10)
PRINT "(3) Pharmacy student
(4) Other"

WHILE NOT INSTAT
WEND

JOB$ = INKEY$
JOB% = VAL(JOB$)
'store type of practitioner in array
DEMO%(A,2) = JOB%

IF JOB% = 1 OR JOB% = 4 THEN
CLS

LOCATE (6),(14)
PRINT "1. Which of the following best describes your primary"
LOCATE (8),(10)
PRINT "practice site?"
LOCATE (10),(10)
PRINT "(1) Acute care hospital
(2) Long term care facility"
LOCATE (12),(10)
PRINT "(3) Independent pharmacy"
LOCATE (14),(10)
PRINT "(4) Chain pharmacy"
LOCATE (16),(10)
PRINT "(5) HMO pharmacy"
LOCATE (18),(10)
PRINT "(6) Other"

WHILE NOT INSTAT
WEND

R$ = INKEY$
R% = VAL(R$)
'store response in array
DEMO%(A,3) = R%

CLS

LOCATE (6),(14)
PRINT "For the next three questions, answer by entering the"
LOCATE (7),(10)
PRINT "correct number from the keyboard then pressing return."
LOCATE (10),(10)
PRINT "2. How many years have you been practicing pharmacy"
LOCATE (11),(13)
INPUT "as a licensed pharmacist";R%
LOCATE (13),(10)
'store response
DEMO%(A,4) = R%
PRINT "3. How many hours do you work as a pharmacist per week?"
LOCATE (14),(10)
INPUT "(Use average per week for the past year.)",R%
'Store response
DEMO%(A,5) = R%
LOCATE (16),(10)
PRINT "4. What percentage of the patients that you see in your"
LOCATE (17),(10)
INPUT "practice do you counsel";R%
'Store response
DEMO%(A,6) = R%
LOCATE (22),(15)
OPEN "DEMO%.DAT" FOR APPEND AS #1
'FOR-NEXT loop for storing data in file
FOR I = 1 TO 6
IF I < 6 THEN PRINT #1, DEMO%(A,I)" ";:ELSE PRINT #1, DEMO%(A,I):
NEXT
CLOSE #1
CALL CHANGE
ELSEIF JOB% = 2 THEN
CLS
LOCATE (6),(14)
PRINT "1. Which of the following best describes the pharmacy"
LOCATE (8),(10)
PRINT "where you work?"
LOCATE (10),(10)
PRINT "(1) Acute care hospital"
LOCATE (12),(10)
PRINT "(2) Long term care facility"
LOCATE (14),(10)
PRINT "(3) Independent pharmacy"
LOCATE (16),(10)
PRINT "(4) Chain pharmacy"
LOCATE (18),(10)
PRINT "(5) HMO pharmacy"
WHILE NOT INSTAT
WEND
R$ = INKEY$
CLS
'Store response in array
R% = VAL(R$)
DEMO%(A,3) = R%
LOCATE (6),(14)
PRINT "For the next three questions, answer by entering the"
LOCATE (7),(10)
PRINT "correct number from the keyboard then pressing return."
LOCATE (10),(10)
PRINT "2. How many years have you been working as a pharmacy"
LOCATE (11),(13)
INPUT "Technician (answer to the nearest year)";R%
'store response
DEMO%(A,4) = R%
LOCATE (13),(10)
PRINT "3. How many hours do you work in a pharmacy per week?"
LOCATE (14),(10)
INPUT "(Use average per week for the past year.)";R%
'store response
DEMO%(A,5) = R%
LOCATE (16),(10)
PRINT "4. What percentage of the patients who come to the pharmacy"
LOCATE (17),(10)
INPUT "do you talk to about their medicines";R%
'store response
DEMO%(A,6) = R%
'Store data in file
OPEN "DEMO%.DAT" FOR APPEND AS #1
FOR I = 1 TO 6
    IF I < 6 THEN PRINT #1, DEMO%(A,I)
ELSE PRINT #1, DEMO%(A,6):
NEXT
LOCATE (22),(15)

CALL CHANGE
ELSE
CLS
LOCATE (6),(14)
PRINT "1. Which of the following best describes the pharmacy"
LOCATE (8),(10)
PRINT "where you have worked as a pharmacy student?"
LOCATE (10),(10)
PRINT "(1) Acute care hospital facility" (2) Long term care facility
LOCATE (12),(10)
PRINT "(3) Independent pharmacy" (4) Chain pharmacy
LOCATE (14),(10)
PRINT "(5) HMO pharmacy" (6) I have no work experience 

WHILE NOT INSTAT
WEND
CLS
'store response
R$ = INKEY$
R% = VAL(R$)
DEMO%(A,3) = R%

LOCATE (6),(14)
PRINT "For the next three questions, answer by entering the "
LOCATE (7),(10)
PRINT "correct number from the keyboard then pressing return."
LOCATE (10),(10)
PRINT "2. How many internship hours have you earned working"
LOCATE (11),(13)
INPUT "as a pharmacy intern";R%
'store response
DEMO%(A,4) = R%

LOCATE (13),(10)
PRINT "3. How many hours do you work in a pharmacy per week?"
LOCATE (14),(10)
INPUT "(Use average per week for the past year.)";R%
'store response
DEMO%(A,5) = R%

LOCATE (16),(10)
PRINT "4. What percentage of the patients who come to the pharmacy "
LOCATE (17),(10)
INPUT "do you counsel about their medicines";R%
'store response
DEMO%(A,6) = R%

'store responses in file
OPEN "DEMO%.DAT" FOR APPEND AS #1
FOR I = 1 TO 6
  IF I < 6 THEN PRINT #1, DEMO%(A,I)" ":ELSE PRINT #1, DEMO%(A,I):
  NEXT
  LOCATE (22), (15)
  CALL CHANGE
END IF
CLOSE

CLS:LOCATE (8), (15)
PRINT "The questions about your practice or work"
LOCATE (10), (15)
PRINT "experience are now complete."
LOCATE (14), (15)
PRINT "Press any key to start the experimental procedure."
CHAR$ = INKEY$
WHILE NOT INSTAT
  WEND

'---------------------
'data collection portion of the program
'RECOGNITION

CLS
LOCATE (6), (14)
PRINT "This is the section of the experiment in which a drug name"
LOCATE (8), (10)
PRINT "will be presented on the screen then you will be asked to"
LOCATE (10), (10)
PRINT "identify which of two drug names that you thought was shown."
LOCATE (12), (14)
PRINT "The drug name will be presented for only part of a second."
LOCATE (14), (10)
PRINT "If you do not have time to recognize the drug name then answer"
LOCATE (16), (10)
PRINT "with your best guess."
LOCATE (18), (14)
PRINT "Accuracy and speed are equally important therefore you"
LOCATE (20), (10)
PRINT "should answer as quickly and as accurately as possible."
When the test begins, you will be presented with a short row of 'XOXOXOX' letters. Focus your eyes on these letters. These letters will be erased and replaced by the drug name. The drug name will be shown for only part of a second then it will be erased and a question will appear asking you to identify which drug you saw. Answer by pressing the '1' or '2' key. Position your hand so that the heel of your hand rests on the table and one finger is resting on the key marked '1' and and one finger is resting on the key marked '2'. This screen will demonstrate how the focus letters, the drug name and the identification question will appear. The focus letters will appear in the center of the screen.

DELAY 5
CLS
PRINT "XOXOXOX"
DELAY 2.0
LOCATE (8),(10)
PRINT "Now the letters will be erased and the drug name will appear."
DELAY 3:CLS
LOCATE (10),(30)
PRINT "Ampicillin"
DELAY 1.0
LOCATE (6),(10)
PRINT "The drug name will be erased and the identification question"
LOCATE (7),(10)
PRINT "will appear. Answer by pressing the number '1' or number '2' key."
DELAY 4:CLS
LOCATE (10),(25)
PRINT "Which drug name is identical"
LOCATE (11),(27)
PRINT "to the name just shown?"
LOCATE (13),(30)
PRINT "(1) Amoxicillin"
LOCATE (15),(30)
PRINT "(2) Ampicillin"
LOCATE (20),(25)
CHAR$ = INKEY$
WHILE NOT INSTAT
WEND
CALL CHANGE
CLS
LOCATE (6),(14)
PRINT "The drug name will now appear exactly as it will appear in the"
LOCATE (8),(10)
PRINT "experimental procedure. Remember to focus on the 'XOXOXOX'"
LOCATE (10),(10)
PRINT "letters and watch closely for the letters to be erased and the"
LOCATE (12),(10)
PRINT "drug name to appear. When the drug name is erased, the question"
LOCATE (14),(10)
PRINT "will appear. Answer the question by pressing the '1' or '2' key."
LOCATE (17),(14)
PRINT "Press any key to see the practice display."
CHAR$ = INKEY$
WHILE NOT INSTAT
WEND
CLS
LOCATE (10),(30)
PRINT "XOXOXOX"
DELAY 0.25
CLS
DELAY 0.4
LOCATE (10),(30)
PRINT "Cefoxitin"
DELAY 0.075
CLS
LOCATE (10),(25)
PRINT "Which drug name is identical "
LOCATE (11),(27)
PRINT "to the name just shown?"
LOCATE (13),(30)
PRINT "(1) Cefotaxime"
LOCATE (15),(30)
PRINT "(2) Cefoxitin"
CHAR$ = INKEY$
WHILE NOT INSTAT
WEND
LOCATE (20),(25)
CALL CHANGE
CLS
LOCATE (6),(14)
PRINT "You are now ready to begin the experimental procedure. The"
LOCATE (8),(10)
PRINT "first four displays will be trial displays so that you "
LOCATE (10),(10)
PRINT "can practice watching for the drug names and can practice "
LOCATE (12),(10)
PRINT "answering the questions. The test displays will follow the"
LOCATE (14),(10)
PRINT "practice displays."
LOCATE (17),(20)
CHAR$ = INKEY$
PRINT "Press any key to begin."
WHILE NOT INSTAT
WEND
CHAR$ = INKEY$
'beginning of test displays
'open stimulus files for stimulus retrieval
OPEN "RECOGDRG.STM" FOR INPUT AS #1 'contains stimulus drug names
OPEN "RECOG1.STM" FOR INPUT AS #2 'contains response drug
names
OPEN "RECOG2.STM" FOR INPUT AS #3 'contains response drug names

'dimension arrays for storing response data
DIM SUBANS% (SUBJNO%:SUBJNO%,1:30):REM-set array dimemsions
'REM-1:x,1:y where x=no of subjects & y=number of stimuli+1
DIM SUBRESP#(SUBJNO%:SUBJNO%,1:30):REM-set array dimensions

'store subject number in data arrays
SUBANS%(A,1)=SUBJNO%
SUBRESP%(A,1)=SUBJNO%

'loop for displaying stimulus & collecting response data
FOR X = 1 TO 20:'***SET AT 20 FOR TEST*
    INPUT #1, DISPLAY$
    INPUT #2, RESPONSE$
    INPUT #3, CHOICE$
    CLS
    SCREEN 2

'print stimulus on screen
    LOCATE (10),(30)
    PRINT "XOXOXOX"
    DELAY 0.5
    CLS
    DELAY 0.4
    LOCATE (10),(30)
    PRINT DISPLAY$
    '------------------------recognition display time
    FOR T = 1 TO 6
    NEXT
    SCREEN 0

'position response question on the screen
    LOCATE (10),(25)
    PRINT "Which drug name is identical "
    LOCATE (11),(27)
    PRINT "to the name just shown?"
    LOCATE (13),(30)
    PRINT "(1) ";RESPONSE$
    LOCATE (15),(30)
    PRINT "(2) ";CHOICE$

'collect response time
MTIMER
WHILE NOT INSTAT 'check for key press
WEND

RESPONSETIME# = CDBL(MTIMER)
ANSWER$ = INKEY$
ANSWER% = VAL(ANSWER$)

'store response data in array
B = X + 1
SUBANS%(A, B) = ANSWER%
SUBRESP#(A, B) = RESPONSETIME#

LOCATE (20), (25)
'call subroutine for initiating next stimulus display
CALL CHANGE

NEXT
'----------inform s that new procedure will begin
CLS
LOCATE (10), (14)
PRINT "The drug name identification section is now complete."

'close all open input files
CLOSE

'open files to store data
OPEN "SUBANS%.DAT" FOR APPEND AS #10
OPEN "SUBRESP#.DAT" FOR APPEND AS #11

'FOR-NEXT loop for storing data in files
FOR Y = 1 TO 21 '20=number of stimulus displays +1
   IF Y < 21 THEN PRINT #10, SUBANS%(A, Y)"
   ELSE PRINT #10, SUBANS%(A, Y):
   IF Y < 21 THEN PRINT #11, SUBRESP#(A, Y)"
   ELSE PRINT #11, SUBRESP#(A, Y):
NEXT

CLOSE #10
CLOSE #11
LOCATE (20), (20)

'end of recognition task
CALL CHANGE

'--------------------------------------------
' JUDGMENT
LOCATE (6),(14)
PRINT "The section of the test in which you will be shown a
drug name"
LOCATE (8),(10)
PRINT "and a brief patient description will now begin."
LOCAITE (10),(10)
PRINT "There will be two lines of information including information about concurrent"
LOCATE (12),(10)
PRINT "drug therapy. You will be asked to indicate whether the"
LOCATE (14),(10)
PRINT "prescribed drug is likely to be appropriate for the patient."
LOCATE (16),(10)
PRINT "Use the information about the patient and other drug therapy"
LOCATE (18),(10)
PRINT "to make this judgment."
LOCATE (21),(15)
CALL CHANGE

CLS
LOCATE (6),(14)
PRINT "The next several displays will demonstrate how the question,"
LOCATE (8),(10)
PRINT "drug name and patient description will be displayed. The"
LOCATE (10),(10)
PRINT "question will appear first. This will be erased and the focus"
LOCATE (12),(10)
PRINT "letters will appear. After the focus letters are erased the"
LOCATE (14),(10)
PRINT "the drug name will appear with the patient description."
LOCATE (16),(10)
PRINT "Indicate whether you think the drug is likely to be appropriate"
LOCATE (18),(10)
PRINT "or inappropriate by pressing the number '1' or number '2' key."
LOCATE (21),(15)
CHAR$ = INKEY$
PRINT "Press any key to start the demonstration displays."
WHILE NOT INSTAT
WEND
CHAR$ = INKEY$

CLS
LOCATE (10),(20)
PRINT "Indicate whether the specified drug is likely"
LOCATE (11),(20)
PRINT "to be __________ for the patient described."
LOCATE (13),(22)
PRINT "(1) Appropriate"
LOCATE (15),(22)
PRINT "(2) Inappropriate"
DELAY 0.75
LOCATE (18),(20)
CALL READY
DELAY 0.4

CLS
LOCATE (10),(20)
PRINT "X O X O X O X O X O X O"
LOCATE (12),(20)
PRINT "X O X O X O X O X O X O"
DELAY 0.5
CLS
DELAY 0.4
LOCATE (10),(20)
PRINT "Keflex for a 35 year old male"
LOCATE (12),(20)
PRINT "taking Tylenol #3."
LOCATE (20),(16)
PRINT "Indicate appropriate by pressing the number '1' key and"
LOCATE (21),(16)
PRINT "inappropriate by pressing the number '2' key."
WHILE NOT INSTAT
WEND
CHAR$ = INKEY$

CLS
DELAY 0.4
LOCATE (5),(14)
PRINT "You are now ready to begin the second part of the experimental"
LOCATE (7),(10)
PRINT "procedure. The first four displays are practice trials"
LOCATE (9),(10)
PRINT "so that you can become familiar with the questions"
and how "
LOCATE (11),(10)
PRINT "to answer. Remember that the question is displayed
first, then"
LOCATE (13),(10)
PRINT "the drug therapy example. Answer the question after
you see the"
LOCATE (15),(10)
PRINT "the example. Position your hand so that your
fingers rest on "
LOCATE (17),(10)
PRINT "the number '1' and number '2' keys. Answer as
quickly and "
LOCATE (19),(10)
PRINT "accurately as possible. The test trials will begin"
LOCATE (21),(10)
PRINT "immediately after the four practice trials."
LOCATE (23),(20)
PRINT "Press any key to begin."
WHILE NOT INSTAT
WEND
CHAR$ = INKEY$

'begin judgment task test
OPEN "JUDGEPT1.STM" FOR INPUT AS #4 'contains response
patient info
OPEN "JUDGEPT2.STM" FOR INPUT AS #5 'contains response
patient info

'dimension arrays for storing data
DIM JUDGAN% (SUBJNO%:SUBJNO%,1:21): REM--set array
dimensions
DIM JUDGETM# (SUBJNO%:SUBJNO%,1:21): REM--set array
dimensions

'store subject number in arrays
JUDGAN%(A,1) = SUBJNO%
JUDGETM%(A,1) = SUBJNO%

'loop for displaying stimulus & collect data
FOR X = 1 TO 20
  INPUT #4, DISPLAY$
  INPUT #5, RESPONSE$
CLS
DELAY 0.4
'position response question on the screen
LOCATE (10),(20)
PRINT "Indicate whether the specified drug is likely "
LOCATE (11),(20)
PRINT "to be ____________ for the patient described."
LOCATE (13),(22)
PRINT "(1) Appropriate "
LOCATE (15),(22)
PRINT "(2) Inappropriate "
DELAY 0.75
LOCATE (18),(20)
CALL READY

SCREEN 2
DELAY 0.4

'print stimulus on screen
LOCATE (10),(20)
PRINT "X O X O X O X O X O X O"
LOCATE (12),(20)
PRINT "X O X O X O X O X O X O"
DELAY 0.5
CLS
DELAY 0.4

LOCATE (10),(20)
PRINT DISPLAY$
LOCATE (12),(20)
PRINT RESPONSE$
'set interval for stimulus
LOCATE (20),(16)
PRINT "Indicate appropriate by pressing the number '1' key and "
LOCATE (21),(16)
PRINT "inappropriate by pressing the number '2' key."

'collect response time
MTIMER
WHILE NOT INSTAT'check for key press
WEND
RESPONSETIME# = CDBL(MTIMER)
SCREEN 0

ANSWER$ = INKEY$
ANSWER% = VAL(ANSWER$)

'store response dat in array
B = X + 1
JUDG AN%(A, B) = ANSWER%
JUDGETM%(A, B) = RESPONSETIME#
DELAY 0.4
LOCATE (10),(20)
'call subroutine for controlling stimulus screens
CALL CHANGE

NEXT
CLS
LOCATE (10),(14)
PRINT "The section concerned with appropriateness is now complete."
LOCATE (16),(14)
'close all open files
CLOSE

'open files to store data
OPEN "JUDGAN%.DAT" FOR APPEND AS #12
OPEN "JUDGETM#.DAT" FOR APPEND AS #13

'FOR-NEXT loop for storing data
FOR Y = 1 TO 21 '21= number of stimulus displays + 1
  IF Y<21 THEN PRINT #12, JUDGAN%(A,Y)" "::ELSE PRINT #12, JUDGAN%(A,Y):
  IF Y<21 THEN PRINT #13, JUDGETM%(A,Y)" "::ELSE PRINT #13, JUDGETM%(A,Y):
NEXT

CLOSE
CALL CHANGE

'------------------------end of prg for judgment task
'DECISION
CLS
LOCATE (6),(14)
PRINT "The section of the test will now begin in which a drug name and"
LOCATE (8),(10)
PRINT "a patient description are provided together and you are to"
LOCATE (10),(10)
PRINT "select a suitable action. You may select one of two actions."
LOCATE (12),(10)
PRINT "One action is to dispense the drug to the patient without"
LOCATE (14),(10)
PRINT "questioning the use of the drug. The second action is to"
LOCATE (16),(10)
PRINT "check with the patient or the doctor about the use
of the "
LOCATE (18),(10)
PRINT "the drug before dispensing it to the patient. "
LOCATE (23),(15)
CALL CHANGE

CLS
LOCATE (6),(14)
PRINT "The next three screens will demonstrate how the question, the "
LOCATE (8),(10)
PRINT "drug name and the patient description will be displayed. "
LOCATE (10),(10)
PRINT "The question will appear first. This will be erased and the "
LOCATE (12),(10)
PRINT "focus letters will appear. After the focus letters are erased the"
LOCATE (14),(10)
PRINT "the drug name and patient information will appear. "
LOCATE (16),(10)
PRINT "Answer by pressing the number '1' or number '2' key.
LOCATE (19),(14)
PRINT "Press any key to begin demonstration displays."
WHILE NOT INSTAT
WEND
CHAR$ = INKEY$

CLS
LOCATE (10),(15)
PRINT "Which of the two actions described below is likely to be a "
LOCATE (11),(15)
PRINT "suitable response for the example drug therapy. "
LOCATE (13),(17)
PRINT "(1) Dispense the drug to the patient."
LOCATE (15),(17)
PRINT "(2) Check with the patient or the doctor about the use "
LOCATE (16),(21)
PRINT "of the drug before dispensing. "
LOCATE (20),(15)
DELAY 0.75
CALL READY

CLS
DELAY 0.4
LOCATE (10),(15)
PRINT "X O X O X O X O X O"
LOCATE (12),(15)
PRINT "X O X O X O X O X O"
DELAY 0.5
CLS
DELAY 0.4
LOCATE (10),(15)
PRINT "Clonidine for a 62 year old female"
LOCATE (12),(15)
PRINT "on Inderal."
LOCATE (20),(15)
PRINT "Indicate 'Dispense the drug' by pressing number '1'
and "
LOCATE (21),(15)
PRINT "'Check the use of the drug' by pressing number '2'."
CHAR$ = INKEY$
WHILE NOT INSTAT
    WEND
CHAR$ = INKEY$
CLS
DELAY 0.4
LOCATE (6),(14)
PRINT "You are now ready to begin the experimental
procedure."
LOCATE (8),(10)
PRINT "The first four displays will be trial displays so
that you "
LOCATE (10),(10)
PRINT "can practice reading the information and answering
the "
LOCATE (12),(10)
PRINT "questions. Position your hand so that your fingers
rest on "
LOCATE (14),(10)
PRINT "the number '1' and number '2' keys. Answer the
questions as"
LOCATE (16),(10)
PRINT "quickly and accurately as possible. The test
displays will"
LOCATE (18),(10)
PRINT "immediately follow the practice displays. "
LOCATE (21),(14)
CALL CHANGE
CLS
LOCATE (8),(14)
PRINT "Remember that the question is displayed first, then
the "
LOCATE (10),(10)
"drug therapy example is shown. Answer the question after"
LOCATE (12),(10)
PRINT "you see the example. Use the information about the patient"
LOCATE (14),(10)
PRINT "and concurrent drug therapy to decide whether to dispense "
LOCATE (16),(10)
PRINT "the drug or to check about the use of the drug before dispensing."
LOCATE (20),(10)
CHAR$ = INKEY$
PRINT "Press any key to begin the experimental procedure. "
WHILE NOT INSTAT
WEND
CHAR$ = INKEY$

'program section for decision task
'open stimulus files
OPEN "DECIDE1.STM" FOR INPUT AS #7 'contains 1st line of stimulus
OPEN "DECIDE2.STM" FOR INPUT AS #8 'contains 2nd line of stimulus

dimension arrays for storing response data
DIM DECIDAN% (SUBJNO%:SUBJNO%,1:21): REM--set array dimensions
DIM DECIDTM% (SUBJNO%:SUBJNO%,1:21): REM--set array dimensions

'store subject number in arrays
A=SUBJNO%
DECIDAN%(A,1) = SUBJNO%
DECIDTM%(A,1) = SUBJNO%

'loop for displaying stimulus & collecting response data
FOR X = 1 TO 20
    INPUT #7, DISPLAY$
    INPUT #8, DISPLAY2$
    CLS:DELAY 0.4
' Position response question on screen
LOCATE (10),(15)
PRINT "Which of the two actions described below is likely to be a "
LOCATE (11),(15)
PRINT "suitable response for the example drug therapy?"
LOCATE (13),(17)
PRINT "(1) Dispense the drug to the patient."
LOCATE (15),(17)
PRINT "(2) Check with the patient or the doctor about the use"
LOCATE (16),(21)
PRINT "of the drug before dispensing."
DELAY 0.75
LOCATE (20),(15)
CALL READY

SCREEN 2
DELAY 0.4
'print stimulus on screen
LOCATE (10),(15)
PRINT "X O X O X O X O X O X O"
LOCATE (12),(15)
PRINT "X O X O X O X O X O"
DELAY 0.5
CLS
DELAY 0.4
LOCATE (10),(15)
PRINT DISPLAY$ 
LOCATE (12),(15)
PRINT DISPLAY2$
LOCATE (20),(15)
PRINT "Indicate 'Dispense the drug' by pressing number '1' and"
LOCATE (21),(15)
PRINT "'Check the use of the drug' by pressing number '2'."
'set delay interval for stimulus
'collect the response time
MTIMER
WHILE NOT INSTAT 'check for keypress
WEND
RESPONSETIME#=CDBL(MTIMER)
ANSWER$ = INKEY$
SCREEN 0
CHAR$ = INKEY$
ANSWER% = VAL(ANSWER$)

'store response data in array
B = X + 1
DECIDAN%(A,B)=ANSWER%
DECIDTM%(A,B)=RESPONSETIME#

DELAY 0.4
LOCATE (10),(20)
'call subroutine to allow s to control screen
CALL CHANGE
NEXT 'end of loop for displaying decision tasks

'close all open files
CLOSE

'open files to store data
OPEN "DECIDAN%.DAT" FOR APPEND AS #14
OPEN "DECIDTM#.DAT" FOR APPEND AS #15

'FOR-NEXT loop for storing data in files
FOR Y = 1 TO 21 '21 = number of stimulus displays + 1
IF Y<21 THEN PRINT #14, DECIDAN%(A,Y)" " ; ELSE PRINT #14, DECIDAN%(A,Y):
   IF Y<21 THEN PRINT #15, DECIDTM%(A,Y)" " ; ELSE PRINT #15, DECIDTM%(A,Y):
END

CLOSE

'end of program section for decision task------------------------
'program section for the knowledge test
' KNOWLEDGE

CLS
LOCATE (6),(14)
PRINT "You have completed the three sections of the experiment"
LOCATE (8),(10)
PRINT "concerned with drug names and patients. You are now ready"
LOCATE (10),(10)
PRINT "for the final section of the experiment. This section"
LOCATE (12),(10)
PRINT "contains 10 questions asking you to identify the generic or"
LOCATE (14),(10)
PRINT "trade names of different drugs and 10 questions asking you to"
LOCATE (16),(10)
PRINT "identify the therapeutic use of different drugs."
LOCATE (19),(14)
CALL CHANGE

CLS
LOCATE (6),(14)
PRINT "The knowledge questions can be answered by pressing
the "
LOCATE (8),(10)
PRINT "number '1' or number '2' key. An example question will "
LOCATE (10),(10)
PRINT "be shown in the next display to demonstrate how the "
LOCATE (12),(10)
PRINT "question will be asked and how you can answer."
LOCATE (15),(14)
CALL CHANGE

CLS
LOCATE (10),(20)
PRINT "1. The generic name for Adapin is: "
LOCATE (12),(25)
PRINT "(1) Diazepam "
LOCATE (14),(25)
PRINT "(2) Doxepin "
CHAR$ = INKEY$
WHILE NOT INSTAT
WEND
LOCATE (17),(20)
CALL CHANGE

CLS
LOCATE (8),(14)
PRINT "The section of the experiment concerned with knowledge "
LOCATE (10),(10)
PRINT "will now begin. There will be no practice trials. Position"
LOCATE (12),(10)
PRINT "your hand so that your fingers rest on the number '1' and "
LOCATE (14),(10)
PRINT "number '2' keys."
LOCATE (16),(14)
PRINT "Answer the questions as quickly and accurately as you can."
LOCATE (19),(15)
CHAR$ = INKEY$
PRINT "Press any key to begin."
WHILE NOT INSTAT
WEND
CHAR$ = INKEY$

'program section for knowledge questions
'open stimulus files
OPEN "KNOW1.STM" FOR INPUT AS #1 'indicates generic or trade name
OPEN "KNOW2.STM" FOR INPUT AS #2 'contains 1st drug name for response
OPEN "KNOW3.STM" FOR INPUT AS #3 'contains 2nd drug name for response

'dimension arrays for storing response data
DIM KNOWAN% (SUBJNO%:SUBJNO%,1:11) :REM--set array dimensions
DIM KNOWTM# (SUBJNO%:SUBJNO%,1:11) :REM--set array dimensions

'store subject number in array
KNOWAN%(A,1) = A
KNOWTM#(A,1) = A

'loop for displaying stimulus & collecting response data
FOR X = 1 TO 10
  INPUT #1, DISPLAY$
  INPUT #2, DISPLAY2$
  INPUT #3, DISPLAY3$

  CLS
  'print to screen
  DELAY 0.4
  LOCATE (10),(20)
  PRINT DISPLAY$
  LOCATE (12),(25)
  PRINT "(1) ";DISPLAY2$
  LOCATE (14),(25)
  PRINT "(2) ";DISPLAY3$

  'collect response data
  M TIMER
  WHILE NOT INSTAT
  WEND
  KNOWTM#=CDBL(MTIMER)
  KNOWAN$ = INKEY$
  KNOWAN% = VAL(KNOWAN$)

  'store responses in array
  B = X + 1
  KNOWAN%(A,B)=KNOWAN%
  KNOWTM#(A,B)=KNOWTM#

  LOCATE (17),(20)
  CALL CHANGE
'close open files
CLOSE
'open files to store data
OPEN "KNOWAN%.DAT" FOR APPEND AS #16
OPEN "KNOWTM#.DAT" FOR APPEND AS #17

'FOR-NEXT loop for storing data in files
FOR Y = 1 TO 11 '11=no. of test items + 1
  IF Y<11 THEN PRINT #16, KNOWAN%(A,Y)" ";:ELSE PRINT #16, KNOWAN%(A,Y)
  IF Y<11 THEN PRINT #17, KNOWTM%(A,Y)" ";:ELSE PRINT #17, KNOWTM%(A,Y)
NEXT

CLOSE

'program section containing questions about therapeutics
CLS
LOCATE (8), (14)
PRINT "You have completed the questions about the trade names 
LOCATE (10), (10)
PRINT "and generic names. The next 10 questions concern the "
LOCATE (12), (10)
PRINT "therapeutic uses of different drugs. The question format "
LOCATE (14), (10)
PRINT "is similar to that used for the section just completed. 
LOCATE (16), (14)
PRINT "Answer the questions by pressing the '1' or '2' keys. 
LOCATE (19), (14)
CHAR$ = INKEY$
PRINT "Press any key to begin. "
WHILE NOT INSTAT
WEND
CHAR$ = INKEY$

'program section for knowledge questions-therapeutics
'open stimulus files
OPEN "KNOW5.STM" FOR INPUT AS #1 'contains question
OPEN "KNOW6.STM" FOR INPUT AS #2 'contains 1st response
OPEN "KNOW7.STM" FOR INPUT AS #3 'contains 2nd response

'dimension arrays for storing data
DIM KNOWAN2% (SUBJNO%:SUBJNO%,1:11)
DIM KNOWTM2# (SUBJNO%:SUBJNO%,1:11)

A = SUBJNO%
'store subject number in array
KNOWAN2%(A,1) = A
KNOWTM2#(A,1) = A

'loop for displaying stimulus & collecting response data
FOR X = 1 TO 10
    INPUT #1, DISPLAY$
    INPUT #2, DISPLAY2$
    INPUT #3, DISPLAY3$
    CLS
    'print to screen
    DELAY 0.4
    LOCATE (10), (20)
    PRINT "A typical indication for ";DISPLAY$;" therapy is:
    LOCATE (12), (25)
    PRINT "(1) ";DISPLAY2$
    LOCATE (14), (25)
    PRINT "(2) ";DISPLAY3$

    'collect response data
    MTIMER
    WHILE NOT INSTAT
    WEND
    KNOWTM2#=CDBL(MTIMER)
    KNOWAN2$=INKEY$
    KNOWAN2%=VAL(KNOWAN2$)

    'store the response in array
    B = X + 1
    KNOWAN2%(A,B)=KNOWAN2%
    KNOWTM2#(A,B)=KNOWTM2#

    LOCATE (17),(20)
    CALL CHANGE
NEXT
'close open files
CLOSE
'open files to store data
OPEN "KNOWAN2%.DAT" FOR APPEND AS #18
OPEN "KNOWTM2#.DAT" FOR APPEND AS #19

'FOR-NEXT loop for writing data to file
FOR Y = 1 TO 11
    IF Y<11 THEN PRINT #18, KNOWAN2%(A,Y)" ";:ELSE PRINT #18, KNOWAN2%(A,Y)
    IF Y<11 THEN PRINT #19, KNOWTM2#(A,Y)" ";:ELSE PRINT #19,
KNOWTM2#(A,Y)
NEXT
CLOSE

CLS

DIM TOTALTIME (SUBJNO%:SUBJNO%,1:2) ' x = subjno & y =
totaltime
TOTALTIME(A,1) = SUBJNO%

LOCATE (10),(20)
PRINT "THE END"
LOCATE (12),(20)
PRINT "Thank you for your participation!"

MIN = VAL(MID$(TIME$,4,2))
PARTMIN = VAL(RIGHT$(TIME$,2))/60
TOTALTIME(A,2) = MIN + PARTMIN

OPEN "TOTALTIME.DAT" FOR APPEND AS #1
FOR Y = 1 TO 2
  IF Y < 2 THEN PRINT #1, TOTALTIME(A,Y) ; ; ELSE PRINT #1,
TOTALTIME(A,Y)
NEXT

END

'------------------------------------subroutines
SUB CHANGE
'this subroutine allows the subject to initiate the screen
change
'reset INSTAT function
CHAR$ = INKEY$

'ask subject to press key to get next stimulus
PRINT "Press any key to continue."

'monitor for key press
WHILE NOT INSTAT
  CHAR$ = INKEY$
END SUB

'------------------------------------
SUB READY
'this subroutine allows subject to call up stimulus screen
CHAR$ = INKEY$
PRINT "Press any key to display the example drug therapy."
WHILE NOT INSTAT
WEND
CHAR$ = INKEY$
END SUB

END
RECOGNITION STIMULI
(RECOG1.STM)

"Lasix"
"Dolonil"
"Adapin"
"Dyazide"
"Nortriptyline"
"Diamox"
"Isordil"
"Terbutaline"
"Florinef"
"Feldene"
"Demerol"
"Triamcinolone"
"Nitroglycerin"
"Diabinese"
"Inderal"
"Seldane"
"Terbutaline"
"Florinef"
"Seconal"
"Triamcinolone"
^Z
"Xanax"
"Dolobid"
"Ativan"
"Clipizide"
"Nitroglycerin"
"Diabinese"
"Inderal"
"Tolbutamide"
"Fiorinal"
"Seldane"
"Seconal"
"Trihexyphenidyl"
"Nortriptyline"
"Diamox"
"Isordil"
"Feldene"
"Tolbutamide"
"Fiorinal"
"Demerol"
"Trihexyphenidyl"
RECOGNITION STIMULI
(RECOGDRG.STM)

"Lasix"
"Dolobid"
"Ativan"
"Dyazide"
"Nortriptyline"
"Diabinese"
"Isordil"
"Tolbutamide"
"Florinef"
"Seldane"
"Demerol"
"Triamcinolone"
"Nitroglycerin"
"Diamox"
"Inderal"
"Feldene"
"Terbutaline"
"Fiorinal"
"Seconal"
"Trihexyphenidyl"
"Tenormin for a 60 year old 
"Aldomet for a 45 year old female" 
"Percodan for a 60 year old male 
"Moban for a 35 year old female " 
"Antabuse(Disulfiram) for a 38 year old male" 
"Tagamet(Cimetidine) for a 17 year old female" 
"Apresoline(Hydralazine) for a 54 year old" 
"Feldene(Piroxicam) for a 68 year old female" 
"Thorazine(Chlorpromazine) for a 14 year old" 
"Cyclospasmol(Cyclandelate) for a 18 year old" 
"Terbutaline(Brethine) for a 78 year old female" 
"Fiorinal for a 28 year old female" 
"Atarax(Hydroxyzine HCl) for a 10 year old" 
"Diltiazem(Cardizem) for a 69 year old obese" 
"Tolbutamide(Orinase) for a 62 year old female" 
"Seldane(Terfenadine) for a 68 year old female" 
"Anturane(Sulfinpyrazone) for a 38 year old male" 
"Trihexyphenidyl HCl(Artane) for a 62 year old" 
"Diflunisal(Dolobid) for a 34 year old male" 
"Tegretol(Carbamazepine) for a 42 year old"
JUDGMENT STIMULI
(JUDGEPT2.STM)

"obese male who smokes."
"on Inderal."
"with a history of by-pass surgery."
"previously on Thorazine."
"Vietnam veteran, smoker & former drug abuser."
"formerly on Phenytoin and Phenobarbital."
"female on Lanoxin and Lasix."
"on Calcium supplements and an antacid."
"male who uses Retin A and benzoyl peroxide."
"male on prednisone."
"who has had multiple refills for Monistat Cream."
"who smokes."
"female using Cortaid cream."
"male on Nitroglycerin who smokes."
"on Theophylline and a former smoker."
"on Calcium supplements and an antacid."
"Vietnam veteran, smoker & former drug abuser."
"male on Amantadine."
"weekend sportsman."
"male who smokes and takes antacids."
DECISION STIMULI  
(DECIDE1.STM) 

"Prednisone for a 60 year old male"
"Sinemet for a 36 year old female"
"Compazine for a 50 year old female"
"Klotrix(potassium chloride) for a 60 year"
"Diflunisal(Dolobid) for an 8 year old male"
"Trihexyphenidyl HCl(Artane) for a 29 year old"
"Dilantin(Phenytoin) for an 8 year old male"
"Anturance(Sulfinpyrazone) for a 54 year old"
"Oral Triamcinolone(Aristocort) for a 62 year"
"Tetracycline for a 14 year old male who"
"Florinef(Fludrocortisone acetate) for a"
"Isordil(Isorbide dinitrate) for a 69 year old"
"Acetazolamide(Diamox) for a 76 year old female"
"Tegretol(Carbamazepine) for a 17 year old female"
"Dilantin(Phenytoin) for a 69 year old obese"
"Nitroglycerin for a 32 year old female"
"Thorazine(Chlorpromazine) for a 28 year old"
"Apresoline(Hydralazine) for a 10 year old"
"Terbutaline(Brethine) for a 62 year old female"
"Atarax(Hydroxyzine HCl) for a 54 year old female"
DECISION STIMULI
(DECIDE2.STM)

"who uses a Ventolin inhaler."
"previously on Elavil."
"who smokes and is on Propranolol."
"old female on Hydrodiuril and Lanoxin."
"on phenobarbital."
"female using a coal tar ointment."
"on phenobarbital."
"male on colchicine."
"old male on amantadine."
"uses Retin A and benzoyl peroxide."
"28 year old female who smokes."
"obese male on nifedipine who smokes."
"using pilocarpine, epinephrine and timolol solutions."
"formerly on phenytoin and phenobarbital."
"male on nitroglycerin who smokes."
"with a recent 20 pound weight loss."
"single, unemployed male on Prolixin."
"female who uses Cortaid Cream."
"on theophylline and a former smoker."
"on Lanoxin and Lasix."
^Z
"The trade name for Cyclosporine is:"
"The generic name for Tegretol is:"
"A trade name for Nitroglycerin is:"
"The generic name for Seldane is:"
"The generic name for Demerol is:"
"A trade name for Terbutaline is:"
"The generic name for Diabinese is:"
"The generic name for Cyclospasmol is:"
"A trade name for Tetracycline is:"
"The trade name for Diltiazem is:"
^Z
KNOWLEDGE TEST STIMULI
(KNOW2.STM)

"Cyclospasmol"
"Carbamazepine"
"Nitrostat"
"Terfenadine"
"Secobarbital"
"Brethine"
"Chlorpropamide"
"Cyclosporine"
"Achromycin-V"
"Dilantin"
"Sandimmune"
"Cimetidine"
"Aventyl"
"Piroxicam"
"Meperidine"
"Orinase"
"Acetazolamide"
"Cyclandelate"
"Thorazine"
"Cardizem"^Z
"Florinef"
"Antabuse"
"Cyclospasmol"
"Dilantin"
"Seldane"
"Tetracycline"
"Demerol"
"Diabinese"
"Triamcinolone"
"Acetohexamide"
"Orthostatic hypotension"
"Alcoholism"
"Kidney transplant"
"Angina pectoris"
"Seasonal allergic rhinitis"
"Psychosis"
"Root canal"
"Glaucoma"
"Parkinson’s disease"
"Glaucoma"
"Headaches"
"Gout"
"Nocturnal leg cramps"
"Generalized tonic-clonic seizures"
"Osteoarthritis"
"Severe acne"
"Insomnia"
"Type II diabetes mellitus"
"Psoriasis"
"Type II diabetes mellitus"

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REFERENCES


