The Applied Science of Clinical Teaching in Dentistry

by

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Preface

Important

HOW TO LEARN FROM THIS BOOK

Learning information for use in clinical teaching requires considerably more effort than just reading this book and passing a midterm and a final examination. Learning for use requires active study and frequent repetition of important principles before the information becomes readily available for daily application. Learning knowledge for use is like any other skill, it requires repetitive practice in retrieving the information. Questions and exercises for obtaining this practice have been provided. Use them or you will not learn well enough to apply the basic information in managing the challenging problems of clinical learning.

The key concepts for understanding, explaining, and controlling problems in clinical learning are presented in the second and third units. Just like the terminology learned in anatomy helps master the other basic science courses, the terminology learned in these early units are essential for mastering the topics presented in the later units. As in any new language, terminology needs to be memorized and practiced before it can be used in thinking. The inserted questions, study questions, and exercises provide practice in such basic skills as recognizing examples of the key concepts drawn from daily life.

Study Guides

Questions inserted in the text with an answer key at the end of each unit. First, answer the inserted questions as you reach them in your reading. These inserted questions are designed to emphasize important content, to integrate learning with what you already know, to increase your understanding by altering your perspectives, to provide practice in thinking and using this information, and to help apply the information in potential future situations. Most of these questions are to help you process and organize the information as you learn it. The inserted questions marked with an asterisk are useful enough to overlearn. Overlearn means to practice beyond the point of being able to answer. Overlearning occurs frequently in sports as when a field goal kicker practices day after day. Analogous to motor skill learning, overlearning is a very important learning strategy for mental skills. For example, expert chess players also overlearn their mental skills through daily practice.

Using information by answering questions and doing exercises will help overlearn the mental skills used in clinical teaching. Thus the reader must

resist the natural tendencies to omit answering the inserted questions. These tendencies result from small but potent influences on behavior that will be clarified in later units. These same small, potent influences also exert detrimental effects on student activity in many clinical learning situations.

Think about the answer to the inserted question before reading the hint. See if your tentative answer matches the hint. Next, write your answer and compare it against the key. Although this procedure slows reading, it greatly facilitates memory gained from self-instruction. Without an instructor, learners are themselves responsible for applying the standards for recall on quizes, and meeting the deadlines for the learning process.

Study questions at the end of each unit with an answer key in Appendix A. Second, you should study the questions at the end of each unit as if they were going to be on an examination the next day. In other words, use the questions to practice recalling the information until you can do so with speed and accuracy. Repetition is as important for developing retrieval skills from long term memory as it is in developing athletic skills. For best results, practice answering the study questions on different days over a period of weeks.

A list of rules derived from each unit to be classified according to categories found in Appendix B. Third, the rules that are provided at the end of each unit (beginning with unit 5) need to be integrated with your memory. An exercise of classifying these rules will help integrate them with the model for one-on-one clnical teaching. Practice classifying the rules into the classification system given in appendix B. Compare your classification decisions against the key in Appendix C. Where your answer disagrees, try to determine the reason for classifying the rule as indicated in the key. Your answer may also be valid, but additional thinking about the classification system will better prepare the information for ready application. The classification system is an organizational guide emphasized in the advanced workshop-course for applying these rules in clinical teaching.

A form for reporting episodes on how a rule was applied in a clinical situation. Fourth, use the episode report given in Appendix D to report an incident in which you applied one or more of the rules given at the end of each unit beginning with Unit 5. Reporting the use of a rule, helps integrate new information into daily activity. Practicing the application of these rules and noting the effects on the instructional process is the ultimate learning exercise for the content of this book. The greater the variety of rules applied, the better you have learned the material presented in the text (See Ref Note #1 at end of Preface).

A checklist for assessing application to your professional activities is found in Appendix E. Fifth, use the checklist to assess the application of your learning to your role as clinical teacher. You should apply your learning to at least five of the activities cited on the checklist during a six month period following the course. Meeting this criteria documents that your learning has had an impact on your teaching.

Expected Outcomes

Dental clinical faculty who have utilized similar materials in the ways advocated in this book have greatly increased their own satisfaction in clinical teaching. They feel that they are more effective in helping students learn. Clinical instructors using improved clinical teaching skills receive positive feedback from students who learn more rapidly and appear to enjoy learning more. Furthermore, the framework that relates basic findings in behavioral science to clinical situations is a rich source of ideas for research in clinical teaching. Useful research can be conducted while carrying out regular teaching duties. Recording observations systematically would be the main additional task.

This book offers concepts, principles and rules of clinical teaching, and applies this knowledge to activities of faculty in complex clinical situations. As examples of applicable activities, the clinical teacher sets a positive tone for learning, provides direction for performance, observes and evaluates, analyzes learning difficulties, points out relevant aspects of clinical events, and emphasizes clinical understanding and judgment. He identifies and corrects motor learning problems, and manages learning difficulties caused by anxiety, or inappropriate values, or lack of motivation. When the clinical teacher performs the above activities in an enlightened manner, he guides students toward a professional life of high quality performance.

Relationship to Discussion Groups

The first course in clinical teaching lays the foundation for the second course which uses videotapes to trigger discussion. It is highly recommended that the information in this book be overlearned before taking the workshop-course. Skill learning requires practice. Thus this book, provides active practice in thinking, analyzing and doing.

Although there are other courses on clinical teaching in the National Curriculum, the information in this book can be directly applied to the improvement of clinical teaching. Readers have done this successfully without ever viewing the videotapes used in the advanced course.

Studying this textbook will prepare you to learn efficiently from viewing and discussing the videotaped examples of clincal teaching given in the next course. You will learn more effectively from the discussion by having mastered this book first. To obtain the most benefit from the discussions you should overlearn this book by reviewing the study questions on a weekly basis. This continued review has important consequences even after you can answer all the questions correctly. You can tell that you still have valuable learning to do, if you hesitate before answering. After several months of this overlearning, equivalent to refining a sport's skill, you will find that you will begin to apply the material automatically when faced by new clinical teaching problems. Overlearning is the most effective of all factors for facilitating the application of knowledge in complex situations.

Acknowledgments

A number of people helped in the development of this book. The author and collaborators, Pat O'Conner, Doris Miller and Tom Green, spent many hours in discussion of the principles and rules as they apply to the clinical instructional encounter. Many others read the book and made helpful suggestions. Among these are Billy Joe Powell, Tom Fast, Marc Gale, Judy Skelton, George Maryniuk, Judy Albino, Lisa Tedesco, and Milt Houpt. A special thanks is due my wife, Claire for the countless hours of editing and trying to make the language of behavioral science more understandable for the reader.

Reference notes

1. If you wish to improve this book for others, please send copies of the completed episode reports (see appendix D) to the author before January 1, 1990. They will be used to produce an improved textbook with more concrete examples and a greater variety of exercises involving realistic situations. Send these to:

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TABLE OF CONTENTS

Mackenzie 1988

Unit 1: Introduction

This book was written to clarify what clinical faculty can do to improve clinical instruction. This book is intended to teach concepts, principles and rules of clinical teaching, and how they are related. By applying useful principles, well established by research, educators can understand why problems in clinical teaching arise and what to do to overcome them.

The major goal of the predoctoral clinical curriculum is to prepare dentists to deliver optimal oral health care while simultaneously monitoring the general health status of their patients. Helping students attain this goal depends on knowing when and how to intervene in the clinical learning process. Excellence in clinical instruction requires skills beyond those obtained in becoming a dentist. Additional knowledge is required to analyze the situations that produce inadequate learning, and additional skill is needed to arrange the conditions for enhancing learning. Skill is also needed to apply principles of instruction effectively. When individual students are having difficulty in learning, the clinical teacher must know when and how to act to attain the goals of instruction.

Problems in traditional clinical instruction.

Usually a clinical instructor does not improve much over time. Instructors continue to teach as they were taught (Meleca, et al, 1978). The author of this book has collected previously unpublished data on the clinical teaching process in dentistry from more than 25 dental schools over a period of 20 years. These data indicate that there has been little noticeable improvement in overall teaching skills in dental education in 20 years.

Traditional clinical instruction is still accepted as a necessarily unpleasant process by many clinical instructors. "Developing an excellent dentist is like making a good sword. The metal must be pounded, beaten and then ground until it reaches a fine cutting edge," is the statement of an anonymous educator in 1967. In 1981 a dental educator expressed a marine boot camp philosophy, "The student must be stripped of every shred of human dignity, so that they can be rebuilt in the proper professional image."

Dental graduates, however, report other effects of the stern approach typically used in clinical instruction.

> *Traditional clinical instruction is perceived as unpleasant by most dental students. Dental education is traumatic, arduous and emotionally draining. It is about time that the leaders in den-*

> *tal education began to realize this, and spend more time and effort trying to reduce this as much as possible. It would probably reduce the amount of cynicism and unprofessional behavior that presently pervades the profession. My personal attitude towards dentistry has been permanently scarred by people with this attitude, despite the fact that I graduated in the top 10% of my class,*

reported a graduate in 1967.

A student of the middle 1970's stated,

> *In the six years since graduation I have completed a pediatric dental residency and have been practicing pedodontics. Occasionally I reflect on my undergraduate education in dentistry. Academically, my education was good. Clinically, it was adequate, but emotionally and psychologically it was devastating. After six years, I am only now beginning to regain my creativity and a positive self image of myself. I feel dental school almost destroyed both of these. And now, with six years of hindsight, I believe the destruction was built into the educational philosophy of the school.*

Conditions appear no better in the 1980's. In 1980 a new graduate said, "The way the students themselves were treated was terrible...Success at any cost was the goal. Many of the faculty were arrogant and abused their (very real) power over the students." And another recent graduate in 1982, "...I was an honor student but still felt the faculty on the whole considered me less than human. I would like to see dental school become a positive rather than a negative experience....Whereas, I have donated to my undergraduate school's alumni program, I have not done so to my dental school for the above reasons."

In recent cases, alumni support for dental schools threatened with closing has not been as strong as dental educators might hope.

Clinical instruction is also a problem in Medicine.

The problem of adequate clinical teaching is not limited to the dental profession. When Mackenzie, in 1966, shared data collected from 20 dental schools with the staff of the Office of Medical Education at the University of Illinois, the medical educators noted that the problems in clinical teaching for medicine were very much the same as for dentistry. In a 1964 study, Reichsman, Browning, and Hinshaw (1964) interviewed medical

departmental chairpersons, faculty and students, and then observed 82 teaching sessions in clinical medicine. They observed that teachers missed opportunities to make significant patient observations; did not observe students at work; did not evaluate student data; rarely taught basic science material; did not find out what students knew about an area; were not clear during discussions; and did not stimulate students to acquire new knowledge. In addition, they observed that clinical reasoning was rarely taught explicitly; students were not challenged to extend efforts in learning or thinking; unprofessional conduct was rarely corrected; and there was an emphasis on techniques rather than patient care. The similarities are striking between these observed problems and those observed in dental clinical teaching.

Based on their systematic observations of clinical teaching, Reichsman et al (1964) believed that the role of the clinical teacher must include the ability to clarify, correct errors, motivate, demonstrate, probe for information, elicit thought processes, answer questions, set tone for learning, observe actions and assess competence, provide a model, direct attention, and give meaning to activities. This role of clinical teaching requires both advanced knowledge and skills.

Need for Improved Medical Teaching

The need to improve clinical teaching has long been recognized. In one of the early studies of Medical Education, Miller (1976) and 12 other faculty concluded, after extended intensive discussion, that teachers might be the major obstacles to learning by medical students. Many others in the health area have concurred that clinical teaching should be improved (Ref. note #1 at end of Unil).

In dentistry, when Saroff (1977) conducted a national survey of dental educators in 1974-1975 he reported that most dental educators reported little or no formal training in education. Less than 15 percent had any. However, over 95 percent believed that increased knowledge in education would be desirable. Independently, the Curriculum Survey in Dentistry of 1976 recommended greater effort toward faculty development (ADA 1977).

Blackerby in 1965 complained that teaching is "a neglected and underdeveloped specialty of dentistry". He felt that this situation was not compatible with the observation that "...it is our teachers who determine, in large measure, the caliber of our dental schools and the stature of our profession". Messer (1978) in a symposium workshop on post graduate pedodontics specialty education raises the question, "Does fulfilling requirements constitute an education?" Requirements that exclude important

aspects of professional education divert the student's energy from learning the unrequired aspects and exemplify the teacher-created-obstacles to learning that Miller (1976) referred to in his pioneer study.

The need for faculty development of those who teach clinical dentistry is often proclaimed by leaders in dental education. The evaluation reports of the curriculum survey of 1976 (ADA, 1977) recommends faculty development programs as do policy statements adopted by the American Association of Dental Schools (House of Delegates, 1977, 1979). At a National Conference of Dental Educators in 1981, concern was expressed about finding ways to identify and to develop good teachers as well as evaluate teaching performance. If effective teaching is one of the critically important attributes of a dental educator, the components underlying this skill should be analyzed, identified and developed in clinical teachers and all other faculty.

Although many agree there is a need to develop a comprehensive approach to clinical teaching and to implement appropriate clinical teacher training programs, such efforts have yet to be made (Daggett, et al., 1979). Other than a project reported in Manchester, England, there have been no reported instances of systematic training efforts in skills of clinical teaching (Harris, et al, 1976).

Specific Skills Identified But Not Applied

Much information concerning the specific skills needed by the clinical teacher has appeared in the literature (Ref #2). Several investigators have analyzed the skill components of clinical teachers and have placed those components into general
categories. This has been done in medicine, in nursing, and in dentistry (Ref. note #3). However, very little of this information has been applied to improve the practice of clinical teaching.

Unfortunately, colleges of education are not prepared to help clinical faculty apply learning principles to clinical instruction. Educational research has indicated that teaching methods are content specific (Glaser, 1976). Thus, dentists who undertake formal training in education to improve their clinical teaching must themselves apply
learning principles to clinical instruction. Since research shows that retrieval cues should be taught with the original instruction (Tulving and Olser, 1968) the failure to correlate principles with clinical teaching during instruction usually leads to a less than ideal educational experience for the clinical instructor who seeks to improve his instructional abilities through formal coursework in a college of education.

Principles Discovered in Basic Research Can Be Applied

Fortunately, in the last decade, behavioral scientists have discovered that principles can be readily applied in many natural settings to predict, explain, and control behavior. Behavioral principles have been successfully applied in a variety of situations, including academic ones (Mahoney 1974). Research at every level of education using basic behavioral principles demonstrates that teachers can be trained to impove their skills in facilitating student learning. Certain behavioral principles appear to be good educational tools. At the University of Minnesota, Partridge et al (1979), found that clinical teachers utilizing basic instructional principles have a positive impact on the clinical performance of their students. Research at the University of Washington demonstrated that the same basic behavioral principles as advocated in this book have worked well for lectures in endodontics (Guild, 1978) and for self-instructional manuals in oral surgery (Hooley and Whitacre, 1978). The principles applied in the above research involved clarification of importance, discrimination of cues, guided processing of information, and management of conditions for learning. The results indicated that student's achievement improved, instructor ratings increased, and instructor enjoyment of teaching increased. These findings have been replicated at several dental schools using the oral surgery manuals (Whitacre, 1984).

The principles reported in Units 2 through 9 of this book have been successfully applied at the University of Florida College of Dentistry. Results show increased instructor enjoyment of clinical teaching and improved student ratings of instructors at every clinical level. The instructors report noticeable changes in receptivity to learning by students resulting from efforts in setting the tone for instruction, and noticeably increased efficiency in learning based on an increased emphasis on the development of observation skills. The improvement in student ratings occurred immediately following training and was maintained after intervals of six months, twelve months, eighteen months, twenty-four months, thirty months, and thirty-six months.

Research in Clinical Teaching

Every science in its early stages undergoes a descriptive phase in which basic observations are made and elements identified. As the sciences progress, the elements and their relationships are analyzed. Ideas on how to better combine the elements are then hypothesized and tested under controlled conditions. In this way a new theoretical framework gradually evolves which will help others in the future to understand this scientific process and to continue to build upon and improve this systematic approach to the prediction, explanation and control of natural events.

Most of the clinical teaching studies have been descriptive in nature, and usually the results have been so general that they are difficult to apply to the improvement of instruction. This book contains a detailed analysis of clinical learning processes. This analysis provides a framework for additional learning about clinical instruction. The interconnected ideas discovered by research in other areas have been tied to clinical situations. The analysis suggests ways that behavioral principles can be applied to the teaching-learning process in clinical dentistry. The analysis also suggests a potential for further study in the application of these behavioral principles.

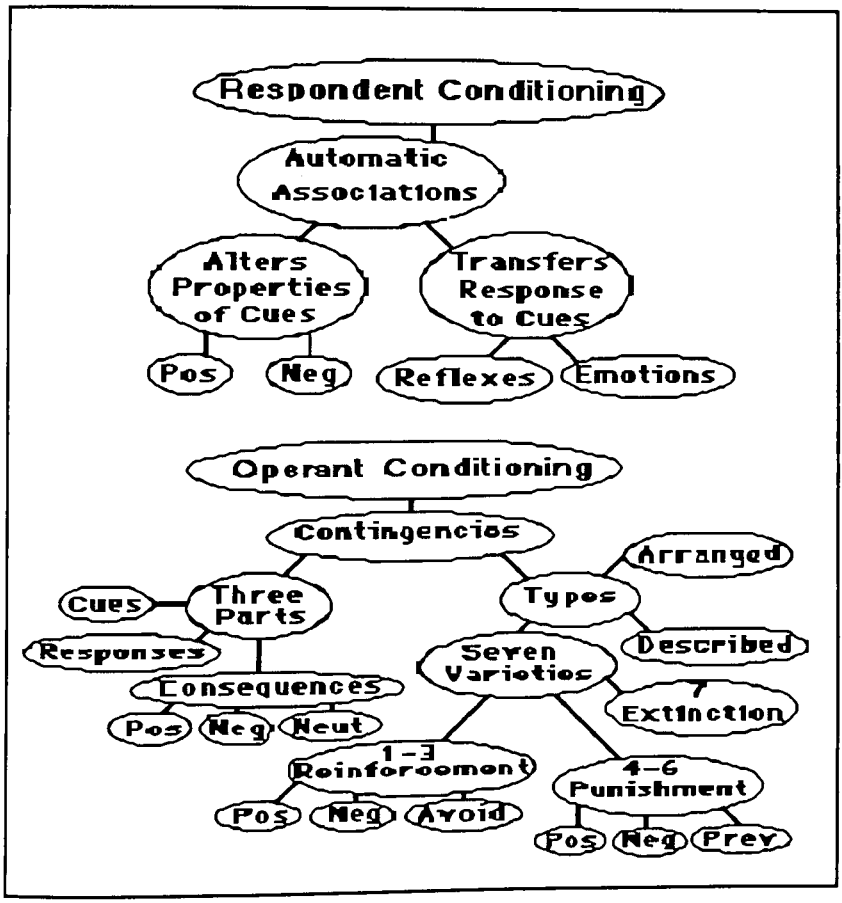
As university professors, clinical teachers should be scholars, filling a lifetime with learning. Although clinical research has been increasing in dentistry, rarely do clinical teachers publish research in the area of clinical teaching. Clinical teaching is almost a virgin area for study with little being done in the health professions.

With some training in fundamentals, many clinical teachers can become productively involved in the process of improving clinical instruction. Critical analysis, systematic observations and experimentation with the clinical learning process opens up a new realm of research for the clinical teacher. A new area of research that is compatible with clinical teaching should be welcomed by many dental school administrators who are under pressure by the research requirements of their university. Since clinical teachers in dentistry spend a greater portion of their time in student contact than do their university colleagues, the ability to do research while teaching will help dental faculty members in the university tenure process. Federal funds to support educational research in dentistry will become available in the next few years. This course and others in the National Curriculum will prepare dental eduators to meet these research challenges.

Basic information from research generated in the behavioral sciences combined with the data collected by Mackenzie and O'Connor over the past ten to twenty years, along with videotapes of many hours of actual clinical instruction, provide a rich resource of examples for the clinical teaching courses in the National Curriculum. Specific critical incidents as reported by hundreds of dental students since 1963 have clearly highlighted the positive and negative aspects of dental education. Applying the behavioral principles described in this book to facilitate clinical learning can be a rewarding educational experience for both teacher and student.

Fundamental Ideas

The fundamental ideas on which this book is based are found in the following diagram. This diagram should be learned beyond accurate reproduction. It should be practiced until it can be drawn very rapidly. This practice should be repeated over several weeks until the diagram can be reproduced rapidly and flawlessly. This overlearning will provide a scaffold for the important basic ideas that will be developed and applied throughout the book. As you read, use the diagram as a basis for adding new ideas. These same ideas will also form the basis for much of the research literature that will develop in the next decade concerning clinical teaching. Knowing the basic terms will help dental faculty to analyze teaching problems, to read the research literature on clinical teaching, and to contribute to this research literature.



Reference Notes

1. These references call for the improvement of clinical teaching (Clissold 1962, Wiggins 1962, Mendel 1965, Wolf 1965, Bolenger and Guild 1967, Berg and Bryant 1968, Field 1971, Walker 1971, Mayberry 1973, Adams 1974, Lutz 1975, Evans and Massler 1977, Meyers 1977, Yanoff 1977, Baxuion 1978, Emling and Fritz 1978, Irby 1978, Meleca, Schimpfhauser, Wittemann 1978, Daggett et al1979).

2. Specific skills needed by the clinical teacher are cited (Bolender and Guild, 1967; Evans and Massler, 1977; Meyers, 1977).

3. Analysis of skill components into categories in medicine (Cotsonas and Kaiser1963; Stritter et al 1975), in nursing (Jacobson 1966), in dentistry (Mayberry 1973), and for all three (Meleca et al 1978).

Unit 1: Study Questions

1.1 By understanding the principles taught in this book, what will clinical teachers gain?

1.2 Why do clinical instructors to have difficulty in transfering the principles they learn in courses taken in the colleges of education to clinical teaching?

1.3 Why is research in clinical teaching a good academic avenue for clinical teachers?

1.4 Name at least two of four outcomes that may be expected from the application of principles taught in this book to clinical teaching.

1.5 Reproduce the diagram depicting the basic ideas needed for understanding the dental applications covered in this book.

Unit 2: Basic Principles of Behavior Underlying Clinical Education

The purpose of this unit is to clarify a few powerful behavioral principles and to provide a few examples of how they might operate in daily life. Unrecognized competition between influences sometimes produces student behavior that interferes with attaining long term learning goals. Without a thorough understanding of behavioral influences and when they are at work, the instructor could misinterpret actions and as a result attribute student behavior to poor attitude. If the instructor's explanation is incorrect, actions based on it are not only ineffective, but often detrimental to the learning process. The relevant behavioral principles are discussed in this Unit, practiced in the next, and then applied throughout the book to analyze and explain some of the more complex learning situations that clinical instructors must manage.

Influences on Behavior are Often Unconscious

Experimenters have shown that a person's behavior is often influenced without his knowing it. For example, nodding and smiling every time a speaker states an opinion in conversation will greatly influence the frequency of opinions, without the speaker being aware of his change in speech (Verplanck 1958). Students with a preconceived plan who become attentive and nod understandingly every time a pacing lecturer moves toward one side of the room, will soon have the lecturer spending most of his time talking from that side. The lecturer will have no awareness of being influenced.

Behavioral traps are also often unrecognized by the person who is controlling a situation. An adult who gives a child a cookie to stop a temper tantrum may get the child to stop, but may increase the likelihood of future temper tantrums. The adult is rewarded for giving the cookie because the crying stops and the child is rewarded for crying. The trap occurs because in the long run non-productive activities are strengthened. Recently a dental student reported observing this episode: "An instructor gave a student a poor grade on a clinical procedure. The student started to cry. The instructor changed the grade." The crying presumably stopped. The observing student was so disgusted he had to leave the clinic. The instructor was probably unaware that he had fallen into a behavioral trap.

> 2.01 Why are some influences on behavior unrecognized by students or instructors? Hint: Think about what happened in the opinion experiment and with the cookie.

Applied Principles Work Effectively

Why do people smoke when they know that the results can be injurious for their health? Research indicates that they smoke, in part, for the same reasons that people overeat, drink too much, gamble, fail to exercise, and fail to brush their teeth after eating (Mallott l972). Research has identified the principles and factors that form the basis for why people act the way they do. One factor that is very powerful is that the immediate effects of behavior are much more influential than delayed effects. The application of behavioral principles has proved so effective in solving behaviorial problems in everyday life that the principles have been widely applied. In the past decade five new journals of applied behavioral science have been started to report the results of this successful research. Over 500 research papers are published annually. The behavioral principles have been successfully applied in the military, industry, correctional institutions, education, family politics, and self-control. Many mystifying behavioral problems have been analyzed, explained, and overcome by the application of these principles (Mallott et al l978).

Understanding basic principles of behavior can help overcome the undesirable effects of competing influences. Through understanding and application of behavioral principles, a person can learn to succeed more readily in helping others obtain their long term goals. In clinical dentistry there are many opportunities to apply behavioral principles for effective teaching.

2.02 Why does a person go on a chocolate binge when they are trying to reduce? Hint: think about immediate versus delayed effects.

Conditioning (Learning)

In order to understand the complexities of managing learning in the clinic, we need to review the basics. All learning affects future behavior. Simply stated, **conditioning is the learning of behavior within a situation or context. Behavior is defined as any kind of response, either observable or unobservable. A response is a reaction to stimuli at the muscular, glandular, or neuronal level. Stimuli are any features of the total environment which are noticeable.** Therefore, conditioning or learning is the process of strengthening the association of a response (including thinking) to given stimuli [cues, situation, or context). Basic conditioning includes two types of conditioning: 1) respondent conditioning and 2) operant conditioning.

Respondent Conditioning (Learning)

Respondent conditioning, also called classical conditioning, is the transfer of the automatic response elicited by an unconditioned stimulus to a second neutral stimulus. Early childhood behavior is often learned through respondent conditioning. The word "no" is a neutral sound to a young child until the word has been associated with many negative, unpleasant actions of the parent. Through the same conditioning process, the word "no" becomes further associated with other previously neutral stimuli until a negative shake of the head, or even a certain facial expression, can control unwanted behavior in the child.

Classical conditioning (Pavlov, I927) is perhaps the most well known example of this type of learning. Pavlov paired food (an unconditioned stimulus) with a bell (a neutral stimulus) and soon the bell was eliciting the salivary response in dogs. Respondent conditioning is the learning of behavior through the association of two stimuli, so that both stimuli come to elicit the same response. A neutral stimulus (bell) takes on the new properties by its association with a non-neutral stimulus (food). In this case the non-neutral stimulus (food) transfers a reflex action to the neutral stimulus (bell) so that the bell by itself produces salivation in the dog. Respondent conditioning functions with involuntary responses, mainly associated with cues that affect feelings, emotions, glandular secretions, reflexes, involuntary muscles, and the autonomic nervous system.

How does respondent conditioning relate to clinical teaching? Respondent conditioning pairs a neutral stimulus with a non-neutral stimulus. Pavlov paired food with a bell and soon the bell was eliciting the salivary response in dogs. Pair an unpleasant instructor with a specific clinical setting and soon that clinical setting arouses anxiety in students.

> 2.03 Although respondent conditioning plays an important positive role in motor skill learning as described in Unit 10, what negative effect does it commonly have on the clinical learning process? Hint: think of the unpleasant instructor.

Once a stimulus acquires positive or negative properties through respondent conditioning, it can then function as a consequence in operant conditioning. This relationship between respondent and operant conditioning is useful in understanding motor skill learning. However, much undesireable student behavior results from influences unanticipated by instructors. These will be discussed in Unit 5 and are the outcome of respondent conditioning and its effects on operant conditioning.

Operant Conditioning (learning)

Operant conditioning occurs when a response to a situation is followed by a consequence. Operant conditioning, also called instrumental conditioning, depends upon subsequent effects or consequences. A child sees a candle, touches it, and as a consequence, burns his hand. The child thus learns about one painful effect of his environment. When the neutral stimulus "no" is learned through respondent conditioning, the word "no" becomes valuable in operant conditioning as a consequence. The firm "no" of his parent becomes the consequence instead of a burned hand. Eventually the child will look at the candle flame and say "no" to himself.

Skinner (1974) noted that in operant conditioning a response in a given situation is strengthened or weakened by its association with a consequence. Research has shown that if a hungry animal presses a lever and receives a pellet of food, the animal is more likely to press the lever again. If the animal receives an electric shock, it will be less likely to press the lever again. Voluntary responses, striated muscles, and thoughts (i.e., verbal statements) become associated with cues and consequences. Prior to Skinner, Thorndike (1927) discovered what he called the Law of Effect. He found that events that follow responses determine whether the response will be repeated or not. Skinner and Thorndike agree that consequences affect future behavior.

2.04 Name two different kinds of learning or conditioning processes. Hint: these were previously mentioned as topic headings.

Basic biological research supports the findings of Skinner and Thorndike. Scientists have discovered that the brain contains **an organization of neurons related to affect, emotions, pleasure and pain.** This neural organization lies predominantly in the **limbic system.** The limbic system contains neural circuits which fire only when the animal is experiencing what could be inferred as a pleasant event, and other circuits which fire only when the animal is experiencing apparently unpleasant, aversive, or noxious events. These circuits have been demonstrated by electrodes, by analysis of neurotransmitter substances, and by surgery. Experimenters have been able to fire these circuits independently by applying electric current or chemicals. Rats will press levers all day to obtain pleasurable brain stimulation, even refusing to stop to eat following long periods of food deprivation. Animals will avoid activities which are followed by stimulation of negative areas. Humans report feelings of pain, discomfort, or displeasure when negative areas are stimulated (Penfield, 1957). Many neurons in many brain locations which did not fire to a stimu-

lus (cue) come to fire when the stimulus is followed by a rewarding brain stimulation (Olds & Fobes, 1981). Learning can effectively be guided by brain stimulation of positive and negative areas (Routtenberg, 1978).

2.05 When the results of one type of research (behavioral) are supported by a completely independent and different line of research (biological), what affect does that have on scientific theory? Hint:The answer has to do with acceptance and further research.

Operant conditioning influences the positive and negative firing of the limbic system in three ways: reinforcement, punishment and extinction.

Reinforcement. When the hungry animal pressed the lever and received a pellet of food, the animal was more likely to press the lever again. **Thus his response led to an effect that caused him to repeat the behavior.** His behavior elicited the firing of a positive circuit in the limbic system and his behavior was reinforced. Primary reinforcers innately reinforce behavior. Food, sleep, water, sex, the ability to manipulate the environment, exploration, and moderate excitation are examples of primary reinforcers. Secondary reinforcers are learned via respondent conditioning after pairing with a primary reinforcer. Examples of secondary reinforcers are money, praise, cleanliness, music, and drugs.

Punishment: The animal that received an electric shock when it pressed the lever was less likely to press the lever again. **Thus, the response led to an effect that caused the animal to inhibit, decrease, or not repeat that behavior.** The behavior elicited the firing of a negative circuit in the limbic system, and the behavior was punished. Primary punishers innately punish behavior. Most intense stimuli, such as extreme pressure, heat, cold, sound, or light are primary punishers. Secondary punishers are learned via respondent conditioning by pairing with a primary punisher. Rejection, disapproval, deprivation, chaos, and lack of sanitation are learned, secondary punishers.

Extinction. If the animal that received a pellet of food when it pressed the lever presses the lever again and does not receive a pellet, it will likely continue to press the lever a number of times but will eventually stop. **When the response of pressing the lever received a stimulus with no negative or positive properties rather than the expected stimulus, the behavior was decreased and eventually lost.**

Reinforcement, punishment and extinction are brought about by various stimuli in the environment. Early man's survival depended on recognition

of signs or stimuli indicating potentially harmful events in his search for water, food, and shelter. He approached a watering place with caution, looking, listening, and smelling in fear of predatory animals. He learned to recognize certain cues (stimuli) that were connected with danger. **A stimulus is any feature of the total environment which is noticeable.** Research with brain waves indicates that the noticeable feature of the environment must be perceived as relevant to some current purpose of the organism before it will become a functioning stimulus (Brown et al 1985). Seeing scratch marks on a tree would mean nothing unless the early man had seen a huge bear make such marks. Then a negative circuit would be fired in the limbic system and he would feel anxiety (punishment) for remaining at the watering hole too long. Seeing that the marks had moss growing on them would reduce his anxiety, turning off his negative circuits and firing positive neurons thus making it more likely that he would drink the water. If he found water here only in the spring, that would extinguish coming in the summer, fall, or winter.

2.06 When a person puts money in a vending machine and nothing comes out, why doesn't the person put more money in the machine? Hint: certain contingencies are at work here.

If early man became violently ill soon after eating an unfamiliar plant, it is likely he would conclude that becoming ill was a consequence of eating the plant. **A consequence is a stimulus change or lack of change (positive, negative, or neutral) that follows a response.** The stimuli must have a direct relationship to the response to be a consequence. However, the consequence must be recognized, i.e. a connection must be made between the response and the stimuli to affect behavior. If the plant had made the man ill a week later instead of shortly after, he may not have made the connection and thus eaten the plant again. **The behavioral effect is another term for consequence.** If the consequence is too delayed or otherwise not recognized as associated with the response, then there is little to no effect on learning.

2.07 When an amalgam is contaminated by moisture, the undesireable consequences are not noticeable until much time has passed. How might this effect the learning of the practicing dentist? Hint: Think about the effects of delay on learning.

Response-generated Cues

All cues do not come unsolicited or by chance. If the cave man wanted to

cross the river to get to a berry patch, he could find out how deep the water was by measuring the depth with a stick and feeling the temperature of the water with his hand. Once he arrived in the berry patch, and believing bears to be near, he would continually remain on watch in order to see a lurking bear before it saw him. If he wished to know if the berries were ripe, he would taste one. If it were sweet, he would pick more. **A cue that results from a response is a response-generated cue.** Measuring the depth of the river with a stick, looking around for the bear, or tasting a berry are responses that generate cues. It is important to realize that response-generated cues are the basis for the chains of behaviors that underlie motor-skill learning (discussed in Unit 9).

2.08. What are some additional words that, when used loosely, can be substituted for the term "cue"? Hint: this question has to do with things that are noticeable in either the internal or external environment.

Class of Behavior

After the man had eaten all the berries he could hold, he might decide to take some home with him. He could carry some in his hands, wrap some in large leaves, fill up his hat with them, or make a pocket out of his clothes. **Several actions that accomplish the same result are called a Class of Behaviors.** If the hungry animal discussed earlier were prevented from pushing the lever with his front paw, he might push the lever with his head, hind foot or shoulder. When a dental student can produce an acceptable cavity preparation, it is likely that he can continue to replicate it in the future. He may not exactly duplicate the hand movements previously used, but will utilize, out of a Class of Behaviors, those hand movements necessary to produce the acceptable results. Since recognizing acceptable results in dental practice reinforce the Class of Behaviors that produce them, it is critical for efficient learning that the student is able to recognize acceptable end points (discussed in Unit 8).

Relevance or Cues

It is also important in the learning of any behavior that the organism recognize the relevant cues before appropriate responses can reliably occur. Consider the story of the complex engine that would not start. The owner called the expert who fixed the complicated machinery by merely adjusting certain screws out of the many screws to be seen. The owner later complained about the size of the bill for service, claiming it took the expert only five minutes. The expert resubmitted the bill, charging only one

dollar for the five minutes labor, but adding $499.00 for knowing which screws to turn. The cue in this situation is the relevant screws to which the expert attends. His response is to adjust the appropriate screws. The consequence is that the engine runs smoothly. The owner did not recognize the relevant cues, and could not get the engine to run smoothly. Even though the owner knows the relevant response (adjusting the screws), he doesn't know that the response is appropriate. Thus, no reinforcement occurs (smooth running engine) and no learning takes place.

Three Part Contingency

To be called a behavioral contingency, there must be three parts: an antecedent stimulus, a response, and a consequent stimulus. The three parts must follow each other in a specific sequence in that a stimulus elicits a response which is, in turn, followed by a consequent stimulus. In the above example, the screws were the first stimulus, the adjustment was the response, the sound of the smooth running engine was the second stimulus. The first stimulus is called a cue and the second stimulus is called a consequence. In order to have an effect on the learner, the three parts must fire off neurons in the limbic system or the contingency is ineffective. Once having fired the sequence of neurons, the contingency has left a trace in the nervous system that will affect future behavior. The limbic system is the part of the brain containing the amygdala and hippocampus that is related to motivation, learning, and memory (Olds and Fobes 1981, Squires 1986).

Sometimes contingencies are arranged by nature, as when a person bumps his head while climbing into an automobile, and sometimes contingencies are arranged by another person, as when an instructor tells a student that his work is very good. In the first instance, the car door is the cue, climbing in with his head held high is the response, and the pain from the bump is the consequence. Nature has arranged a punishment contingency that decreases the likelihood that the person will hold his head so high the next time. In the second instance, the cue is the completed work, the response covers the activities that lead to completing the work, the consequence is the instructor's evaluation. In this second instance, many activities are reinforced by the instructor. The going to the instructor for a check is reinforced. The internal response of the student in recognizing that the work is completed is reinforced. When responses are reinforced, their probability of occurring in the future are increased.

2.09 What are the three parts of a contingency? Hint S-R-C.

Malfunctioning Contingencies

Many contingencies, however, do not have the desired effect as planned by the arranger of the contingency. For example, a wife works all day preparing a gourmet meal for her husband in order to please him. The husband, preoccupied with the newspaper, does not even notice that the meal is different. Since her husband took no notice of the meal-stimulus, and therefore made no response, there was no consequential pleasure. Since the first part of the contingency had no relevant impact on his nervous system, there could be no effect on his future behavior. However, the husband's response arranged a contingency for his wife. The wife had produced a meal for her husband. When he did not respond in the positive way that she expected, her inclination to prepare fancy meals was decreased, thus her future behavior was affected. An extinction contingency was in effect for the wife's activity. This activity included not only the preparation of fancy meals, but also the wife's concern for pleasing her husband. An extinction contingency decreases the future likelihood of the responses influenced by the contingency.

The wife could have increased the effectiveness of the contingency which she arranged for her husband by emphasizing the relevant cues that comprise the first part of the contingency. If she tells her husband about the enjoyment she experienced all day while preparing this special meal just to please him, she is helping him notice cues he might not otherwise notice, and at the same time increasing their more positive aspects by means of respondent conditioning. The likely result is that the husband will notice the meal as special, and that her associating pleasure with the meal will start the firing of positive neurons in his limbic system, enhancing the likelihood of his finding pleasure in the meal as he eats it. Under these new circumstances, positive neurons would be fired in her limbic system, reinforcing her and increasing the probability of both producing more gourmet meals and trying to please her husband.

Another example of a contingency not working as expected concerns the plight of a preclinical technique student bringing a cavity preparation to an instructor. The instructor abruptly tells him the preparation is not done right and to look at the models and redo it. The student returns with the new preparation and the instructor tells the student it is still not correct. Without additional help, some students will take a very long time to discover what aspect of the cavity preparation is important to notice. Some students will feel frustration and anger which might transfer to the instructor via respondent conditioning. If the transfer of negative feelings occurs, the student might avoid seeking future help from that instructor. Just going to the instructor has become punishing. The dental instruc-

tor, by abruptly telling the student to redo the cavity preparation, caused negative circuits to be fired in the student's limbic system, thus punishing the student and causing frustration, anger, and avoidance. The student might not be able to learn by looking at the models. To him the models could be as incomprehensible as the complex engine was to its owner. The owner could not tell by looking at the engine which screws to adjust. The student cannot tell by looking at the cavity preparation which features of his own work need adjusting. The instructor's abrupt direction to look at the models and redo the preparation fires negative neurons in the student and may well interfere with his future learning if it causes the student to avoid interacting with the instructor. Although the student cannot totally avoid the instructor, he may avoid asking any questions or may put off going to him as long as possible, thus delaying the accomplishment of other pre-clinical laboratory requirements as well.

The instructor could have made the redoing of the cavity preparation a positive experience for learning. He could find some part of the preparation that is correct and point out that feature to the student, firing positive circuits. The student would then be more receptive to listening and attending to those features that the instructor identifies as incorrect. The instructor needs to make sure the student sees the crucial differences between the student's own work and the model. If the student really does not see the difference, he does not have the appropriate neurons fired to begin the cue, response, consequence sequence of the contingency, and learning does not occur. When the students do not respond as expected, the instructor suffers in the same manner as the wife in the previous example. The instructor's concern for student learning may extinguish. Similarly, if the students do respond as expected, the instructor is positively reinforced for helping and through respondent conditioning he enjoys teaching more.

2.10 Besides extinquishing of concern for student learning, what else might extinquish for the instructor? Hint: think of the wife's emotional reaction.

2.11 If a consequent stimulus is neutral, does it make any difference what operations or arrangements are done with it? Hint: neutral is neither positive or negative.

2.12 Why do contingencies arranged by teachers not always work as expected in clinical situations? Hint: think about other contingencies that may be influencing behavior at the same time.

Analyzing Situations for Contingencies

When learning situations do not seem to go as intended, the instructor needs to analyze these situations for contingencies, and the relationships of their parts to the learning problem. It is important to remember that the probability of responses in similar future situations are affected by the consequences. Cues are more likely to bring forth a response if the consequence of the response has fired a positive limbic circuit. If the consequence has fired a negative one, the associated future situations are less likely to bring forth that response. Sometimes consequences involving positive stimuli fire positive circuits and sometimes they fire negative. It is important for the effectiveness of clinical teaching to recognize the types of arranged conditions that fire positive neurons and the types that fire negative neurons.

2.13. Which is likely to increase the listening response? A or B?

A. "That shade is ridiculous!"
B. "The shape is good, let me show you something about the shade."

Summary

Powerful principles of behavior underlie clinical education. Some of these work in a direction opposite to the long term best interests of the educational process. To compound the problem, some of these principles do not function in a direct, easily recognizable fashion. A basic knowledge and understanding of these principles will help an instructor know what to observe and how to arrange conditions to manage effectively the complex clinical learning situation.

Unit 2: Study Questions

2.01 What are the powerful principles that influence behavior?

2.02 For what purpose have scientists used behavioral principles?

2.03 What is a behavioral contingency?

2.04 What is the name of the system in the brain that contains positive and negative circuits influencing behavior.

2.05 When a positive effect follows a response, what factor has an impor-

tant influence on whether the response will occur again in the future?

2.06 To elicit a response, do cues need to be specific or general?

2.07 What function does an antecedent cue have when it has frequently been associated with a reinforced response?

2.08 Why is talking to ourselves important to our behavior?

2.09 What are some additional words that, when used loosely, can be used to substitute for the term "cue?"

2.10 What is the limiting factor about a cue?

2.11 Name two different kinds of learning or conditioning processes.

2.12 In recent years, scientists have discovered that thinking and other mental responses follow the same laws as observable responses. What does that finding imply for teaching of thinking?

Unit 2: Inserted Question Key

2.01 Why are some influences on behavior unrecognized by students or instructors?

Answer: Influences on behavior are sometimes unrecognized because they occur at the unconcious level. In addition, the consequences of an action (giving a cookie) sometimes produce more effects on future behavior than are intended and the time delay of the effects prevents making the connection.

2.02 Why does a person go on a chocolate binge when they are trying to reduce?

Answer: The pleasant taste and texture of the chocolate are immediate, and the loss of weight by avoiding eating is delayed. Because of this delay difference the competition between influences is biased in favor of eating.

2.03 Although respondent conditioning plays an important positive role in motor skill learning as described in Unit 10, what negative effect does it commonly have on the clinical learning process?

Answer: Respondent conditioning can produce unintended emotional

responses to clinical situations that lead to avoidance of learning opportunities.

2.04 Name two different kinds of learning or conditioning processes.

Answer: Operant conditioning (or instrumental conditioning) and respondent conditioning (or classical conditioning).

2.05 When the results of one type of research (behavioral) are supported by a completely independent and different line of research (biological), what affect does that have on scientific theory?

Answer: The confirmation by a different line of research strengthens the acceptance of the theory. Furthermore, the increased understanding of the process suggests additional new research.

2.06 When a person puts money in a vending machine and nothing comes out, why doesn't the person put more money in the machine?

Answer: It is punishing to lose money, and obtaining no product from the machine extinguishes the response of putting money into it.

2.07 When an amalgam is contaminated by moisture, the undesirable consequences are not noticeable until much time has passed. How might this effect the learning of the practicing dentist?

Answer: If the delay prevents the dentist from making the connection, no learning will occur and no action will be taken to prevent contamination.

2.08. What are some additional words that, when used loosely, can be used to substitute for the term "cue"?

Answer: Stimuli, attribute, feature, situation, occasion, context, setting, signal, and sign.

2.09 What are the three parts of a contingency?

Answer: The cue (stimulus, context, situation), the response (behavior, act), and the effect (consequence). S-R-C is the stimulus, response, consequence.

2.10 Besides extinguishing of concern for student learning, what else might extinquish for the instructor?

Answer: The instructors satisfaction with teaching might decrease.

2.11 If a consequent stimulus is neutral, does it make any difference what operations or arrangements are done with it?

Answer: No.

2.12 Why do contingencies arranged by teachers not always work as expected in clinical situations?

Answer: Other contingencies are influencing student behavior and sometimes these contingencies, because of such factors as immediacy, exert the more powerful influence.

2.13. Which is likely to increase the listening response? A or B?
A. "That shade is ridiculous!"
B. "The shape is good, let me show you something about the shade."

Answer: The listening response is reinforced and punished just like any other response. Thus, starting with something that can be praised will help keep attention focused.

Unit 3: Seven Types of Contingencies

The purpose of this unit is to introduce seven basic types of contingencies; to help the reader recognize and distinguish between the types of contingencies; and to help the reader practice applying knowledge of the contingencies in example situations. Familiarity with the seven basic types ofcontingencies will be necessary in later units in order to interpret complex interactions occurring in dental education. For supplemental reading on this topic there are several good sources (Ref #1).

The reason for using terms such as contingencies to explain clinical events is that the term ties the experiences of the clinical teacher to an extensive research literature (Mahoney 1974). Access to the research literature helps clarify variables that influence specific clinical situations. By linking real life to the knowledge gained by research, the clinical teacher develops the ability to manage failing teaching situations. The teacher must link the terms to real life situations before they become useful. Knowledge is useless for making decisions unless it is elicited by the situation. An old Chinese proverb said that the basis of wisdom is calling things by their right names (Moyers1973). If a clinical teacher can recognize a contingency when it occurs, he gains the power afforded by the knowledge of causation. When an entire class of dental students act as if they have a poor professional attitude, usually the reason lies not in the attitude, but in unrecognized contingencies that have been arranged by the faculty.

To help clinical instructors function better within the complex environment of the clinic, the authors have identified seven different types of contingencies that influence the way students learn. These seven types of contingencies are based on the relationship of consequences to the responses that preceed them. It was previously stated that a stimulus can be anything in the environment, internal or external, and in terms of consequences, it can be either positive, negative, or neutral. A positive stimulus fires a positive circuit in the limbic system when presented to an organism and fires a negative circuit when removed. A negative stimulus fires a negative circuit in the limbic system when presented and a positive circuit when removed. A neutral stimulus fires neither a positive or a negative circuit when presented or removed.

Seven Types of Contingencies

The effective contingency manager knows the seven types of contingencies thoroughly so that he can recognize them in their various forms. Reinforcement, punishment, and extinction are constantly at work in the

clinic. Many contingencies work independently of the instructor and are unrecognized by him.

Reinforcement Contingencies

When a response is followed by an effect which makes a behavior more likely, the contingency is called a reinforcement. There are three types of contingencies that produce reinforcement.

Positive Reinforcement Contingency: **In the first type, a response becomes more likely when a positive stimulus follows a response.** A hungry rat presses a lever and receives food (consequence). A child subtracts two numbers and the teacher says "very good". A beginning dental student cuts a perfect outline form in a mandibular molar and the instructor says "well done". An advanced dental student adjusts a high spot on a restoration and the patient says, "it feels comfortable". This contingency results in firing positive limbic circuits in the learner. **It is called positive reinforcement,** or more briefly, reinforcement. It is reinforcement by adding something positive following a response.

Negative Reinforcement Contingency: **A second type of reinforcing contingency occurs when an aversive stimulus (noxious, unpleasant) is removed (escaped) following a response.** A rat presses a lever and a mild electric current in the floor of his cage is turned off. A sleepy man reaches over to his clock and turns off the ringing alarm. He escapes the noxious sound of the alarm. A woman takes off a shoe that is pinching her toes. A beginning dental student is finally able to remove a roughness on the distal buccal root of a maxillary second molar. An advanced dental student is able to stop the hemorrhaging following an extraction. The response is reinforced because it removes something undesirable. **This contingency is called negative reinforcement.** Escaping an aversive stimulus is called negative because it subtracts (removes) a stimulus. The delivery of a positive reinforcer (food, water) when a response occurs has the same effect as the escape of an aversive event. In both cases, the preceeding response is reinforced, the probability that it will occur again in the same situation is increased. Note that "negative reinforcement" is the equivalent to "rewarding" in layman's terms and not as "punishing". The second type is reinforcement by subtracting a negative stimulus.

3.01 A whining child interrupts a conversation between two adults, the parent picks up the child to quiet him. This reinforces both the whining and the picking up. What kind of reinforcement is occuring for the child and for the parent? Hint: This is a behavioral trap because the arranged contingencies encourage behavior on the part of the parent that increases the likelihood of whining in the child.

3.02 Sort each of the following ten examples into one of the categories of positive or negative reinforcement. The asterisk indicates the response involved in the relevant contingency.

a. Wife nags husband to clean garage until he cleans* it.
b. A traveler breaks* the silence in the group by commenting* on the weather.
c. Person pulls* on gloves after stepping out into the winter cold.
d. Child repeatedly drops* clothes pins into a small mouth bottle.
e. Adult improves* score at golf.
f. Person moves* away from a hot stove.
g. Dog receives biscuit for sitting up*.
h. Child receives attention for crying*.
i. Person scratches* an itch.
j. A husband drops* the hot handle of a frying pan.

Avoidance Contingency: **A third type of reinforcement contingency occurs when an action prevents the occurrence of an aversive stimulus.** In this contingency, one learns the response that results in avoiding an aversive event. When a rat hears a bell that has preceded an electric shock, it may respond in some way. For example, it might jump to another part of the cage. Over a series of trials in which the shock is delivered after the bell when the rat does not jump to another part of the cage and is not delivered when it does jump, the rat will be more and more likely to jump, thus avoiding the shock. When a dental student is told to complete a cavity preparation by a certain time or he will fail, the student's quickness in completion is reinforced by avoidance of a failing grade. By doing the right thing, a conscientious student avoids the feeling of guilt that he has learned to associate with wrong doing. In the latter instance, doing the right thing is reinforced by avoidance. **The avoidance contingency is the third type of contingency that**

increases the probability of a response. All three types of reinforcement contingencies fire positive circuits in the limbic system.

A variation of an avoidance contingency occurs when a person takes action to prevent loss of a positive stimulus. A man scolds his girl when she flirts with another man. A traveler locks his wallet in a hotel safe. A person pays a fine rather than going to jail. A housewife carries an extra key to the car in her purse in case she leaves the keys in the ignition of her locked car. The loss of a positive stimulus is equivalent to the presentation of an aversive stimulus. Both would fire negative circuits if they occurred. **The third type of contingency is also reinforcement by avoidance of something negative that is expected to occur.**

3.03 What is the common factor that is used to classify the three contingencies as reinforcement? Hint: think of the effect on behavior.

3.04 What are the three operations on stimuli that produce reinforcing consequences following a response? Hint: what are three things that happen to stimuli following a response?

3.05 What are two types of stimuli that can participate in a reinforcement contingency? Hint: these two types are not neutral.

3.06 What is required of future situations for a reinforcing contingency to produce an increased probability of future responses? Hint: the answer involves the relationship of present and future situations.

Punishment Contingencies

Punishment Contingencies: There are also three types of contingencies that decrease the future probability of a behavior.

Positive Punishment Contingency: The first occurs when an aversive stimulus follows a response. When a rat presses a lever and receives a shock the probability that it will press the lever again in the same situation decreases. When a beginning dental student angles his handpiece the wrong way and realizes that he has removed too much tooth tissue, the probability that he will angle the handpiece in that manner decreases, (if he realizes that angling the handpiece caused the

error). When an advanced dental student reams a ledge in a root canal, the probability of his continuing to ream the same way decreases. When a student drops an instrument on the floor, starts to place the instrument back into the patient's mouth and an instructor stops him, pulls him aside, and scolds him, the instructor has arranged a punishment contingency. Nature arranges a punishment contingency when a student tries to seat an ill fitting inlay with a gold foil mallet and the tooth splits. Nature also arranges a punishment contingency when a student burns his arm over a bunsen burner. Punishment contingencies decreases the probability of a response occurring in the future. **This fourth type of contingency is punishment by adding a negative stimulus (consequence) to the situation following a response.**

3.07 Sort each of the following ten examples of contingencies into one of the four categories of 1) positive reinforcement, 2) negative reinforcement, 3) avoidance contingency, 4) positive punishment. The asterisk indicates the response involved in the relevant contingency.

a. Touching* a hot frying pan using only a hot pad.
b. Pinching* one's nose while driving by a dead skunk.
c. Pinching* one's nose before entering a garbage truck.
d. Spitting out* a rancid pecan.
e. Discarding* a discolored pecan.
f. Slapping a child for cursing.
g. Jumping* from a third floor window to the ground.
h. Jumping* from the path of a speeding car.
i. Slapping a masochist on the wrist for sarcasm*.
j. Touching* a loved one.

Negative Punishment Contingency: A second type of punishment contingency that reduces the probability of a response occurs when a positive stimulus is removed following a behavior. If a child does something wrong and his candy is taken away from him, this is a form of punishment. When a person pays a fine for a traffic violation, this is a punishment. This removal of something is called negative punishment to make it analogous to negative reinforcement. In both cases a stimulus is removed to change the probability of response. The contrast is that in negative punishment a **positive** stimulus is removed. The following are examples of punishment involving the loss of a positive stimulus. If a student drops his finished onlay and the patient swallows it, this punishes the student's carelessness. If a student hands a wax pattern to an instructor, the instructor purposely crushes the pattern without an explanation and tells the student to carve the pattern

again, this punishes the student for going to that instructor. If a student does not prepare for a clinic session and the instructor dismisses the student's patient without further treatment, this is a punishment by removal of a positive stimulus (one needed to progress toward graduation). **This fifth type of contingency is punishment by subtraction of a positive stimulus from the situation.**

Preventive Punishment Contingency: A third contingency that reduces the occurrence of a behavior is an event which prevents the obtaining of a positive stimulus. When a teenager stays out all night and his father punishes him by taking away his privilege of driving the family car, this is a form of punishment which is analogous, but opposite to the avoidance contingency used in reinforcement. If a dental student misbehaves in the clinic and is barred from treating patients for a week, this is punishment by preventing a desired activity. Placing a person in jail prevents him from attaining his usual reinforcers. **This sixth type of contingency is punishment by prevention of a positive stimulus that is expected to occur in the future.**

3.08 Sort each of the following ten examples of contingencies into one of the six categories of 1) positive reinforcement, 2) negative reinforcement, 3) avoidance contingency, 4) positive punishment, 5) negative punishment, 6) preventive punishment. The asterisk indicates the response involved in the relevant contingency.

a. Sending a hungry child to his room without finishing supper for kicking* his sister.
b. Placing* hands over ears in presence of a shrieking jet airliner.
c. Child is kept inside for a week for breaking* a window.
d. Dressing* warmly before going out on cold winter day.
e. A person has wallet stolen after leaving* it in hotel room.
f. Expelling roudy teenager from swimming pool for pushing*.
g. A mother sends* child out to play while she watches TV.
h. Child sticks* finger into active light socket.
i. Putting up* umbrella when caught in rain.
j. Inmate is placed in solitary confinement for fighting*.

3.09 What is the main difference between reinforcing contingencies and punishing contingencies?

3.10 How do the same operations of removal or adding stimuli produce the contrasting contingencies of reinforcement and punishment?

3.11 Describe how the three operations (adding, subtracting, and preventing) the two types of stimuli (positive and negative) interact to produce the six contingencies involved in reinforcement and punishment.

Extinction Contingency: A seventh contingency which, like punishment, decreases the probability of a response, is called "extinction". Extinction occurs when a response previously reinforced or punished is no longer consequated. A rat no longer receives food for pressing a lever. A child no longer receives attention and praise for producing baby talk. Busy clinical instructors no longer take time to listen to what the student has read about the care of the student's patients. All of these conditions lead to a weakening of the preceding response through a process called extinction. When a delinquent misbehaves in school to gain attention, teachers ignore the behavior to extinguish it. Attempted punishment is sometimes perceived by the delinquent as a form of attention (positive stimulus), which reinforces the misbehavior. Extinction occurs in this instance through ignoring or providing no attention for misbehavior. **The event that follows a behavior during extinction is neither the previously experienced positive stimulus or aversive stimulus.**

Avoidance behaviors are highly resistant to extinction. Avoidance is maintained by anxiety which is created by the anticipation of the arrival of the aversive stimuli. The behavior which avoids the aversive stimuli is reinforced by the reduction of anxiety. Since the cue and the response occur before the aversive stimulus is presented, the behavior never has a chance to undergo extinction. If a person touches an electric fence, they never touch it again even if they might wish to discover if it is off. An electric fence can keep animals in an enclosure even when the electricity is off. The animals do not touch the wire (cue) and hence do not experience the absence of shock which would lead to extinction. If a person develops food poisoning from eating in a diner, he may never return to learn that tainted food was served only that once.

3.12 Reinforcing a behavior by reduction of anxiety is what kind of reinforcement contingency? Hint: think of escape from something.

3.13 Why is fear of spiders or snakes maintained for such long periods, perhaps for a life-time? Hint: think of the requirement for extinction.

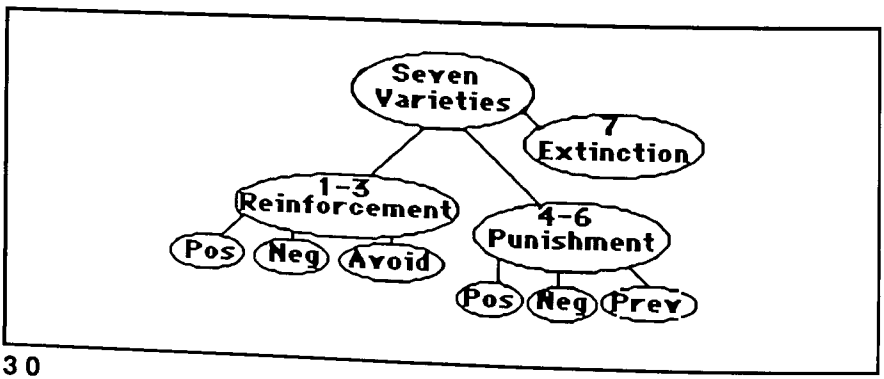
3.14 What conditions are necessary for an avoidance behavior to undergo extinction? Hint: what would cows have to do to learn that an electric fence is not on?

A person who develops an aversion to endodontics while in dental school may never change because the conditions necessary for extinction never occur. Therefore, the dentist refers all his endodontics work.

3.15 What are the main differences between operant conditioning and respondent conditioning? Hint: think of the role of consequences and the types of responses usually involved.

3.16 A young child fell from a tree after an airplane flew low overhead. For the next week, everytime an airplane flew overhead, the child ran screaming to the house. What kinds of conditioning have occurred here and give your rationale? Hint: fear was learned and then reduced.

Understanding the seven basic contingencies provides the foundation necessary for recognizing, analyzing and rearranging the contingencies in effect in the dental clinic. Because the dental student can arrange his own contingencies the clinical situation can become complicated. The next unit elaborates on some of the complexities that influence learning.



3.17 Sort each of the following ten dental examples of contingencies or respondent conditioning into one of eight categories of 1) positive reinforcement, 2) negative reinforcement, 3) avoidance contingency, 4) positive punishment, 5) negative punishment, 6) preventive punishment, 7) extinction, 8) respondent conditioning. The asterisk indicates the response involved in the relevant contingency.

a. Every time an instructor who belittles a student ap proaches, the student's anxiety* increases.
b. Dental student locks* instruments in cabinet.
c. Faculty member keeps working without acknowledg ing the student's suggestions*.
d. Instructor tells student that the student has re moved* too much tooth tissue.
e. Patient tells instructor that the student is very gentle.*
f. Student removes* matrix band carefully from newly packed amalgam.
g. Dental student is banished for a week from the clinic for wear ing* improper attire.
h. Dental student stops* hemorrhage during gingival surgery.
i. Dental student uses* firm finger rest while disking tooth.
j. Dental student breaks* marginal ridge off amalgam while re moving matrix band.

Contrasting The Use of Terms

Since negative reinforcement (reinforcement by subtracting) involves a negative stimulus, it should be distinguished from punishment which also involves a negative stimulus. In negative reinforcement the organism escapes from an unpleasant situation which is already present. In punishment the unpleasant aspect (stimulus) occurs (presents) after the response. Although both involve an aversive stimulus, the term negative reinforcement is often used as a substitute for punishment by authors in the dental literature and this misuse produces a confusing contrast with the main body of the basic research literature. Negative reinforcement, in contrast to punishment, is the escape of stimuli or event, which if not escaped, would be punishing. Reinforcement, in contrast to punishment, increases future behavior.

"Punishment" as used in this book is a contingency that decreases be-

havior. "Punishment" as found in research literature uses the same operations as does punishment employed in daily life, but it is usually milder and involves a greater variety of stimuli. Punishment in daily life usually has an intention to punish, whereas the term as used herein is not necessarily intended. Punishment as employed in behavioral science refers to all the technical operations of presenting, removing, or preventing any subsequent event (stimuli) so that there is a decrease in behavior. These operations are similar to those employed by laymen. The operations of laymen usually involve inflicting pain, removal of privileges, or incarceration. These commonly employed contingencies are analogous to the technical contingencies of the research literature in that inflicting pain is equivalent to an aversive stimulus, removal of privileges is equivalent to subtracting positive stimuli, and incarceration is the equivalent of preventing the attainment of positive reinforcement. In contrast, "punishment" as used in the research literature involves a greater variety of stimuli than is commonly considered punishment by the lay person. For example, simply frowning may reduce the probability of future behavior without producing the emotional connotation of what the layman means by punishment. Something that requires effort may be punishing in a technical sense. The need to expend effort is why people may not brush their teeth or exercise even when they know the long range benefits are important. Fortunately, effort stops being aversive when it becomes habit. When first learning a habit, effort fires negative circuits. As the task becomes habitual, it requires less effort and begins to fire positive circuits. In fact, a frequently performed activity becomes rewarding enough that an animal will learn other tasks to be able to do it (Premack 1965).

3.18 Sort each of the following into the categories:
1) Layman's idea of punishment;
2) Technical punishment.

a. Paddling.
b. Frowning.
c. Correcting an error.
d. Sending a child from the dinner table.
e. Taking away driving privileges.
f. Pointing out overhanging enamel rods.
g. Expelling from the clinic.
h. Keeping child after school.
i. Shaking head.

Research has found that the presentation, or removal, of a whole variety of stimuli results in decreased behavior. These stimuli are usually milder than those employed by laymen in a conscious act of punishment.

Hence, the technical term "punishment" has a slightly different connotation than the commonly used term. The admonition of not using punishment in education refers to the layman's idea of punishment. The admonition occurs because the strongly aversive punishment usually employed by the layman has side effects detrimental to the learning process. On the other hand, it is absolutely essential to use "punishment" in the technical sense in clinical teaching. For instance, student responses that are detrimental to the patient's well being must be stopped immediately, and technical punishment is the one contingency of the three with the most immediate effect. These ideas will be discussed more thoroughly in a later unit. Technically, a punishment is anything that fires a negative circuit in the limbic system. This firing may occur without awareness, as it often does when mild forms of punishment occur.

Arranged and Described Contingencies

An arranged contingency occurs when an instructor presents, removes, or prevents a positive or negative stimulus following a student response. By arranging the contingency the instructor changes future behavior of the student. A described contingency occurs when the instructor gives directions, advice, or points out what might happen if the student does something. For example, the instructor might say, "if you remove the matrix band too soon,the amalgam might fracture." or "if you leave the flange too long on the denture, a sore spot will develop." A described contingency lets the student know what to expect following some activity. In our society, laws help control behavior by describing contingencies. Speed limit 25 describes a contingency by implication. Described contingencies and their clinical functions will be discussed in more detail in later units.

Complexities of Contingencies

Contingencies arranged or described by teachers do not always work in clinical situations. Because of previous learning or competing contingencies, the consequences arranged by teachers may not work in the way expected. Rewarding a student for rapid, high quality performance by giving the student additional assignments does not always produce the desired effect. Sometimes teacher arranged contingencies are in conflict with contingencies arranged by the environment or by other teachers and are not powerful enough to overcome the other contingencies. Sometimes teachers are disappointed by students who do not seem to want to learn something that will be useful to them later in practice. When this happens, it is usually because other, more powerful, contingencies are competing for and successfully controlling the activities of the student. Some of the complexities of the clinical environment will be analyzed further in Unit 6.

Reference Notes

1. Several good sources for developing greater depth of understanding of these principles are (Kazdin 1977; Favel 1977; Mahoney 1974; Skinner 1974; Meichenbaum 1977; Poteet 1973; Ferster and Perrott 1968; Reynolds and Stark 1983; Bellack and Hersen 1977; Gambrill 1977).

Unit 3: Study Questions

3.01 What is the advantage in relating scientific terminology to clinical teaching?

3.02 What is a behavioral effect?

3.03 What three types of behavioral effects are there?

3.04 What are the three parts of a contingency?

3.05 What three operations or arrangements can occur to create a behavioral effect?

3.06 If a cue is neutral does it make any difference what operations or arrangements are done with it?

3.07 Compare and contrast punishment and reinforcement in terms of operations and types of stimuli.

3.08 Based on the types of consequences (positive, negative, neutral stimuli), and the operations that can be done to them, how many contingencies there, and can you arrange them?

3.09 Why do contingencies arranged by teachers not always work as expected in clinical situations?

3.10 Answer inserted question 3.02.

3.11 Answer inserted question 3.07.

3.12 Answer inserted question 3.08.

3.13 Answer inserted question 3.17.

Unit 3: Inserted Questions

3.01 A whining child interrupts a conversation between two adults, the parent picks up the child to quiet him. This reinforces both the whining and the picking up. What kind of reinforcement is occuring for the child and for the parent?

Answer: The child receives positive reinforcement because the child's action is followed by a positive stimulus (attention, picking up). The parent receives negative reinforcement because the parents' action is followed by a termination of an aversive stimulus (whining).

3.02 Sort each of the following ten examples into one of the categories of positive or negative reinforcement. The asterisk indicates the response involved in the relevant contingency.

a. Wife nags husband to clean garage until he cleans* it.
b. A traveler breaks* the silence in the group by commenting* on the weather.
c. Person pulls* on gloves after stepping out into the winter cold.
d. Child repeatedly drops* clothes pins into a small mouth bottle.
e. Adult improves* score at golf.
f. Person moves* away from a hot stove.
g. Dog receives biscuit for sitting up*.
h. Child receives attention for crying*.
i. Person scratches* an itch.
j. A husband drops* the hot handle of a frying pan.

Answer:
Positive Reinforcement: d,e,g,h
Negative Reinforcement: a,b,c,f,i,j.

3.03 What is the common factor that is used to classify the three contingencies as reinforcement?

Answer: All three contingencies produce an increased probability that the response will recur under similar conditions. All three fire positive circuits in the limbic system.

3.04 What are the three operations on stimuli that produce reinforcing consequences following a response?

Answer: Positive stimuli are presented or appear following a response.Negative stimuli that are impinging on the organism are removed following a response. Anticipated negative stimuli are prevented from oc-

curring by the response. The three operations are: presentation, removal, prevention.

3.05 What are two types of stimuli that can participate in a reinforcement contingency?

Answer: Positive (rewarding) stimuli which are presented and negative (aversive) stimuli which are removed (escaped) or prevented from occurring. The two types are positive and negative stimuli.

3.06 What is required of future situations for a reinforcing contingency to produce an increased probability of future responses?

Answer: The organism must perceive the situations as similar. The more similar, the greater the probability, the less similar the less likely the response will recur in that situation. If no relevant cues are recognized there is no reason for the response to occur. Without established cues the reinforcement contingency is not in effect.

3.07 Sort each of the following ten examples of contingencies into one of the four categories of 1) positive reinforcement, 2) negative reinforcement, 3) avoidance contingency, 4) positive punishment. The asterisk indicates the response involved in the relevant contingency.

a. Touching* a hot frying pan using only a hot pad.
b. Pinching* one's nose while driving by a dead skunk.
c. Pinching* one's nose before entering a garbage truck.
d. Spitting out* a rancid pecan.
e. Discarding* a discolored pecan.
f. Slapping a child for cursing.
g. Jumping* from a third floor window to the ground.
h. Jumping* from the path of a speeding car.
i. Slapping a masochist on the wrist for sarcasm*.
j. Touching* a loved one.

Answer:
1) Positive Reinforcement: i,j
2) Negative Reinforcement: b,d
3) Avoidance Contingency: a,c,e,h
4) Positive Punishment: f,g.

3.08 Sort each of the following ten examples of contingencies into one of the six categories of 1) positive reinforcement, 2) negative reinforcement, 3) avoidance contingency, 4) positive punishment, 5) negative punishment, 6) preventive punishment. The asterisk indicates the re-

sponse involved in the relevant contingency.

a. Sending a hungry child to his room without finishing supper for kicking* his sister.
b. Placing* hands over ears in presence of a shrieking jet airliner.
c. Child is kept inside for a week for breaking* a window.
d. Dressing* warmly before going out on cold winter day.
e. A person has wallet stolen after leaving* it in hotel room.
f. Expelling roudy teenager from swimming pool for pushing*.
g. A mother sends* child out to play while she watches TV.
h. Child sticks* finger into active light socket.
i. Putting up* umbrella when caught in rain.
j. Inmate is placed in solitary confinement for fighting*.

Answer:
1) Positive Reinforcement: none
2) Negative Reinforcement: b,i
3) Avoidance Contingency: d,g
4) Positive Punishment: h
5) Negative Punishment: a,f,e
6) Preventive Punishment: c,j.

3.09 What is the main difference between reinforcing contingencies and punishing contingencies?

Answer: Reinforcing contingencies increase the probability of response while punishing contingencies decrease the probability of response. They also fire different circuits and different types of neurons in the limbic system.

3.10 How do the same operations of removal or adding stimuli produce the contrasting contingencies of reinforcement and punishment?

Answer: In reinforcement and punishment, the same operations are applied to opposite types of stimuli. For example, to produce punishment, a positive stimuli is removed, whereas to produce reinforcement, a negative stimuli is removed. Punishment occurs when a negative stimulus is added following a response, whereas reinforcement occurs when a positive stimulus is added following a response.

3.11 Describe how the three operations (adding, subtracting, and preventing) the two types of stimuli (positive and negative) interact to produce the six contingencies involved in reinforcement and punishment.

Answer: Adding a positive stimuli, and subtracting or preventing (avoid-

ing a negative stimuli all reinforce behavior making it more likely. Avoiding a negative stimuli, and subtracting or preventing a positive stimuli all punish behavior making the behavior less likely in the future given the same environmental cues.

3.12 Reinforcing a behavior by reduction of anxiety is what kind of reinforcement contingency?

Answer: Negative reinforcement. A negative stimulus (anxiety) is subtracted from the environment. This causes a positive circuit in the limbic system to fire.

3.13 Why is fear of spiders or snakes maintained for such long periods, perhaps for a life-time?

Answer: Avoidance behavior prevents the conditions necessary to produce extinction.

3.14 What conditions are necessary for an avoidance behavior to undergo extinction?

Answer: The person must be kept in the presence of the feared object without an aversive event occurring. To increase the rate of extinction, incompatible responses such as relaxation while in the presence of the aversive cue are reinforced. This form of therapy which employs extinction of the anxiety response to an avoided aversive stimuli is called desensitization.

3.15 What are the main differences between operant conditioning and respondent conditioning?

Answer: Operant conditioning depends on environmental effects or consequences. It usually involves striated muscle movements, but may include other voluntary responses such as thoughts (private verbal statements). Respondent conditioning usually involves the association of a neutral stimuli and a non-neutral stimuli. The conditioning involves feelings, reflexes, involuntary muscles, and the autonomic nervous system. Reflexes or emotional feelings usually produced by the non-neutral stimuli can be transferred to the neutral stimuli by pairing.

3.16 A young child fell from a tree after an airplane flew low overhead. For the next week, every time an airplane flew overhead, the child ran screaming to the house. What kinds of conditioning have occurred here and give your rationale?

Answer: Respondent conditioning and then operant conditioning. The child associated the fear and pain of falling with the neutral stimulus of the airplane. The airplane developed into a negative stimulus associated with fear and crying (respondent conditioning). This negative stimulus then became an event that the child wished to escape. Escaping the airplane was a negative reinforcer for running to the house (operant conditioning).

3.17 Sort each of the following ten dental examples of contingencies or respondent conditioning into one of eight categories of 1) positive reinforcement, 2) negative reinforcement, 3) avoidance contingency, 4) positive punishment, 5) negative punishment, 6) preventive punishment, 7) extinction, 8) respondent conditioning. The asterisk indicates the response involved in the relevant contingency.

a. Every time an instructor who belittles a student approaches, the student's anxiety* increases.
b. Dental student locks* instruments in cabinet.
c. Faculty member keeps working without acknowledging the student's suggestions*.
d. Instructor tells student that the student has removed* too much tooth tissue.
e. Patient tells instructor that the student is very gentle.*
f. Student removes* matrix band carefully from newly packed amalgam.
g. Dental student is banished for a week from the clinic for wearing* improper attire.
h. Dental student stops* hemorrhage during gingival surgery.
i. Dental student uses* firm finger rest while disking tooth.
j. Dental student breaks* marginal ridge off amalgam while removing matrix band.

Answer:
1) Positive Reinforcement: e
2) Negative Reinforcement: h
3) Avoidance Contingency: b,f,i
4) Positive Punishment: d
5) Negative Punishment: j (the marginal ridge, which is positive, is removed).
6) Preventive Punishment: g
7) Extinction: c
8) Respondent Conditioning: a

Mackenzie 1988

3.18 Sort each of the following into the categories:
1) Layman's idea of punishment;
2) Technical punishment.

a. Paddling.
b. Frowning.
c. Correcting an error.
d. Sending a child from the dinner table.
e. Taking away driving privileges.
f. Pointing out overhanging enamel rods.
g. Expelling from the clinic.
h. Keeping child after school.
i. Shaking head.

Answer:
1) Layman's idea: a,d,e,g,h.
2)Technical punishment: b,c,f,i.

Unit 4: Overview of the Clinical Instructional Encounter

"I was doing a preparation for an amalgam. He came over and harshly criticized the preparation, threw the mirror and explorer on the mobile top and walked away (harsh positive punishment contingency). I just wish he had the ability to call me aside and explain the mistake (mild punishment contingency) and how to correct it." (describing negative reinforcement contingency) (Anon 1982). What the student wished for would have provided more effective learning contingencies. There is a sequence and a flow to every effective instructional encounter in the clinic, the components of which can be learned like any other skill. This Unit provides a framework for the model of clinical teaching that is used in the one-on-one workshop course involving videotapes.

Effective teachers not only assess students present status, they know how to intervene appropriately (Bransford et al 1985). Analyzing the contingencies that influence clinical learning guides the effective instructor in managing the learning problems of individuals. The clinical instructional encounter provides a framework to help understand the cues, responses, and consequences that will be discussed in more detail in later units.

Most instructional encounters in the clinic, the interaction between faculty, student, and patient, can be characterized as having five phases. These phases vary in extent and content depending on the circumstances. Examples of influencing circumstances are student level of development (e.g. junior level), stage of service being rendered, the number of encounters on each patient appointment, and what happens during the encounters. The five instructional phases that usually occur with each encounter are: 1) setting and maintaining the tone (produces respondent conditioning); 2) giving directions or advice (described contingency); 3) observing some feature or activity (standing back and analyzing the contingencies); 4) analyzing and assessing the observations (deciding about arranging or describing contingencies); 5) providing remedial instruction based on the analysis (describing and arranging contingencies). The learning impact of each phase is enhanced by applying principles of respondent and operant conditioning.

The phases of 1) tone setting and 2) information giving receive more emphasis on initial patient visits, or during the first encounter of the day, with 3) observing 4) analyzing and 5) remediating usually occurring following some type of student activity. There may be overlap in instructional phases with some observing and analyzing occurring during the first, second, and fifth phases of the encounter. The predominant activity of each phase, however, is 1) tone, 2) information, 3) observation, 4) assessment, and 5) instruction.

The Emotional Tone Phase

Setting the emotional tone is accomplished through respondent conditioning. The instructor does things which elicit a positive feeling (fires a positive limbic circuit) in the student. The instructor is friendly, greets students and patients, uses praise and positive reinforcement, says good things about the student to the patient, and identifies things the student has done correctly before giving corrective feedback. All these activities produce positive feelings. The instructor, the clinical discipline, the clinic, all take on a positive aura because of the linking of these instructor behaviors with the situation. Just as food helps the bell to produce saliva, the instructor's pleasant behavior links good feelings to the clinical situation in which it occurs.

Setting and maintaining emotional tone occurs, of course, throughout all phases of the instructional encounter. The emotional tone should always be positive, but more often is seen by the student as being negative. Initially in each encounter, the instructor sets or maintains a positive tone by displaying the common courtesies of our society. The instructor greets the patient and student, uses their names and, where appropriate, further indicates respect for them by mentioning something that conveys caring, concern or interest. Examples of such statements to a patient would be "Did you have any difficulty getting here in this weather", "Nice to see you again", or "How are you holding up during this long appointment?"

Students also appreciate faculty members who display courtesy toward them."Treated me as a person by asking how I'm doing. Smiling, simple comments acknowledging I'm a person, not just a pawn in a cubicle." (Anon 1982). When asked about a characteristic that a student recalled about an outstanding teacher, the student said, "On the first day with the instructor, he came up to each student individually and introduced himself, shook hands, and said, 'We'll be working together...'" (Anon 1982). Another student commented, "I like instructors who treat me as an adult, and not like a grade school kid." (Anon 1982). For a student to perceive that the instructor has little respect or concern for the student may have undesirable consequences for the teaching-learning environment. "Asking instructor for advice on technique, it was my impression that he thought my questions were 'nickel and dime'."(positive punishment contingency). "I will not ask for his advice on anything since he considers my questions unimportant." (Anon 1982). The outcome of the encounter mentioned in the last quote demonstrates a negative stimulus resulting in an avoidance contingency (not asking questions) that is detrimental to long term functioning of that student in the clinic.

Research on patient satisfaction with physicians (Comstock et al 1982) indicates that the two main factors that correlate with patient satisfaction are the common social courtesies and giving of information. By taking time with the social amenities the instructor not only increases patient satisfaction with dental care at the dental school, but serves as a model for the student. Students may also generalize, drawing the inference that the instructor cares about them as well. In commenting on clinical teachers, one student said that if instructors acted the same way in the rest of their life as they do in the clinic, they wouldn't have any friends (friends depend on positive reinforcement contingencies). Another student commenting on a good teacher said, "Spent a few moments conferring with patients, a hand shake, a warm smile, shows a little concern for the patient's feelings." (Anon 1982).

The instructor should always take the time to keep the patient briefly informed about progress being made and his assessment of this progress. The instructor should also be sensitive to comments made by himself or the student that would cause concern or uncertainty in the patient. Since most problems that occur during student performance are readily managed, the patient should be reassured that all is under control. Again the instructor should serve as a model for the student in promoting patient satisfaction with the dental care being received. Common courtesy and giving information are two important factors in promoting patient satisfaction.

Another important aspect of tone to which an instructor should be sensitive is the rapport the student has with the patient. Some students have difficulty in establishing rapport and an unthinking instructor can readily undermine this relationship. As one student recently reported, "The cardinal sin for an instructor (in my opinion) is to insult, berate, reprimand, or otherwise severely correct the student in the presence of the patient." (Harsh positive punishment contingency). "This totally destroys trust and rapport with the patient." (Anon 1982). Setting the tone will be discussed at greater length in Unit 5.

4.01 Besides undermining student-patient rapport, what additional detrimental side effects might the following reported incident create. "A different instructor saw the result a month later (root amputation), asked what had been done, and said in front of the patient that it should never have been done. Hint: think of the patient's opinion of dental care at the dental school.

4.02 Name two aspects of emotional tone that involve the patient. Hint: think of modeling and rapport.

The Information Phase

In the second phase of the encounter, which occurs primarily during the initial visit of the patient, or the first contact of the day, the instructor clarifies purposes, objectives, or criteria that are relevant to the immediate tasks of the student. In this informational phase the instructor is presenting described contingencies that let the student know that if the student follows those directions and uses the information given, then the day's activities should progress reasonably well with a minimum of problems. The instructor may give directions or advice based on his knowledge of common problems of students at the same level, or on his knowledge of the special needs of the particular student. For example, an instructor, when giving the starting check on a procedure, may say to the student, "Other students have been having difficulty getting the slope of the pulpal floor just right on this preparation. Remember the pulpal anatomy of the right mandibular first bicuspid." Describing a possible way to avoid trouble with a sloping wall is like giving the speed limit to a driver and provides an avoidance contingency, preventing a negative stimulus from occurring. This avoidance contingency is beneficial to the long term functioning in the clinic. Telling the student that other students have been having difficulty makes the directions more salient and motivates the student to pay attention to this aspect of the procedure. The comment also communicates concern for the welfare of the patient and the student.

The instructor should gear his information to the ability and experience of the student, taking into account skills in preclinical techniques, perceptual abilities, anxiety level, etc. The directions are based on the instructors knowledge of the situation, the potential trouble spots for the average student, or the personal abilities of this particular student.

4.03 In the information phase, what are the two main purposes?

The Observation Phase

Sound management of contingencies requires careful observations. Based on these observations, assessments are made and the instructor then reinforces desirable portions of student activities, and stops or alters undesirable portions as discussed in later units.

During the first encounter of the day, the instructor has set the tone and given needed information or directions. The instructor may observe processes, products, patient reactions, human relation skills, and other student behavior such as work organization or behaviors that are consistent

with professional values. Further observations should be related to the type and difficulty of the patient service, and the progress of care related to the time alotted for the current appointment. The instructor should be alert to conflicting contingencies that might impede progress.

4.04 What are some factors that determine the relative emphasis of the instructional phases that occur during a teaching encounter?

In the observing process, the instructor may unobtrusively notice such activities as how the student holds the instruments, uses finger rests, orients the patient's head, generates heat during drilling or polishing, sequences the use of instruments, talks to the patient, or shows concern for the patient's comfort or welfare. The instructor may observe the nonverbal interactions of the student and patient. The instructor may even ask whether the patient was always comfortable during the procedure.

An objective method of observing the process of clinical performance was used at the University of Alabama School of Dentistry during the middle1960's. The faculty of the experimental teaching station used videotapes to observe the process of care delivery of students using the four handed dentistry approach. The faculty reviewed the videotapes with the students and were able to point out where the process of care delivery could be improved. Using the videotapes the instructors were able to demonstrate the three parts of the contingencies at work and how to alter the contingencies to improve dental care.

The instructor usually observes products visually, tactilely, and occasionally by hearing. He inspects the product for form and flaws. He feels vibrations via an explorer or probe and he listens for clicks as his explorer moves across surfaces. The instructor may seek further information to clarify the observations about the product. The instructor may request a demonstration of how the student performed part of the procedure, or he may ask questions about the student's perceptions of the product quality. These additional observations will help in analyzing the performance and in determining the cause of any deficiencies observed.

The instructor should be aware of contingencies at work related to his request for the student to perform. Under certain conditions, described in Unit 5, the student may view requests to perform as harrassing, punishing, and aversive.

The instructor may probe the student's thought processes by asking questions about the procedure or to respond to related hypothetical situations. For example, "What would you do if the caries had undermined

this cusp?" By asking questions the instructor can broaden the student's clinical experience while, at the same time, assessing the student's ability to apply basic principles, strategies and intellectual skills in adapting to the variations in clinical procedures that may be faced in future practice.

4.05 How is the observation phase of clinical instruction similar to preparing for a diagnosis of patient problems? Hint: think about adequacy of information.

The Assessment Phase

Assessment implies placing a value judgement on observations to decide whether to reinforce or modify the behaviors that produced what was observed. Since efficient learning requires that contigencies be applied consistently, instructors should apply the same criteria in making these judgments so that all the instructors responsible for clinical teaching are consistent in applying the contingencies. The extent to which instructors are inconsistent, increases the number of procedures required for the student to attain competency. Since instructor consistency is not easy to produce (Mackenzie et al 1982), the right kind of inservice training with adequate practice in making these judgments is required.

In addition to striving for consistency, the instructor must remain alert for clues that indicate what class of problems the student may be having with their performance. The major class of clinical learning problems are related to: 1) emotional tone; 2) competing contingencies; 3) motivation; 4) perception; 5) mediation; 6) motor abilities, all of which are discussed in later units.

4.06 Of the four phases of clinical instruction thus far discussed, which ones present the best opportunities for associating biological concepts with clinical decisions?

4.07 If a student cannot evaluate the quality of his own work correctly, which class of clinical learning problems is most likely to contain the etiological variables?

The Instructional Phase

In the instructional phase, the instructor should arrange or describe contingencies to overcome problems in the performance of students. Because of differing capabilities (Feuerstein 1979) or interfering contingencies, a small portion of students do not respond to traditional forms of clinical teaching. Malott, et al (1978, pp 244-352) reports using analysis and arranged contingencies to teach a cerebral palsy child to walk. Learn-

ing was not possible under traditional methods of teaching (e.g., holding the child on her feet and saying "go to daddy"). The child's physician had told the parents that the child would never walk, but therapists analyzed the components of the task and arranged contingencies for each. This approach was successful in teaching the child to walk. Clinical teachers use the "go to daddy" method for most clinical instruction because it usually works. When it does not work, the instructor sometimes gives up just like the above physician. For certain types of students, clincial instructors need to learn how to **analyze** situations and redesign them so that they can produce a new approach to instruction.

4.08 What does the "go to daddy" approach imply about clinical instruction?

The "go to daddy" approach usually works because the normal child learns to walk by contingencies arranged by nature. Those behaviors that lead to falling are punished by the fall, and those which maintain balance and making steps are rewarded by getting to the goal. Instructors evaluate students and the students are rewarded for meeting the standards. Most students attain these standards with little help from instructors. By minor adjustments of components that they themselves recognize, they reach their goal of competent performance.

When natural learning does not occur, the instructor must intervene and analyze the problem. Analysis of clinical performance problems involves identifying the three parts to the learning contingencies. The three parts of a contingency are the cue, the response, and the consequence. These three parts must function for learning to occur. Try telling a student to wiggle his ears when he has not learned to do so. Telling him to wiggle his ears has no value at his level of performance. Some students are admitted to dental school with serious problems in such skills as recognizing and attending to detailed aspects of three-dimensional tasks; managing people without losing their goodwill or interest; producing fine motor movements in a precise manner under defined conditions. For students with deficits in such prerequisite skills as these, a behavioral analysis of the troublesome clinical tasks can help teachers decide on an instructional approach to use with these students. For example, discrimination learning is a technique described in a future unit for helping students with a cue perception problem, and shaping is a technique described in a different unit for helping students improve their fine motor skills.

A student reported an incident that had happened to him in the clinic in which the instructor had failed to diagnose the student's problem or to respond to the student's request for help. "I knew I was deep in removing caries and I asked how much further to go. The instructor said to go as far

as possible without hitting pulp (a virtually useless answer). I went a bit further, then in checking the floor it hemorraged. Direct pulp cap and loss of confidence in instructor for letting me flounder." (Anon 1982). The instructor should have elicited more information (cue for instructor) so that he could determine how he might help the student (teaching response). If the exposure (consequence) had then occurred, at least the student would not have felt that he had been abandoned.

Frequently when observing or evaluating a product, the instructor must **analyze** information to determine the cause of errors. The instructor must determine if the problem exists because a student is unable to recognize what is acceptable, the student does not know the flaw has detrimental consequences, the student lacks professional values, the student is weak in motor skills, or the student's anxieties or motives interfere with performance. Cues for these problems direct the instructor's response in order to produce an effective consequence.

Each problem, depending on its category, requires a different emphasis and even a different approach by the instructor. Recognizing the category as perceptual, mediating, motor, or motivational then cues the instructor as to which instructional strategy to select for helping the student overcome the problem.

Unit 4: Study Questions

4.01 Besides undermining student-patient rapport, what additional detrimental side effects might the following reported incident create. "A different instructor saw the result a month later (root amputation), asked what had been done, and said, in front of the patient, that it should never have been done.

4.02 What are the five phases of the clinical teaching encounter?

Unit 4: Inserted Question Key.

4.01 Besides undermining student-patient rapport, what additional detrimental side effects might the following reported incident create. "A different instructor saw the result a month later (root amputation), asked what had been done, and said in front of the patient that it should never have been done." Hint: think of the patient's opinion of dental care at the dental school.

Answer: The instructor's comments might raise doubts concerning the advisability of going to the dental school for treatment. In an era of growing patient shortages this statement made without an excellent rationale

is a serious breach in public relations, to say nothing of good sense and professional ethics.

4.02 Name two aspects of emotional tone that involve the patient.

Answer: 1) Treating the patient with courtesy and caring provides a role model for the student. 2) Treating the student with respect in front of the patient maintains student-patient rapport.

4.03 In the information phase, what are the two main purposes?

Answer: 1) Facilitate performances. 2) Prevent future problems.

4.04 What are some factors that determine the relative emphasis of the instructional phases that occur during a teaching encounter?

Answer: 1) History of the student.
2) History of previous students on the procedure to be done.
3) Type of patient service being rendered.
4) Point at which encounter occurs during day of patient's appointment.

4.05 How is the observation phase of clinical instruction similar to preparing for a diagnosis of patient problems?

Answer: In both instances the dentist or instructor must collect additional observations in areas where there is not enough information to make adequate decisions concerning what the problems are.

4.06 Of the four phases of clinical instruction thus far discussed which ones present the best opportunities for associating biological concepts with clinical decisions?

Answer: The information, observation and assessment phases.

4.07 If a student cannot evaluate the quality of his own work correctly, which class of clinical learning problems is most likely to contain the etiological variables?

Answer: The etiology is likely to be in the perceptual class of problems.

4.08 What does the "go to daddy" approach imply about clinical instruction?

Answer: It implies that instructors set goals for students and then expect them to obtain these goals basically on their own.

Unit 5: Emotional Tone in Clinical Learning

Overwhelming research evidence reviewed in this unit indicates that setting a negative tone for the clinic environment is likely to produce behaviors detrimental to the learning process. Setting a positive tone is likely to encourage behaviors that facilitate the learning process. Setting a positive emotional tone for clinical learning is a simple instructional skill well worth learning, for the rewards lead to increased satisfaction in clinical teaching.

The importance of emotional tone for influencing the outcomes of human interaction has been established by research in many contexts. Positive rapport, caring, and respect have been established as important emotional tone variables influencing: suggestibility, the placebo effect, hypnosis, pain reduction, incorporation of values, acceptance of arranged contingencies, and effectiveness of modeling behavior. These same emotional tone variables have produced a decrease in birth complications, more rapid recovery from illness, fewer physical symptoms, and fewer psychological symptoms. Respondent conditioning created by a supportive environment with caring, empathy, and respect is a powerful and important variable for encouraging positive reactions from others (Ref. #1).

"I can't wait to graduate and I am working as hard as I am physically and mentally able. Not because I want the knowledge (that's important but secondary) but because after almost four years I have been drained of most of my ideals and professional/personal respect. All I want is to graduate." (Anon 1982). This outcome is one of the consequences of the negative emotional tone which is set by clinical teachers in dental education.

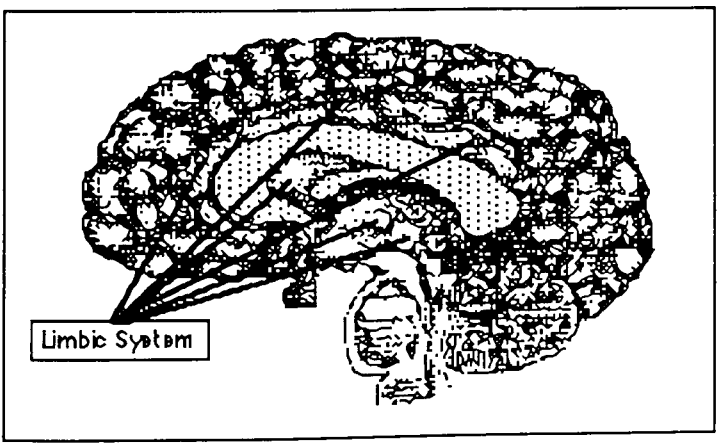
Research indicates that the marine boot camp philosophy that was cited in Unit 1 is not the best approach even in the marines. Reported in 1982 by Sarason and Navaro, marine drill instructors who saw themselves as counselors, teachers, and parent surrogates produced better marines (as evidenced, for example, by good promotion records) than did less empathetic, less outgoing, less recruit oriented drill instructors. Positive effects were detected in the two year follow-up after basic training.

5.01 Is a person (more or less) likely to be suggestible, or subject to the placebo effect, if the person has positive rapport and a caring relationship with the physician?

5.02 Is a person (more or less) likely to incorporate values or accept arranged contingencies from a person with whom he is antagonistic?

Biological Basis of Emotional Tone

Research has shown that endorphin, a specific type of neuro-peptide that is a morphine-like substance produced in the brain, is released under conditions which produce effects of placebos and acupuncture (Watkins and Moyer 1982). It has been shown to be related to the effects of acupuncture, analgesia, sedative, and emotional stress (Snyder 1984). Endorphin release is probably related to reduction of fear and anxiety as well as pain. Research has shown that opiates disrupt the retention of pain-motivated tasks and gamma endorphin facilitates the extinction of avoidance behavior (Koob and Bloom 1982). One could hypothesize that a supporting environment might also release internal substances to encourage the firing of positive circuitry in the limbic and related systems and thus make positive reinforcement more effective. Several investigations have shown that retention and learning are improved by the release of neurohormones that are normally released by emotional experiences (Weid and Bohus 1979; McGaugh 1979). Sperry's work (1982) with split brain preparations shows that emotions cross over the barrier from one hemisphere to the other when all neural connections are cut. Research with cats indicate that emotional stimuli produce a delayed effect that lasts a long time (Panksepp 1982). Neuropeptides take seconds to minutes to have an effect and then the effect lasts minutes to hours (Krieger and Liotta 1979). Neuropeptides circulate in the cerebrospinal fluid (Reppert et al 1981), anatomically adjacent to the limbic system. All these data are consistent with a neurohumor hypothesis for emotion. It is possible that specific neuropeptides in the brain are secreted in situations of positive and negative emotional tone as determined through respondent conditioning.



Existing Tone in Clinical Teaching

Data collected by the author from many dental schools and through many discussions with dental students during national meetings indicate that dental clinic teachers commonly do not set the tone of the clinical environment in a positive manner. As one leader of the dental profession recalled from his dental school experience, "Every instructor criticized me. I never did anything right, always did everything wrong" (Devine, 1978). Many dental students indicate that very little is praised, but if anything is wrong the faculty is quick to criticize. "Instructors are always quick to tell you how 'wrong' your work is, but rarely do you hear anything positive" (Anon 1982). "That looks like garbage. Why did you go into dentistry?" (Anon 1982). "Did you drop a firecracker into your prep?" (Anon 1982). "Criticized without telling me the right way to do it." (Anon 1982).

Potential Consequences of Emotional Tone

The emotional tone experienced as a student has a direct affect on later practice. A study in nursing (Rosendahl, 1973) showed that qualities of empathy, nonpossessive warmth, and genuineness in instructors helped nursing students develop these valuable skills for patient management. In contrast, research has shown that dental students in longitudinal studies during dental school tend to place less value on rapport and interpersonal skills (DeMarco and Pearlmutter, 1976), (Vinton, 1978). A study conducted in dental practice (Collett, 1973) indicated that 25% of patients sought treatment from another dentist because of unsatisfactory dentist-patient relationship, and that 49% of the dentists were willing to lose a patient because of poor interpersonal relations. In hard times, this policy could lead to bankruptcy for those dentists unwilling or unable to change.

> 5.03 A study in nursing indicated that the interpersonal relationship between the nursing instructor and the nursing student influences the student-patient relationship. What is the potential implication of this finding for dental education?

Persons trained in behavioral therapy find it very important to develop positive relationships with their clients (Gazda, 1975) because the positive relationship makes the therapist a more effective source for arranging contingencies (Mallott et al 1978). Without the positive relationship, the arranged contingencies do not work as intended and the client does not acquire the intrinsic motivation needed to continue carrying out th

learned behaviors once the therapy has stopped.

In general, clinical teachers in dentistry do not build positive relationships with students. If dental clinical instructors would provide more reinforcement contingencies they would set a more positive tone for learning. The positive tone increases student compliance. Moreover, disapproval (mild punishment contingency) of someone with whom one has a positive relationship creates a more effective contingency.

5.04 Since empathy, respect, and unpossessive warmth exert such a powerful effect in so many areas of human behavior, speculate on the underlying biological reason. Hint: think about cerebral spinal fluid.

Modeling Behavior

Imitative behavior results in the translation of instructor's statements into private verbal statements (see Unit 9) of the student's own. Private verbal statements are the basis for rule governed behavior and professional values which are very important for self-regulation of behavior. Imitative behavior is particularly helpful in developing professional values. Research indicates that imitative behavior (copying, modeling) is more likely to occur if the model is considered as successful, or knowledgeable, and as sincerely interested in the welfare of the imitator (Bandura, 1969). Instructors who are considered as disinterested, more interested in hassling than teaching, more aversive than rewarding, will not be imitated as readily. "I'll do as they say while I'm here but when I'm out, I'll do as I damn well please." (Anon 1963-1979).

The teaching of professional values is especially dependent on the student-instructor relationship. If one person does not like another, the likelihood of accepting values from the disliked person is decreased.

5.05 If a dental student's intrinsic motivation to produce quality work is only the result of the harsh, punishing contingencies of the instructor, what quality work will the student likely produce after graduation? Hint: think about learning of values.

More Praise is Needed

Withholding praise interferes with the learning process. If the faculty member withholds praise until perfection is reached, many average students will suffer extinction and stop trying. **To shape behavior toward perfection, praise the approximations of the desired**

results. As the student improves, only results that approach perfection should be praised. In sports, an olympic gymnast would not receive praise from his coach for the same quality performance that an intermediate gymnast would. Yet the intermediate gymnast knows he has room for improvement because his coach tells him what needs to be done. This combination of praise and correction is also important for effective clinical instruction. As indicated in Unit 7, praise and correction are critical for developing intrinsic motivation. Experience in personnel management shows that people are more receptive to suggestions for improvement when the suggestions follow praise for some aspect of the activity that was done correctly.

Research also helps explain why praise is important at initial phases of the learning interaction. **Mathemagenic behaviors was a term coined by Rothhopf (1970) to categorize those behaviors that are necessary for learning.** Mathemagenic behaviors include orienting, attending, listening, and processing of information. These mathemagenic behaviors are influenced by contingencies just like other behaviors. One of the reasons for starting a learning interaction with praise is that it reinforces the attending response. People are ready to listen to what follows because their attention has been reinforced and a positive tone for learning has been set. The tone is conducive to acceptance of suggestions for change.

Along the same dimension, clinical instructors must remain constantly aware of the delicate nature of the patient-student-instructor triad when offering criticism of any type. Strongly worded negative remarks about therapy should not be made in the presence of the patient, while constructive comments which improve the student's image in the eyes of the patient should. Instructors must, on some occasions, indicate errors or inadequate therapy in the patient's presence. When this correction occurs, praise also sets a more positive context for the patient. Most humans are susceptible to anxiety because of the unknown. A patient does not know what is happening in his dental care by an inexperienced person and is very sensitive to instructor comments. A criticism may be blown out of proportion by the patient and thus interfere with the student-patient rapport. Praise for some portion of the work that is good, sets the context for the patient and produces a feeling of satisfaction with the student's work even though there is some other correctable imperfection. An example of this positive approach in front of the patient is provided by Heins (Mackenzie et al 1979). "Feel this area with me, it's smooth and very well done. In private practice, if you do all your debridements as well as you have done this tooth you will be a superb clinician. Let's take a look now at another area, feel this by holding the instrument with me. Do you feel that gritty bump? It's a hard-to-reach area but let me

try to remove it while you watch. Now let's feel again." (many more specific examples of positive interaction with students are included in the videotapes developed for discussion).

On the other hand, instructors should not be insincere or indiscriminant with their praise. Persons do not like to be praised for something which they do not consider worthy of praise. The discrepancy raises questions concerning the sincerity or the competency of the praiser. "If the instructor highly praises a s----- job, if that happens, I do not take his positive comments seriously in the future." (Anon student 1980). The praise should be directed at a specific aspect of the work that was done well. This selection and praise of the correctly done portion has direct benefits for teaching a motor skill involving a chain behavior as discussed in Unit 10. Noticing and reinforcing portions of the work that are correctly done increases the efficiency of learning and prepares the student for constructively accepting criticism of the other portions.

Traditionally the use of praise in clinical dental teaching is too rare. Many clinical teachers do not realize the positive side effects of praise (Epstein 1985) that praise is a very important aid to helping students learn. Far too many instructors are stingy with praise. Things need to be perfect before some instructors will give praise, and sometimes, even then, they do not. "If one praises without perfection, the student will never rise to that height." "Students really should do good work without praise because it is the professional way." Because of beliefs such as these, some clinical instructors hold back praise and spend most of their time criticizing.

Many students have commented on the extent of imbalance between praise (positive reinforcement contingencies) and negative criticism (positive punishment contingencies). One student sums up this feeling and the reaction to it. "I feel that the instructors lose sight of the fact that this is a school. School is a place where one is supposed to learn. Learning takes place most rapidly when a student is positively reinforced. I believe that very few instructors here have adequate training in positive thinking and motivation. Dental school for some students may be the most frustrating experience they have ever encountered. I believe the faculty needs to constantly reassure the student that he is doing o.k. and that he (the faculty) understands what you are going through. Up to this point I have received very little encouragement."

Besides verbal comments showing approval or disapproval, an instructor has many nonverbal ways to employ contingencies. Smiles, nods, a pat on the back, listening attentively to the student: all are usually rewarding. Frowns, raised eyebrows, shaking the head, an angry glare, and certain hand gestures can serve as the aversive effects related to clinical student

activity. If a clinical member employs too many aversives during instruction, the student will probably minimize contact (behavior) because the punishing effects generalize to the instructor himself. Consequently, the student avoids the instructor and loses a valuable resource for learning. "I now bring my patient on a day when Instructor A is not teaching in the clinic."

> 5.06 What are some attributes in a Class II cavity preparation that can be praised when the only error is inadequate placement of a groove.
>
> 5.07 What are some qualities and consequences of praise that are useful to learning?

Excessive Punishment

Excessive punishment interferes with learning. When a clinical teacher berates a student as lazy, dishonest, or incapable of becoming a dentist, the instructor is applying excessive punishment. Instructors are also overly punishing when they criticize a student in front of the patient or display strong anger or disapproval. Excessive punishment not only prevents a behavior from occurring, but also reinforces other behaviors involving escape and avoidance (Poteet 1973). The student is reinforced by mentally escaping the instructor. The student escapes by not listening and by not asking questions. The student's lack of responsiveness to instruction then tends to extinguish the instructor's desire to help. In addition, the student avoids the instructor as much as possible. If other instructors are available the student works with them, sometimes never contacting the aversive teacher again. Furthermore, "Students pass advice on to underclassmen as to which professor to avoid in the clinics." (Anon 1979).

> 5.08 For an instructor who does not enjoy student contact, what kind of reinforcement contingencies are operating?

When an instructor continually uses excessive punishment, the students arrange their own contingencies. They justify not listening to him by telling themselves that the instructor is "too picky", "too impractical", "he could not make it in practice". This reduces the conflict that arises from not listening or seeking the help of this instructor. It is not unreasonable to avoid someone who is perceived as incapable of helping you.

Excessive punishment also creates other undesirable side effects through respondent conditioning. Specific features that are present during excessive punishment become conditioned aversive stimuli (aversive

stimuli are negative stimuli). The same type of learning is involved when a person, who has been hurt during a dive, acquires a fear of the high diving board. In clinical dentistry,if a very punishing incident occurs, the dental clinic or specialty clinic may become so aversive that the student becomes anxious every time he enters. A clinical discipline may become so aversive that the student avoids it as much as possible, even after graduation. Some dentists have confided that they avoid doing certain endodontic procedures or oral surgery because they did not like the teachers in that particular discipline.

5.09 Give some reasons why excessive punishment should be avoided in clinical teaching.

Properly Employed Punishment

The punishment contingency, however, is necessary in clinical instruction and should be used properly. Punishment is the only contingency of the three (punishment, reinforcement, and extinction) that stops harmful activities immediately. For the patient's welfare, punishment (in the technical sense) must be employed by the clinical teacher. Fortunately, it can be employed without creating the disruptive side effects.Side effects can be avoided by using mild punishment (positive punishment contingency), combining it with initial praise (positive reinforcement contingency), and providing information on what is the correct way to avoid the error in the future (avoidance contingency). This is the "one-two-three combination punch" of clinical teaching. Punishment by itself only suppresses behavior, it does not help the student learn what to do. Without corrective feedback, punishment promotes an inefficient form of trial-and-error learning. "I spend a lot of time trying to find someone who knows how to do the procedure." (Anon student 1979).

Since punishment is an important contingency in clinical instruction, instructors should learn to employ it properly. Properly employed punishment focuses on punishing the incorrect response and not the person. The instructor must make clear that he respects the student, although he may not approve a particular behavior of the student.

In clinical teaching, combining praise (reinforcement), error identification (punishment) and how to improve (reinforcement) reduces adverse emotional reaction to the interaction. "I know you don't want names but I think Dr. X is an example of what I mean. He is dedicated to excellence and perfection of our learning and makes us do our best. At the same time he is strict in discipline and grading, but open-minded for our explanations and decision. He makes a learning experience out of every situation and when you are depressed over an error committed, he motivates you and

makes you raise your spirit and start again. I know all faculty cannot be Dr. X but they could sure try to be more like him." (Anon student 1979).

Consider the implications of the above quote! Many dental teachers believe that students avoid them because they demand excellence. Demanding excellence, however, is not the crucial factor. It is the tone set by the instructor that determines student avoidance. Students want to be helped toward excellence, it embodies their intrinsic drive toward competence (Deci 1971). They will happily strive toward excellence for someone who respects them and shows concern. It is not the demand, but the "tone" that is the more crucial variable.

The effects of tone can be observed even in the treatment of young dental patients. Melamed et al (1983) found that, unless accompanied by positive verbal feedback after appropriate behavior, firmly-spoken criticism of inappropriate patient behavior had a detrimental effect on the child's cooperation at future sessions.

Tone Influences Perception

Setting a positive tone for instruction not only lessens the likelihood of an adverse emotional reaction, but influences how situations are perceived by the student. With the wrong tone any ambiguous situation tends to be interpreted in a negative manner by students. One student commented that the instructor "kept hovering around behind him waiting to jump on him". Another student enjoyed having the instructor available for help. The different affective tone perceived by these two students caused them to perceive the same situation in a completely different light. This is a common occurrence for humans. If you give two people exactly the same paragraph on politics and tell them it was written by Abraham Lincoln, you obtain a completely differentinterpretation of the meaning than when they believe it was written by Lenin. Others have shown that the emotional state influences what thoughts are retrieved from memory (Ellis et al 1985; Bloney 1986). Thus, if the tone is positive in the clinic, many neutral events will be considered positively, whereas, if the tone is negative, the neutral events will be considered negatively.

Even negative events will be interpreted positively when the tone is positive enough. Pavlov (1927) ran an experiment with dogs. He gave the dogs a mild electric shock and they trembled and cringed every time they received the shock. Then Pavlov paired the mild electric shock with food. Soon the dogs stopped trembling and cringing with the shocks, instead, when they felt the shock they wagged their tails, wiggled in excitement, and salivated. The emotional response to the shock had apparently changed due to the context in which the shock was given.

Mackenzie 1988

The way an individual labels or evaluates a situation determines his subsequent actions (Meichenbaum, 1977). If an instructor has some means of determining how a stimulus will be perceived, he can increase the accuracy of his prediction of student performance (Mahoney, 1974). **Overwhelming research evidence reviewed in this unit indicates that setting a negative tone for the clinic environment is likely to produce behaviors detrimental to the learning process, whereas setting a positive tone is likely to encourage behaviors that facilitate the learning process.**

5.10 If a student is asked a question regarding basic science information related to a patient he is currently treating, how will this be interpreted under these two conditions: a) an instructor who has a history of excessive punishment; b) an instructor who has a history of helpfulness?

Setting a Positive Tone

To create a positive tone there are several constructive things that clinical instructors can do. Several have already been mentioned. 1) Praise students liberally, but deservedly. 2) Praise students in the presence of their patients. 3) Start each identification of error with praise. 4) End each error criticism with positive corrective steps. 5) Avoid use of overly strong punishment. 6) Listen to the student's ideas and paraphrase them before giving either correction or reinforcment. All these actions contribute to a positive learning tone in the clinic.

The essential variable in setting the proper tone is to have students perceive instructors positively. This perception depends on the instructor being concerned with student's welfare, caring about their progress, and respecting them as individuals. This perception of the caring person is the variable common to the range of research cited in the second paragraph of this unit. These variables of caring, empathy, and respect have surfaced in many areas where the helping relationship is important.

Showing Respect for the Student

Showing respect for the student is another dimension of establishing the environmental tone for learning. It is punishing for the student to have his self-respect damaged by the treatment he receives from people who have power over him. An instructor shows respect for the student by conveying the message that he believes in the student's ability to succeed and that he values the student as a person. Respect is shown by paying attention and listening carefully to what the student says. When an in-

structor gives a student his undivided attention, he demonstrates that he is committed to understanding the student and the student feels that the instructor considers him a significant person. Paraphrasing what the student says shows that the instructor listened carefully and understands.

Advice passed down from advanced dental students to underclassmen indicates that students acutely feel the lack of respect that clinical teachers seem to demonstrate. "Be prepared to have your self-esteem repeatedly attacked." "Learn to become subservient to professors." "Students are not treated like people, more like some sort of slave." "Hold your breath, it only hurts for four years." "Don't make waves, keep a low profile." "Lay low so no one knows who you are." "Dental school is not for the weak of spirit." "Be sure you want this desperately." "Teachers give you a hard time and harass you --and that you just have to put up with."

How an Instructor Communicates Lack of Respect

The instructor communicates disrespect for the value and dignity of the student when he ignores the student waiting for help and continues talking to another instructor. The instructor shows disrespect by taking over and doing things for the student when the student feels capable. "Comes in, tells you it looks like ---- and then does the work for you without explaining what they're doing or what was wrong." (Anon 1982). "Working on my patient without even asking, instead of asking if I would like to do it." (Anon 1982). The instructor also conveys lack of respect when he ridicules the student, makes fun of the student's findings, or tells the student that what the student is feeling is minor or unfounded. Inferring or directly telling the student that he is lazy, dishonest, incompetent, or that he will never succeed as a dentist also shows lack of respect and interferes with the environmental tone needed for learning. The instructor shows disrespect by ignoring the student's ideas. "I was outlining a plan that I had come up with just for consideration or criticism. He cut me off or interrupted me without letting me finish my explanation and told me how he wanted it done. I felt stifled. I had used accepted principles and concepts to come up with an innovative idea and the instructor wouldn't even listen to it." (Anon 1982).

How an Instructor Communicates Caring

Since students must also infer that the instructor cares about them, what behaviors of the instructor does the student observe that helps him draw this inference? For example, the student infers caring when the instructor comes over to the student's cubicle, greets the student by name, and greets the patient. The instructor may indicate that he is pleased to see the patient back again, or he may say something nice about the patient to

the student. When he examines the student's work he reassures the patient that all is going well, or at least is under control. He makes sure that the student recognizes any error present, knows how to prevent future recurrences, and understands why the error is important to the patient's welfare. When the student has had a clinical setback the instructor sympathizes, helps the student plan his recovery, and reassures the patient that the setback is only temporary and also occurs occasionally with any good dentist.

The effective clinical instructor learns about hobbies, sports, or future plans of students. The instructor then relates instruction to this information. If a student is planning to practice in a rural area, the instructor may indicate that this point is particularly important for a general practitioner who cannot easily refer his patients.

All these observations indicate to the student that the instructor cares about him, is concerned with his learning problems, knows how to help him, cares about his patients and his relationship with them, and wants to help the student succeed. This type of environment encourages learning, promotes modeling, and results in a warm pleasant greeting from students or graduates in social situations.

5.11 On what basis does the student conclude that an instructor cares about students?

How an Instructor Communicates Lack of Caring

In contrast, students infer lack of caring when instructors arrive late to clinic and leave early. The instructor uses the phone frequently, telling students he will be over later when he finishes his fishing story. He is capricious in his comments to student, he seems arbitrary and gives no reasons for the grades he assigns. He treats patients like manikins and shows no interest or concern about student problems. He plays favorites among students, spends a great deal of time with a few students, and will sometimes help students out of turn. He insults and belittles students in front of patients. He accuses students of dishonesty, or unethical behavior when the situation does not warrent such harsh rebukes. Published research (More 1961 and Guild 1966) and personal research for over twenty years indicates that these instructor activities are common, well established, and ongoing. One student summed up his reaction. "Oppression and being put in my place because I am a student, because I knew something the instructor didn't. I never knew the meaning of the phrase, 'I hate school' until I came here."

Authenticity and Empathy

Two other factors that research has shown as important for establishing emotional tone are authenticity and empathy (Carkhuff and Berenson 1977; Gazda et al 1975). An instructor is perceived as authentic when she presents herself as a real person without pretense or professional facade, she acknowledges error, speaks of hobbies and feelings, refers to similar experiences, and does not mislead. An instructor is perceived as empathetic when he communicates an understanding of the student's feelings by describing the situation and the feelings which were likely induced; by paraphrasing a student's expression of feelings; by acknowledging the student's feelings of self-doubt, anxiety and discouragement, then offering help. These actions on the part of the instructor help establish a positive emotional tone.

Instructor Attention and Extinction

Attention from the instructor is not only a way to show respect, but helps maintain desirable behavior in the student. The new student to the clinic is eager to learn about his patients and often reads about their conditions. When he tries to discuss what he has read with the instructor, the instructor dismisses the conversation as if it were not important. By ignoring the student's attempts to learn about his patients the instructor extinguishes the students reading activity. Many times the instructor does not intend to do this, but either does not feel comfortable with the discussion or is pressed for time. **Ignoring leads to extinction.**

When students receive inadequate instructional attention from teachers, there is also a possibility that extinction will occur. Initially, most students have a strong desire to learn about clinical procedures because thelearning is so relevant to their goal of private practice. If faculty provide too little instruction when checking student's work, the student receives no reinforcement for wanting to learn. Under this type of contingency, one would expect the desire to learn to decrease. Indeed, considering how important clinical learning is, too many students do show a surprising lack of desire to learn while in the clinic. "I just want to get out of here." (Anon student 1963-81).

Nonverbal Cues of Student Reactions

By observing nonverbal behaviors of students that occur while interacting with an instructor, one can notice cues that indicate the perceived tone of instruction. When the tone is not conducive to learning, the student does not face the instructor, has arms folded across the chest, shuffles feet, clenches and unclenches his fists, speaks only when spoken to

and then only briefly in monosyllables, rarely smiles, and agrees readily. When the student finds the environmental tone conducive to learning, the student faces the instructor, asks questions, watches the instructor closely, leans toward the instructor, smiles frequently, and stands firmly with arms in open position (Weitz 1974; Carkhoff 1977).

5.12 Why is it important to observe nonverbal cues when interacting with students?

Summary

The student's conflict between wanting to learn and the negative tone set by some clinical teachers is summarized by this statement. "Maybe the theory of education that some of these faculty members have is that pain associated with a certain event will imprint that event in the student's mind. The imprints have occured. I just don't know how some of these people can live with themselves or maybe they are totally blind. I will learn dentistry, but I don't know what the cost will be. I often have a difficult time convincing myself at the end of the day that it's worth it." (Anon student 1979)

The next two units examine contingencies that often interfere with learning. Setting a positive tone is the first step toward thwarting these competing contingencies. A negative tone supports contingencies that interfere with the long range goal of creating a competent dentist.

On the other hand, setting a positive emotional tone for instruction, reinforcing desirable behaviors, keeping punishment mild and associated with reinforcers, being genuinely concerned about student's and patient's welfare, showing respect for the student, and attending to the student's desire for learning will lead to more optimal learning conditions in the clinic. As a result, students will learn to manage patients and auxiliaries more effectively, respond in a desirable fashion to instruction, and maintain motivation for learning.

Reference Notes

1. For further reading concerning how to apply the factors related to emotional tone, there are several good sources (Gazda 1975; Carkhuff and Berenson 1976; Carkhuff and Pierce 1976; Carkhuff and Berenson 1977; Carkhuff Institute 1978).

Unit 5: Study Questions

5.01 What factors in interpersonal relationships have been found by researchers to exert a powerful influence on human behavior in many areas (e.g., modeling, placebo effect, suggestibility)?

5.02 What are some areas of importance to clinical teaching for which interpersonal factors have been found to exert a positive influence on behavior?

5.03 What are mathemagenic behaviors?

5.04 What is the reason for starting a corrective procedure with praise?

5.05 What may happen if an instructor only praises perfection?

5.06 What quality of punishment reinforces its use in social situations?

5.07 What additional effect besides stopping the target behavior does excessive punishment have?

5.08 Give some examples of instructor behavior that produce excessive punishment.

5.09 How can punishment be applied without producing undesirable side effects?

5.10 Why is punishment by itself inadequate for efficient clinical learning?

5.11 What influence does the emotional tone of the environment have on the interpretation of ambiguous situations?

5.12 Identify some things the instructor does that conveys respect for the student.

5.13 Identify some things an instructor does that conveys to the student that the instructor cares about people in general and the student in particular.

5.14 How do people (instructors or students) find out about unobservable behaviors (e.g. thoughts, motivations) of another person?

Unit 5: Inserted Question Key.

5.01 Is a person (more or less) likely to be suggestible, or subject to the placebo effect, if the person has positive rapport and a caring relationship with the physician?

Answer: More likely

5.02 Is a person (more or less) likely to incorporate values or accept arranged contingencies from a person with whom he is antagonistic?

Answer: Less likely

5.03 A study in nursing indicated that the interpersonal relationship between the nursing instructor and the nursing student influences the student-patient relationship. What is the potential implication of this finding for dental education?

Answer: The instructor-student relationship may influence the dentist-patient relationship in dental practice.

5.04 Since empathy, respect, and unpossessive warmth exert such a powerful effect in so many areas of human behavior, speculate on the underlying biological reason.

Answer: A possible common mechanism is the release of a neural peptide that predisposes positive or negative circuits to fire. This may be related to such phenomena as the loved one who can do no wrong (positive effects) or why some married couples have no desire to reconcile their marriage when there is every reason to do so (negative effects).

5.05 If a dental student's intrinsic motivation to produce quality work is only the result of the harsh, punishing contingencies of the instructor, what quality work will the student likely produce after graduation?

Answer: Some students will not have acquired the intrinsic motivation for maintaining quality care when no one is around to check their work.

5.06 What are some attributes in a Class II cavity preparation that can be praised when the only error is inadequate placement of a groove.

Answer: Wall orientation, removal of developmental grooves, pulpal floor depth, marginal ridge thickness, and so forth.

5.07 What are some qualities and consequences of praise that are useful

to learning?

Answer: Specificity as to what was done right aids learning. Praising some feature worthy of praise, also reduces patient anxiety and supports student-patient rapport.

5.08 For an instructor who does not enjoy student contact, what kind of reinforcement contingencies are operating?

Answer: Negative reinforcement and avoidance contingency. Students not asking questions is negative reinforcement for the instructor's punishing behavior because the punishment removes an aversive stimulus for the instructor who does not like questions. Any behavior that stops students from asking questions is reinforced by an avoidance contingency.

5.09 Give reasons why excessive punishment should be avoided in clinical teaching.

Answer: It produces escape and avoidance behavior. It conditions students to avoid certain clinical instructors, disciplines or clinics.

5.10 If a student is asked a question regarding basic science information related to a patient he is currently treating, how will this be interpreted under these two conditions: a) an instructor who has a history of excessive punishment; b) an instructor who has a history of helpfulness?

Answer: Under condition "a" the student will probably interpret the question as harassment and a waste of valuable clinic time. Under condition "b" the student will probably interpret the question as trying to help him better understand the situation.

5.11 On what basis does the student conclude that an instructor cares about students?

Answer: The student observes the instructor interacting with staff, patients, other students and with the student himself. The student observes common courtesy, inquiries concerning the welfare of others, ready availability, and quickness to help.

5.12 Why is it important to observe nonverbal cues when interacting with students?

Answer: The instructor should observe nonverbal cues when interacting in order to determine how the student perceives the tone of instruction.

Exercise: Unit 5

Classify the rules derived from Unit 5 into the categories provided in Appendix B and then write an episode report (Appendix D) recounting the application of one or more of these rules during clinical instruction.

- Communicate with patient during instruction to clarify and set at ease.
- Communicate that you understand how a student feels by paraphrasing the students' expressed feelings.
- Relate instruction to students interests and goals.
- Maintain confidentiality.
- Provide extra time for students who have fallen behind.
- Avoid attacking a student's character, only apply contingencies to his behavior.
- Indicate to students that you feel they are capable and will succeed.
- Avoid prolonged conversations with colleagues.
- Show concern for a student who is having trouble and appears anxious.
- Say positive things about the student to the patient.
- Inform students in advance when you will be away from the clinic.
- Establish, where possible, some common interests.
- Be consistent in your oral and written evaluation.
- Indicate how you had similar difficulty as a student.
- Greet student and patient.
- Never belittle student's personality or personal characteristics.
- Imagine yourself in the situation facing the student.

- Call students by name.

- Avoid excessive criticism in front of the patient.

- Focus punishment on the behavior of the student, not his character.

- Give student the benefit of the doubt.

- Consider the students suggestions.

- Compliment students when you are pleased with their progress.

- Attend to the students questions and concern so that he feels respected.

- If you make an error, acknowledge it.

- Occasionally talk to students about things other than dentistry.

- Allow independence consistent with students' skills and patient welfare.

Unit 6: Understanding and Managing Contingencies in the Clinic

Influencing human learning is not as simple as the discussion of contingencies in Units 2 and 3 would suggest. As any experienced parent or teacher realizes, influencing learning in human beings is not simply a matter of reinforcing and punishing responses. The teaching-learning situation is more complex. In order to produce desired results the instructor must be sensitive to competing contingencies. In addition to emotional tone and its consequences, he must learn to manage competing contingencies including those generated by the learner. Factors that make clinical contingencies complex are described in this Unit.

Immediacy and Certainty

Research has shown that certain conditions create more potent contingencies than others (Mallott 1978). For instance, immediate effects are much more influential than delayed effects. Mining company executives are more influenced by obtaining annual profits from mining than they are by the long-term environmental effects. In the case of industrial polution, society must step in to rearrange contingencies so that immediate effects (payment of fines) support important long-range goals.

Students have a similar problem. The immediate consequences of talking to friends, watching television, going to a movie, and reading a novel exert a more powerful influence on behavior than the long-range benefits of studying and learning. A person studying this book on their own might tend not to do the exercises because the effort, although only slightly negative, is immediate. Formal schooling helps the student attain long term goals, when an instructor arranges immediate consequences (tests) that are consistent with these goals. The essence of the research on self-control indicates that a person must arrange immediate consequences that are compatible with his delayed goals. After long hours of review and study, a student wants to quit. Instead, he writes at the top of his paper, his name and Doctor of Dental Medicine, to bring his behavior in line with his own long term goals.

The degree of certainty that a consequence will be applied is another powerful variable. A juvenile deliquent who has only a small chance of being caught is less influenced than one who is certain to be caught. A student is more likely to study Monday night, if he is certain that he will have a test on Tuesday, than if there is only a chance for a test. For any individual there is only a very small chance that not fastening a seat belt will lead to serious injury. Over and over, research has shown that contingencies that have even relatively insignificant consequences, but are immediate and certain, exert greater influence on behavior than delayed

Mackenzie 1988
and uncertain consequences of great magnitude.

> 6.01 For many faculty members, which is likely to exert more influence, having coffee with their colleagues or writing that paper for publication? Give your rational. Hint: think about overeating.

There are many examples of the relative influence of immediate, certain consequences, compared to delayed, uncertain consequences. This differential effect occurs even when the immediate consequences are of small significance when compared to the importance of the delayed consequences. The small, immediate pleasures of smoking and overeating are common examples in our society. The long range consequences of loss of health, discomfort, and even early death may have less control of the ongoing behavior than consequences which occur promptly. The same analysis holds for careless sex and overindulgence in alcohol and drugs.

Another example of the immediacy of consequences controlling behavior is failing to exercise or failing to perform oral hygiene. The activity requires effort which produces an immediate and slightly aversive stimulus (punishment). The competing reinforcement contingency depends on the long term consequences of good health and pleasing appearance. One reason some students will try to patch an error in a preclinical technique course rather than start over is that the chance of an immediate solution seems more desirable than the certain and extensive effort required to begin again.

> 6.02 Why do some students take short cuts in learning rather than practicing the skills and habits that will help make them successful in practice? Hint: think about the cause of one of mankind's biggest problems.

Some students will learn answers only to the questions that they feel confident will be on the test rather than studying the rest of the subject matter. Give students a copy of the test in advance and observe what they do. The immediacy and certainty of what to study will exert a very powerful influence on how these students will spend their time. For the same reasons some students will try to get by with inadequate clinical products rather than take the time to learn the correct way. Students rationalize taking short cuts in learning. They may justify their behavior by saying that they can learn the information later when they have more time, or that it's really not important for dental practice. These statements prevent the build up of guilt or anxiety (immediate punishers) that would occur if they were to acknowledge that their short cuts were detrimental to

developing their competency for dental practice.

As indicated earlier, immediacy is such a potent factor that trivial consequences which are immediate and certain are more likely to influence behavior than delayed consequences which are important and less certain. Keeping a goal in mind provides some internal consequences which are immediate. Doing something that helps accomplish the goal is immediately rewarding. Thus, immediate contingencies often come into conflict. The goal conflicts with other immediate contingencies in the students environment. Frequently these contingencies compete for the student's time and effort. When this conflict occurs in the clinic, such as when the student tries to avoid a learning experience, it is the instructor's role to help the goal contingency win.

Deadline Contingencies

Instructors have at their disposal a very potent contingency to encourage students to work steadily toward graduation. This contingency is called a deadline contingency. The deadline contingency uses an increasing degree of immediacy to influence behavior. If a person does not complete a clinical test by Thursday at noon, he will lose a whole letter grade. If a student does not finish the amalgam by 4:30 p.m. he will fail the certification examination. If a student does not study by examination time on Tuesday, he may receive a poor grade. Students study or complete an assignment (avoidance contingency) to avoid the punishment that could occur at the deadline. Of course, deadline contingencies may also involve reinforcement as when one pays a smaller electric bill for paying on time.

Deadlines have a way of capturing attention. There are many contingencies competing for a student's time. For many students playing golf, watching television, playing cards, and sleeping compete very favorably with studying when there are no deadlines. As a deadline approaches the urge to study increases. The closer to the deadline, the stronger the need to study until there is nothing else strong enough to compete successfully. If a deadline is a month away a person is more likely to watch television, than if the deadline is tomorrow. Deadlines are effective competitors in guiding learners toward their long range goals.

6.03 Why do some people work better with deadlines? Hint: think about people with low resistance to temptation.

Generalization

Generalization differs from respondent conditioning. Respondent conditioning pairs a neutral stimulus with a non-neutral stimulus. **Generalizaton associates a non-neutral stimulus with an entire class of similar stimuli,** enabling humans to learn rapidly. For example, once a dental student has identified the cues necessary for a quality cavity preparation, he can utilize those cues in a variety of patients. Generalization can be both positive and negative.

If a person almost drowns in rough water, he may be afraid thereafter to go swimming in any water. If a policeman roughly handles a teenage boy, the boy may avoid contacting the police for any reason in the future. Contingencies arranged by a clinical instructor for one purpose may have unintended side effects. Consequences following a response may generalize to a similar class of responses and to a similar class of cues. Arranged contingencies may come to influence other responses than those intended. For example, the activity that is reinforced or punished may be the general category of behavior and not just the specific activity. If people laugh at a person's joke, he is more likely to tell additional jokes in the future (class of responses). If an endodontic instructor goes out of his way to help a student during a difficult procedure, the reinforcement contingency may generalize and all endodontic activity may increase in the future (class of responses). Conversely, if an oral surgeon severely chastizes a student in front of his patient, the student may avoid Oral Surgery, thus decreasing all oral surgery behavior (class of responses). Behavioral effects (laughter) generalize to broader classes of responses (telling other jokes).

Cues also generalize. Cues do not have to be exactly the same to produce a behavior. Varying degrees of exopthalmos in different patients will signal a dentist to search for further information about possible hyperthyroidism. Varying degrees of gingival inflammation signal the need for some form of periodontal therapy. Unhappy personal experiences with authority figures (cue) can generalize to clinical instructors (class of cues). Traumatic experiences with a few clinical instructors (cue) early in a student's career can generalize to other instructors (class of cues) so that the whole clinic learning experience is made less effective.

Individual Differences in Students

Some students do not respond in the same way as other students to contingencies arranged by instructors. The different learning histories of the students may cause the same environmental event to fire positive circuits in one student and negative in another. A student who received

many rewards from previous clinical teachers is likely to be reinforced by attention. A student who received punishment as the primary interaction with clinical teachers may find attention aversive. So attention can be rewarding for some students and punishing for others.

Similarly, students differ in their response to receiving new learning opportunities. Some students seek new experiences and are reinforced by new opportunities. Other students are more interested in doing only what is required. These latter students are punished by receiving unrequired learning opportunities. So if a student does something you want to encourage, do not "reward" him by giving him more work, unless you are sure he will perceive this effect as positive.

Events also differ in their degree of aversiveness for different students. Some students are crushed by a critical comment from an instructor. Others would almost need expulsion from school to attain an equivalent effect. The degree of perceived aversiveness is important in clinical teaching because consequences that are too aversive for the particular individual have detrimental side effects. Instructors need to be sensitive to non-verbal cues that give insight into the degree of responsiveness of students to similar contingencies.

6.04 Why do some students enjoy an instructor who brings students to his office for a friendly talk whereas others dislike the experience? Hint: think about student backgrounds.

Counter-Control for Contingencies

Human beings do not always repond as expected to contingencies arranged by experimenters or instructors. If the human subjects of an experiment do not like the experimenter (a variable), they take pleasure (an effect) in thwarting his experiment. For instance, juvenile delinquents with whom the experimenter has not developed rapport will not respond to arranged contingencies in the same way as most normal people in other circumstances. This phenomena is called counter-control (Mahoney 1974). A person using counter-control rearranges contingencies mentally.

Animals and very young children do not use mediating responses, but the adult human being past the early elementary school age (Kendler and Ward 1972) uses **mediating responses (e.g. thinking, mental images, values and other guiding rules) to break from the control of environmental contingencies.** Mediating responses are discussed in detail in Unit 9. Under certain circumstances mediating

Mackenzie 1988

responses result in behavior that would not be predicted by knowledge of the immediate environmental contingencies alone.

The response to environmental contingencies frequently depends on the way the human feels about the situation. What a person says to himself in any particular situation has a great impact on how he behaves, thinks and learns. A person with religious training may say to himself "a soft answer turneth away wrath" and thus defer anger that would interfere with learning. It is very important for the attainment of instructional goals, that the environmental context in the clinic support positive feelings. A student can be coerced into performing observable behaviors, but his thoughts may not be compatible with what he is doing. A person who is coerced in school, cannot be relied upon to continue to perform after graduation when his performance is controlled by his own way of thinking.

6.05 Why is an aversive, coersive learning environment a possible problem for future health care? Hint: think about the student's motivation.

Environmentally Arranged Contingencies

At any given moment in time, there are usually competing contingencies at work. The contingency which is the most powerful will exert the most influence. Often the competing contingencies are vying for **responses that are incompatible. When two responses in a situation cannot occur at the same time, like sitting down and standing up**, the reinforcement of one decreases the probability of the other. For example, in clinical situations at any one point in time, students can either ask questions or not ask, listen or not listen, work to learn for later practice or work only to meet requirements, do quality service for a patient or cut corners, study or relax, make an acceptable product or not. If only one response can be given in a situation, the change in probability of one response changes the probability of all responses in that situation (Kazdin 1982).

Much of student behavior is externally controlled. Much of what appears to be **maladaptive behavior (not adapted to long range goals)** on the part of students is usually not due to some deep seated motive, but is actually an easily influenced condition resulting from competing contingencies. As described earlier, the clinic environment has complex contingencies influencing behavior. Analyzing the environment and detecting these contingencies is part of the role of a good clinical teacher.

Students are continually bombarded with contingencies arranged by

their immediate environment or described by several different clinical disciplines. Students must manage differences in patient behavior, scheduling problems, logistics of facilities and equipment, the behavior of clinic staff, differences between instructors, and the described contingencies set forth by each clinical department and by the clinical and school administrators. Often, clinical and school contingencies come into conflict, or produce effects other than the ones intended.

Environmental Contingencies Versus Patient Care

Sometimes the effects arranged by the environment interfere with the practice of proper professional conduct. If much effort is required to do what ought to be done, proper professional conduct may not occur. Excessive effort is aversive and punishes the response immediately preceeding it. One example of this phenomenon cited in the literature (Mager and Pipe 1970) was the instructional problem of students not adjusting dentures properly. Students would not respond to the pressures exerted by the instructors to perform better. The instructors concluded that the students had a poor attitude toward learning. Actually what had happened was that the physical layout of the school had arranged a punishment contingency that interfered with good performance. To reach the laboratory where dentures could be adjusted, students had to climb a flight of stairs and walk the length of the school. Since the adjustment process usually required several attempts, much effort was involved. When the problem was analyzed and the laboratory was moved adjacent to the clinic, the problem disappeared.

Analysis of a problem involving competing contingencies requires: 1) the realization that the problem exists (e.g., in the above problem, too many patient complaints associated with dentures); 2) that the instructor can specify exactly what environmental stimuli characterizes the problem (e.g., the sore areas actually exist); 3) that he can associate an inappropriate response with the problem (e.g. students are not adjusting the dentures properly); 4) that he can identify a contingency that interferes with an appropriate response (e.g., a punishment contingency involving excessive effort that reduced the likelihood of the denture adjustment by the student). In the case of the poorly adjusted dentures the contingency was one arranged by the environment.

A similar environmental problem occurred in an old fashioned dental clinic. The wash basins were centrally located in the old large dental clinic. Some students had to walk as much as 75 feet to wash their hands. As anyone who understands behavior can imagine, aseptic technique was frequently broken in that clinic.

Mackenzie 1988

6.06 Explain, using a knowledge of contingencies, why the aseptic technique in the old fashioned dental clinic was frequently broken. Hint: think about denture adjustment example.

When an area of a patient's oral cavity has difficult access, some students will do an inadequate job of examination or scaling and currettage in the area. For a novice who does not know how to gain access, the extra effort required interferes with performing the proper service. The student ignores the area and forgets about it before summoning an instructor. Again, a natural contingency has interfered with good dentistry. An instructor without knowledge of contingencies might naturally infer that the student has a poor professional attitude. Whenever student behavior seems inconsistent with professional values, instructors should not infer character defects but should analyze the situation for competing contingencies. As an example, this student took offense at the instructors inference, "The instructor pointed out that calculus was remaining. Then after calling me away from the patient, stated that I had the integrity and tactile sense to detect and remove calculus. My morality is not based upon the removal of calculus." (Anon student 1979).

Sometimes school policies unwittingly arrange contingencies that interfere with goal attainment. "When faculty grading stressed independent work, I quit asking questions because the faculty graded me down. It's hard to learn if you can't ask questions." (Anon student 1979).

Clinical requirements can be arranged so that students will strive to attain the requirements at the expense of their patient's welfare. If the student must find a particular carious lesion for a standardized clinical test, the other dental needs of that patient may become of secondary importance. Sometimes deadlines, excessive workloads, or directions imposed by another department cause students to cut corners. For example, some students may ignore periodontal disease in order to do restorative work. Understanding how contingencies work helps prevent the faculty from arranging contingencies which cause immediate student needs to conflict with patient welfare. "Concentrate on the procedures, accept only patients who seem to be what you need. This is a rotten way to do things, but it seems to be what the students are being forced into doing to keep ahead of trouble."

6.07 If students commonly ignore the welfare of patients, what should the faculty do? Hint: faculty need to analyze for something.

6.08 When a department develops a new clinical rule or procedure what question should always be asked? Hint: think about what contingencies do in addition to influence the target behavior.

Faculty Arranged Contingencies Can Create Conflict

Sometimes the contingencies are those described by other clinical departments. For example, if Department X announces a deadline that requires much effort in a short time, students will skip other responsibilities to complete the assignment. Occasionally, the sum total of expectations is greater than the time available. If a number of different faculty are making demands without anyone monitoring the overall situation, the student may appear to lack responsibility by missing deadlines. Another problem is that students must treat patients comprehensively (complete all treatment on patients). A student spends eight months correcting periodontal problems and doing operative dentistry to prepare a patient for bridges and partial dentures, then suddenly discovers the patient has moved from the city. The clinic rules (contingencies described by faculty) indicate that the student must obtain a new partial denture patient and again begin mouth preparation. For most students, this type of situation creates heavy stress. Aggressive students replace lost patients by obtaining patients needing only partials, while timid students accept the patients who are assigned to them. This situation is not only inequitable, but may seriously jeopardize the graduation date of a student who abides by the rules. "Suddenly both removable partial patients dropped out of the program as I was finishing work before partial treatment. An instructor told me that there was no way I could graduate on time. Fear, worry, lack of sleep, I immediately requested new partial patients from oral medicine, but it was lucky one of my classmates had an extra partial patient." With the help of student leaders, rules judged as unreasonable by faculty can be identified and removed so that they do not encourage unethical behavior on the part of students.

6.09 What are the two main sources of contingencies? Hint: in the above discussions where did conflicts arise for students.

Clinical requirements are a set of described contingencies that indicate to a student what he needs to do to graduate. Sometimes these requirements come into conflict with what is in the best interest of patients. This conflict is apparently general enough that a resolution was presented by the Council of Students at the 1977 annual session of the American Association of Dental Schools.

Mackenzie 1988

"Resolve that the council of students urge the American Association of Dental Schools to express to the American Dental Association's Commission on Accreditation, concern that student clinical requirements appear to be considered more strongly than patient needs."

The Council of Students gave a background statement which, in summary, stated that the placing of importance on clinical requirements over that of patient welfare fosters unethical behavior. In light of what we know about effectiveness of contingencies, one would expect such an outcome. Progress toward meeting requirements provides immediate, certain reinforcement as each increment of the total requirement is attained. Meeting patient needs is also reinforcing because it is consistent with professional values and leads to the long-term goal of a healthy relationship between the profession and society. Just as in overeating and compulsive gambling, the immediate reinforcement overpowers the long-term, but more important goal. Progress toward graduation exerts more influence than acting in accordance with professional values.

Faculty Compensate for Weak Environmental Contingencies

Instructor arranged contingencies are important for learning when the environmental effect is not obvious to the student (See Unit 9). For example, environmental effects are not obvious when the consequences may not occur for some time. Learning from nature is less effective when the consequence is not immediate. Sometimes a delay prevents the learner from ever associating the action and the consequence. As a result the behavior is not influenced by the naturally arranged contingency. For example, when a novice student prepares a shoulder margin on a crown preparation, he does not know if the particular result is good or not. When the instructor approves or disapproves, the student comes to recognize when the form of the shoulder is acceptable (rewarding), or not acceptable (punishing). Sometimes a student does not find the results of his activities punishing when he should. A student runs his fingers through his hair (act) and then puts his fingers directly into the patient's mouth. An instructor calls the student aside and strenuously disapproves (aversive effect) of this unhygenic act. If the instructor does not observe this act, and the patient does not object directly, but simply does not return, then the student or dentist may never connect the behavior with its effect. For any treatment with delayed outcomes, faculty need to direct the attention of students to the delayed consequences.

6.10 Which of the following will produce immediate consequences and which will produce delayed consequences (delay for more than six hours)?

a. Missing the nerve when giving local anesthetic.
b. Injecting too large a volume of anesthetic into one area by repeated injection.
c. Allowing moisture to contaminate the amalgam during condensation.
d. Cutting the lingual artery.
e. Producing too much heat when cutting tooth tissue under local anesthetic.
f. Using a contaminated instrument to do curettage.
g. Leaving a restoration too high.
h. Leaving an open margin on a bridge abutment.
i. Not completely sealing the apex of a root ca nal.
j. Touching a rubber dam with a revolving drill.

Analyzing Influences on Faculty Behavior

Sometimes faculty behavior is influenced by competing contingencies that occur in the clinic. Many times faculty are unaware that the contingencies are altering their behavior. Lack of understanding of how contingencies operate to influence behavior, and lack of awareness of these contingencies leave faculty open to these sometimes detrimental influences. Consequently, faculty misinterpret student motives, and act in ways that interfere with positive student motivation.

Young faculty, who have recently been students, are very empathetic to students' stresses and problems. Based on their own experience as students, they often feel that if they act friendly and leniently, students will show their true nature and respond in a professional way. Unfortunately, the many contingencies that are described or arranged for students by other sources cause many students to appear to take advantage of the new instructor's leniency. As the new instructor perceives these "betrayals" (a punishment contingency for the instructor), he may over generalize and change his behavior toward all students, becoming more strict and less trusting.

Other contingencies are also at work on the new instructor. As he changes his own behavior toward students, he discovers that the punishment

contingencies he arranges have immediate effects on the behavior of students whereas reinforcement contingencies do not have as dramatic or as immediate effects

(Feurster and Perrott 1968). As was discussed earlier, immediate and certain contingencies have potent effects on behavior. Consequently, arranging punishment contingencies becomes more frequent while reinforcing contingencies extinguish. Punishment contingencies include fault finding, criticizing errors, scolding for inadequate behavior, neatness or organization, and chiding for not keeping up with the required rate of work. Student data from almost every dental school indicate that punishment contingencies in the clinic exceed reinforcing contingencies by a considerable margin. The intrinsic motivation that is naturally present in becoming more competent is eroded by this predominant behavior of instructors.

> 6.11 Why do clinical instructors use so much punishment? Hint: think about the characteristic of consequences that have a powerful effect.

Another problem for instructional behavior is that it competes with checking behavior. Every dental school, for legal reasons, must supervise student work. The patient records must show that the instructor supervised the work of the student. Departmental chairpersons and clinic directors follow-up to make sure records are properly kept and the work done by students is reviewed by faculty. Clinical regulations describe contingencies that indicate that instructors must check student's work and provide evidence of this in the patient records. There is usually no such described contingency for instruction. No one checks to determine what kind of instruction an instructor gives, or even whether he gives any instruction. When instruction and checking are in conflict, the instructor usually checks. With eight students waiting for a check before dismissing a patient, an instructor cannot afford to give instruction. The described contingencies of the clinic favor checking behavior in competition with instruction.

With no described contingencies influencing instructional behavior by faculty, contingencies arranged by the clinical environment begin to shape instructor behavior. Students who are pleasant, appreciative, or attractive, begin to receive more than their share of the instructor's time. The instructor receives positive reinforcement for spending time with students he likes. Some students are argumentative, abrasive, sneaky, drab, uninteresting, and not only provide little positive reinforcement, but may be aversive to the instructor. The instructor is punished for spending time with these students. Given these contingencies, is it little wonder

that some students reportexcellent clinical instruction, others report occasional instruction, and some students report essentially no clinical instruction from the same group of teachers (Mackenzie, et al, 1979). Students become frustrated by what they perceive as inequality of instruction and their motivation drops.

In the late 1970's when women began entering dentistry in larger numbers, more and more male students reported that attractive female students were receiving a disproportionate amount of time from the predominantly male instructors. "A frustrating situation is where you work very hard on something yourself and then notice an instructor just about doing something entirely for another student while that student just sits there and watches. Females, in particular, seem to enjoy the advantages." (Anon 1979). "An instructor left the clinic he was assigned to cover with several students waiting for his help to go to another clinic to help a female student (who was working on her free time and who had not requested his help"). "Instructor spent 95% of clinic coverage time in corner of clinic where the females are located)." (Anon 1979). "One instructor in particular ignores 15 students in need of help for three hours while giving individual instruction to four females." "Male teachers definitely female oriented, females get anything faster/easier." (Anon 1982). Obviously very potent biologically based contingencies were in effect here. If instructors are not aware of this contingency they may unconsciously spend time with attractive students (not necessarily based on opposite sex, but also socially adept students). Since no other contingencies are currently described or arranged to prevent an unequal distribution of instruction, an inequality of instruction results. The first step in preventing these detrimental influences is awareness by the instructors who are being influenced by these unconscious contingencies. A second step is to describe contingencies for equality of instruction.

> 6.12 What sort of contingencies might be arranged that would promote equality of instruction? Hint: why does checking receive attention?

Managing the Clinical Teaching Environment

Someone in the dental school needs to oversee the clinical teaching environment. This person might be the administrator in charge of the curriculum, the director of clinics, or some other individual, depending on local circumstances. Through a student-faculty advisory committee, for example, this person monitors for clinical teaching problems. He should watch for problems that result from contingencies which are inadequately arranged, or have unintended side effects.

Mackenzie 1988

Examples of observations that indicate a problem with contingencies are: 1) patients being dropped before completion of treatment; 2) patients waiting extensive periods between appointments; 3) students having too much to do in a short interval prior to graduation; 4) clinical attendance varying greatly from one period of the year to another; 5) faculty arriving late, spending too much time talking to one another or on the phone; 6) students spending a great amount of time waiting for instructors; 7) clinical instruction not equitably distributed across students even when differences in needs are controlled; 8) huge variations in length of time to complete procedures existing between students; 9) anxiety, stress, frustration, and discouragement very high in students; 10) the proportion of unpaid bills from patients is very high; 11) the number of broken appointments and patient cancellations is large; 12) aseptic techniques and precautions against infections inadequately applied; 13) clinic is untidy; and 14) incomplete or missing clinical records are excessive.

The above problems indicate an imbalance in contingencies in terms of immediacy, consistency of application, competition for time, deadlines, clinic rules and regulations, emotional tone of instruction, and unconscious influences on faculty. Departmental chairmen and clinical faculty must play a role in identifying problems and in cooperating in their solution. By analysis and changing the emphasis of the contingencies in effect on faculty and students, most of the conditions creating the above problems can be resolved.

Summary

Applying contingencies in clinical teaching is complex. The clinical teacher needs to consider all sources of contingencies that are affecting student activity. There are environmental contingencies, contingencies arranged by others, contingencies arranged by the learner, and contingencies influencing faculty behavior. To be effective in producing efficient clinical learning, the teacher must know how to analyze for contingencies presently in effect and how to arrange effective competing contingencies.

Unit 6: Study Questions

6.01 What are at least two variables that strongly influence the effectiveness of contingencies?

6.02 Why are deadline contingencies a powerful means of influencing behavior?

6.03 Counter-control contingencies arranged by human subjects of ex-

perimentation depend on what two conditions (variables)?

6.04 What is an arranged contingency?

6.05 What techniques applied to prisoners during recent wars indicate that environmental contingencies can influence strongly held beliefs and values?

6.06 What types of contingencies in the environment exert a powerful influence on behavior even overcoming beliefs, desires, and goals?

6.07 What are important variables that help an instructor resist the effect of immediate contingencies which adversely affect instruction?

Unit 6: Inserted Question Key.

6.01 For many faculty members, which is likely to exert more influence, having coffee with their colleagues or writing that paper for publication? Give your rational.

Answer: Having coffee with friends provides immediate and certain reinforcement. Writing the paper takes effort (punishing) and offers delayed and uncertain rewards (might not be accepted for publication).

6.02 Why do some students take short cuts in learning rather than practicing the skills and habits that will help make them successful in practice?

Answer: The immediate outcomes exert a more powerful effect than the delayed, but important, consequences of success in practice.

6.03 Why do some people work better with deadlines? Hint: think about people with low resistance to temptation.

Answer: The deadline arranges a contingency that becomes more and more immediate until it competes effectively with all other contingencies. Perhaps these people lack the self control to work steadily toward a goal. They seem more influenced by immediate contingencies.

6.04 Why do some students enjoy an instructor who brings students to his office for a friendly talk whereas others dislike the experience?

Answer: Past experiences (rewarding, punishing) with authority figures differ.

6.05 Why is an aversive, coersive learning environment a possible prob-

lem for future health care?

Answer: The performance observed under the aversive, coercive environment may not be the same as the performance under the free environment. High quality clinical performance under the supervision of faculty may not be continued in private practice.

6.06 Explain, using a knowledge of contingencies, why the aseptic technique in the old fashioned dental clinic was frequently broken.

Answer: Washing hands required effort. Since effort is punishing, the frequency of washing hands decreased. Since students frequently contaminate their hands, aseptic technique was repeatedly broken.

6.07 If students commonly ignore the welfare of patients, what should the faculty do?

Answer: Analyze the situation for competing contingencies and try to modify or eliminate the undesirable contingency.

6.08 When a department develops a new clinical rule or procedure what question should always be asked?

Answer: What undesirable side effects may also result if this rule is implemented?

6.09 What are the two main sources of contingencies?

Answer: Contingencies are arranged by the environment and by people (faculty, patients, other students, spouses).

6.10 Which of the following will produce immediate consequences and which will produce delayed consequences (delay for more than six hours)?

a. Missing the nerve when giving local anesthetic.
b. Injecting too large a volume of anesthetic into one area by repeated injection.
c. Allowing moisture to contaminate the amalgam during condensation.
d. Cutting the lingual artery.
e. Producing too much heat when cutting tooth tissue under local anesthetic.
f. Using a contaminated instrument to do curettage.
g. Leaving a restoration too high.
h. Leaving an open margin on a bridge abutment.

i. Not completely sealing the apex of a root canal.
j. Touching a rubber dam with a revolving drill.

Answer: Immediate: a, d, j; Delayed: b, c, e, f, g, h, i.

6.11 Why do clinical instructors use so much punishment? Hint: think about the characteristic of consequences that have a powerful effect.

Answer: The effects of punishment are immediate, whereas the effects of reinforcement are delayed.

6.12 What sort of contingencies might be arranged that would promote equality of instruction?

Answer: Some sort of verifiable evidence that the instructor has provided instruction to the student.

Exercise: Unit 6

Classify the rules derived from Unit 6 and previous units into the categories provided in Appendix B. Then write an episode report (Appendix D) recounting the application of one or more of the rules during clinical instruction.

- Identify an immediate contingency that is interfering with obtaining a desired but delayed result.

- Ask student to give rationale for a correction.

- Praise things well done, giving the positive consequences as the reason.

- Indicate to the student specifically how he has improved.

- Present yourself as a real person without pretense or facade.

- When evaluating work, focus on the work, <u>not</u> on deficiencies in the student.

- Recognize when counter-control of contingencies may be occur ring.

- Recognize situations when behavioral effects are generalizing to other behav iors in undesirable ways.

Mackenzie 1988

- Provide instruction to every student, not just attractive pleasant students.

- Respond to student as an individual, not as a type (race, sex, attractive).

- Use deadlines to help students move at a more even pace toward graduation.

- Listen to students and be sure that you understand them.

- Be aware of contingencies that influence your behavior in ways detrimental to the learning process of students.

Unit 7: Anxiety, Values, and Motivation

Although emotional tone influences how contingencies function, competing contingencies, anxiety, values, and motivation all add complexities that affect student behavior in the clinic. Anxiety and values interact with the motivation for performing a particular response. Ultimately it is motivation that gives energy to behavior.

The interaction between anxiety, values, and motivation sometimes interferes with learning. Desired goals of the clinical instructor are to reduce anxiety, to encourage professional values, and to increase intrinsic motivation in the students.

Anxiety is an emotional state characterized by autonomic nervous system activity. In small to moderate amounts it facilitates performance, but in excess it interferes with performance. Moderate to high anxiety is an aversive negative stimulus, a potential consequence that dental students wish to avoid. Research has shown that anxiety in animals is related to performance via an inverted U shaped function. In the inverted U, performance is highest in the middle range of anxiety and lowest at both ends. In other words performance is facilitated by moderate anxiety and interfered with by little or excessive amounts. For example, teachers of public speaking know that people with excessive anxiety perform poorly and that many experienced speakers must feel a little anxious if they are to perform at their best.

Values are sets of rules that guide human behavior. Values help overcome the impact of immediate environmental contingencies that, in the long run, would be detrimental to the individual or to society. Dentistry has a set of professional values that place public welfare above the immediate welfare of the individual dentist. Ethical behavior depends on a set of values. These values function by arranging internal contingencies that are both immediate and certain. Behavior that matches ethical beliefs is a positive stimulus (consequence). If personal behavior does not match, the generated feeling is punishing. Socialization of the human being and professionalization of the dentist both depend on incorporation of guiding values.

Motivation is also an internal state that influences performance. An animal that is not hungry or thirsty will not search for food or water. About twenty years ago researchers discovered that, in addition to such innate motivational needs as hunger, thirst, and sex, there was another innate exploratory drive that motivated animals to search for a moderate degree of novel stimulation (Hunt 1965, Berylne 1978). This exploratory drive, along with a drive to gain some control over the

environment, is why children and animals will learn from experience. Seeking competence, a person is positively reinforced when he approaches competence, and punished when he sees himself doing tasks that do not lead to competence.

Anxiety

Understanding the influence of anxiety in the clinic is essential because anxiety may interfere with learning. Some anxiety is a direct result of instructor behavior and can thus be controlled or prevented. The instructor can also reduce environmental anxiety and thus promote learning.

Excessive punishment may interfere with many activities through the emotional reactions generated by the event. Many clinical instructors punish students by belittling them in front of patients, derogating the student's character, or displaying little concern for the student's welfare or personal worth. This form of punishment increases the students' level of anxiety in the clinical situation. A high level of anxiety reduces the ability of the student to learn, plan, organize, and perform. Research on the effects of anxiety indicates that high arousal narrows the perceptual field, decreases accuracy, and decreases the ability to handle strategy problems (Stallings 1982). Complex tasks requiring fine coordination or fine discriminations are impeded by higher levels of anxiety (Cratty 1984). The clinic environment produces anxiety in many students and part of the instructor's job should be reducing this anxiety, not increasing it.

Anxiety is provoked in the clinic by unfamiliarity and uncertainty. The student is unsure of his ability to manage the patient and does not know what the patient might do. Some students are afraid they will make a mistake that will harm the patient. Students are worried that they will fail to meet a standard of performance required in the clinic. Students are sometimes uncertain of what these standards of performance are (Hinkelman et al 1982).

> 7.01 Why should clinical instructors be concerned about student anxiety? Hint: think of the relationship to learning.
>
> 7.02 What can instructors do to help decrease excessive anxiety in students? Hint: think of when you are highly anxious, how does someone help you.

One desirable aim of instruction is to create settings that do not engender high levels of anxiety (See Unit 5, Setting Emotional Tone). Anxiety develops when difficult demands for performance are made and little help

or emotional support is given. Research has shown that nurturant, personal, and rewarding interaction improves the performance of anxious persons (Sieber et al 1977).

Highly anxious persons tend to be considerably more responsive to positive verbal reinforcement than are low-anxious persons. The feedback "good" produces better performance in anxious persons than does "try harder."

Reduction of uncertainty also helps highly anxious students. When instructors do not agree on procedures, a degree of uncertainty is created that fosters worry and anxiety. As senior students recently said, "One faculty member tells you to do one thing and the other criticizes you for doing it." "Two instructors look at the same prep and one says 'too shallow' and the other 'too deep'." "One instructor may give you a list of criteria; when you use these criteria on a posttest, you are failed by another instructor with different criteria." (Anon 1980).

When students are asked, "What is your reaction to conflict and contradiction in instruction?", the students reply: "confusion and uncertainty", "confuses and causes undue anxiety", "a little frustrating to be told one thing by one instructor and later told by another that its wrong", "builds stress because you don't want to step on toes", "it kills my motivation and confuses me", "very confusing if not presented as a personal opinion, but as an absolute"(Anon. I980).

Dental school faculty should take positive steps toward reducing conflict and contradiction in instruction. Much practice in making these evaluative judgments is needed to produce consistent results. For example, Mackenzie et al (1982) used models of teeth from many clinical disciplines to determine ways to calibrate or standardize evaluative performance in instruction.

When asked, "Have you experienced any specific 'mental' or physical signs and symptoms of worry, anxiety, or fear since you became a dental student?", students describe: "increased occlusal 'clenching and bruxism'", "stress, nervousness, some sleepless nights", "I have been depressed and much harder to get along with for my mate", "migraine headaches, stomach pains, difficulty sleeping, tense neck muscles, bruxing", "I get a bad case of neurodermatitis","severe migraine headaches, weight loss" (Anon 1980). These feelings are consistent with data reported in the literature for dental students (Guild, 1966; Litman and Summer 1978). Environmental contingencies, uncertainty, and excessive punishment contribute to a clinical environment that interferes with learning. Observant, caring instructors can detect signs of extreme anxiety and

should attempt to analyze the case for specific causes. Instructors can also lessen anxiety and promote learning by providing a supportive atmosphere and by using a high proportion of positive reinforcement.

Values as Contingencies

Values are important to clinical instructors because values control behavior. Values are related to the moderating variables of immediacy and delay (see Unit 6) in that values provide immediate consequences consistant with attaining long range goals. Folklore, maxims, and proverbs involve thinking, mental images, values, and other guiding rules. Skinner (1974) noted that folklore, maxims, and proverbs are useful guides to behavior because most of the consequences of the behavior cited are long delayed and thus do not function well as effective contingencies. Society passes these sayings on from generation to generation so that individuals can learn and repeat them to themselves as part of their rule governed behavior. The critical feature of self-control lies in the persons adopting "contingency rules" that guide his action in the absence of positive immediate reinforcement from the environment, or in spite of contrary contingencies exerted by the environmental situation.

7.03 Speculate on how values help resist the effects of the immediate contingencies arranged in the environment. Hint: think about fighting fire with fire.

A strong value system can exert great influence on behavior. Ethical behavior in a dentist is based on a professional value system designed to protect the welfare and rights of the public. Professionalization of students depends on their learning of values which then guide their behavior. A student of strong moral conscience will not look at another student's test paper even though the consequence of not looking may mean failure. Personal values are capable of overcoming very potent immediate external consequences. For example, in the early 1960's, the Buddhist Monks who ignited themselves using gasoline in protest of Vietnamese government policies were being consistent with their values in the face of some very painful and immediate external effects.

A religous fanatic will tolerate many immediate hardships to progress toward his goal. Working for a "cause" blocks the influence of contrary immediate effects. For some people, a "cause" may be simply maintaining a self-concept of being honest and fair under all circumstances. Actions which are inconsistent with this self-image produce internally arranged aversive contingencies (e.g. guilt).

Students with strong goal-oriented values resist temptation. They resist

the influence of immediate contingencies that are detrimental to long range plans. They study instead of playing cards, and they keep trying to learn inspite of barriers. "No matter how unfair I may feel that I have been treated, nothing discourages me toward my goals. But I will avoid the specific instructors in the clinic. I'll keep trying for excellence." (Anon 1979). This quote typifies the responses of many students. Clinical instructors should analyze their own behavior to be sure that their influence does not interfere with the students' application of sound professional values.

Teaching Professional Values

Ethical issues usually occur when immediate contingencies reward one course of action, but long term interests require another. Ethics are needed in society because the immediate behavioral effects of personal gain and pleasures frequently encourage activities that are not best for society. For effective self-control, the dentist's actions must come under the control of the immediate consequences that they themselves provide. These consequences result from matching their behavior to their values, and avoiding behaviors that are punished by guilt, due to inconsistencies with ethics. It is likely that an action may be simultaneously rewarded for matching a rule (positive reinforcement) and avoiding guilt or loss of self-image (avoidance contingency). The private statements of values and self-image cue activity and provide effects (e.g., good feeling) for behavior consistent with the intent of the value system.

7.04 In ethical behavior, if the effects following the response do not come from the environment, where do they come from? Hint: think about how you feel when you have done the right thing, and when you have done wrong.

Value statements made by instructors may serve as models for students. These statements are incorporated into the private verbal repertoire of the student, especially if the tone of the learning environment is positive. Evaluative statements such as "open margins are bad dentistry" describes a punishment contingency. If a student leaves an open margin he has a twinge of guilt. Guilt fires negative circuits in the brain and thus provides immediate punishment contingencies for the preceding thoughts or actions.

7.05 What kind of statement can the instructor make to serve as a model for future self-control of student behavior. Hint: neutral is incorrect.

[Mackenzie 1988]

Instructors can also influence the student's self image. An instructor might say to an excellent student, "Your high quality of work may become your trademark." To another student who has shown concern for his patients, "You care about your patients, that is a good quality for a successful dentist." The instructor is providing a value statement to the student that the student can repeat to himself. If it becomes part of the student's self image, it will exert a stabilizing influence on his future behavior. It is aversive for someone not to live up to his self-image. Instructors should encourage every student to develop a self-image that will elicit quality care for patients. For example, "I ought not leave that open margin because that is not the quality of dentistry that I perform." Imparted values such as these will help maintain quality care in practice. As stated earlier, a positive emotional tone is a very important factor for influencing students to accept these statements as their own.

7.06 What types of contingencies are involved when self-image is the important factor? Hint: think about your reactions when your self-image is enhanced and when it is violated.

7.07 What types of contingencies are involved when guilt feelings predominate? Hint: think of guilt as equivalent to a negative stimulus.

Professional values learned in dental school may gradually lose control of behavior. This loss of control is particularly likely when the immediate effects of breaking the rule are very desirable and guiding rule statements are only weakly established. A person may get an immediate reward for not redoing a restoration because he avoids the aversive effect of loss of time, money, and convenience to patients. In not redoing the restoration, he contributes in the long run, of course, to greater problems for the patient. Unfortunately, immediate effects are very potent influences and may, if unchecked by certain safeguards, eventually erode quality of service.

7.08 What types of immediate contingencies occur in dental practice that erode the control of professional values on the behavior of the dentist?

To help prevent this erosion, the faculty should show students how to gain environmental support for quality care. It is too easy for people to rationalize, for example, as in smoking, eating, drinking, or drug abuse behavior. "You only live once, you might as well enjoy it." Or in the case of dental quality, "It's no worse than what I see everyday from other dentists." Many people need environmental support for doing right in the

face of counter contingencies, hence the popularity of Alcoholics Anonymous and Weight Watchers. A concerned peer group is a major factor in maintaining standards. Groups such as gold foil study clubs have served this function for many years. On the other hand, if a dentist spends time with other dentists who put their own immediate rewards above a lasting service to patients, it takes a very exceptional person to continue to strive for excellence. While in school, students could be given experience in study clubs that involve social support for maintaining excellence. Continuing this informal system of peer review throughout professional life helps support the professional conscience of its members. An instructor can take positive action in encouraging quality care and professional ethics by sponsoring a study club for this purpose.

7.09 If natural contingencies in dental practice erode professional values, what can be done to support the influences favorable to the common good? Hint: think of a more general principle than study clubs.

Forewarning prevents the erosion of values. Individuals who are unaware of the role of contingencies in influencing behavior are more easily controlled by others or by circumstances. Dental students should be warned that certain contingencies in dental practice will influence them toward lower quality work. Instructors should explain to students how time and financial demands will put pressure on them to cut corners. Research on counter propaganda during the Second World War indicated that sensitizing people to the arguments of the other side would increase their resistance to persuasion (Lunsdaine and Janis 1953). By analogy, being aware of the detrimental influences in dental practice will help dentists resist these influences.

7.10 What factors might help a dentist to maintain quality work inspite of the immediate contingencies in dental practice that erode quality? Hint: name two of the factors that have been mentioned in the past four or five pages.

7.11 What social organizations outside of dentistry are examples of support groups that help members counteract the immediate contingencies of their environment?

Intrinsic Versus Extrinsic Motivation

Intrinsic motivation comes from within. A person who does something because he wants to learn or because he feels it is the right thing to do, is intrinsically motivated. In a free choice situaton, internal mo-

tivation determines what a person chooses to do. On the other hand, **extrinsic motivation occurs when there is external incentive to do something.** If a person learns only to pass a test, not for later use; or paints a house only to receive money, then the primary motivation is extrinsic.

Motivation refers to what a person will do, whereas ability refers to what he can do (Keller, 1983). Effort is usually good evidence of motivation. However, we know from analysis of competing contingencies that a person may be motivated, but competing contingencies alter which activities occur. Lack of effort when other contingencies are in effect does not necessarily mean lack of intrinsic motivation. A person may be highly motivated to play golf, but does not do so because of other commitments. The instructor should not misjudge the student's intrinsic motivation based on observations within the constrained environment of the dental school. Knowledge of the relationship of extrinsic influences to intrinsic motivation can be useful for a clinical instructor.

Contingencies arranged by faculty, under certain conditions, can destroy intrinsic motivation. There is a substantial body of research which indicates that when extrinsic motivators (e.g. rewards) are employed to elicit some activity, the intrinsic motivation for that activity decreases (Ref #1). The decrease of intrinsic motivation for a task following receipt of an extrinsic motivator has been demonstrated in education, on the job, and during psychotherapy (Ref #2). If these results held under all circumstances, the implications for traditional education would be very serious. Any activity for which a grade was received, a deadline established, or a contingency arranged, would decrease in frequency when the learner graduated and was free to do something else.

Fortunately, there are certain conditions under which **extrinsic (external) motivation does not decrease intrinsic (internal) motivation.** These conditions occur **when extrinsic motivation supports activity perceived as increasing competency.** If the learner, however, is forced to become competent in an area not selected by the learner, then becoming competent is not enough to support intrinsic motivation. Everyone is familiar with the child who is forced to practice the piano by his parents. As soon as the parents stop forcing the child to play, the child chooses to do something else, sometimes never to touch the piano again. Fortunately for dental education, if the person desires to become competent in an area, he becomes willing to receive extrinsic (external) motivation (e.g. arranged contingencies) without losing intrinsic (internal) motivation for the task.

7.12 Why do you think that a drive for competence would be inherent just like a drive for food or water? Hint: evolution.

Research has shown that when feedback on competency (external motivation) is part of the contingency, intrinsic (internal) motivation is maintained (Ref #3). Other research has shown that if the learner is given the choice of participating, intrinsic motivation is maintained when extrinsic motivators are applied (Swann & Pittman 1977; Zuckerman et al 1978).

Research has shown that competition may decrease intrinsic motivation, impair performance, and produce aggressive behavior (Berkowitz 1972; Deutsch 1969). On the other hand, **achievement motivation (McClelland et al 1953), which is competition against a standard,** seems to facilitate performance. Competition against a standard is compatible with the research which indicates that feedback on competency motivates a person to keep trying to improve, if the feedback indicates the person is improving. In competition between people the winners are likely to be motivated, the others not. In competition against a standard, each person regardless of relative ability has an opportunity to progress toward competency, so every student has the opportunity to develop intrinsic motivation toward high quality dentistry. Making standards clear and praising their attainment will promote the intrinsic motivation that will maintain high standards in practice.

Matching

Matching performance to a standard provides reinforcement. When behavior does not match the standard, the mismatch provides punishment. Matching provides an intrinsically acceptable contingency that can be utilized by instructors in the form of feedback about competency.

Preparing models that demonstrate the steps of a procedure provide the student with a standard against which to match his skill, thus increasing competency and his intrinsic motivation to succeed. When the student matches or mismatches the provided models, information on performance is gained. Matching a standard strengthens skill components, mismatching alters the components. Matching provides feedback. **Feedback is a consequence following a response that gives information about the response.** It may provide only information as to the correctness or incorrectness (consequences). It may provide additional information, as in corrective feedback. Corrective feedback will be discussed further in later units.

Research has shown that a person who feels he has a chance to succeed

is intrinsically motivated to proceed (Morgan 1984). Instructors should be aware that harsh criticism demeans a student's ability so that they may begin to doubt their ability ever to perform high quality work. Positive feedback, using the one-two-three punch (praise, criticism, and corrective feedback), is extrinsically motivating. There are many ways instructors can use the matching principle to encourage intrinsic motivation for quality work. These approaches will be described in detail in later units.

Labeling (an extrinsic motivator)

Labeling, as discussed in later units, is a technique used to increase distinctiveness of cues so that they generalize more readily and have more meaning. Labeling can also be a strong extrinsic motivator when combined with matching.

As discussed earlier, instructors can use positive labeling of students to increase self-image and professional values. However, negative labeling of students can be detrimental. Faculty tend to blame poor attitudes on the part of students or defects in student character when the approach of students to their learning is not what it should be. These labels do not solve the problem and frequently stop the search for causative agents that could be altered. For example as previously mentioned, Mager and Pipe (1970) described an episode in which clinical teachers blamed poorly fitted dentures on "poor attitude" of the students. Whereas the real motivational problem had little to do with poor attitude. The problem was related to a poorly located prosthetics laboratory.When the faculty moved the prosthetic laboratory adjacent to the clinic, the "poor attitude" of the students disappeared. Faculty directives and the "proper attitude" were no longer outweighed by the negative contingency of excessive effort.

If faculty observe students acting as if they do not care about learning or about patients' welfare, it is more likely that contingencies are malfunctioning than that the whole class has a poor attitude. When most of the class is involved in the problem, it is usually fruitful to analyze for detrimental influences in the learning environment.

7.13 In analyzing the situation in which many students were not adjusting denturesproperly, what did the faculty probably notice that indicated that there was a problem? Hint: what did they see or hear, this was not mentioned in text.

7.14 What made the faculty think the students had a poor attitude? Hint: what did the faculty observe that lead to this inference?

7.15 What type of contingency was arranged by the environment to interfere with the act of adjusting the denture properly? Hint: the same kind that is arranged for patients who are trying to learn to brush their teeth after every meal.

Instructors may infer that students are unmotivated, argumentative, or incompetent, and then respond to the student as "lazy", "hostile", or "inept". Labeling leads the instructor to search no further for explanations and to treat students as though they were personifications of the labels. Usually labels are misapplied, since further analysis of the situation is likely to discover other contingencies causing the inappropriate behavior. For example, a "lazy" student was kept from graduating and, apparently, had little motivation to succeed. It was discovered he had a hypothyroid condition. Another student could not master the fine motor skills. Careful analysis found a visual problem related to focusing on close work.

Punishing a student in accordance with a "label" will only aggravate the problem. A "hostile" student may lack the perceptual skills for self evaluation and, as a result, consider the instructor an unrealistic perfectionist. An "inept" student may lack prerequisite motor skills because she has had little previous experience working with her hands. Analyzing problems leads to hunches that explain learning problems and these ideas suggest individualized instructional strategies to change behavior.

7.16 When students are behaving in a way detrimental to the learning process or to the welfare of their patients, what should this indicate to an instructor? Hint: competition involving what?

7.17 In the following incident, what inference did the student perceive the instructor to be making that the student found offensive? "I asked the instructor about an objective, since I did not fully understand the objective as written. (The instructor) took off on a tirade about how he didn't want students getting the objective signed off--I was simply asking about it. (I) just listened and walked away at the first break in talking." Hint: something that guides behavior for many people was involved here.

7.18 If students are not filling out patient records properly, in spite of several directives from the clinic director, what is a likely cause as determined by a behavioral analysis? Hint: what contingencies may be poorly arranged?

Examples of Extrinsic Motivators

Since extrinsic motivation occurs when there is an external incentive to accomplish a task, extrinsic motivation can come from the environment or be applied by the faculty. A patient responds to treatment; a completed denture fits well; the patient tells a student he plans to come to him when he graduates; all are extrinsic motivators from environmental sources. However, faculty can double the benefit by using them as deserved praise, relating them as sources of satisfaction in later practice. The instructor sets a deadline contingency; gives deserved praise; listens attentively to a student's treatment plan; provides the one-two-three punch of praise, punishment, and corrective feedback; shows personal interest, respect, and empathy; helps reduce anxiety; all are externally applied influences on behavior.

More extrinsic motivators applied by faculty are: grades; advancing the student to the next level; granting the student more freedom, lessening supervision as the student progresses; inviting students to observe in faculty practice; increasing contact with students via a study group; presenting and clarifying learning goals as standards to match; providing positive feedback; and adding to privileges. If these are applied in a context of positive emotional tone with the emphasis on increased competency then intrinsic motivation for continued learning will be maintained.

Summary

Solving instructional problems involves consideration of anxiety, values, motivation, and competing contingencies. A sensible approach to analyzing a problem that appears to involve many students is to ask a sample of students about the cause of the problem as they see it. Interpreting their answers in the light of experience gives the faculty member an idea of how to improve the situation for the class. When the problems involve a few students, the faculty should observe the individual students to monitor their anxiety, watch for discrepancies between student behaviors and professional values, strive to tie extrinsic motivators to competency, and encourage students to match their performance against standards, models, ethical principles, and a good professional self image. Applying these methods will improve some learning problems in the clinic. Analyzing and solving more specific skill learning problems of individuals will be discussed in the following units.

Reference Notes

1. These references show a very consistent effect that when extrinsic motivation is employed to elicit some activity, the intrinsic motivation for

that activity decreases (Deci 1971, 1972; Calder and Stow 1975; Condry 1977; Leeper and Green 1978; Leeper et al 1973; Anderson et al 1976; Green et al 1976).

2. The decrease of intrinsic motivation for a task following an extrinsic motivator has been related to education (Levine and Fasnacht 1974), work motivation (Notz 1975), and psychotherapy (Arkes 1978).

3. When feedback contains information on competency, extrinsic motivators do not affect intrinsic motivation (Deci and Porac, 1978; Engle and Ross 1978; Rosenfield et al 1982; Pittman et al 1982).

Unit 7: Study Questions

7.01 What is the problem with identifying the source of clinical dificulties as due to poor attitudes or lack of professionalism on the part of students.

7.02 When students try to get by, instead of learning something obviously useful to them, what does this imply?

7.03 When a person should do something like avoid overeating or excessive smoking, what type of contingency is usually counted on to control behavior (and usually does not)?

7.04 How does a person's self-image control his behavior?

7.05 How does a statement involving professional ethics or values work in the face of opposite, immediate, competing environmental contingencies?

7.06 How does peer review help maintain quality in practice?

Unit 7: Inserted Question Key.

7.01 Why should clinical instructors be concerned about student anxiety?

Answer: Because anxiety may interfere with learning, and instructors tend to increase the level of anxiety beyond the natural amount already felt by students.

7.02 What can instructors do to help decrease excessive anxiety in students?

Answer: Do not use excessive punishment, use praise more frequently,

provide emotional support (empathy, respect, nonpossessive warmth), reduce uncertainty.

7.03 Speculate on how values help resist the effects of the immediate contingencies arranged in the environment.

Answer: Values are able to arrange other competing immediate contingencies which influence people in the direction of their long term best interests.

7.04 In ethical behavior, if the effects following the response do not come from the environment, where do they come from?

Answer: They come from the person's conscience.

7.05 What kind of statement can the instructor make to serve as a model for future self-control of student behavior.

Answer: Evaluate statements.

7.06 What types of contingencies occur when self-image is the important factor?

Answer: Living up to a self-image involves positive reinforcement. Not being consistent with a self-image involves applying an aversive or a punishment contingency. One could also say that living up to a self-image avoids an aversive, or reinforces through an avoidance contingency.

7.07 What types of contingencies are involved when guilt feelings predominate?

Answer: Guilt feelings evoke an avoidance contingency or punishment. If guilt is already present, then an act which removes guilt produces negative reinforcement.

7.08 What types of immediate contingencies occur in dental practice that erode the control of professional values on the behavior of the dentist?

Answer: Loss of time, loss of money, inconveniencing waiting patients, and effort.

7.09 If natural contingencies in dental practice erode professional values, what can be done to support the influences favorable to the common good?

Answer: To enhance professional values, try to restructure the environment so that it also exerts some influence toward the common good.

7.10 What factors might help a dentist to maintain quality work inspite of the immediate contingencies in dental practice that erode quality?

Answer:
1) A self-image that requires quality performance.
2) Guilt feelings that result from failure to maintain quality.
3) Contact with support groups that encourage quality (e.g., Gold Foil Study Club).
4) Arranged contingencies in the environment that support quality (e.g., peer review).
5) An awareness of contingencies in practice that will exert influence to lessen quality.

7.11 What social organizations outside of dentistry are examples of support groups that help members counteract the immediate contingencies of their environment?

Answer: Examples of support groups outside of dentistry are: Alcoholics Anonymous, Weight Watchers, stop-smoking groups, and family.

7.12 Why do you think that a drive for competence would be inherent just like a drive for food or water?

Answer: The drive for gaining some control in the environment is probably an indispensible one in the survival of a species.

7.13 In analyzing the situation in which many students were not adjusting dentures properly, what did the faculty probably notice that indicaed that there was a problem? (Not mentioned in text).

Answer: Many patients had complaints about the comfort of the dentures.

7.14 What made the faculty think the students had a poor attitude?

Answer: Students did not improve their performance even when inadequacies were identified and the faculty applied the usual amount of pressure for change.

7.15 What type of contingency was arranged by the environment to interfere with the act of adjusting the denture properly?

Answer: The effort required to go to the laboratory for making the adjustment was very time consuming. This produced an aversive event every time an adjustment was needed. An aversive event following a response forms a punishment contingency which decreases the likelihood of the future behavior.

7.16 When students are behaving in a way detrimental to the learning process or to the welfare of their patients, what should this indicate to an instructor?

Answer: It should indicate a need to analyze for contingencies that are supporting the competing, incompatible responses. The instructor should ask students for reasons to explain their behavior, or should observe the environmental conditions. A knowledgeable instructor can usually identify potential competing contingencies by listening to the student's explanations of their behavior.

7.17 In the following incident, what inference did the student perceive the instructor to be making that the student found offensive? "I asked the instructor about an objective since I did not fully understand the objective as written. (The instructor) took off on a tirade about how he didn't want students getting the objective signed off--I was simply asking about it. (I) just listened and walked away at the first break in talking."

Answer: The student's self concept was not one of trying to avoid learning and he found it offensive that the instructor should immediately assume this motive.

7.18 If students are not filling out patient records properly, in spite of several directives from the clinic director, what is a likely cause as determined by a behavioral analysis?

Answer: It takes effort to fill out records properly (immediate punishment). If clinical faculty are not paying attention to having the records correct (are not arranging contingencies for record keeping), then record keeping behavior may extinguish. The immediate contingency of effort will probably outweigh the unlikely delayed event of the clinic director reviewing their records and holding them accountable.

Exercise: Unit 7

Classify the rules derived from Unit 7 into the categories provided in Appendix B. Then write an episode report (Appendix D) recounting the application of one or more of these rules during clinical instruction.

- Seek to identify consequences that encourage the students to do other than what he should be doing.

- When requiring extra work, clarify why it is in the student's interest to do it.

- Analyze learning situations that are not doing as they should.

- Monitor student cancellations and frequency of appointments and intervene.

- Attend carefully to flaws that, if unrecognized, can lead to later difficulty.

- Make praise match the effort and accomplishment of the student.

- Stress service to the public as more important to a profession than money.

- Avoid attributing cause to internal events such as attitude, laziness, dishonesty.

- Ask student for his/her interpretation of the cause for a learning problem.

- Consider if contingency you arrange or describe might have detrimental side effects to overall learning.

- Praise students for accurate evaluation of their own performance.

- Remember, more behavior than the specific act may be influenced by effect.

- Convey rationale for recommending changes.

- Warn about things in practice that may erode quality of care.

Unit 8: Developing Student Observational and Perceptual Skills

If a young man is meeting the parents of his fiance for the first time, it is unlikely that he will pay attention to the color of the carpet, walls, or curtains in their home. His attention is more likely directed at the expressions of the prospective parents-in-law, for signs of approval or disapproval. Human beings do not respond at random, but depend on cues. At any one instant, the environment is filled with millions of cues that can be noticed. The problem is paying attention to the right ones. For example, the relevant cue for a response in the above social situation may be very subtle, such as a slight upturn to another's lips or a slight wrinkling around the corners of the eye. In the same manner, the cues in a cavity preparation can be very subtle, like a marginal ridge that is slightly too thin.

In contrast to fine details, the cues may involve the entire context of the situation including information not present outside one's brain. For example, a shadowy figure holding a gun suddenly appears from behind a chair in your darkened living room. Your reaction depends on the context. If your son has been playing "cops and robbers" in the yard, your initial autonomic nervous system reaction would be minor. On the other hand, if a dangerous escaped convict had been reported in your neighborhood, your ANS reaction would be much greater. Similarly, the context for a slight hemorrhage is quite different when it involves a normal patient verses a hemophiliac. **The role of the clinical teacher is to help students separate relevant cues from the complex background of irrelevant features that are always present in any situation, and to help them connect these cues to relevant information and context stored in memory.**

Stimulus Control

In humans, well learned associations often occur below the level of consciousness. The beginner at tennis must concentrate on fundamentals such as grip and stroke production: the advanced player can tell automatically when the ball leaves the opponent's racket whether the ball is going to be in or out and, if in, approximately where it will land. The advanced player is free to plan strategy, but the beginner must concentrate on getting to the ball and what to do when he gets there. When a response is automatic, the "stimulus control" of behavior is well established. Even though the person may be unaware of the stimulus, he must notice it for the stimulus to exert control.

Behavior comes under the control of stimuli, by association with some environmental effect (consequence). Under certain conditions, such as many reinforced repetitions, the same or similar sti-

muli can be expected to automatically bring forth the response.

Failure to Notice May Interfere with Teaching Stimulus Control

Stimulus control is what the clinical teacher is trying to develop in teaching perceptual-motor skills. In situations where stimuli are complex, teaching students is not as easy as simply arranging contingencies for responses. One can tell a neophyte dental student that her cavity preparation is not correct and that she needs to look at the demonstration models more closely. When following these directions, the student may not recognize the crucial difference between her preparation and the model.

When a card shark is playing with a marked deck, untrained people rarely observe differences in the patterns on the card backs. For responses to come under the appropriate stimulus control, the untrained person must learn to recognize and attend to the relevant features of the stimuli that are present.

> 8.01 While looking at the back of a marked card belonging to the card shark, and after being asked what the card is, what is the difference between the average person and the card shark? Hint: attention.

Innate and Learned Differences in Observational Skills

A person's observational skill in any situation has both innate and learned components. Newborn babies spend more time orienting toward certain patterns rather than other patterns. This orienting response indicates an innate tendency for certain patterns to capture the attention of humans. Researchers have long known that animals have innate tendencies to attend to certain features of their environment (Flaherty et al 1977). For example, birds use visual cues to avoid food poisoning whereas rats use olfactory and taste cues. Humans, when examining objects, tend to look first at lines, then angles, and then areas (Vitz and Todd, 1971). Just as there are innate differences in many other human abilities, there are likely innate differences in the ability of humans to examine objects in detail.

Experimentation in animals (Zernicki 1979) shows that early deprivation of visual experience interferes with ability to detect cues, while enriched early visual experience facilitates ability to detect cues. Dendrites in the visual cortex are reduced in dark-reared mice, but sprout on exposure to light (Routtenberg 1978). When an area of the brain is stimulated at an early age it becomes thicker. Dendrites proliferate and so do axons. There are more synapses per unit area (Lynch 1978) (Greenough 1978).

Adult humans, after removal of congenital cataracts, continue to show defects in the ability to notice cues, even after training. Thus, both innate influences and past experiences contribute to individual differences in the ability to orient and to perceive cues.

Feuerstein (1972, 1974) has found that early impoverished, learning experiences have produced perceptually disadvantaged individuals. These individuals have difficulty noticing and attending to details. Feuerstein (1979) has shown that these adult individuals can be trained to notice detailed cues but training involves considerable amounts of practice. Recent unpublished research at the University of Michigan has shown that training on perceptual skills significantly reduces the numbers of first year dental students requiring remediation of basic operative technique courses during the summer.

Nominal Verses Functional Stimuli

It was not until the early 1960's that researchers in verbal learning discovered that, even for simple stimuli, there was a difference between the presented stimulus and the stimulus to which the learner responded (Underwood and Shultz 1960). For example, if the researcher presented a three letter nonsense syllable like "WRX" and the learner was to associate this presented stimulus with a second nonsense syllable (the intended response), the learner might attend only to the first letter "W" and associate that with the response. In this case, the "WRX" is called the nominal stimulus and the "W" is called the functional stimulus. The "W" might remain a valid cue, if it were the only nonsense syllable presented that began with "W".

Verbal research defined **the nominal stimulus as a cue to which the instructor expects the student to attend.** It is the critical cue necessary for the correct response. **The functional stimulus is defined as the cue to which the student actually attends.** The functional stimuli may be incorrect.

Applying this principle in dentistry, when a student is asked to observe the difference between his preparation and a model, the critical difference is the nominal stimulus. What the student attends to is the functional stimulus. The functional stimulus may be entirely different from what the instructor intended. It is this functional stimulus that will control his response until corrected. If the student's response is to cut another preparation, it may be several hours before he receives new feedback. Thus, depending on preparations of cavities to teach the recognition of critical cues is very inefficient.

8.02 If a Class I cavity preparation for amalgam is the nominal stimulus, name several critical features. Hint: what do instructors evaluate?

8.03 Considering depth of the pulpal floor as a critical feature of a Class I cavity preparation, what would be a cue that would indicate that the value of the floor depth was too shallow? Hint: what does the instructor notice?

8.04 How is it possible to reproduce all the critical features of a model without attending to all the critical features? Hint: uncritical features play a role.

8.05 Why is it important for all critical features to be attended to during learning? Hint: think of the three part contingency.

8.06 What is the implication for future situations when a critical cue exerts no control over motor responses? Hint: error detection.

Even if the student repeats a procedure several times, she may eventually produce an acceptable product without ever attending to all the critical cues. This situation is similar to the "W" in the nonsence syllable example. Many clinical faculty do not realize that there is a difference between nominal stimuli and the functional aspect of stimuli, or they may not know how to correct the situation. This failure to teach critical cues as part of the motor skill learning contingency produces inefficient learning.

Discrimination Learning

It is very important for instructors to realize that students do not always recognize the critical features that the instructor is pointing out. Discrimination learning is an effective method to help students learn relevant cues. **Discrimination learning is learning to judge which portions of the total situation are relevant to the task, thus separating relevant from irrelevant cues.**

Discrimination learning technique is a well established research method for training attention. Objects are presented that are either correct or incorrect. The learner gives his opinion and receives immediate feedback (principle of immediacy). The instructor reinforces correct responses (positive reinforcement contingency), and gives corrective feedback (mild positive punishment combined with mild reinforcement) for incorrect responses until the desired features are recognized consistently.

The goal of discrimination training is to teach critical cues. Research literature provides the term discriminant stimulus (SD). It is equivalent to the term nominal stimulus used in verbal learning research. Either term refers to the critical cues necessary for the correct response. By observing enough responses, the instructor makes sure that the student recognizes the critical cue.

According to Faveli (1978) the discriminent stimulus (SD) controls, signals, and sets the occasion for the response. For example, undermined enamel signals the need for removal of unsupported enamel rods. If the undermining is not noticed, no action occurs. Noticing the SD is essential for effective contingencies. In the case of the unsupported enamel (SD), the consequence of not removing the SD (unsupported enamel) is correction (punishment) from the instructor. The SD signals the likelihood of reinforcement or punishment for a particular response (or non-response). If the SD is not noticed the expected learning does not occur.

8.07 Explain how reinforcement for removal of undermined enamel is an avoidance contingency. Hint: what is the student avoiding?

8.08 Explain how positive reinforcement might be involved in removing undermined enamel. Hint: consider the role of matching.

In discrimination training, an instructor may ask whether undermined enamel is present and the student replies "yes." The instructor reinforces the student if the SD (undermining) is present and punishes the student with a correction if no undermining is present. Discrimination training can be applied to tactile and auditory cues as well as visual cues.

8.09 If you ask a student whether a widened periodontal membrane at the apex of a tooth is likely due to pulp disease, what is the SD for affirmative reply? Hint: consider the role of lamina dura.

8.10 If you ask a student whether a widened periodontal membrane at the apex of a tooth is likely due to occlusal forces, what is the SD for an affirmative reply? Hint: lamina dura.

8.11 If you ask a student whether a widened periodontal membrane at the apex of a tooth is likely due to pulp disease, what is the SD for a negative reply? Hint: what about the lamina dura?

Secondary Reinforcer

Because of pairing of an SD with reinforcement or with punishment (respondent conditioning), the SD itself takes on secondary reinforcing or punishing properties. An amalgam overhang (SD) because of association with instructor punishment (criticism) becomes an aversive (negative) stimulus. The removal of the SD becomes negative reinforcement for the act of removal. Remember, negative reinforcement increases the behavior which it follows. On the other hand, not having an overhang is a positive stimulus and provides positive reinforcement for any action which results in no overhang. The SD takes on secondary reinforcing or punishing properties which are important for teaching complex motor skills to problem learners as discussed in Unit 10.

Teaching Discriminations in the Clinic

An instructor may use a discrimination learning technique in the clinic in the following way. If a student has left something unfinished in the cavity preparation, the instructor may tell the student what the problem is and then ask if the student sees the problem. If the student says no, then the instructor draws a schematic and asks the student if she understands now. If the student says yes, then the instructor asks the student to take a careful look at the problem in the mouth. The instructor uses the instrument necessary to make the correction, turns to the student, and says, "Did I completely make the correction, partially make the correction, or not touch it at all"? The student then examines the preparation and gives a response. If the response is correct, the instructor says "good" and tells the student to proceed. If the student is incorrect, the instructor may redraw the error and/or repeat the procedure. To aid discrimination learning, the instructor must direct the student's attention to the cue, request a response, and then provide a consequence for that response.

Another approach is to have the student take the instrument needed to correct an error and, without making the correction, have the student place the instrument in the places requiring correction, while the instructor watches and gives feedback. It is important for discrimination learning that the instructor be able to confirm that a response is indeed related to attending to the critical cue (SD). Simply accepting a "yes" or "no" answer to the question of whether the student understands does not insure the instructor that the student is attending to the correct discriminant stimulus. Confirming (making sure) that the student actually sees the cue is an important part of clinical instruction.

8.12 If an instructor asks a student to feel the vibration in a probe when he runs it over calculus on a tooth root, and asks the student if he feels the calculus, is he using a discrimination learning sequence? If not, what is missing? Hint: think about making sure.

In discrimination learning, just as a scientist must rule out chance, a clinical instructor must observe enough activity to feel certain that the student can really detect the discriminant stimulus. To establish that the student can really feel the vibrations (SD) associated with the presence of calculus, the instructor should run the probe over a root surface without calculus and then over one with calculus. Since the student has a 50% chance of guessing correctly, the instructor should select several more teeth. The student is asked to probe a particular surface and say whether there is calculus present. Three trials have the probability of correct guessing in all instances of .125 (0.5x0.5x0.5); five trials is 0.5 to the fifth power which equals .0313. With five trials there is less than four chances in one hundred that the student would guess correctly for all five trials. This is statistically significant at the .05 level which is an acceptable criteria for most scientists to rule out that the student is correct by chance.

8.13 How can the instructor become fairly certain in a short period of time that the student really is attending to the vibration (SD)? Hint: think of what scientists do.

Importance of Repetition in Learning Observation Skills

Repetition in learning is **the most important factor** in strengthening recognition memory (Underwood, 1954). Studies in neural biology indicate why repetition is important in learning and remembering. The rate of synthesis of RNA in nerve cells is proportional to the total stimulation received by the cell (Thatcher and John 1977). RNA then helps the cell synthesize enzymes which, in turn, increases the production of neurotransmitters. The neuron becomes more ready to fire. The amount of electric current needed for contraction decreased after conditioning. After extinction, however, the amount of current returned to previous levels (Farel 1978). Chemical stimulation of RNA synthesis accelerates the rate at which memory consolidation is achieved. Protein synthesis inhibitors interfere with memory consolidation (Thatcher and John, 1977). Surprisingly, even the synapses of sensory nerves store memories outside of the brain (Votaw, 1979).

Research shows that visual and auditory thresholds are directly related to frequency of experience. Extensive word counts measuring the frequency of occurrence of words in printed materials such as books and

newspapers gives the relative frequency of experience with words in our culture. Flashing words on a screen and asking experimental subjects to identify the words, "shows that the more frequently a word has been encountered in books and newspapers, the faster it will be recognized" (Reed, 1973).

Research has shown that when paradoxical sleep (brain activity during sleep) is high following a learning task, both animals and man perform better on subsequent learning trials (after paradoxical sleep) than they did immediately at the end of learning. When paradoxical sleep is prevented, the learning advantage disappears (Pearlman and Becher 1974; Fishbein et al 1974). Apparently, the newly learned patterns of neurons are firing during sleep, thus increasing the effectiveness of the memory trace.

8.14 When a traumatic event occurs, a person seems to remember the event quite well even though the event occurred only once. Why do you think this single event is consolidated in memory so well? Hint: what do people usually do with traumatic events?

8.15 What is the point of the discussion of frequency for observational learning?

Neurological Evidence of Perception

Thatcher and John (1977) have been using the computer to analyze brain waves. They have discovered in animals, as has the Russian Bechtrev (1979) in people, that a stimulus creates a unique wave pattern in the brain. They have found that it is this unique wave pattern that actually controls the response. They have trained animals to give different responses to different auditory tones. The unique wave pattern associated with one tone always elicits one response and the second pattern elicits the second response. When a tone is presented half way between the two tones, the animal produces, through stimulus generalization, one of the two brain wave patterns. Without exception, the brain wave pattern that is produced always elicits the learned response previously associated with it. Apparently the way the animal perceives the stimulus(stimulus generalization) controls which response is elicited.

Variety of Experiences

Having experience with a variety of stimuli that evokes the same label (e.g. gingivitis), increases the transfer of that learning to new situations (Ref #2). Apparently, transfer is aided because having the same label increases the psychological similarity of stimuli. The role of frequency and

variety as an aid to recognition of stimuli has important implications for **preclinical instruction** in dentistry. According to Ellen Gagne' (1978), variety in learning increases the accessibility to neural patterns when new stimuli are presented. Due to training with variety, the stimuli generalize (transfer) better to future conditions. Practice with little stimulus variety, such as practicing only with typodont teeth, facilitates initial learning, but will not aid the transfer of learning to clinical situations. Research indicates that **initial practice with little variety, then supplemented with variety is an effective approach for both acquisition and transfer** (Bransford 1979). Later practice with a greater variety of stimuli (e.g., sets of teeth varied in systematic ways) will increase the likelihood that the student will effectively alter the application of the principles of cavity preparations to fit new situations such as rotated teeth.

8.16 Why do you think that variety is an important variable in producing transfer of learning to new situations (e.g., from one patient to another)? Hint: think of Ellen Gagne's comments.

Providing Variety Efficiently

Again, the method of having students reproduce a model by cutting preparations falls short of providing enough frequency and enough variety for recognition. It takes a student too long to produce a product (cut a preparation) so that she can receive feedback on whether all the critical features of the product were recognized. In addition, models that the student copies are usually enlarged plaster models presenting little or no variety. If, in an hour or two, a student can examine 100 models of all shapes and sizes, the conditions would be right for efficient discrimination learning. In several hours, using these 100 models, the student could make many decisions and receive much immediate feedback. Under traditional instruction it would take hundreds of hours of steady work for each student to produce enough products to receive an equivalent amount of practice in discrimination learning.

Because of the lack of variety and the infrequency of feedback, students are not as well prepared to benefit from clinical instruction. Using many models to train perceptual decisions provides more practice per unit time. For this instruction, faculty could collect products produced by students and let students make decisions about them. The faculty then indicates the correctness or incorrectness of the decision either in person or by providing an answer key with the models. With enough models, subsets emphasizing certain critical features could be set aside for use with students who have perceptual problems.

8.17 In terms of contingencies, how does an answer key function to influence learning? Hint: remember how matching functions?

Increased Efficiency of Motor Skill Learning

Discrimination training with models does not substitute for preparing dental products (e.g., cutting cavity preparations), but early discrimination training enhances the value of motor skill practice. Preparation of a product requires the student to attend to the product for a long period. The longer an item occupies the attentional focus the more likely it is to be remembered. The neurons involved in the recognition of the pattern are repeatedly firing over this long period of time. Unfortunately, if the student is attending to the wrong features, much of this time is wasted. In order to maximize the benefits of motor skill practice, the student should already be trained to discriminate the critical features. This can be done by using the previously described sets of models to train on the critical cues. Thus, when prolonged attention is required in producing a product, the proper details are attended to and a finely detailed recognition memory of the product results.

In clinical medicine, medical students do histories and physicals on several patients and then present the patients on ward rounds while other medical students, interns, and residents watch. The medical student has the opportunity to have his observations checked by several others and, also, the opportunity to make a number of observations regarding other patients without having to do the complete workup. Observing the patients of other students, interns, and residents broadens the variety of observations that a medical student can make in a given period of time, and increases the opportunities for feedback either directly or vicariously.

8.18 How might a clinical dental instructor provide an opportunity for more patient variety and feedback for a student who is having difficulty with a particular aspect of a tooth preparation? Hint: think of the medical student example.

Role of Concepts in Observational Skills

A concept requires two basic processes: discrimination and generalization. The person who has a good grasp of a concept can **discriminate** between those things which are examples of the concept and those things which are not. He can also **generalize** across objects which appear to be different, but which should be classified as examples of the concept.

8.19 What is accomplished by labeling bony pockets one walled, two, and three walled? Hint: think about the dentist's response.

Concepts are very important in clinical dentistry because clinical entities that are classified together are usually treated in similar ways. Carious dentin and non-carious dentin, one, two, and three walled bony pockets, acceptable products and unacceptable products, Class I, II, and III malocclusions, and Kennedy Partial Denture Class I, II, III, and IV are examples of clinical concepts which imply different treatment.

Proper clinical concept formation requires the ability to observe critical attributes (discriminant stimulus) and to classify the clinical entity on the observation. An SD for an amalgam restoration is marginal integrity. The values of marginal integrity would be "catch both ways" (SD), "catch one way" (SD), and "no catch" (SD), using a sharp explorer moving back and forth from tooth surface to amalgam and amalgam to tooth surface. The value for this dental attribute, and the value for others, would permit the clinician to classify the amalgam as acceptable or not. The ability to correctly classify a variety of amalgam restorations is the test of the clinicians **concept of acceptability** for amalgam restoration.

8.20 What are the cues (discriminant stimuli) that one notices which indicate that a patient is beginning to have a toxic reaction (concept) to local anesthetics? Hint: cues are signs.

8.21 Agitation is more like an inference than a cue. What are the observable cues from which one infers that a patient is agitated?

Conceptual Errors Interfere with Skill Performance

There has been much research on teaching concept formation which involves the ability to discriminate and generalize between and across concepts. Variables that influence this skill have been identified. Just giving examples of the concept does not lead to good concept formation. Examples and non-examples need to be given. Using both examples and non-examples avoids overgeneralization, undergeneralization, and misconception (Merrill and Tennerson, 1977).

8.22 Does traditional instruction in preclinical techniques use both examples and non-examples of acceptable work?

8.23 In what way does the use of both examples and non-examples facilitate discrimination learning? Hint: how are differences highlighted?

An overgeneralization error occurs when the student incorrectly identifies some of the non-examples as examples (the acceptable). An undergeneralization error occurs when the student incorrectly identifies some of the examples as non-examples (calls acceptable cavity preparations unacceptable). A misconception error occurs when the student incorrectly assumes that one of the non-critical attributes is critical, for example, a cavity preparation must have sharp internal line angles. In misconception errors he classifies some acceptable and some unacceptable examples incorrectly.

8.24 A student is given five acceptable and five unacceptable marginal ridges. He classifies all five accepted ones correctly, but misses three of the five unacceptable. What type of error has he made: overgeneralization or undergeneralization? What type of discrimination training does this student need?

8.25 If the student classifies three of the acceptable ridges incorrectly and none of the unacceptable incorrectly, what type of error has the student made: overgeneralization or undergeneralization. What type of discrimination training does this student need?

If the student makes an overgeneralization error and classifies an unacceptable preparation as acceptable, then the student needs more practice observing cavity preparations that vary the values of the relevant attributes. For example, if the student undermines or weakens a marginal ridge, and the problem is perceptual, then the student needs practice in making decisions about the adequacy of marginal ridges. The student needs more discrimination practice involving both examples and nonexamples of acceptable marginal ridges.

If the student makes an undergeneralization error and classifies an acceptable cavity preparation as unacceptable, then the student needs more practice observing a variety of unusually shaped cavity preparations that are acceptable. This practice should place emphasis on critical attribute(s) (SD) that caused the original error in classification. Teeth which have extensive caries or are rotated or malformed may require unusually shaped preparations to which the basic principles of design still apply.

If the student makes a misconception error and focuses attention on an

attribute that is not critical for the acceptability of the cavity preparation, review the reasons with the student as to why this attribute is not considered critical.

> 8.26 What clinical circumstances provide an opportunity for faculty to estimate the student's grasp of the acceptability of a dental procedure? Hint: think about how to focus attention on the student's decision process concerning acceptability.

Application to Teaching

One of the major problems with developing observational skills is that a student does not have time to see the variety of patients and examples of work needed to make reliable judgments concerning dental products. By providing students with more time to observe the work of other students and to receive feedback on judgments, a variety of experiences necessary for transfer to future situations may be gained.

The problem of observing, agreeing on what to observe, assigning values to observations, and combining values of attributes to classify clinical phenomena is one of the major problems of clinical judgment in medicine (Feinstein, 1967). Feinstein found in his research on rheumatic fever that clinicians did not agree on what to observe, or on the value of what they were observing. He also found that they could develop better agreement through establishing criteria, discussion, and practice.

Evidence on the degree of reliability for assessing the quality of products by clinical examiners in dentistry indicates that a similar problem also exists in dentistry. (Ref #3). Apparently, the educational process in dental education does not develop the observational skills or the clinical concepts necessary to reliably classify the quality of dental clinical procedures. More time needs to be taken and more emphasis placed on making observations in a reliable fashion. Discrimination learning sequences and practice with a greater variety of examples and nonexamples is in order.

Reference Notes

1. Frequency of repetition is one of the most important variables for memory, transfer, and motor responses (Hayes-Roth 1977; Hudgins 1977; Gagne' 1978; Postman and Knecht 1983; Perolli and Anderson 1985).

2. Having experience with a variety of stimuli that evoke the same label increases the transfer of that learning to new situations (Hudgins, 1977; Di-

Vesta and Peverly 1984; Derry and Murphy 1986).

3. Many investigators have found that clinical examiners have difficulty in agreeing on the evaluation of products (Fuller, 1972; Gaines et al 1974; Hinkelman and Long 1978; Houpt and Kress 1973; Natkin and Guild 1967; O'Conner and Lorey 1978; Ryge and Snyder 1973; Patridge and Mast 1978).

Unit 8: Study Questions

8.01 What two factors influence the ability of students to notice important cues?

8.02 What is the difference between a nominal cue and a functional cue?

8.03 Why is asking the student if he recognizes an error an ineffective method for assessing the students perceptual abilities?

8.04 What must the instructor do to obtain a fair degree of certainty that the student can really discriminate the critical features (SD)?

8.05 What variables seems to be of great importance to the strength of learning, whether the learning be sensory, ideas, or motor skills?

8.06 Why is the preparation of products as the sole source of learning an inefficient approach to technical skill learning in dentistry?

8.07 What two basic processes are important in the formation of concepts?

8.08 What strategy for teaching clinical concepts is important for avoiding overgeneralization, undergeneralization, and misconceptions?

Unit 8: Inserted Question Key.

8.01 While looking at the back of a marked card belonging to the card shark, and after being asked what the card is, what is the difference between the average person and the card shark?

Answer: The card shark knows where to look to observe the cue while the untrained person searches unsuccessfully for some hint that will reveal how to answer the question.

8.02 If a Class I cavity preparation for amalgam is the nominal stimulus, name several critical features.

Answers: Depth of the pulpal floor, incorporation of developmental grooves,supported enamel, adequate wall strength, irregular cavosurface margin.

8.03 Considering depth of the pulpal floor as a critical feature of a Class I cavity preparation, what would be a cue that would indicate that the value of the floor depth was too shallow?

Answer: Smooth, hard, shiny surface of the floor characteristic of enamel. Islands of pearl-like, white, hard substance surrounded by a tanned color and softer material. The explorer tip slides smoothly over the island and vibrates more over the tan aspects of the floor. These are cues that the student has not yet gone completely through the enamel.

8.04 How is it possible to reproduce all the critical features of a model without attending to all the critical features?

Answer: The student may be attending to certain uncritical aspects of the model that, when copied, forces an unnoticed critical feature to be produced properly.

8.05 Why is it important for all critical features to be attended to during learning?

Answer: A cue that is not attended will not be associated with a reinforced response and, consequently, will exert no future control over that response.

8.06 What is the implication for future situations when a critical cue exerts no control over motor responses?

Answer: In future situations the critical cue may be left uncorrected.

8.07 Explain how reinforcement for removal of undermined enamel comes from an avoidance contingency.

Answer: The student knows that if he leaves undermined enamel, harm will come to the patient in the long-run, and, that in the short-run, the instructor may give a failing grade. By avoiding these aversive events, the response of removing the undermined enamel is reinforced.

8.08 Explain how positive reinforcement might be involved in removing undermined enamel.

Answer: If the student knows what non-undermined enamel looks like,

then when he removes the undermining and his preparation matches his recollection of what non-undermining looks like, he receives positive reinforcement.

8.09 If you ask a student whether a widened periodontal membrane at the apex of a tooth is likely due to pulp disease, what is the SD for affirmative reply?

Answer: A disrupted lamina dura surrounding the widened periodontal membrane.

8.10 If you ask a student whether a widened periodontal membrane at the apex of a tooth is likely due to occlusal forces, what is the SD for an affirmative reply?

Answer: An intact lamina dura surrounding the widened periodontal membrane.

8.11 If you ask a student whether a widened periodontal membrane at the apex of a tooth is likely due to pulp disease, what is the SD for a negative reply?

Answer: An intact lamina dura.

8.12 If an instructor asks a student to feel the vibration in a probe when he runs it over calculus on a tooth root, and asks the student if he feels the calculus, is he using a discrimination learning sequence? If not, what is missing.?

Answer: The instructor has done nothing that would allow him to confirm the ability of the student to discriminate calculus. In reality, the student may think he feels it when he does not.

8.13 How can the instructor become fairly certain in a short period of time that the student really is attending to the vibration (SD)?

Answer: Have the student respond correctly to four or five instances.

8.14 When a traumatic event occurs, a person seems to remember the event quite well even though the event occurred only once. Why do you think this single event is consolidated in memory so well?

Answer: The person thinks about the event, providing frequent firing of the neural patterns associated with the event. Thus, although an event occurs only once, the brain receives reinforcement of the event by fre-

quently reprocessing its occurrence.

8.15 What is the point of the discussion of frequency for observational learning?

Answer: Dental educators need to find ways to provide more practice with feedback. Traditional clinical instruction does not provide enough practice on discrimination judgments of critical cues.

8.16 Why do you think that variety is an important variable in producing transfer of learning to new situations (e.g., from one patient to another)?

Answer: According to Ellen Gagne', variety in learning increases the accessibility to neural patterns when new stimuli are presented. Stimuli generalize more readily to produce the same pattern of firing. Practice with little stimulus variety, such as practicing only with typodont teeth, does not transfer learning to clinical situations as would practice with a greater variety (e.g., sets of teeth varied in systematic ways).

8.17 In terms of contingencies, how does an answer key function to influence learning?

Answer: The student compares his answer to that of the key. If the answer matches the student is reinforced. If the answers do not match, the response is punished and the student learns not to give that response. At the same time, the key provides a response that the student may substitute for his punished response. Thus the student not only learns what not to respond, but what to respond in order to receive reinforcement when a similar stimulus is presented. Thus, the answer key provides feedback to guide future behavior.

8.18 How might a clinical dental instructor provide an opportunity for more patient variety and feedback for a student who is having difficulty with a particular aspect of a tooth preparation?

Answer: Show preparations of other students at the appropriate stages.

8.19 What is accomplished by labeling bony pockets one walled, two, and three walled?

Answer: The current status of periodontal therapy treats one, two, and three walled bony pockets differently. The label helps the dental student both discriminate in a meaningful way between different examples of bony pockets and to generalize among the differently appearing bony pockets that should be treated in the same way.

8.20 What are the cues (discriminant stimuli) that one notices which indicate that a patient is beginning to have a toxic reaction (concept) to local anesthetics?

Answer: Talkativeness, agitation, restlessness, rise in pulse rate, increase in blood pressure, irregular and rapid respiration, report of nausia.

8.21 Agitation is more like an inference than a cue. What are the observable cues from which one infers that a patient is agitated?

Answer: Talkativeness, rapid voluntary movements of head and body, rolling of eyes, wringing of hands.

8.22 Does traditional instruction in preclinical techniques use both examples and non-examples of acceptable work?

Answer: Rarely. The most common approach to instruction is to present a few examples (models) demonstrating acceptable work.

8.23 In what way does the use of both examples and non-examples facilitate discrimination learning?

Answer: If the non-examples (unacceptable work) differ from the examples (acceptable work) only in the critical attributes, they direct the attention of the student to the relevant cues. The only differences are the relevant cues. In the examples the relevant cues have acceptable values (SD) and in the non-examples they have unacceptable values.

8.24 A student is given five acceptable and five unacceptable marginal ridges. He classifies all five accepted ones correctly, but misses three of the five unacceptable. What type of error has he made: over generalization or undergeneralization? What type of discrimination training does this student need?

Answer: Overgeneralization because he classifies unacceptable ridges as acceptable. The student needs practice on classifying a variety of unacceptable ridges mixed with acceptable. The unacceptable ridges need to vary from very unacceptable to almost acceptable.

8.25 If the student classifies three of the acceptable ridges incorrectly and none of the unacceptable incorrectly, what type of error has the student made: overgeneralization or undergeneralization. What type of discrimination training does this student need?

Answer: Undergeneralization because the student classifies acceptable

ridges as unacceptable. The student needs discrimination training with a variety of acceptable preparations varied from very acceptable to almost unacceptable. Again a few unacceptable ridges must be mixed into the training models.

8.26 What clinical circumstances provide an opportunity for faculty to estimate the student's grasp of the acceptability of a dental procedure?

Answer: The faculty may ask a student to evaluate his own work before the faculty checks it. This would likely identify overgeneralizations more than undergeneralizations or misconceptions. A second method would be to require students to evaluate work, about half of which is unacceptable. Every time the instructor finds an unacceptable product, he should find another one that is acceptable and then have students judge both.

Exercise: Unit 8

Classify the rules derived from Unit 8 into the categories provided in Appendix B. Then write an episode report (Appendix D) recounting the application of one or more of these rules during clinical instruction.

- Use schematic drawings to direct attention to critical features of the service.

- Ask students to give rationale for corrections.

- Use discrimination learning techniques to ascertain whether the student is attending to the proper cues.

- When a student is discouraged and you have acknowledged the feelings, tell her/him about a similar problem you faced as a student or dentist.

- Ask student to demonstrate the ability to detect differences between acceptable and unacceptable work.

- Provide the opportunity for students to examine the work of other students and to make judgments about it.

- Point out what the differences are between acceptable and excellent work.

- Describe cues in terms of what the student will encounter in practice.

Mackenzie 1988

- Specifically comment on aspects of a product or process done well.

- Check awareness of cues underlying indications and contraindications by asking student to point them out.

- Be consistent with students as individuals and as a group.

- Label cues to increase similarity in function.

- Indicate what cues in the clinical situation lead to your decisions.

Unit 9: Developing Mediating Skills

"One should not only talk to oneself, but listen" (Meechembaum, 1977). Through respondent conditioning, the word "no" from the parent became the consequence to substitute for the child burning his hand. When the child learns to say the word "no" to himself, he controls his own behavior. The word "no" becomes **a mediating response, a thought, or chain of thoughts, that lead to action or inaction.**

Mental images, values, rule statements (knowledge), associating rules (understanding), processing rules (thinking and reasoning), deciding on categories and plans (judgment), are all examples of mediating responses. These responses are called mediating because they intervene between the environmental cue that triggers them and the observable activities that follow. Mediating responses are not directly observable, but may be inferred from actions taken, the ability to answer questions, and self-reports. Research has shown that mediating responses can also be verified by distinctive patterns of electrical recordings in the brains of animals (Thatcher and Johns 1977) and humans (Bechterev 1979).

9.01 In everyday language, what is a mediating response? Hint: people become lost in them.

9.02 Why is the response called "mediating"? Hint: think of a mediator in labor negotiations.

The purpose of this unit is to improve instruction that leads to better thinking and development of judgment. Mediating responses are influenced by contingencies and also participate in contingencies to influence other behavior. Contingencies have been used successfully to modify cognitive behavior in a variety of research areas: chronic anger, medical crises, control of pain, test anxiety, social anxiety, depression, assertiveness, and impulsive behaviors (Reynolds and Stark 1983).

Described Contingencies

Verbal communication provides the instructor with a powerful tool in clinical teaching. He can describe delayed consequences in such a way as to prevent a harmful result. **A described contingency indicates to a person what consequences to expect if he responds to a cue in a certain way.** Sometimes the consequences are described and sometimes they are implied. The world is filled with examples of described contingencies. A door with "MEN" and a door with "WOMEN" de-

scribes a contingency for those so motivated. A traffic sign that says 25mph describes a contingency. A sign that says "no smoking" describes a contingency. A law exerts control over behavior because it is a described contingency. If a person disobeys the law, he can expect or anticipate certain types of consequences.

When an instructor tells a student that there will be a clinical test on Tuesday at 9:00 a.m., he is describing a contingency. When clinic rules state that all patients must be dismissed by 5:00 p.m., a contingency is described. When an instructor tells a student that a cavity preparation must have slightly convergent walls, he is describing a contingency. Described contingencies have many uses in clinical instruction.

9.03 How does a described contingency have an effect? Hint: what kind of information is involved.

When no connection is made between a behavior and its consequence, no learning occurs. The consequence (effect) does not develop controlling properties. One function of the clinical teacher is to associate reinforcement or punishment with delayed clinical consequences using described contingencies. These come to influence behavior by providing self-imposed contingencies when the instructor is not present.

Described contingencies are used by instructors to help sharpen students' observation, to enhance understanding, and to shape motor skills. The good instructor knows how to elicit responses, provide feedback, probe for information, connect information to cues, actions and consequences, and to set the tone for instruction. He also knows how to detect contingencies that are interfering with learning and what to do about them when he detects them. These instructional activities are described in detail in other units.

Descriptive Contingencies: Bridge Gap in Time

Described contingencies govern behavior. They are consequence statements that bridge the gap in time between an act and its delayed behavioral effect (consequence). For example, an open margin on a new restoration will produce no immediate effect. A delayed contingency is ineffective in producing learning, thus instruction needs to describe the expected contingency.

9.04 Is a statement concerning a delayed consequence an arranged contingency or a described contingency?

9.05 Is a statement concerning earning money to go on a vacation an arranged contingency or a described contingency?

9.06 Is the statement, "do not leave an undermined marginal ridge or it may fracture", an arranged contingency or a described contingency?

An act and its behavioral effect or consequence, although separated by time, may be linked by a described contingency. "Don't leave the marginal ridge high or it may fracture." The cue is the high marginal ridge. The response is to lower the marginal ridge, because of the expected consequence ("may fracture"). Describing the consequence tends to decrease the probability of actually leaving the marginal ridge high (assuming the student recognizes the cue). The described contingency bridges the gap in time by predicting the consequence.

9.07 In regard to consequences, what do mediating and observable responses have in common? Hint: related to probability.

Describing contingencies is an important, valid instructional strategy to help students make the connection between clinical activities and the remote effects of their actions. Clinical disciplines need to be analysed for these remote consequences and the described contingencies systematically covered.

Private Verbal Control

Talking to oneself can also influence future behavior. "Stupid oaf!" "Poorly done." "Good work!" "Fits perfectly." Private verbal control is thus more than verbalization of described contingencies. It also provides consequences for one's own actions. Private verbal control fulfills many functions. It permits a person to plan, check potential consequences, overcome immediate environmental contingencies, guide procedures, and evaluate correctness of performance (Chaiklin 1984). Even with effective learners, showing them how they are already using a rule implicitly improves subsequent use of that rule (Ericsson and Simon 1980; Campione and Armbruster 1985). **A private verbal statement is a saying, rule, or guiding principle that a person repeats to himself in order to influence his own behavior.** Examples are statements used in self image and ethical values. What a person thinks or says to himself becomes a mediating response affecting his own behavior.

9.08 What are some equivalent names for the idea "private verbal statement"?

Even the effects of verbalization on behavior have a biological basis. Research has shown that the intact frontal lobes of the brain are necessary for verbalizations to direct behavior (Stuss and Benson 1984). When the frontal lobes are damaged, the applications of rules are impaired and a person cannot follow directions. A person without functioning frontal lobes is unable to use knowledge of incorrect performance as a guide to improving future performance. They cannot overcome previously established response patterns. Without functioning rules they do **not** adapt to new situations.

Rule Governed Behavior

Private verbal statements that serve as a guide, or standard for behavior, exemplify rule governed behavior. The stated rule becomes the standard of behavior. Personal behavior that matches the rule is immediately reinforcing. A mismatch produces punishment in the form of guilt or anxiety. Changing behavior to more closely match the rule lessens anxiety and guilt producing reinforcement via escape or avoidance contingencies.

9.09 How does rule governed behavior function? Hint: think of how matching provides consequences.

Verbal rule statements are particularly valuable for guiding behavior when environmental contingencies are complex, unclear, or otherwise ineffective. Delayed consequences or consequences that are not easily recognized profit from rule statements. Rule statements used in clinical instruction help learning problems caused by defective contingencies.

Self generated statements can also prevent extinction. A goal statement is commonly used to support activity that might otherwise extinguish because of delay of reinforcement. The goal statement serves as a self-generated cue that guides the student toward a distant goal. The rule-goal describes contingencies and provides matching conditions for self arranged consequences. Actions are reinforced or punished on whether they help or hinder goal attainment. "If I can get that patient's gingiva healthy, I can start those bridges needed for graduation." If the student's actions match his goal statement, he is reinforced. The student tries to avoid not matching his goal statement because failure to match is aversive. Matching goal statements with behavior provides immediate behavioral effects that keep a student moving toward his long-range goal.

Components of Rule Statements

By teaching rules that contain the main components of learning, clinical instructors will focus attention and thus facilitate learning under stress. Well stated rules emphasize the critical aspects of learning. The complete rule should contain four parts: the occasion, the specific cue, the response, and the consequence. For example, "when you feel vibration (cue) in your instrument while exploring the root surfaces of a tooth (occasion), remove the roughness (response), or inflammation will continue (consequence)." "When polishing a tooth (occasion), notice the speed of the handpiece (cue) and the duration of polishing (cue), keep the speed slow and the duration brief (response), or you will traumatize the pulp (consequences)." "When a patient for deep scaling (occasion) gives a history of rheumatic fever (cue), prescribe penicillin (response) or the patient may get subacute bacterial endocarditis (consequence)."

9.10 What are some other names for "occasion"?

9.11 What are some other names for "response"?

When giving rules, an instructor should make them clear and unambiguous. For example, when stating a rule, describe the cues in terms of what the student will experience. Say, "The explorer catches in the margin when traveling in both directions", rather than saying "margin is open." "When evaluating margins on amalgam restorations (occasion), if a sharp explorer catches in both directions (cue), then remove the restoration and start again (response) as this prevents recurrent decay (consequence)."

Providing Feedback

Feedback is discussed in several units of this text because it has an important influence on setting tone, motivation, discrimination learning, mediating responses, and motor skill learning. **Feedback is a consequence following a response that gives information about the response as to correctness or incorrectness, usually providing additional information in the form of corrective feedback** (the one-two-three punch: praise, mild punishment, and corrective feedback). Properly applied feedback increases intrinsic motivation that improves the likelihood that the student will continue the activity after graduation. In the previously covered discrimination learning, matching responses to models helps with corrective feedback and concept generalization. In this unit, feedback can be in the form of a rule to which behavior is matched, thus arranging a consequence that reinforces or punishes behavior. In motor skill learning discussed in the next unit,

feedback becomes important in avoiding problems and learning how to correct problems when they occur. Feedback, properly applied, serves as a model for internalized statements that direct future behavior. Feedback statements depend on analysis. The analysis of learning is done during the assessment phase of the clinical encounter (See Unit 4 for the five phases of the clinical encounter). The analysis guides the instructor in remedying any difficulty in learning. "When you are extending the margin of the cavity preparation, you need to pay more attention to where the opposing cusp hits the tooth or else the margin may fail." "You are changing the orientation of the handpiece from one side of the preparation to the other. Thus parallel walls and retention are lost."

Positive feedback tends to maintain acts or make them more likely, and corrective feedback tends to change acts or make them less likely. Good corrective feedback provides a rationale. Corrective feedback indicating its value is likely to be more effective in influencing future behavior than will feedback for which the student does not understand the importance. In a negatively toned atmosphere, the student will not likely ask for clarification. Without understanding, the feedback becomes one more hassle adding to the aversiveness of the situation.

9.12 What components should corrective feedback include and why, in terms of contingency management? Hint: think in terms of purpose.

Verbal feedback has advantages for learning. Feedback can be non-verbal. Smiles, nods, a pat on the back are rewarding. Frowns, raised eyebrows, and shaking the head are punishing. Non-verbal feedback, tends to emphasize the behavioral effects, whereas good verbal feedback serves both as a behavioral effect and as a cue for improving future behavior. Poor verbal feedback such as "a piece of rubbish" does not have much cue value, only behavioral effects. Providing corrective feedback, with cue value and stated consequences, facilitates learning.

9.13 Using the four parts of a rule statement, label the following statement: If a patient presents a medical history (1) that indicates excessive thirst (2) you should investigate the possibility of diabetes (3) because early detection can help control the disease (4).

9.14 Label the parts of the following rule statement: If during the examination of the patient's oral tissues (1) you notice an ulcerated lesion (2), you should palpate the lesion with a finger cot or rubber glove (3) to prevent a possible syphilitic infection (4).

9.15 What type of contingencies are described in the two questions which are inserted immediately above?

Clinical Understanding

The overall effectiveness of mediating responses depends on understanding. Clinical understanding helps retrieve relevant information at the appropriate time. One of the most challenging problems of clinical teaching is to help students develop the clinical understanding that underlies their judgments and decisions. **Understanding of any topic is measured by the number of interconnected ideas that the person can bring to bear on the topic.** The more ideas, the better the understanding. One of the main purposes of the biological sciences is to give dentists a sound understanding of the biological processes underlying health care. Understanding the cardiovascular system for example, requires an interconnected network of concepts and principles regarding the structure and function of the system and how it responds to outside influences such as stress, drugs, and disease.

In contrast to the network of associations learned in the basic sciences, clinical understanding involves two additional types of associations. One association is on the cue side of the mediating response and the other is on the response side. The first association involves connecting basic information to the clinical cues that will elicit the information at the appropriate times. The second association is to connect the information elicited by the clinical cues to the decisions and actions that the dentist must make. **A complete clinical understanding occurs when the dentist, given any clinical situation, can bring forth the appropriate information and use it to arrive at a sound decision concerning treatment.** Clinical understanding helps retrieve relevant information at the appropriate times and facilitates critical thinking and the application of sound judgment.

9.16 What two types of associations are important for developing clinical understanding? Hint: analogous to the three part contingency.

9.17 The degree of understanding of an idea depends on what main variable?

Questioning Aids Clinical Understanding

In order to provide consequences, an instructor must observe responses. Questioning brings forth cognitive responses so that they can be reinforced or corrected.

Understanding involves the ability to answer questions (Bransford et al 1985). Just like other types of behavior, questions function as arranged contingencies to facilitate the learning of cognitive responses (mediating). Given a situation, the faculty member asks a question (cue) to elicit the underlying cognitive response so that it can be observed and given feedback (consequence). To strengthen clinical understanding, the questions should require students to attach information to clinical cues and decisions. For example, ask the student to identify the cues that indicate or contraindicate treatment and to explain why these cues are related to anticipated treatment outcomes (consequences). The clinical instructor can then reinforce or correct the student's thought processes.

To strengthen clinical understanding, ask the student to give reasons for procedures; to state a principle that guides behavior in a given situation; to predict short-term and long-term effects of treatment on the patient; to explain or make predictions about conditions observed in the patient. Questions such as these will serve as models to improve future decisions and to guide the development of clinical judgment.

9.18 In terms of cues and decisions, what are the instructor's questions doing? Hint: think of the effect of frequency.

The instructor may notice something about the students' work that is not quite right. The instructor might then probe (question) to determine whether students recognize the problem and its significance. The instructor might notice something about a restoration placed several weeks earlier. "Would you please recheck the restoration in tooth 30? What is your evaluation of this restoration at the present time? What criteria do you apply in assessing a restoration? Anything else? Okay, examine the occlusal surface, do you notice anything? What does that shiny spot suggest?" Probing questions that focus on cues improve the ability to manage clinical problems.

Questioning does not always work as intended. Unless the appropriate conditions for instruction have been set, this strategy of asking questions will likely not work. In the typical clinical environment, most students would consider instruction aimed at the development of thinking as harassment. The emphasis in most clinical instruction has been on technical performance. Asking questions may be perceived by the students as stealing time away from this important activity. Care must be taken in helping students recognize the importance of thinking about patient care. Remind them that thinking and judgment are the essence of the professional person. With this explanation, and a positive emotional tone, most students will view questioning as valuable. For an even more effective

approach to gaining student acceptance of clinical questions, some schools have added answering questions correctly to their clinical requirements (Shreve et al 1980).

> 9.19 How does making answering questions a clinical requirement encourage student acceptance? Hint: Use the principle of immediacy and competing contingencies.
>
> 9.20 What benefit, concerning cause and effect, might be derived from reviewing the dental work that exists in a patient's mouth? Hint: think about delayed effects.

To recapitulate, questioning can help the student connect what he has previously learned to the cues in the present situation. It can allow the instructor to determine if the student knows how to handle rare events such as emergencies or necessary precautionary measures. It helps the instructor determine if the student knows the consequences of certain actions or the probability that some consequences will occur.

Analyzing, Rephrasing and Transfer of Stimulus Control

Analyzing, rephrasing, and transferring of stimulus control are instructional methods that help the student utilize the power of cognitive mediating responses to change behavior. Analyzing a clinical situation is an aid to fuller understanding. If several factors bear on the patient's problem, can the student identify and combine them to provide the best care? Analysis involves discriminating clinically relevant cues and establishing their relationships to underlying principles. **Analysis is the breakdown of a problem into component parts so the parts can be resynthesized for an improved solution.** Analysis requires understanding and, in turn, further enhances understanding (Galambos and Black 1985).

> 9.21 Bringing to bear what you know of the process of understanding, describe why the analysis of a clinical situation would facilitate the understanding of that situation. Hint: think in terms of associations.
>
> 9.22 How is clinical understanding analogous to a kaleidoscope?

If it is necessary to tell students what information is relevant and how it relates to what they are doing, make sure students understand what you have told them. If they are able to paraphrase information, they must un-

derstand it. **To verify understanding, make sure students can rephrase what you have told them.** The ability to rephrase lets both students and instructor know that the information has been understood. Part of the rules for clinical procedures should be that the students are expected to rephrase instruction to verify their understanding.

Finally, an important step for developing clinical understanding is transferring stimulus control of student responses from the teacher to the clinical setting. **Stimulus control is the degree to which a stimulus calls forth a specified response.** The instructor knows that stimulus control has been achieved when the behavior occurs in appropriate situations and does not occur in inappropriate situations. For example, the student stops removing enamel rods when the appearance of the margin indicates there are no more unsupported rods, and does not stop removal until then.

Prompts are cues added to a situation that are necessary to bring forth the desired response. Patient cues do not retrieve much of the relevant information taught in traditional didactic courses. During the questioning, the clinical instructor provides the necessary prompts and then reduces prompts by providing fewer and fewer verbal cues to the student as questioning continues. Eventually, the student should state the relevant information with minimal prompts so that the instructor can reinforce the connection between the patient cue and the information. **The process of reducing prompts is called "fading".** The instructor's role is to prompt, to elicit the information, and then, to fade the prompts so that the cues from the patient come to elicit the necessary information. Fading transfers stimulus control from the instructor to the patient. Stimulus control is an essential part of clinical thinking and judgment.

9.23 Given a situation in which a beginning student has failed to notice gingival cues indicating periodontal pathology, the instructor may ask a series of questions which fade prompts. Place the following series of questions about pathological color changes in order from the most prompts to the least.

1) Do you detect anything unusual next to tooth #33?
2) What is the difference in color between these two papilla?
3) Which papilla shows the greatest change in bluish hue?
4) Find an area that deviates from normal.
5) Notice the bluish hue in this papilla.

Summary

Mediating responses guide behavior and influence learning, enabling greater cognitive control by the student dentist over clinical activities. Describing contingencies helps a student anticipate delayed consequences. Consciously matching behavior to rules arranges cognitive contingencies that reinforce or punish responses. Clinical understanding contributes to the retrieval of relevant mediating responses. Instructors can increase the availability of mediating responses in clinical situations by asking questions (cues) and providing feedback (consequences) that strengthens the ability of clinical cues to elicit the requisite information (mediating responses) for making decisions and guiding the future clinical activities (responses) of dentists.

Unit 9: Study Questions

9.01 What does rule governed behavior permit humans to do relative to their environment?

9.02 What is the importance of a statement that bridges a gap in time?

9.03 What are the four parts to a rule statement designed to guide behavior?

9.04 What two parts should corrective feedback contain?

9.05 Non-verbal feedback contains which part of the corrective feedback process?

9.06 What is the basic variable in understanding?

9.07 Clinical understanding, as compared to basic understanding, involves which two additional ingredients?

9.08 What three techniques might be used to improve clinical understanding?

9.09 Why should an instructor restate the student's answer to a question?

9.10 Why should the instructor ask the student to rephrase what the instructor has just said?

9.11 What should the instructor do if it is clear that the student does not have the specific information needed?

9.12 Why is it important to the instructor to transfer stimulus control of information to the clinical situation?

Unit 9: Inserted Question Key.

9.01 In everyday language, what is a mediating response?

Answer: A mediating response is a mental image, a set of values, a guiding rule, or a thought.

9.02 Why is the response called "mediating"?

Answer: Because the response occurs somewhere between an observable cue and an observable response. It is a thought or train of thought that leads to action. It mediates action giving it flexibility and adaptivity.

9.03 How does a described contingency have an effect?

Answer: A described contingency usually indicates to a person that he may anticipate certain consequences if he responds to a cue in a certain way. The described contingency provides information as to what to expect.

9.04 Is a statement concerning a delayed consequence an arranged contingency or a described contingency.

Answer: A described contingency.

9.05 Is a statement concerning earning money to go on a vacation an arranged contingency or a described contingency?

Answer: A described contingency.

9.06 Is the statement, "do not leave an undermined marginal ridge or it may fracture", an arranged contingency or a described contingency?

Answer: A described contingency.

9.07 In regard to consequences, what do mediating and observable responses have in common?

Answer: The probability of either reoccurring in a given situation is influenced by the consequences that follow the response.

9.08 What are some equivalent names for the idea "private verbal state-

ment"?

Answer: Mediating response, thought.

9.09 How does rule governed behavior function?

Answer: The match between a behavior and a rule provides a consequence that influences the behavior. When the behavior and rule are consistent (match), reinforcement occurs. When the behavior and rule are not consistent (mismatch), punishment occurs.

9.10 What are some other names for "occasion"?

Answer: Situation, context, setting, stimulus, cue.

9.11 What are some other names for "response"?

Answer: Action, activity, behavior, act.

9.12 What components should corrective feedback include and why, in terms of contingency management?

Answer: What the error is, how to change it, how to avoid it, and why it is important not to have the error occur. Corrective feedback is a punishment. The purpose component prevents emotional side effects if the emotional tone is positive.

9.13 Using the four parts of a rule statement, label the following statement: If a patient presents a medical history (1) that indicates excessive thirst (2) you should investigate the possibility of diabetes (3) because early detection can help control the disease (4).

Answer: 1) occasion; 2) specific cue; 3) response 4) consequence

9.14 Label the parts of the following rule statement: If during the examination of the patient's oral tissues (1) you notice an ulcerated lesion (2), you should palpate the lesion with a finger cot or rubber glove (3) to prevent a possible syphilitic infection (4).

Answer: 1) occasion; 2) specific cue; 3) response; 4) consequence

9.15 What type of contingencies are described in the two questions which are inserted immediately above?

Answer: Positive reinforcement for the first question and an avoidance

contingency for the second.

9.16 What two types of associations are important for developing clinical understanding?

Answer: The association of information with clinical cues that will trigger retrieval and the association of the information with the decisions and actions (responses) that must occur in dental care delivery.

9.17 The degree of understanding of an idea depends on what main variable?

Answer: The number of associations the person has with the idea. The more associations the better understanding.

9.18 In terms of cues and decisions, what are the instructor's questions doing?

Answer: The questions are activating the connections between cues, information (mediating responses), and decisions. This strengthens the connections and increases the probability of future activation.

9.19 How does making answering questions a clinical requirement encourage student acceptance? Hint: Use the principle of immediacy and competing contingencies.

Answer: Graduation requirements are more immediate than the long range benefits of learning to think. Making questions a requirement gives them the advantage of immediacy and thus encourages the acceptance of questioning.

9.20 What benefit, concerning cause and effect, might be derived from reviewing the dental work that exists in a patient's mouth?

Answer: This provides an opportunity for students to observe delayed effects and make connections with potential reasons for the existing conditions in the patient's mouth.

9.21 Bringing to bear what you know of the process of understanding, describe why the analysis of a clinical situation would facilitate the understanding of that situation.

Answer: Since the degree of understanding is directly related to the number of associations that a person has with an idea or situation, the more relevant features that can be identified, the more detailed associa-

tions there are that can be created. Hence, analysis facilitates the depth of understanding about any particular situation.

9.22 How is clinical understanding analogous to a kaleidoscope?

Answer: The more pieces in a kaleidoscope, the more combinations that can be created by turning things over. The greater the depth of understanding, the greater the ability to find solutions to problems created by new variations of a clinical situation.

9.23 Given a situation in which a beginning student has failed to notice gingival cues indicating periodontal pathology, the instructor may ask a series of questions which fade prompts. Place the following series of questions about pathological color changes in order from the most prompts to the least.

1) Do you detect anything unusual next to tooth #33?
2) What is the difference in color between these two papilla?
3) Which papilla shows the greatest change in bluish hue?
4) Find an area that deviates from normal.
5) Notice the bluish hue in this papilla.

Answer: The order of most to least prompts is: 5,3,2,1,4. The greatest prompt (#5) uses the verbal cue of bluish as related to a particular area. There is a slight fading prompt in #3 as the student must indicate which of two areas is the most bluish. #1 eliminates the word of color as a prompt and #4 eliminates both the word color and a specific area as a prompt.

Unit 9: Exercise

Classify the rules derived from Unit 9 into the categories provided in Appendix B and then write an episode report (Appendix D) recounting the application of one or more of these rules during clinical instruction.

- Ask student to give the delayed consequence of errors or activities.

- Ask student to give the rule governing a procedure (occasion, cue, response, consequence).

- Inform students about your participation in clinical learning opportunities.

- Ask hypothetical questions about what might happen if...

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- Ask students to relate clinical observations to basic science learning.

- Ask students to make predictions about conditions observed in patients.

- Ask students to paraphrase your explanations to make sure they understand.

- Ask students to identify the cues that indicate a particular condition.

- Help students identify reasons why their patient is not responding to therapy.

- Encourage students to consider themselves as ethical future providers of quality care.

- Convey rationale for recommending changes.

- Provide consequence statements that will bridge a time gap between an error and its consequences.

- Ask students to give rationale for actions or decisions.

- Provide rules to guide student behavior by giving the cue, action, and consequence.

- Caution students about potential rewards in practice that will undermine quality service.

Unit 10: Developing Motor Skills

Developing motor skills utilizes all of the principles discussed in previous units. The goal is to produce excellently trained dentists who provide quality health care to the public. In order to produce dentists who continue to provide quality work in practice, the stimulus control of basic information and motor skills must transfer from the textbook, lecture, and instructor to the clinical situation. The result is more efficient learning with more learned in less time, and a better long term outcome.

Practice and Immediate Feedback

Traditional dentistry utilizes the "Go to Daddy" approach where students are shown models and are expected to imitate or reproduce them. However, practice is time consuming and practice with inadequate feedback does not develop skill. Developing the concept of acceptability of a task before practicing (see Unit 8) guides the performance or practice. Research has shown that practice, while using their personally developed knowledge of results, helped students produce better quality results (Salmoni et al 1984). Schmidt (1983) found that more practice attempts with positive feedback also resulted in better quality results. Research has shown that the optimal time for immediate feedback is about half a second. Salvendy et al (1975) constructed electronic typodents to signal the students immediately when they had cut a cavity preparation to the right depth. As expected they found that students learned more quickly with immediate feedback.

Since immediate feedback is such a powerful contingency in shaping responses, teaching students to identify acceptability of the end product will produce more efficient learning than waiting an extended period for an instructor to check the result and provide feedback.

10.01 Students were blindfolded and asked to draw a four inch line 1,000 times. One group was told "good" or "not good" after each attempt. The other group was given no feedback until the end. In terms of immediacy of reinforcement, which group showed no improvement after 1,000 practice attempts, and why?

10.02 Name at least two advantages of perceptual-motor skill learning in having the learner acquire the necessary discriminations before practicing the motor skill. Hint: answer in terms of learning and feedback.

Rule Versus Intuitive Control

An instructor is like the tennis pro. The stimulus control for much of his clinical knowledge has become automatic or intuitive. However, rule governed behavior is important to the student in the initial stages of motor skill learning, since otherwise, the student must learn intuitively by trial and error. It is important for the instructor to be able to describe the rules involving cues essential for student understanding. Eighty years ago a prosthetic specialist would have had difficulty explaining why he had intuitively decided to extract a tooth rather than use it as an abutment for a bridge. Analysis now shows the decision is based on such rules or cues as length and shape of root, length and shape of crown, force of bite, amount of bone support, rate of bone loss, and length of span for the bridge. Knowing these rules allows the student to relate cues and responses with delayed effects.

10.03 List the cues that indicate that a person is interested in what you have to say? Hint: think mainly in terms of nonverbal cues.

10.04 When an instructor tells a student that the preparation is not correct but gives no corrective feedback or only gives a general idea of what is wrong, what type control of motor skill learning is being taught?

Automatic stimulus control, or intuitive control, is desirable in attaining chaining behavior discussed later. However, intuitive control creates difficulty in adapting behavior or correcting errors. As discussed earlier, the behavior must be analyzed and brought into conscious or cognitive awareness in order to be corrected. If a person is not aware of what he is doing to produce an error, he cannot correct it.

10.05 A person drives a colleague home from work using the same streets as usual. When the driver arrives at the intersection where the path must change and the two are talking, the driver is likely to continue on his regular route. Why? Hint: Think of the function of consciousness.

10.06 If a dentist is giving a routine injection of local anesthetic and doesn't consciously notice that the area for injection is inflammed and probably infected, what is he likely to do? Hint: Think of the driver in the above example.

Learning Efficiency and Verbal Control

Dental students are already proficient in language. Therefore, verbal cues can control behavior. **When verbal cues are introduced, and the person already has the component skills, learning may be accomplished rapidly,** sometimes in one trial (O'Conner 1979).

The use of verbal cues in the form of giving directions can considerably improve the efficiency of learning. For example, if one group of students mount a cast on an articulator with no directions, they will have to learn by trial and error. Hence, their learning will be slow and gradual. In contrast, if a second group of students were given directions, they would likely accomplish the task in one trial.

Verbal instruction is limited by the component skills of the student. It is futile to direct a student to cut a class II amalgam cavity preparation if he has never seen one, nor had practice in cutting cavity preparations. Learning curves of non-verbal young children and rats are incremental in nature (Kendler and Kendler 1970). Each learning attempt adds only a little learning until, after a number of attempts, performance is satisfactory. **Incremental learning is learning that progresses in small amounts. Stimulus control progresses slowly from no control toward complete control.** Different areas of the brain seem to mediate verbal learning and procedural (incremental) learning (Squire 1986).

Much motor learning in dentistry is not under verbal control. It improves with practice in an incremental fashion. Once the motor components are learned, however, they can be attached to new cues. Verbal control can produce one-trial learning when the components come under cognitive control and need only be linked together. Harlow (1979) demonstrated the linking of similar cues in a 'learning to learn' phenomena. Monkeys learned to solve problems in one trial because of the many hours of previous experience they had had with solving similar problems.

Give a competent person directions and he can change his behavior immediately. On the other hand, if responses are not under verbal control, they are difficult to change (Schneider and Shiffrin, 1977) and change slowly.

10.07 Describe how hitting a deep forehand in tennis differs between a novice and an expert in terms of incremental learning and verbal control. Hint: think in terms of performance to verbal requests.

10.08 Which of the following characterize intuitive control and which rule governed behavior: 1) incremental learning; 2) one trial learning; 3) environmental effects; 4) following directions; 5) non-verbal cues; 6) non-awareness; 7) adaptivity to altered circumstances; 8) manages delayed consequences; 9) facilitates instruction; 10) concept labels; 11) feelings.

10.09 Under what condition will verbalizing cues make motor learning more efficient? Hint: consider degree of previous learning.

In order to determine how to help a student learn motor skills effectively, the instructor must analyze the situation through observation and questions.

Analysis of Motor Skill Problems

As indicated previously, learning depends on arranged contingencies. When a student is having problems with a particular area of motor skill learning, there are several likely sources that may be producing the difficulty. These sources relate to the three parts of the learning contingency and to difficulty in linking the chain of responses that make up the final motor skill. A person has difficulty in learning a motor skill when any of the parts of the learning contingency are not functioning properly. One of the major causes of malfunction is failure of awareness of any one of the three parts of the contingency. The motor skill problem may result from lack of awareness of 1) critical cues (SD), 2) detrimental portions of the response, or 3) the relationship of consequences to the response. Chaining of response becomes a problem when reinforcement of intermediate steps is defective, or when correct intermediate steps are unintentionally punished.

Problems with Cue Recognition

A problem occurs when the student is not attending to the cues that should be controlling his response. For example, the student may not recognize when a step in a procedure is completed, thus wasting time on non-essentials or by going too far (i.e., removing too much tissue). The student does not recognize the tactile sensations related to calculus or rough CE junctions. The student may not discern the difference between enamel and dentin on the floor of a cavity preparation. The student may not recognize a crown preparation that has the bulge too high on the buccal. The student does not recognize marginal areas of unsupported enamel, a weakened cusp, or a near pulp exposure. He does not recog-

nize a surgical flap lacking adequate blood supply. He does not recognize a suture placed with excessive tension on the tissue. When a student does not recognize that his work deviates from acceptable, or has made an error and cannot point it out or cannot describe the features that led the instructor to classify it as an error, the instructor should emphasize cue recognition.

Problems with Response Recognition

In dental education a problem occurs when a student is unable to recognize all of the components of the response. A student may unconsciously apply too much pressure while polishing teeth and damage the pulp. He may be unaware of contaminating a root canal, a wound, or traumatizing gingival tissue during surgery. He does not recognize that his finger rests are inadequate for stability, and that is why he inflicts so much trauma during scaling or why his preparations lose too much tooth structure. He does not realize that he wobbles his handpiece back and forth while he works and thus has difficulty attaining parallel walls in a preparation. He does not know why he cannot obtain local anesthesia. He does not realize that his slow rate of work results from inefficient use of instruments. If a student recognizes a discrepancy in the outcome of his performance, but cannot explain why it happens, the instructor should explore response recognition with the student.

> 10.10 Name some typical responses or process errors in delivering a motor skill that contribute to a poor result, recognized by the student but without insight as to cause.

Biofeedback, as shown in research (Schwartz and Beatty 1977), is a good example of overcoming the problems for learning when a person is not aware of the response. A person can learn to control such responses as blood pressure, tissue temperature, kidney function, heart rate, individual muscle spindles, and brain waves when biofeedback brings the response to consciousness. When the response is recognized, the person can learn consciously to control it.

Problems with Consequences Recognition

In addition to learning difficulties arising from not recognizing controlling cues or from unintentional actions, the student may not learn because he does not recognize consequences (responses). Behavioral effects are occurring, but he does not respond to them because he does not recognize them as being related to his actions. The dental student may keep waving the anesthetic syringe around in front of the patient because he

does not recognize the signs of fear increasing in the patient (white knuckles, dilated pupils, perspiration). The student may continue to inject local anesthetic rapidly because he does not know about the patient discomfort that occurs later. The student may continue reaming the root canal in the same way because he does not recognize the shoulder he is creating. A dentist may continue to design partial denture clasps which extend too far into a retentive area because he does not recognize that the periodontal trauma that occurs later is the result of removal and insertion of a partial with an overly retentive clasp. Failure to recognize the effect produced by behavior interferes with learning. Instructors should help students become aware of the delayed negative effects (consequences) of their actions.

10.11 Many times patients have minor signs and symptoms following treatment by students such as sensitive teeth, sensitive gingiva, sore muscles, and headaches which are not reported. How can the instructor bring these conditions to the student's attention?

10.12 What is the purpose of bringing these conditions of the patient following treatment to the students attention? Hint: think unaware.

Problems with Chaining

Combining a sequence of movements into a skilled technique is called a chain of behavior. A chain links together a series of cues and responses into a stable sequence. Each response generates a cue consequence which then (as an antecedent cue) triggers the next response in the chain. The difference between an expert and non-expert is that, given a cue, the expert can talk for a long period because each idea cues the next idea. In motor skills, the experienced dentist runs through a skill quickly and smoothly with each action producing a cue that leads to the next action (response). The beginning dental student works with hesitation depending on rules to direct his next activity rather than a response generated cue. If a student is very slow at learning a particular procedure, it may mean that consequences are inadequate for the intermediate steps in the chain.

10.13 If a student calls an instructor for a check of a "completed" procedure and has left an unrecognized error in the product, in what two parts of the contingency is the instructor likely to find a problem? Hint: think which parts a recognition error would likely occur.

10.14 How might the instructor discriminate between a cue or consequence error?

10.15 If the student indicates that his work is not of good quality, what should the instructor do? Hint: gather information.

10.16 If the student spends an excessive amount of time with a preparation and changes instruments frequently, what type of problem is the likely cause?

Instructional Strategies for Motor Skill Problems

Utilizing knowledge of cue recognition, response recognition, consequence recognition and chaining behavior, the instructor analyses the clinical teaching situation to determine the student's motor skill learning problem. For many students, the "go-to-Daddy" approach to learning, with a little help from the instructor, enables the student to produce acceptable work. Applying instructional strategies with these students can be especially rewarding because such guidance can enable the students to produce excellent work. For a few clinical students, careful instructional assistance can enable them to succeed in producing acceptable work. The instructional strategies employed by the clinical instructor will depend upon the types of problems exhibited by the students.

Discrimination Training in the Clinic

The instructional strategy needed for the cue recognition of motor skill problems is to direct the student's attention to the cues that should be controlling his behavior. Practice should be given with a variety of examples using discrimination training techniques described earlier. This can be done by asking the student to point out, on his patients and other student's patients, whether the critical cue or cues are present in the situation. The instructor provides immediate feedback on whether or not the student is correct. Initially the instructor may have to give prompts by indicating where the student should look, or verbally describing what he should see. These prompts should be withdrawn during the course of instruction, which may involve several clinic periods, so that the only cues present in the final stage of instruction are the conditions that students must observe in the mouth.

Another aid by which clinical students learn the discriminant stimuli (critical attributes) for motor skills is through written protocols. Written descriptions of how to recognize discrepancies and acceptable critical attributes should be given to students to aid them in bringing their activities under

verbal control. These descriptions should follow the same approach as protocols given to dental examiners for evaluating clinical examinations. The descriptions should involve operational definitions (e.g. what one does to make the observation: draw a sharp explorer back and forth across the margin) and the use of low inference terms (e.g. not a high ridge, but a low inference description such as, "no pearly areas" of enamel showing on the wall of the marginal ridge). Written protocols should be developed for every dental procedure.

Demonstration

The demonstration is another method currently used as a model for students to copy or imitate. A demonstration is a method of instruction where the instructor, by actually performing an operation, shows the trainee what to do, how to do it, and through explanations, brings out why, where, and when it is done. By asking questions during the demonstration, the instructor can direct the attention of students to various portions of the process. The student then imitates the instructor with little feedback. Demonstration has limitations similar to the "go-to-daddy" approach for the students who do not recognize the cues, responses, or consequences being demonstrated.

When students are unable to perform following verbal instructions or a demonstration, the teacher may need to watch the student's performance. For example, students who have difficulty in the response area, involving lack of awareness of actions, should be watched carefully, much like a coach watches the performance of an athlete. When the response problem area is recognized, the instructor provides a rule for the student that will help him remember to control the action. "Let your fingers rest on the tooth closest to the one on which you are working." "When you cut the two bridge abutments, keep the long axis of the bur parallel for a line of draw." When verbal cues are introduced, and the person already has the component skills, learning may be accomplished rapidly. Rules statements also provide reinforcing, immediate feedback for the student to match his behavior.

Coaching

Coaching, as an instructional activity, is of particular importance where the person does not obtain immediate feedback from the environment, or establishes no relationship between cause and effect. Coaches in every sport develop techniques that work with the majority of athletes that they are developing. Instructors in each clinical discipline should attempt to identify problem processes. The instructors should then develop coaching techniques and rule statements for these areas of clinical learning.

Rules statements for guiding student's performance should be written down, shared, and improved upon among instructors, then enlarged upon at departmental meetings. Once these rules statements have been developed and agreed upon, they should be distributed to the students as part of the instructional process.

Shaping

For students who do not respond adequately to simple coaching, "shaping" is a third technique for helping students with problems in the area of deficient responses. Sometimes an individual is unable to produce the motor movements even after an explanation or demonstration. For example, how do you teach a person to wiggle his ears if he cannot produce the movement? A professional coach in sports frequently observes uncoordinated people who are paying for lessons. These people are simply unable to produce the movement required, even when they are made aware of what they should do. When this happens, the good teaching professional applies a technique called shaping. **Shaping is used when the target behavior never occurs, and thus cannot be reinforced.** Shaping is the basic ingredient of a children's game in which an object is hidden in a room and the young children are directed toward finding the object by reinforcing movements in the right direction. This is done by telling the child he is getting warmer, and punishing movements in the wrong direction by telling the child he is getting colder. When the child gets close to the object he is told he is getting very hot.

Shaping is also the technique used by animal trainers to teach animals to do complicated tricks. For example, Holland and Skinner describe a procedure for teaching a dog how to touch a door handle with its nose. The **shaping is accomplished with a procedure called successive approximations.** The dog is reinforced every time it moves toward the door. As training progresses, the criteria for reinforcement changes so that the movements must be closer to the door. When the dog finally arrives at the door, it is reinforced for any movements toward the door knob. Finally the dog is only reinforced for touching the door knob with his nose. In using successive approximations as a means of shaping behavior, the person providing reinforcement must be careful not to change the requirements for reinforcement too quickly or the subject will not get reinforced often enough and will undergo extinction.

Prompting and Fading

A fourth technique, which is useful for difficult problems in the response area, is called "prompting and fading". Sometimes animal trainers will sup-

ply prompts to speed the process. **A prompt is a cue which is likely to elicit the response so that it can be reinforced.** For example, if the trainer would place the scent of roast beef on the door knob, the dog would likely touch the door knob with his nose sooner and thus could be reinforced. The trainer would then **fade** the prompt by washing the door knob between trials so that the scent would become more and more faint. **Eventually the door knob would have no more roast beef scent and the stimulus control would be shifted from the original cue (the scent) to the new cue (the door knob itself).**

Applying Shaping, Prompting, and Fading

In teaching a motor skill that is not yet under verbal control, and does not respond to directions, use shaping, prompting, and fading. For example, assume a student is having difficulty performing the correct motion in scaling a tooth. If, after verbal instruction (prompt) or a demonstration (prompt), the student is unable to perform the correct movements, the instructor might then try a combination of shaping, prompting, and fading. The instructor asks the student to perform the motion. The instructor says "good, the first part of the motion is correct" (successive approximation), "but the last part you moved your fingers too much" (corrective feedback and prompt). "This will cause fatigue, if you have to scale for half an hour" (rationale). "Try it again. Ok, you did the first part right again, but the second part didn't improve much. Here watch me" (prompt). "Ok, try it again. That's a little better" (successive approximation). "Watch me again and then watch your fingers" (cue), "try to make them move in the same way as mine. There, I think you have it. Do it again" (no prompt or fading). "Try and remember what that feels like" (transfer of stimulus control from vision to proprioception).

The same technique can be applied to products. If a student is doing acceptable work, but not doing excellent work, an instructor can point and give verbal directions. When the student completes the procedure, the instructor can say, "You are getting better. The occlusion looks much better on the distal, you still need a little more anatomy on the mesial." The next time the instructor might say, "Your mesial looks better but your distal is not quite as good. Do you see the difference?" (prompt). Obviously, to shape student behavior toward excellence, the instructor must remember the student's work. Instructional notes would be one way to facilitate memory. Perhaps some physical or evaluative record of past work which has enough detail to record progress toward excellence (successive approximation) could be devised. For example, students who are having problems with preparations might be required to keep stone casts of their preparations which are reviewed as each new example is added.

10.17 Which process is going on in the following examples (shaping, fading, prompting)?

1) "In general your work is acceptable, but I believe you are capable of excellence."
2) "The margin on the distal is acceptable, the mesial is good, and the buccal and lingual are excellent. Do all your margins like the buccal and lingual and you will be doing excellent work."
3) "Notice the catch in the margin in both directions; notice the catch in this margin; what do you notice about this area of the margin; what do you notice about this margin?"

Bridging Gaps in Time

Problems with delayed consequences are overcome by giving the student the verbal rules that connect the immediate results of his actions to the delayed consequences for the patient (described contingencies). "If you leave an inadequate contact between two adjacent teeth, the teeth will tilt and drift resulting in premature occlusal contacts. What might be the outcome of premature occlusal contacts? That's right, it could lead to traumatic occlusion. What else might result from inadequate contact between two adjacent teeth? What about food?" (prompt). "That's right, food might be impacted leading to inflammation and bone loss."

Reinforcement Earlier in the Chain

Problems in the fourth area involving chaining of behavior can be recognized in students who are hesitant in their pattern of work flow. Students who do not finish with an instrument before putting it down but instead jump back and forth between burs or instruments, are students who have not developed an effective chain of behavior. The chain of reinforcement is linked through cues and responses. Each response generates a cue-consequence that becomes an antecedent cue (SD) for the next response. At the end of the chain is a final consequence. The consequence might be in reaching an endpoint in the task which the learner recognizes, thus reinforcing his own behavior, or the consequence might be in the instructor saying, "very good." The consequence reinforces the last link in the chain immediately. The other links either received delayed reinforcement or, because of respondent conditioning, become secondary reinforcers themselves. As a result of the delayed association with the reinforcer at the end of the chain, the cue consequences at earlier points gain reinforcing properties for the responses that produce them. In this manner the final effect at the end of the chain works

backward, strengthening reinforcement in each link of the chain, until it becomes strong enough to produce the smooth execution of the skill that characterizes the expert.

For some individuals reinforcement at the end of the chain takes too long to work back toward the beginning. If the instructor observes slow learning, the instructor should intervene with reinforcement in the middle of the chain. In preclinical learning, instructors who design a series of models, depicting various stages in a procedure, produce matching reinforcement early in the chain. In the clinic, **the instructor should intervene by asking the student having trouble to complete a step with the particular instrument.** The instructor then examines the work and provides reinforcement for the work in its present stage. This action on the part of the instructor strengthens the reinforcing properties of that cue which otherwise would acquire reinforcing properties slowly due to the distance from the reinforcement at the end of the chain. Walls et al (1981) uses knowledge of chaining to improve motor skill learning through more effective reinforcement.

10.18 If strengthening a chain of behaviors depends on the consequence working backward through the chain, what can an instructor do to hasten the process? Hint: Think about the principle of immediacy.

Avoid Unintentional Punishment of Chain Links

Another problem that occurs is that instructors will sometimes provide punishment at the check point (end of the chain) without indicating which link of the chain is inadequate. Consequently, all links in the chain are punished, whether correct or incorrect. This weakens correctly performed links which then require additional practice for restrengthening. Instructors who start a corrective feedback procedure with praise (for reinforcing listening and for emotional tone) increase learning speed by reinforcing those links in the chain that have been done correctly.

10.19 The instructor checks a crown preparation and gives the student a "C" grade with no explanation. What is happening in terms of chaining behavior? Hint: think of the information being transmitted.

10.20 If an instructor sees a student frequently changing instruments, what should the instructor do? Hint: (Answer assumes that an efficient operator would complete a step with the first instrument before going on to the second instrument.)

Strengthening Environmental Reinforcers

The instructor, in providing reinforcement for the student, should realize that he must eventually transfer reinforcing properties to events that will occur in practice. As the student has more experience with clinical work, the instructor should request that the student assess his own work with the instructor providing reinforcement or corrective feedback. A student may have done the work acceptably, but the instructor should help the student recognize how acceptable work differs from excellent work. Too often students are labeled as "C" students and no attempt is made by instructors to shape these students toward excellence. The instructors sometimes prejudge these students as average and no instruction is given that would interfere with the prejudgment.

In transferring stimulus control of reinforcement to various environmentally occurring cues, the instructor makes sure that the students recognize the cues (that is why the students are asked to assess their own work). Then the instructor, by reinforcement or by providing corrective feedback (which by definition includes clarification of the correct cue), helps the environmental cues attain reinforcing power. Corrective feedback provides reinforcing power to cues by providing descriptive contingencies and reinforcement provides reinforcing power by respondent conditioning. In asking for a student assessment, the instructor is fading his own reinforcing activities to develop those of the student. A standardized performance test then provides an indication of the student's ability to function independently.

When a student has completed a procedure, request his assessment of it. A student may feel his work is not quite right, but not incorrect enough to be considered an error. Ask for the student's evaluation of possible improvements. Are there any aspects that need changing to make them excellent? When the student feels that there is an error, have him summarize the steps to be taken in correcting his work. Asking the student to assess his performance, before knowledge of results is given, should focus attention on the task and its sensory qualities and away from a reliance on the instructor (Hogan and Yanowitz 1978). Evaluating the student's ability to assess his own work should become an important part of competency assessment.

10.21 What information does the instructor obtain if the student does not assess his work properly? Hint: think about which of the parts of the three part contingency might be involved.

Summary

To aid motor skill learning, the instructor analyzes performance in order to focus on the cues that control responses. By directing attention to these cues some learners improve their motor skills dramatically. By providing guiding rules and clear descriptions to the student, learning efficiency often improves. When the students are slow to learn, the difficulty usually arises from inadequate awareness of the relationship of cues, responses, or consequences. Sometimes the problem arises from inadequate linkage of the motor skill components into a chain of responses. The instructor can employ several strategies for overcoming these problems including discrimination training techniques, demonstrations, coaching, shaping, prompting, fading, intervening, and strengthening environmental reinforcers.

Unit 10: Study Questions

10.01 Why does learning to discriminate acceptability of a product facilitate motor skill learning?

10.02 Why does verbal control (verbal directions) enhance the learning process?

10.03 Under what conditions will verbal directions facilitate learning?

10.04 What are the four problem areas for motor skill learning?

10.05 What two areas of cue recognition contribute to problems in motor-skill learning?

10.06 Name some potential causes of poor performance that are related to actions (responses) rather than ability to discriminate. (Cue recognition)

10.07 Why is knowledge of long term consequences important to assess?

10.08 What links a series of responses together into a so-called chain of behavior?

10.09 What is a ready source of teaching aids for helping students with discrimination problems?

10.10 What coaching approach can be used to help make students more aware of their actions?

10.12 Where is coaching as an instructional activity particularly important?

10.13 When is shaping of behavior required of a coach?

10.14 What is done in the procedure called successive approximations?

10.15 What is a method for speeding the process of successive approximations?

10.16 What is an instructor obstacle to shaping a students' work toward excellence?

10.17 What type of conditioning occurs that transfers reinforcement from the instructor to the naturally occurring cues?

10.18 What information about cue control is provided by an independent test of the student's clinical abilities.

10.19 What does competency mean when applied to a student?

10.20 Why is the inference of competency a weak one when based on traditional clinical teaching?

Unit 10: Inserted Question Key

10.01 Students were blindfolded and asked to draw a four inch line 1,000 times. One group was told "good" or "not good" after each attempt. The other group was given no feedback until the end. In terms of immediacy of reinforcement, which group showed no improvement after 1,000 practice attempts, and why?

Answer: The delayed feedback group showed no improvement because no contingencies were given to influence behavior until it was too late. Practice by itself does not produce improvement.

10.02 Name at least two advantages of perceptual-motor skill learning in having the learner acquire the necessary discriminations before practicing the motor skill.

Answer: 1) The person attends to the proper details while doing the motor skill and thus consolidates the proper recognition memory. 2) The

person knows what the endpoint of each step should be and thus provides immediate feedback to himself while approaching the endpoint and completing the step.

10.03 List the cues that indicate that a person is interested in what you have to say?

Answer: Eye contact, facing the speaker, nodding at appropriate times, verbally responding, and asking questions. Absence of such behaviors as yawning, looking at watch, looking around the room, and edging toward the door.

10.04 When an instructor tells a student that the preparation is not correct but gives no corrective feedback or only gives a general idea of what is wrong, what type control of motor skill learning is being taught?

Answer: Intuitive control which leads to less efficient incremental learning.

10.05 A person drives a colleague home from work using the same streets as usual. When the driver arrives at the intersection where the path must change and the two are talking, the driver is likely to continue on his regular route. Why?

Answer: Automatic behaviors do not change readily because they are under the control of unconscious cues. To alter routine, the person must change the controlling cue by giving himself verbal instructions to change.

10.06 If a dentist is giving a routine injection of local anesthetic and doesn't consciously notice that the area for injection is inflammed and probably infected, what is he likely to do?

Answer: He is likely to give the routine injection because he does not think about the inflammation and infection altering the consequences of the injection.

10.07 Describe how hitting a deep forehand in tennis differs between a novice and an expert in terms of incremental learning and verbal control.

Answer: With the novice, if the verbal direction is given to hit the ball deep, much variability in depth is exhibited because incremental learning is still taking place. If the same directions are given the expert, he responds by hitting the ball deep since the response is already learned and needs only be associated with the verbal command.

10.08 Which of the following characterize intuitive control and which rule governed behavior: 1) incremental learning; 2) one trial learning; 3) environmental effects; 4) following directions; 5) non-verbal cues; 6) non-awareness; 7) adaptivity to altered circumstances; 8) manages delayed consequences; 9) facilitates instruction; 10) concept labels; 11) feelings.

Answer: Intuitive control: (1, 3, 5, 6, 11); rule governed behavior (2, 4,7, 8, 9, 10).

10.09 Under what condition will verbalizing cues make motor learning more efficient?

Answer: When the response is already learned and needs only to be associated with a cue to which the learner has not previously attended (noticed).

10.10 Name some typical responses or process errors in delivering a motor skill that contribute to a poor result, recognized by the student but without insight as to cause.

Answer: Excessive pressure, unstable finger rest position, inefficient use of instruments, unsharpened instruments, unrecognized movements.

10.11 Many times patients have minor signs and symptoms following treatment by students such as sensitive teeth, sensitive gingiva, sore muscles, and headaches which are not reported. How can the instructor bring these conditions to the student's attention?

Answer: The next time the patient returns for treatment, ask them about any symptoms following their last visit.

10.12 What is the purpose of bringing these conditions of the patient following treatment to the students attention?

Answer: To determine if the student recognizes any causal connection with his therapy.

10.13 If a student calls an instructor for a check of a "completed" procedure and has left an unrecognized error in the product, in what two parts of the contingency is the instructor likely to find a problem?

Answer: Cue recognition: the student does not notice the cue for the error; Consequence recognition: the student recognizes the cues but does not realize potential consequences.

10.14 How might the instructor discriminate between a cue or consequence error?

Answer: She might ask the student if he notices anything wrong. If not, she might ask the student for the consequence of this type of error. If the student knows the consequence, it is likely an error in cue recognition.

10.15 If the student indicates that his work is not of good quality, what should the instructor do?

Answer: Ask the student what is wrong and why he made the error. If the student can explicitly indicate the cue for the error, but does not know how he produced it, then the problem is in consequence recognition.

10.16 If the student spends an excessive amount of time with a preparation and changes instruments frequently, what type of problem is the likely cause?

Answer: The student is having difficulty linking a chain of stimulus-response elements together.

10.17 Which process is going on in the following examples (shaping, fading, prompting)?

1) "In general your work is acceptable, but I believe you are capable of excellence."

Answer: Prompting.

2) "The margin on the distal is acceptable, the mesial is good, and the buccal and lingual are excellent. Do all your margins like the buccal and lingual and you will be doing excellent work."

Answer: This is a form of vicarious shaping. The student can see what needs to be done to receive "excellent" as an arranged contingency.

3) "Notice the catch in the margin in both directions; notice the catch in this margin; what do you notice about this marginal area; what do you notice about this margin?"

Answer: Fading of prompts.

10.18 If strengthening a chain of behaviors depends on the consequence working backward through the chain, what can an instructor do to hasten the process?

Answer: The instructor can intervene to provide immediate reinforcement in the middle of the chain. This is particularly important for students having difficulty in learning the chain. For example, instead of waiting for the student to ask for a check, go to the student before he has finished and provide feedback on the aspects he has completed correctly.

10.19 The instructor checks a crown preparation and gives the student a "C" grade with no explanation. What is happening in terms of chaining behavior?

Answer: The student knows that everything must be acceptable, but does not know whether the preparation is uniformly average or whether some parts are excellent and others are average.

10.20 If an instructor sees a student frequently changing instruments from one to another, what should the instructor do? (Answer assumes that an efficient operator would complete a step with the first instrument before going on to the second instrument.)

Answer: The instructor should ask to look at the work and determine whether or not the student should be finished with the first instrument. If the student is not done, the instructor should ask the student to take a close look at the distal aspect (the unfinished portion) and to compare it with the mesial. Does the student see the difference? If the student says yes, then the instructor asks the student to make the distal look like the mesial. If the student does this, the instructor says "good" and reminds the student that he should try to finish a step with a particular instrument, then move on to the next. Otherwise, he will lose efficiency in practice.

10.21 What information does the instructor obtain if the student does not assess his work properly?

Answer: The student is having cue recognition problems or consequence recognition problems. The student is either not attending to the critical cues or does not know that what he has done has detrimental consequences.

Exercise: Unit 10

Classify the rules derived from Unit 10 into the categories provided in Appendix B. Then write an episode report (Appendix D) recounting the application on one or more of these rules during clinical instruction.

- Give help with the process of skill delivery (how to hold instrument, access, finger rests, pressure, instrument arrangement).

- Indicate what has been done correctly as well as any errors.

- Ask the student to give the rule statement that guides behavior in a given situa tion.

- Give instruction that indicates what to do and why.

- Remember the instructional needs of a student from one time to the next.

- Help students detect visual cues and feel tactile sensations relevant to providing excellent care.

- Watch students delivering care to identify areas for improvement.

- Ask questions during demonstrations to direct attention to various components of the process.

- Help students become more efficient in work habits.

- Observe student's work before completion and provide information on how the work is progressing.

- Indicate to the student specifically how he has improved.

- Make sure student knows how to correct any errors and how to avoid them in the future.

- Verbalize the cues that control your decisions in technical skills.

- Make student aware of his motor activity and its relationship to its consequences.

- Provide corrective feedback indicating what is wrong, what to do differently, and what the consequence will be.

- Be sure student understands the purpose of corrective feedback.

- Be sure the student can make a statement about the delayed effects of their clinical activities.

Unit 11: Research Ideas to Improve Clinical Teaching

Considering the vast time commitment, resources, and expense related to clinical instruction, it is surprising that more attention has not been devoted to the clinical teaching-learning process. Every day, in dental clinics across the country, a great deal of useful information for understanding the clinical teaching process is lost because no attempt is made to collect and study the data systematically. The purpose of Unit 11 is to suggest research to improve teaching and learning in the clinic that can be accomplished by an individual or as a departmental effort.

The primary obligation of the clinical teacher is to promote excellent health care delivery to the public via dental practice. Therefore, improving clinical teaching should have a direct effect on practice after graduation. For example, increased efficiency in learning should result in a wider variety of clinical experiences which, in turn, might result in a greater variety of procedures performed in practice (a researchable hypothesis).

Research ideas are abundant and many are related to the aspects of the applied science of clinical instruction discussed in this book. Clinical teachers can fulfill the obligation to do research and publish as stressed by the university community while improving their own skills and overall job satisfaction at the same time. Some of this publishable research may even be supportable by outside funding.

Publishing

Many universities, rightly or wrongly (Mackenzie 1985), define scholarly activity as publishing in refereed journals. Since much information about clinical teaching is yet to be discovered, there are many opportunities to publish, not only in dental journals, but in other educationally oriented journals as well. In addition to the Journal of Dental Education, and specialized journals in periodontics, prosthodontics and operative, there are nationally refereed journals in higher education, science education, educational psychology, and many more disciplines that would publish articles of general interest on the educational process.

Outside Funding

There are foundations and government agencies which have the mission of improving teaching after high school and applying basic principles of behavior to the improvement of learning and instruction. Dental schools, with a four year curriculum combining extensive knowledge and performance, have a much better opportunity than most areas of education to study transfer from lectures and laboratories to clinics. Because of its

unique features, dental education is a wonderful laboratory for doing basic research on instructional variables. In addition, dental graduates are more accessible for longitudinal study of the impact of educational variables then are the graduates of most general education programs (e.g. psychology and education). To take advantage of these opportunities, dental faculty should seek outside funding. To initiate the process, they need a source of theoretical ideas such as those presented in this book, and an association with a behavioral scientist who has a track record in the specific research area (usually found in other colleges of the university). In addition, the research idea must be competitive: clearly connected to a general problem as supported in the published literature, well designed, and with important implications (Mackenzie 1986). Given these ingredients, resources for research previously untapped by dental educators become available. In addition to the American Fund for Dental Health, there are foundations that will support research in dental education if it fits their current mission. These include Kellogg and Robert Woods Johnson Foundation. Government agencies with limited possibilities are the National Library of Medicine, The National Center for Health Services Research, and the Behavioral Sciences branch of NIDR. Government agencies outside of the health area with possibilities for dentistry are the Fund for Improvement of Post Secondary Education and the Behavioral and Cognitive Science branch of the National Science Foundation. The Fund for Medical Education is restricted by its charter to medical education, but combined projects with medicine and dentistry might be funded. Other foundations such as the Commonwealth Fund that limit their support to medicine might also be tapped by combined projects. Within the next half decade, additional federal funds will likely be earmarked to support educational research in dentistry.

Descriptive and Experimental Research

There are basically two types of research that fit the clinical situation, descriptive and experimental. **A descriptive study makes basic observations and identifies elements of a problem.** For example, a descriptive study of student errors counts the relative frequency of, and determines the status of errors. In a descriptive study variables are **not** manipulated, only observed.

Measurement is a key factor in research, providing a precise way of describing something according to a scale of measure. Analysis is the method of breaking down an entity into component parts. Measurement and analysis are essential to both descriptive and experimental research.

Experimental research manipulates variables. If the experi

menter changes one variable, what effect will it have on another. For example, if a dentist prescribes vitamin C, does it reduce the mobility of teeth? Another example pertains to excessive practice. Does excessive practice (overlearning) with a series of models improve the concept of the finished product? Does excessive practice (overlearning) in the lab transfer to work on patients in the clinic? In experimental research the investigator works with at least two groups. One group participates in the experiment, the other acts as a control group and does not participate in the treatment, acting only as a comparison group for determining the impact of the experimental manipulation. In science there is a natural progression from descriptive to experimental research as ideas on how to put the elements together are expressed as hypothesis and tested under controlled conditions.

Measurement in Research on Clinical Teaching

Much valuable research can be accomplished simply by measuring something and analyzing the results. General experience indicates that the ability to measure a phenomenon stimulates research on the topic. The following are examples of measures that might be used to describe existing conditions or to compare the outcomes of different approaches to clinical teaching. For example, the differing approaches might involve changes in lectures or textbooks that would stimulate transfer and use of knowledge or changes in preclinical laboratory instruction that would require less of the clinical instructor's time for remedial instruction. Suggested changes to be measured are listed according to the method by which the data are collected.

Sources of potential differences are given in parentheses.

1. Tape recorder carried by clinical teacher (content analysis technique).

   1.1 Counts of applied principles (rules) and violations of these rules by the clinical teacher (before reading this book, after reading, and as time passes).
   1.2 Number of questions asked of instructors (changes in clinical instruction such as emotional tone).
   1.3 Types of questions asked of instructors (changes in lectures or laboratory teaching).
   1.4 Content of student answers to questions posed by instructors (changes in lectures or textbook instruction).
   1.5 Percentage of students requiring aid in discrimination of cues related to knowledge of consequences, etc. (changes in lecture, textbook or laboratory instructions).
   1.6 Percentages of students able to state complete rules applica-

ble to a clinical situation (changes in lectures, textbooks, or laboratory instruction).

2. Special Teaching Records

2.1 Number of errors made by students (changes in lecture, clinical or laboratory instruction).
2.2 Types of errors made by students (changes in lecture or laboratory instruction).
2.3 Percentage of students able to classify correctly clinical products as acceptable or unacceptable (changes in laboratory or clinical instruction).
2.4 Proportion of clinical teaching time to complete various clinical tasks (changes in laboratory or clinical teaching).
2.5 Proportion of total clinical teaching time spent with students (changes in faculty development courses, clinical teaching management).
2.6 Student wait time from the moment need for teaching assistance is indicated until the time of instructor arrival (changes in clinical teaching of management).

3. Clinical Records

3.1 Average number of days between appointments for patients (changes in clinical teaching management).
3.2 Average number of patient cancellations and broken appointments (changes in lectures and clinical instruction).
3.3 Productivity per unit clinic time (changes in clinical teaching management).
3.4 Relative frequencies of clinical tasks undertaken (changes in clinical teaching management).
3.5 Average number of patient visits per unit clinic time (changes in clinical teaching management).

4. Alumni Surveys

4.1 Relative frequencies of tasks performed in practice (changes in clinical teaching).
4.2 Percentage of graduates involved in quality support groups (study clubs used in clinical teaching).
4.3 Percentage of graduates involved in structured learning experiences (changes in clinical teaching management).

Opportunities to measure phenomena in clinical teaching are limited only by the imagination. Usually instructional measurement and research is

is compatible with the performance of quality clinical instruction. The natural urge to improve instruction, combined with systematic record keeping and analysis necessary for research, also lead to higher quality instruction.

Clinical teaching is almost a virgin area for study with very little currently being done in the area of the health professions. The context of this book has analyzed the process of clinical instruction into detailed elements underlying clinical learning. This analysis provides a framework for investigative research that will help fill the present void in research.

A number of ideas are presented in this text that with further investigation should produce useful, publishable information. A careful analysis of these areas will also help faculty manage troublesome problems in clinical instruction. Analysis will probably lead to additional research ideas and additional reading in other areas such as education, cognitive science, and applied behavior analysis, will suggest more research. Care must be taken to make reliable observations and to control the conditions carefully when manipulating variables and analyzing the data.

> 11.01 Based on your knowledge of scientific method, what approaches might the clinical teacher use to improve clinical instruction?

Ideas for Descriptive Research

Reinforcement Research: In each clinical discipline faculty should carefully analyze the opportunities for applying reinforcement to student learning. What points in a clinical procedure or what processes are good opportunities to apply reinforcement? What types of immediate reinforcers are available for use by clinical faculty and which ones seem to work well with the dental students?

Research to Identify and Solve Areas of Learning Difficulty: In your department, which areas of clinical learning seem to present the students with the most difficulty? This may differ from dental school to dental shcool in any particular discipline. The way lectures and laboratory instruction are presented may cause certain knowledge and skills to transfer differently to the clinic. Clinical teachers can identify those areas which present learning difficulties for students by keeping records of what causes students the most trouble. Once these are identified, the instructors can then discuss techniques that can be used for overcoming these problems. Sometimes one instructor is very successful in helping students with a particular problem but not with another. As an example, tennis magazines always have instructional tips for tennis-pros on teach-

ing techniques that work to overcome specific motor skill problems. The tennis teachers share the techniques that have worked for them. In clinical instruction and publishing, recording the teaching tips generated by a departmental discussion can become a valuable resource for new clinical teachers and also clinical instructors in other dental schools.

Research on mental practice: Mental practice of motor skills has a long history of research (Richardson, Part I & II 1967). However, recent reviews of this research indicate that performance improvement through mental practice takes place predominantly within the cognitive aspects of motor skills (Ryan and Simons 1983). Nevertheless, mental practice in sports has a high payoff. The winners in world class sporting events tend to use mental practice much more than non-winners (Janson 1983).

Many experts become very good with mental practice. Many Japanese Abacus Masters, can use an abacus for arithmetic functions faster than trained personnel can use electronic calculators. They are even able to calculate faster and more accurately by using the visual image of an abacus than by actually using the abacus itself (Hatano et al 1977).

Experience with the motor activity enhances the effect of mental practice. Instructors might encourage seniors to think through their procedures during nonclinic hours as a way of improving speed and accuracy. Mental practice might be particularly good for standardized performance tests such as state board examinations.

Research on errors: The use of errors to improve instruction (Fisher and Lipson 1985) is an area that has been neglected in education. By systematically recording and analyzing errors made by students, faculty will begin to develop hypotheses about the underlying causes and this information will suggest ways to improve instruction. The improvements may be not only in clinical teaching, but also in improving the preclinical instruction so that less errors are made in the clinic and less clinic time is required for learning. The use of errors is a good starting place for research on clinical instruction.

Research on determining competency: Competency assessment involves observations by faculty that indicate the student is likely to perform adequately in the future under a variety of circumstances. The ability to function independently in a variety of circumstances is the most accurate predictor of competency. If the student can recognize acceptable products in the variety of situations faced by the dentist, and can independently perform the chains of behaviors necessary to attain these acceptable products, the faculty can be fairly certain that the student will continue to be competent. Unfortunately, faculty depend almost exclu-

sively on the student's ability to perform procedures as an indicator of competency. The student cannot do enough work in the available clinic time to cover all relevant conditions, particularly when the work has not been systematically selected.

To overcome this inadequate opportunity for observation, faculty should develop new methods to assess the tasks that they are teaching in their discipline. Simulated performance tests, involving models and photographs designed to cover all important variations in the product, is one way to assess competency in a more thorough and efficient manner. Since all necessary tests would be too numerous to administer to any particular student, instructors depend on samples. By drawing a random sample, the faculty can get a fairly accurate estimate of how the student would score if he were given all the tests. The degree of accuracy of this estimate is lawfully related to the size of the sample. The larger the sample, the less the estimate would deviate from the score received if all items were given. With this method, the student's ability to assess acceptable performance could be determined for a wide variety of tasks in a short time.

Research on Patient Viewpoint: Little has been done in systematically studying clinical instruction from the patient's point of view. What sort of things do instructors do that bother patients? A descriptive study of instructor's behaviors that are particularly pleasing to patients verses instructor behaviors that are annoying to patients would be valuable at a time when dental school clinics are experiencing shortages of certain oral conditions needed for instruction. It is good public relations for the dental school to have instructors modify teaching techniques in a way that is more satisfying to clinical patients.

Research on Verbal Control: Another study that can be done involving difficult learning areas is to analyze the task components (three part contingency) that are causing the difficulty. Once these components are identified, the instructors should develop ways of verbalizing instruction in this area so that the task can be brought under the verbal control of the student. For example, if students were having difficulty with extending the proximal box in a Class II amalgam preparation, the instructors might develop a verbal rule that says that the box should be extended until it has one millimeter clearance, or until such and such instrument can just squeeze through. This is a described contingency that is already used by many teachers for facilitating learning of this specific point. In areas of instructional difficulty, faculty should attempt to find verbal instructions that will describe the contingencies necessary to facilitate learning and then investigate the effect of verbal control.

Research on Nonverbal Cues from Students: Another descriptive analysis that clinical instructors might make is a study of the kinds of statements or other cues which students provide that suggest they are experiencing certain feelings. These cues, of course, are important for monitoring the tone of the learning environment. Instructors might then discuss these cues generated by students in terms of what response the instructor could make to indicate he understands these feelings. For example, the student might express feelings of anxiety, frustration, or despair. How can instructors respond to these verbal and non-verbal communications of students in a supportive way? Investigate how the nonverbal cues of students change, following the change in instructor behavior.

Research to Encourage Thinking: If our objective is to teach the student how to learn generalizable information from treating a patient, what special conditions do we need to arrange so that the student will be encouraged to think about what he has learned and how he will use it in the future? What are some additional methods that faculty can arrange beside clinical notebooks, study clubs, and clinical conferences? There is a need for improving thinking and judgment, and the use of information by dentists in practice (Mackenzie1986).

Research on Guidance Manual for Teachers: Besides employing a systematic approach to improving instruction, faculty can help new teachers by providing guidance in the form of a clinical teaching manual. The manual can contain the results of systematic analyses such as those described above. It can also contain discussions of how experienced clinical teachers handle certain types of problems. It can contain rules to guide teachers in the describing and arranging of contingencies and in setting the tone for the learning environment. It can also identify the critical attributes of the various procedures taught in the department, along with appropriate descriptions of how to assign values to these attributes in a reliable fashion. A guidance manual would probably be welcomed at other dental colleges and results of using the manual could be described and published.

11.02 What type of studies have been suggested for investigating the clinical teaching process?

Ideas for Experimental Research

Faculty can become involved in experimental studies such as those for improving the relationships among didactic, laboratory, and clinical instruction, or studies for validating the effectiveness of the clinical teaching approach applied by the department.

Research on Transfer: If faculty have studied the clinical areas in which students have difficulties, and have established a baseline rate for which students require help with some portion of a particular procedure, then the faculty can study the effect of discrimination training sequences or other variables that influence transfer of learning. By using suitable controls, an experiment can demonstrate the effect that would result from redesigning didactic instruction to influence the amount of clinical instruction required on a specific topic.

Research on the Impact of Education on Dental Practice: A second study faculty could undertake would be the validation of clinical teaching methods against outcomes in practice. For example, preliminary work in nursing has indicated that a change in the environmental tone set by faculty influenced the tone set by students with their patients. Thus, one hypothesis would be that if faculty could succeed in changing the tone of clinical instruction toward more positive effects, perhaps there would be less patient turn over due to interpersonal reasons in practice. Another hypothesis might be that graduates would be more inclined to return to the school for continuing education.

Research on Observational Skills: A third experimental study that faculty might undertake is the effect of intensive training on attending to clinical cues. Wright (1979) in Science Education provided intensive training in cue attendence which required subjects (persons) to pay attention to details involving events, objects, and attributes. He found the intensively instructed group to be superior for all dependent variables: number of observed details, number and diversity of information search questions, and the number and quality of generated hypotheses. A delayed 14 month retest gave the same results and provided evidence for a lasting effect of training. Wright also had similar findings for both ninth graders and college students. These findings would indicate that training dental students to observe more relevant cues from their patients would help them in solving future clinical problems. With this training, there would be more likelihood of identifying new relationships between predictor variables and outcome variables. This investigation could be done experimentally with appropriate controls using specially kept student journals as one of the data sources.

The studies suggested above are only a few that clinical faculty might undertake to investigate improving clinical teaching. The theoretical framework presented in this book that relates basic findings in behavioral science to clinical instruction is a rich source of ideas for research in clinical teaching. Much research can be done while carrying out regular teaching duties in the clinic. Recording observations systematically would be

the main additional task.

Summary

All serious learning requires the ability to think in a disciplined manner and to have enough imagination to ask searching questions. There are many questions that need to be asked about clinical teaching. The history of dental education has not provided many examples of advances in the science of clinical instruction. Most teachers teach in the way they were taught. It is now time to take a close, careful look at clinical instruction to improve teaching and learning in the clinical situation. Careful research using descriptive studies and experimentation can lead to more economical and efficient instruction producing improved health care delivery to the public.

Unit 11: Study Questions

11.01 What are some methods that clinical teachers can use to learn from their own teaching experiences?

11.02 What does this book contribute to the potential for improving the possibilities for learning from clinical teaching experiences?

11.03 What are some research topics to help improve clinical teaching?

11.04 Why should student's perceptions of instruction be studied?

11.05 What are some experimental studies that faculty can conduct to improve clinical teaching?

Unit 11: Inserted Question Key

11.01 Based on your knowledge of scientific method, what approaches might the clinical teacher use to improve clinical instruction?

Answer: 1) Systematic recorded observations; 2) Reliable observations; 3) Manipulation of variables under controlled conditions.

11.02 What type of studies have been suggested for investigating the clinical teaching process?

Answer: Descriptive studies in which observations are recorded and categories developed, and experimental studies in which variables are manipulated.

Appendix A: Answers to the Study Questions.

Unit 1: Study Questions

1.01 By understanding the principles taught in this book, what will clinical teachers gain?

Answer: The ability to analyze problem situations in clinical teaching, and to restructure them to aid the learning of individual students. The ability to predict, explain, and influence student clinical behavior. The satisfaction of success and appreciation of students.

1.02 Why do clinical instructors have difficulty transferring the principles learned in courses taken in colleges of education to clinical teaching?

Answer: Application of learning principles are context specific and colleges of education do not ordinarily include clinical teaching and its unique context in their instruction.

1.03 Why is research in clinical teaching a good academic avenue for clinical teachers?

Answer: It is a relatively untouched area for research that can be done while teaching. There will also be a good potential for outside funding for research in this important area.

1.04 Name at least two of four outcomes that may be expected from the application of principles taught in this book to clinical teaching.

Answer: Increased receptivity to learning by students, an apparent increase in learning efficiency, increased ratings of instructors by students, and increased enjoyment of teaching by instructors.

1.05. Reproduce the diagram depicting the key concepts needed for understanding the dental applications covered in this book.

Answer: See diagram in Unit 1.

Unit 2: Study Questions

2.01 What are the powerful principles that influence behavior?

Answer: respondent conditioning, the contingencies that govern operant conditioning, and the factors that modify these contingencies.

2.02 For what purpose have scientists used behavioral principles?

Answer: To predict, explain and influence behavior.

2.03 What is a behavioral contingency?

Answer: It is a relationship between a situation, an activity, and what happens following the activity. It has three parts: a stimulus, a response, and a consequence.

2.04 What is the name of the system in the brain that contains positive and negative circuits influencing behavior.

Answer: The limbic system.

2.05 When a positive effect follows a response, what factor has an important influence on whether the response will occur again in the future?

Answer: Similar conditions. The presence of the same or similar cues that were present when the response produced a positive effect is very important.

2.06 To elicit a response, do cues need to be specific or general?

Answer: Cues can be either specific or general.

2.07 What function does an antecedent cue have when it has frequently been associated with a reinforced response?

Answer: It sets the occasion for the response. It brings the response forth. It also acquires secondary reinforcing properties.

2.08 Why is talking to ourselves important to our behavior?

Answer: The words are response-generated cues for other behaviors.

2.09 What are some additional words that, when used loosely, can be used to substitute for the term "cue?"

Answer: Stimuli, attribute, feature, situation, occasion, context, setting,signal, and sign.

2.10 What is the limiting factor about a cue?

Answer: It must be capable of being noticed or sensed by the person or organism.

2.11 Name two different kinds of learning or conditioning processes.

Answer: Operant conditioning (or instructional conditioning) and respondent conditioning (or classical conditioning).

Unit 3: Study Questions

3.01 What is the advantage in relating scientific terminology to clinical teaching?

Answer: It connects the factors which scientists have identified that explain, predict, and control behavior to clinical situations in which they can be applied for teaching and research.

3.02 What is a behavioral effect?

Answer: It is a stimulus that occurs in the environment following a behavior.

3.03 What three types of behavioral effects are there?

Answer: Positive (pleasant, desired), neutral (midpoint on the continuum, expected stimuli does not occur), and negative (aversive, unpleasant).

3.04 What are the three parts of a contingency?

Answer: The cue (stimulus, context, situation), the response (behavior, act) and the effect (consequence). The S-R-C, the stimulus, response, consequence.

3.05 What three operations or arrangements can occur to create a behavioral effect?

Answer: The cue or stimulus can be presented (brought forth), removed, or prevented.

3.06 If a cue is neutral does it make any difference what operations or arrangements are done with it?

Answer: No

3.07 Compare and contrast punishment and reinforcement in terms of operations types of stimuli.

Answer: The operations for both are the same: presenting, removing, or preventing a stimulus following a response. The types of stimuli are the same positive or negative. The difference is that in punishment the operation involves the opposite stimulus. A negative stimuli is presented, a positive stimuli is removed or prevented.

3.08 Based on the types of consequences (positive, negative, neutral stimuli), and the operations that can be done to them, how many contingencies are there, and can you arrange them?

Answer: Seven: positive reinforcement, negative reinforcement, avoidance reinforcement (contingency), positive punishment, negative punishment, preventive punishment, and extinction. These are arranged by presenting, removing or preventing positive or negative stimuli and by an expected stimuli not occurring.

3.09 Why do contingencies arranged by teachers not always work as expected in clinical situations?

Answer: Other contingencies are influencing student behavior and sometimes these contingencies exert the more powerful influence.

Unit 4: Study Questions

4.01 Besides undermining student-patient rapport, what additional detrimental side effects might the following reported incident create. "A different instructor saw the result a month later (root amputation), asked what had been done, and said, in front of the patient, that it should never have been done".

Answer: The instructors comments might raise doubts concerning the advisability of going to the dental school for treatment. In an era of growing patient shortages this statement made without an excellent rationale is a serious breach in public relations, to say nothing of good

sense and professional ethics.

4.02 What are the five phases of the clinical teaching encounter?

Answer: 1) tone; 2) information; 3) observations; 4) assessment; 5) instruction.

Unit 5: Study Questions

5.01 What factors in interpersonal relationships have been found by researchers to exert a powerful influence on human behavior in many areas (e.g., modeling, placebo effect, suggestibility)?

Answer: Empathy, respect, nonpossessive warmth, authenticity.

5.02 What are some areas of importance to clinical teaching for which interpersonal factors have been found to exert a positive influence on behavior?

Answer: Suggestibility, imitative behavior (copying, modeling), behavioral therapy (source of behavioral effects), professional values, job satisfaction,job productivity.

5.03 What are mathemagenic behaviors?

Answer: Behaviors that are necessary for learning, including orienting, attending, and processing of information.

5.04 What is the reason for starting a corrective procedure with praise?

Answer: It reinforces mathemagenic responses leading to learning.

5.05 What may happen if an instructor only praises perfection?

Answer: The student may not reach perfection and thus never receive reinforcement which then leads to extinction of certain responses such as attention.

5.06 What quality of punishment reinforces its use in social situations?

Answer: The immediacy of its effect on the person being punished.

5.07 What additional effect besides stopping the target behavior does excessive punishment have?

Answer: It arranges conditions that reinforce escape and avoidance behaviors in students. It makes the learning environment aversive by respondent conditioning.

5.08 Give some examples of instructor behavior that produce excessive punishment.

Answer: Attacking the students character, belittling the student in front of his patient, producing strong emotional overtones such as anger.

5.09 How can punishment be applied without producing undesirable side effects?

Answer: Use mild punishment combined with initial praise and followed by corrective information.

5.10 Why is punishment by itself inadequate for efficient clinical learning?

Answer: Because punishment only suppresses behavior, it does not help the student learn what to do. By itself punishment only promotes an inefficient form of trial and error learning.

5.11 What influence does the emotional tone of the environment have on the interpretation of ambiguous situations?

Answer: The interpretation of ambiguous situations goes in the direction that is consistent with the emotional tone.

5.12 Identify some things the instructor does that conveys respect for the student.

Answer: To convey respect, the instructor listens attentively, indicates that he expects the student to succeed, avoids belittling remarks, builds up the students character.

5.13 Identify some things an instructor does that conveys to the student that the instructor cares about people in general and the student in particular.

Answer: He greets the student by name, greets the patient, sets the patient at ease, compliments the student, and makes sure the student understands how to avoid repeating an error in the future and why avoiding the error is important to the future success of the student. The instructor finds out about student interests and goals and tries to

relate learning to these characteristics of the student. If the student shows signs of stress, the faculty member provides emotional support. The instructor is readily available when needed.

5.14 How do people (instructors or students) find out about unobservable behaviors (e.g. thoughts, motivations) of another person?

Answer: They draw inferences from observed behaviors (what the other person says or does). The student draws inferences about the empathy of instructors and instructors draw inferences on how the student perceives the tone of instruction, or whether the student understands something.

Unit 6: Study Questions

6.01 What are at least two variables that strongly influence the effectiveness of contingencies?

Answer: Immediacy and Certainty.

6.02 Why are deadline contingencies a powerful means of influencing behavior?

Answer: The impending contingency becomes more and more immediate, until it out-competes other contingencies for the behavioral responses that can occur in a limited time.

6.03 Counter-control contingencies arranged by human subjects of experimentation depend on what two conditions (variables)?

Answer: 1) Whether the human subjects like or dislike the experimenter, and 2) whether the subjects are aware of intentions.

6.04 What is an arranged contingency.

Answer: An arranged contingency is one in which the consequences are applied. A positive or negative consequence is presented, removed, or prevented.

6.05 What techniques applied to prisoners during recent wars indicate that environmental contingencies can influence strongly held beliefs and values?

Answer: Brainwashing.

6.06 What types of contingencies in the environment exert a powerful influence on behavior even overcoming beliefs, desires, and goals?

Answer: Immediate, certain contingencies, even when small and inconsequential.

6.07 What are important variables that help an instructor resist the effect of immediate contingencies which adversely affect instruction?

Answer: Awareness that the contingencies are operating, and provisions for other immediate contingencies that will help support the desired behavior.

Unit 7: Study Questions

7.01 What is the problem with identifying the source of clinical difficulties as due to poor attitudes or lack of professionalism on the part of students.

Answer: The explanation usually stops the search for other antecedent conditions that could perhaps be changed so as to produce the desired behavior.

7.02 When students try to get by, instead of learning something obviously useful to them, what does this imply?

Answer: There are other contingencies in the environment that are successfully competing for control of the students behavior. (Probably immediate and certain contingencies)

7.03 When a person should do something like avoid overeating or excessive smoking, what type of contingency is usually counted on to control behavior (and usually does not)?

Answer: Long-term, delayed, and somewhat uncertain contingencies. Even though these contingencies are very important they fail to exert effective control.

7.04 How does a person's self-image control his behavior?

Answer: When a person's actions are consistent with his self-image, he is reinforced. When his actions are not consistent with his self-image, the person finds this punishing.

7.05 How does a statement involving professional ethics or values work in the face of opposite, immediate, competing environmental contingencies?

Answer: Being consistent with professional ethics provides immediate reinforcement, whereas being inconsistent creates guilt which is an immediate punishment contingency.

7.06 How does peer review help maintain quality in practice?

Answer: It provides opportunities for aversives to occur. These are avoided by maintaining quality.

Unit 8: Study Questions

8.01 What two factors influence the ability of students to notice important cues?

Answer: Innate tendencies and past learning experiences.

8.02 What is the difference between a nominal cue and a functional cue?

Answer: The nominal cue is what is presented. In clinical situations the nominal cue is very complex and has thousands of noticeable aspects. The functional cue is composed of those aspects that are attended to.

8.03 Why is asking the student if he recognizes an error an ineffective method for assessing the students perceptual abilities?

Answer: The student may think he recognizes an error when he does not or the student may not wish to admit uncertainty.

8.04 What must the instructor do to obtain a fair degree of certainty that the student can really discriminate the critical features (SD)?

Answer: The instructor needs to provide enough trials to which the student must respond to the SD so that the instructor can rule out chance guessing. This requires about four or five trials.

8.05 What variables seem to be of great importance to the strength of learning, whether the learning be sensory, ideas, or motor skills?

Answer: Frequency of firing of the patterns of neurons related to that

learning.

8.06 Why is the preparation of products as the sole source of learning an inefficient approach to technical skill learning in dentistry?

Answer: The amount of feedback received per unit time is too infrequent for effective discrimination learning. Also the time spent during the preparation may not be spent attending to critical cues, thus wasting valuable learning time.

8.07 What two basic processes are important in the formation of concepts?

Answer: Ability to discriminate between examples and nonexamples of the concept, and the ability to generalize across all instances of the concept.

8.08 What strategy for teaching clinical concepts is important for avoiding overgeneralization, undergeneralization, and misconceptions?

Answer: Using both examples and nonexamples that differ only on critical attributes and are the same on non-critical attributes.

Unit 9: Study Questions

9.01 What does rule governed behavior permit humans to do relative to their environment?

Answer: Resist the control of environmental contingencies.

9.02 What is the importance of a statement that bridges a gap in time?

Answer: Environmental contingencies lose their effectiveness if the consequences are too long delayed. Only immediate contingencies are effective for influencing behavior.

9.03 What are the four parts to a rule statement designed to guide behavior?

Answer: The occasion, the specific cue, the activity, and the effect of the act.

9.04 What two parts should corrective feedback contain?

Answer: A behavioral effect and a consequence of not making correc-

tion.

9.05 Non-verbal feedback contains which part of the corrective feedback process?

Answer: The behavioral effect.

9.06 What is the basic variable in understanding?

Answer: The number of associations or interconnected ideas that a person can relate to the idea or situation.

9.07 Clinical understanding, as compared to basic understanding, involves which two additional ingredients?

Answer: Association with clinical retrieval cues and with clinical decisions and actions.

9.08 What three techniques might be used to improve the clinical understanding of students?

Answer: 1) Stop student during a procedure and ask what he has not completed and reiterate the consequences of not finishing. 2) Ask students about hypothetical situations.3) Ask about features of the student's clinical work that is not correct.

9.09 Why should an instructor restate the student's answer to a question?

Answer: To show the student that he understands the answer, even before he corrects it.

9.10 Why should the instructor ask the student to rephrase what the instructor has just said?

Answer: To make sure that the student understands the message.

9.11 What should the instructor do if it is clear that the student does not have the specific information needed?

Answer: If prompting does not work, the instructor should give the information to the student and ask the student to rephrase it.

9.12 Why is it important to the instructor to transfer stimulus control of information to the clinical situation?

Answer: Because, after graduation, the instructor will not be present in the student's dental practice to serve as a retrieval cue (to ask questions).

Unit 10: Study Questions

10.01 Why does learning to discriminate acceptability of a product facilitate motor skill learning?

Answer: Because the learner can supply immediate feedback to his own actions, rather than waiting for feedback from an instructor (delay).

10.02 Why does verbal control (verbal directions) enhance the learning process?

Answer: The thousands of hours of experience with words and their relationships in a variety of contexts facilitate positive transfer of learning to new situations.

10.03 Under what conditions will verbal directions facilitate learning?

Answer: When the response is already learned and needs only to be connected to new cues.

10.04 What are the four problem areas for motor skill learning?

Answer: 1) Cue recognition; 2) response recognition 3) consequence recognition; 4) smooth sequencing of chaining.

10.05 What two areas of cue recognition contribute to problems in motor-skill learning?

Answer: The student may not recognize cues that initiate a procedure, or the student may not recognize cue-consequences which end a procedure acceptably.

10.06 Name some potential causes of poor performance that are related to actions (responses) rather than ability to discriminate. (Cue recognition)

Answer: Excessive pressure, unstable finger rests, inefficient use of instruments, unrecognized movements.

10.07 Why is knowledge of long term consequences important to as-

sess?

Answer: The consequences are not readily recognizable from experience. Thus the student may not recognize the relationship unless the contingency is described to him.

10.08 What links a series of responses together into a so-called chain of behavior?

Answer: Each response produces a cue-consequence. This cue then triggers the next response. A response-produced-cue might be identified by visual inspection or by proprioceptive feedback.

10.09 What is a ready source of teaching aids for helping students with discrimination problems?

Answer: Models and Intra oral photographs of student's work depicting various degrees of acceptability and unacceptability of products.

10.10 What coaching approach can be used to help make students more aware of their outcomes?

Answer: Models and intraoral photographs of student's work depicting various degrees of acceptability and unacceptability of products.

I0.11 What coaching approach can be used to help make students more aware of their actions?

Answer: Provide a rule statement that will direct the learner's attention to the problem movement.

10.12 Where is coaching as an instructional activity particularly important?

Answer: Coaching is important where the learner has difficulty making a connection between his action (responses) and a consequence. This may be due to a delay in the consequence or due to lack of awareness concerning the action.

10.13 When is shaping of behavior required of a coach?

Answer: When verbal instruction does not produce the movements because the learner has not yet learned the chain of behavior necessary to execute the desired response.

10.14 What is done in the procedure called successive approximations?

Answer: The teacher reinforces responses that are similar or progressing toward producing a correct response. As learning occurs, the criteria for reinforcement changes until the response meets the requirements for the desired response.

10.15 What is a method for speeding the process of successive approximations?

Answer: The use of prompting and fading.

10.16 What is an instructor obstacle to shaping a students' work toward excellence?

Answer: Inability to remember the details concerning what a student has done before.

10.17 What type of conditioning occurs that transfers reinforcement from the instructor to the naturally occurring cues?

Answer: Classical conditioning or respondent conditioning. The effect is achieved by pairing the natural cues with the cue provided by the instructor's act of reinforcement.

10.18 What information about cue control is provided by an independent test of the student's clinical abilities.

Answer: Naturally occurring cues are exerting the control desired by the instructor. Instructors are providing no prompts.

10.19 What does competency mean when applied to a student?

Answer: Competency is an inference based on observation of cues that a student is likely to perform adequately in similar situations in the future.

10.20 Why is the inference of competency a weak one when based on traditional clinical teaching?

Answer: There is not enough clinical time for the students to do the variety of procedures with enough frequency to indicate competency in all clinical areas.

Unit 11: Study Questions

11.01 What are some methods that clinical teachers can use to learn from

their own teaching experiences?

Answer: Systematically record observations, make reliable observations, review the recordings of trends, develop hypotheses, test hypotheses under controlled conditions.

11.02 What does this book contribute to the potential for improving the possibilities for learning from clinical teaching experiences?

Answer: The book provides a theoretical frame of reference that the teacher can use to build new knowledge.

11.03 What are some research topics to help improve clinical teaching?

Answer: 1) Identify areas for reinforcing students. 2) Identify areas of learning difficulty for students. 3) Describe the patient viewpoint in clinical instruction. 4) Analyze the components of clinical learning tasks. 5) Develop verbal rules to guide areas of learning difficulty. 6) Identify cues to student feelings and develop guidelines for instructor responses to these feelings.7) Develop rule statements for students to use in specific circumstances. 8) Study contingencies in effect during clinical instruction. 9) Identify clinical decisions and their relationship to underlying biological knowledge.10) Determine hypothetical situations that would be useful in probing clinical understanding of students.11) Study student rates of clinical learning.12) Identify student types and their influence on clinical learning.

11.04 Why should student's perceptions of instruction be studied?

Answer: Because students react to their perceptions as if they were reality. Misconceptions can be detrimental to instruction and should be recognized and corrected.

11.05 What are some experimental studies that faculty can conduct to improve clinical teaching?

Answer:
1) Study the variables that influence transfer of learning from didactic instruction to clinical instruction.
2) Validate clinical teaching methods against outcomes in practice.
3) Study the effect of intensive training to attend to clinical cues.

Appendix B: Classification System for One-on-One Model.

ESTABLISH AND MAINTAIN GOOD RELATIONSHIPS WITH STUDENTS

1. Facilitate learning by conveying positive regard, authenticity and empathy. (Extend to all students regardless of their individual characteristics or their performance.)

1.1 Show positive regard.

A. Be accessible to students.

a. Be in clinic or laboratory during scheduled hours. Try to take breaks when students' need for you is relatively low.

b. Inform students in advance of when and for how long you will be away from the clinic or the laboratory.

c. Provide instruction equitably to all students. Try not to favor pleasant, assertive or able students.

d. Respond to students' instructional needs in order of request except in emergency.

e. Avoid prolonged conversation with colleagues.

f. Provide extra time (outside class if necessary) for students who have fallen behind.

g. Be pleasant, responsive to students' requests, i.e., <u>not</u> forbidding, detached, bored or involved in other activities.

h. Listen to students and be sure that you understand them. Respond to questions that students ask.

B. Relate to students as individuals.

a. Remember students' names and call them by name.

b. Ask students something about themselves apart from their student roles, (e.g., hobbies, interests) and refer to these interests later on.

c. Occasionally talk to students about things other than dentistry. Smile, nod, greet students outside class and occasionally stop to chat with them. When it is possible, establish eye contact when speaking to students.

C. Show concern for students and belief in their worth and potential.

a. Express concern for students, their learning and their success.

b. Convey to students that they are generally capable and ultimately will succeed, (e.g., "I think you will find this technique will save time when you are in prac-

tice"; "Let me show you a method I use to reduce pain from injections. It will help you in building your practice."

c. Allow independence consistent with students' skills and patients' welfare.
d. Avoid attributing the cause of a problem to "attitude", laziness, or indifference.
e. Give students the benefit of the doubt.
f. When evaluating work, focus on the work itself, not on deficiencies in the student.
g. Maintain confidentiality, (e.g., speak softly, do not discuss one student's work with another).
h. When students propose equally acceptable alternative treatments, give them consideration.
i. Enhance or maintain student-patient rapport, (e.g., say positive things about students to patients).

D. Treat patients as individuals. Show (model for students) concern for patient and compliment students for doing so.
a. Introduce yourself to patients. Call patients by name.
b. Show concern for patient comfort, (e.g., adjust headrest, focus light away from patient's eyes, validate that anesthetic has taken effect).
c. Orient patients to procedures.
d. Offer options to patients when there are alternatives.
e. Convey empathy to patients.

1.2 Be authentic. (Be genuine, real. Be yourself honestly.)
a. Present yourself as a real person without pretense or professional facade.
b. Acknowledge that you are subject to human error. If you make a mistake or cannot answer a question, do not ignore, deny or place blame on student.
c. If you were hostile, rejecting to student, acknowledge your error.
d. Broaden interactions with students. Speak of personal things occasionally, (e.g., your hobbies, events in your life, feelings).
e. Refer to your own experience as a student and as a dentist.
f. Be sure that your oral evaluations of students are consistent with your written evaluations. Do not mislead.
g. Compliment students when you are pleased with their performance or progress.
h. Honestly inform students when their performance is inadequate. Do not ignore or gloss over an error about which you believe you should inform a student.

1.3 Communicate empathy to students.

a. Imagine yourself in the situation facing the student to understand better how the student feels.
b. Communicate your understanding of a student's feelings (self-doubt, anxiety, discouragement, relief, pride) by describing the situation and the feelings it is likely to have induced, (e.g., "It's really disappointing when something happens to slow you down", "I'll bet you are pleased with this bridge."
c. When a student is discouraged and you have acknowledged the feelings, tell her or him about a similar problem you faced as a student or as a dentist, (e.g., "There were times in dental school when I really questioned my ability.")
d. Acknowledge students' self doubts, anxiety and discouragement and offer help.
e. Relate to students as colleagues with shared goals and responsibilities.

MANAGE MOTIVATION AND PERFORMANCE

2. Apply the principle that the consequences of behavior (experienced or anticipated) affect future behavior.

2.1 Reward (reinforce) behaviors to strengthen and maintain desirable student behavior, (e.g., be responsive when student mentions reading about a patient's condition, applies a principle from the basic sciences or teaches patient about home dental care.)

a. Praise students for accurate evaluation of their own performance.
b. Specifically comment on aspects of a product, process well done.
c. Indicate to the student specifically how he or she has improved.
d. Praise things that are done well, giving the positive consequences as a reason.
e. Try to make your praise more nearly commensurate with the effort and accomplishment of the students, (e.g., for a fine gold inlay say more than, "That is O.K.")
f. Start by identifying a positive aspect and praise the student before identifying aspects that require improvement.
g. Strengthen natural reinforcers that function to maintain desirable behavior, (e.g., be positively receptive when patient compliments the student, infer when students

experience justifiable pride and comment upon it. ("It's very satisfying to have constructed such a fine bridge." "You should feel proud for having improved so much in the last few weeks.")

h. Reward (reinforce) desirable behaviors even though they should occur on their own merit.

2.2 Give corrective feedback. Providing corrective feedback is, without question, necessary for student progress. Criticism without sufficient knowledge of how to improve is not instructive and is likely to be punishing and thus lead to undesirable side effects (anxiety, loss of confidence, weakened positive motivation). In contrast, analyzing the student's performance problem and skills and providing needed information is likely to reduce anxiety, raise confidence, strengthen positive motivation and improve performance. The examples below illustrate methods to maximize the informational value of corrective feedback and to minimize side effects.

a. Be sure that the student knows the implication of the feedback for action, (e.g., if necessary diagnose problem, prescribe action).

b. Limit corrective feedback to instructional component, i.e., do not convey negative inferences about the student's motivation, ability.

c. Convey rationale (clinical consequences) for recommending changes.

d. When requiring extra work, clarify that it is in the student's best interest to do it.

e. Attend carefully to flaws, that if unrecognized, can lead to later difficulties.

f. When the difficulty of a task clearly contributes to an error, acknowledge this to the student, (e.g., "Many students have made this same error", "Access was particularly difficult here".)

g. Seek to reduce the likelihood of errors, (e.g., warn students in advance of frequently occurring errors, clearly convey to students clinic requirements).

h. When possible, limit the task to increase the likelihood of success.

2.3 Identify and alter consequences that encourage students to act in ways that jeopardize learning, performance or long-term professional behavior.

a. Seek to identify consequences that encourage the stu-

dent to do other than what he or she should be doing.
b. Identify an immediate consequence that is interfering with a desired but delayed result.
c. Find out if you have arranged or described a negative consequence for a desirable student behavior, (e.g., criticized student for asking questions).
d. Find out if you have arranged or described a positive consequence for an undesirable student behavior, (e.g., rewarded dependency by doing work that the student should do).

TELL THEM WHAT, HOW AND WHY

3. Inform selectively. Selection based on: (a) importance for making decisions; (b) need to amplify, clarify lectures and text material; (c) likelihood that information will help students to avoid errors. Methods include: giving directions, questioning to inform, modeling, demonstrations and drawings.

3.1 Clarify purposes, objectives and criteria.
a. State expectations in advance to students.
b. Set clear (specifically described) criteria for performance.
3.2 Clarify materials, procedures and instrumentation.
3.3 Help students to avoid problems by alerting them to potential errors.
a. Notice and remember errors that occur frequently and warn students in advance.
b. Alert individual students to problems that your experience with their past performance leads you to anticipate.
c. Be sure that students understand the relationship between an error and its clinical consequences.
3.4 Associate relevant basic science information with clinical decisions.
3.5 Associate relevant professional values with clinical decisions.

CHECK THEM OUT

4. Observe students (you may need to elicit response in order to observe).
4.1 Observe students' products (for example, preparation) in final and pre-final stages (PRODUCT).
a. Observe students' product before completion in order to find out whether they are moving toward acceptable products.

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CHECK THEM OUT

4. Observe students (you may need to elicit response in order to observe).
4.1 Observe students' products (for example, preparation) in final and pre-final stages (PRODUCT).
a. Observe students' product before completion in order to find out whether they are moving toward acceptable products.

b. Monitor the frequency of students' appointments with patients and cancellations and seek the cause of low frequency of appointments.

4.2 Observe students working (Process).

a. Observe students to gain information about whether they are following proper methods, instrumentation.

4.3 Observe patients' reaction to students. (VERBAL AND NON-VERBAL).

4.4 Observe students interacting with patients and staff.

4.5 Elicit evidence of students' thinking.

a. Ask students about their plan (subsequent steps).

b. Ask students to give rationale for actions or decisions.

c. Question students to be sure information was conveyed.

FIGURE OUT THEIR PROBLEM

5. Evaluate, Analyze, Assess.

5.1 Evaluate performance in terms of specific objectives and criteria.

a. Have students evaluate their own work.

b. Evaluate all components of a product when examining, (i.e., do not ask students to make changes and then tell them that something else is wrong).

5.2 Follow standards of evaluation consistently.

a. Be consistent with individual students and also with all students.

b. Use standards that are consistent with those of other instructors.

5.3 Give students clear, specific information about the quality of performance.

a. Indicate both what is acceptable and what is unacceptable.

b. Validate that students understand the basis for evaluation.

c. Support, explain standards in terms of clinical consequences.

d. Ask students to give rationales for corrections.

e. Clarify specifically in what ways both unacceptable an acceptable work may be improved within the current capabilities of students.

5.4 Elicit further information about detected problems if necessary.

a. Observe, talk with, question s tudents and patients.

5.5 Identify the cause of the discrepancy between students' performance and desired performance, (i.e., perceptual skills, thinking skills, professional values, motor skills, and interpersonal skills).

STRAIGHTEN THEM OUT

6. Individualize teaching to student.
   6.1 Teach perceptual skills (visual, tactile, auditory).
      a. Use models to show what the student should attain.
      b. Use schematic drawings to direct the student's attention to critical features of the work.
      c. Point out or ask the student to detect differences between acceptable and unacceptable work.
      d. Point out or ask the student to detect differences between acceptable and excellent work.
      e. Model systematically a sequence for product evaluation.
      f. Give reasons for necessary deviations from the ideal.
      g. Teach and stress methods of self evaluation.
      h. Become aware of and learn how to inform students of the cues that guide your decisions and/or your own motor activity.
      i. Direct attention to visual, tactile and auditory cues and make sure the student can detect them.
      j. Help the student detect visual, auditory and tactile cues.
      k. Help the student seek varied sources of perceptual information.
      l. Ask student to use visual, tactile, auditory cues to make discriminations, (e.g., differentiate between calculus and tooth structure, dentin and enamel, sufficient and inadequate taper).
      m. Utilize cues in one sense modality to enhance learning in another modality, (e.g., visual to tactile).
   6.2 Teaching thinking skills.
      A. Use questioning techniques to maximize positive motivation and reduce threat.
         a. Begin with a question that is reasonable to expect the student to answer.
         b. Pause to give the student time to think but give the answer when it is clear that she or he cannot answer.
         c. Prompt, give hints to help the student answer your question.
         d. Encourage students to ask questions.
      B. Model analytic thinking.
         a. Stress principles.
         b. Give reasons for procedures.
         c. State a principle or fact that guides behavior in a situation.
         d. Predict short-term and long-term effects of treatment on

the patient.
e. Identify indicators that imply treatment should or should not be undertaken.
f. Explain or make predictions about conditions observed in the patient.
g. Relate observations to didactic learning.
h. Convey to the student the information you collect and use it to draw inferences for treatment.
i. Raise hypothetical questions about what might happen if.
j. Distinguish between necessary and sufficient causes for conditions observed in the patient.
k. Convey your thoughts as you try to determine why the patient is not responding to treatment in typical fashion.
l. Present alternatives and new ideas about the case.

C. Ask students questions (Parallels B above).
a. Ask the student to state principles.
b. Ask the student to give reasons for procedures.
c. Ask the students to state a principle or fact that guides behavior in a situation.
d. Ask the student to predict short-term and long-term effects of treatment on the patient.
e. Ask the student to identify indicators that imply treatment should or should not be undertaken.
f. Ask the student to explain or make predictions about conditions observed in the patient.
g. Ask the student to relate observations to didactic learning.
h. Guide the student to collect information from a variety of sources.
i. Ask the student to suggest hypothetical questions about what might happen if.
j. Ask the student to distinguish between necessary and sufficient causes for conditions observed in the patient.
k. Help the student through questioning to identify why the patient is not responding to treatment in a typical fashion.
l. Encourage the student to present alternatives and new ideas about the case.

6.3 Help student to internalize high professional values.
a. Consider the kinds of behavior that reflect high professional ideals and model them (exemplify them in your own behavior).
b. Explicitly compliment students for behaviors reflecting

these ideals.

c. Encourage self-evaluation, (e.g., away from patient ask: "How well did you handle this case?" "How might you have handled it better?")
d. Encourage students to keep and review records to help them to learn from experience.
e. Warn against things in practice that may erode the quality of care.
f. Stress service to the public as more important to a profession than money.
g. Encourage students to consider themselves as ethical and as future providers of only quality care.
h. Convey to students preventive orientation, concern with long term dental health.

6.4 Teach motor skills.

A. Demonstrate procedures.
a. Demonstrate procedures to student.
b. Describe what you are doing.
c. Ask questions to direct attention to components of the process.
d. Leave part for the student to do.

B. Give help with the process of skill delivery.
a. Help students learn how to hold instruments, gain access, establish finger rests, apply correct amount of pressure, arrange instruments.
b. Explain the principles and mechanics of instrumentation.
c. Make students aware of their own motor activity and its relationship to its consequences.
d. Help students to become more efficient in work habits and time management.

C. Observe and evaluate student's motor activity.
a. Give corrective feedback indicating what was right, what was wrong, what to do differently, and what the consequences will be.
b. Find the cause of improper motor activity.
c. Ask the student to perform so that you can observe.
d. Ask the student to demonstrate to show you the effects of instruction.
e. Intervene immediately when student's motor activity is incorrect.
f. Point out the (physical) cues that indicate improper mo tor activity.
g. Show the student the difference between what you are doing and what the student is doing.

h. Give the reasons for particular approaches.

6.5 Teach interpersonal skills.

a. Model the behaviors described under 1.1, 1.2, and 1.3.
b. Compliment the student for interpersonal skills.
c. Identify and seek to satisfy patients' requirements and desires, (e.g., encourage students to schedule appointments to complete treatment in a reasonable time.)
d. Make suggestions for patient management.

Appendix C: Key for Classification.

Unit 5

1.1.D - Communicate with patient during instruction to clarify and set at ease.
1.3.b - Communicate that you understand how a student feels by specifically paraphrasing the students' expressed feelings.
1.1.B - Relate instruction to students interests and goals.
1.1.C - Maintain confidentiality.
1.1.A - Provide extra time for students who have fallen behind.
1.1.C Avoid attacking a student's character, only apply contingencies to his behavior.
1.1.C - Indicate to students that you feel they are generally capable and will succeed.
1.1.A - Avoid prolonged conversations with colleagues.
1.3.d - Show concern for a student who is having trouble and appears anxious.
1.1.C - Say positive things about the student to the patient.
1.1.A - Inform students in advance when and for how long you will be away from the clinic.
1.1.B - Establish, where possible, some common interests.
1.2.f - Be consistent in your oral and written evaluation.
1.2.e - Indicate how you had similar difficulty as a student.
1.1D - Greet student and patient.
1.1.C - Never belittle student's personality or personal characteristics.
1.3.a - Imagine yourself in the situation facing the student.
1.1.B - Call students by name.
1.1.C - Avoid excessive criticism in front of the patient.
1.1.C - Focus punishment on the behavior of the student, not his character.
1.1.C - Give student the benefit of the doubt.
1.1.C - Consider the students suggestions.
1.2.g - Compliment students when you are pleased with their progress.
1.1.A - Attend to the students questions and concern so that he feels respected.
1.2.b - If you make an error, acknowledge it.
1.1.B - Occasionally talk to students about things other than dentistry.
1.1.C - Allow independence consistent with students' skills and patient welfare.

Unit 6

2.3 - Identify an immediate contingency that is interfering with obtain-

ing a desired but delayed result.
2.2 - Ask student to give rationale for a correction.
2.1 - Praise things well done, giving the positive consequence as the reason.
2.1 - Indicate to the student specifically how he has improved.
1.2 - Present yourself as a real person without pretense or facade.
1.1.C - When evaluating work, focus on the work itself, not on deficiencies in the student.
2.3 - Recognize when counter-control of contingencies may be occurring.
2.3 - Recognize situations when behavioral effects are generalizing to other behaviors in undesirable ways.
1.1.A - Provide instruction to every student, not just attractive pleasant students.
1.1.B - Respond to student as an individual, not as a type (race, sex, fraternity).
2.3 - Use deadlines to help students move at a more even pace toward graduation.
1.1.A - Listen to students and be sure that you understand them.
2.3 - Be aware of contingencies that influence your behavior in ways detrimental to the learning process of students.

Unit 7

2.3 - Seek to identify consequences that encourage the students to do other than what they should be doing.
2.2 - When requiring extra work, clarify why it is in the student's interest to do it.
2.3 - Analyze learning situations that are not doing as they should.
2.3 - Monitor student cancellations and frequency of appointments and intervene.
2.2 - Attend carefully to flaws that, if unrecognized, can lead to later difficulty.
2.1 - Make praise match the effort and accomplishment of the student.
6.3 - Stress service to the public as more important to a profession than money.
1.1.C - Avoid attributing cause to internal events such as attitude, laziness, dishonesty.
1.1.C - Ask student for his/her interpretation of the cause for a learning problem.
2.3 - Consider if contingency you arrange or describe might have detrimental side effects to overall learning.
2.1 - Praise students for accurate evaluation of their performances.
2.3 - Remember, more behavior than the specific act may be in-

fluenced by effect.
2.2 - Convey rationale for recommending changes.
6.3 - Warn about things in practice that may erode quality of care.

Unit 8

6.1 - Use schematic drawings to direct the students attention to critical features of the work.
5.3 - Ask students to give rationale for corrections.
6.1 - Use discrimination learning techniques to ascertain whether the student is attending to the proper cues.
1.3.c - When a student is discouraged and you have acknowledged the feelings, tell her/him about a similar problem you faced as a student or dentist.
6.1 - Ask student to demonstrate the ability to detect differences between acceptable and unacceptable work.
6.1 - Provide the opportunity for students to examine the work of other students and to make judgments about it.
3.1 - Point out what the differences are between acceptable and excellent work.
6.1 - Describe cues in terms of what the student will encounter in practice.
2.1 - Specifically comment on aspects of a product or process well done.
6.1 - Check awareness of cues underlying indications and contraindications by asking student to point them out.
5.2 - Be consistent with students as individuals and as a group.
6.1 - Label cues to increase similarity in function.
6.1 - Indicate what cues in the clinical situation led to your decisions.

Unit 9

3.3 - Ask student to give the delayed consequence of errors or activities.
6.2C - Ask student to give the rule governing the procedures (occasion, cue, response, consequence).
6.3 - Inform students about your participation in clinical learning opportunities.
6.2C - Ask hypothetical questions about what might happen if...
3.5 - Ask students to relate what they observe in treating a patient to basic science learning.
6.2C - Ask students to make predictions, or to provide explanations about conditions observed in patients.
4.5 - Ask students to paraphrase your explanations to make sure they understand.

Mackenzie 1988

6.1 - Ask students to identify the cues that indicate the presence or absence of a particular condition.
6.2B - Help students identify reasons why their patient is not responding to therapy in typical fashion.
6.3 - Encourage students to consider themselves as ethical future providers of quality care.
2.2 - Convey rationale for recommending changes.
6.2C - Provide consequence statements that will bridge a time gap between an error and its consequences.
4.5 - Ask students to give rationale for actions or decisions.
6.2B - Provide rules to guide student behavior by giving the cue, action, and consequence.
6.3 - Caution students about potential rewards in practice that will undermine quality service.

Unit 10

6.4B - Give help with the process of skill delivery (how to hold instrument, access, finger rests, pressure, instrument arrangement).
2.1 - Indicate what has been done correctly as well as any errors.
6.2C - Ask the student to give the rule statement that guides behavior in a given situation.
2.2 - Give instruction that indicates what to do and why.
3.4 - Remember the instructional needs of a student from one time to the next.
6.1 - Help students detect visual cues and feel tactile sensations relevant to providing excellent care.
4.2 - Watch students delivering care to identify improvement.
6.4C - Ask questions during demonstrations to direct attention to various components of the process.
6.4B - Help students become more efficient in work habits.
4.1 - Observe student's work before completion and provide information on how the work is progressing.
2.1 - Indicate to the student specifically how he has improved.
2.2 - Make sure student knows how to correct any errors and how to avoid them in the future.
6.2B - Verbalize the cues that control your decisions in technical skills.
6.4B - Make student aware of his motor activity and its relationship to its consequences.
6.4C - Provide corrective feedback indicating what is wrong, what to do differently, and what the consequence will be.
2.2 - Make sure student understands the purpose of corrective feedback.
6.2C - Make sure the student can make a statement about the delayed effects of their clinical activities.

Appendix D: Episode Report.

Episode Report Form

Think of a time during the past week when you either observed a situation involving you or another clinical instructor in which either the application of a clinical rule facilitated clinical teaching, or failure to apply the rule may have interferred with learning. To be important enough for reporting, you should have observed some indication of the effect on the learner.

Be specific:

0l. Describe the situation in which the episode took place.

02. Specify the rule that is applied in this episode.

03. What exactly did the clinical teacher (or you) do or say that was consistent or inconsistent with the application of the rule?

04. Describe the three part contingency that may be in effect in the situation, or describe the respondent behavior that may be occurring.

05. Describe the verbal or nonverbal behavior of the learner that indicates an effect resulted from the faculty behavior in the situation.

Mackenzie 1988

Episode Report Form

Think of a time during the past week when you either observed a situation involving you or another clinical instructor in which either the application of a clinical rule facilitated clinical teaching, or failure to apply the rule may have interferred with learning. To be important enough for reporting, you should have observed some indication of the effect on the learner.

Be specific:

01. Describe the situation in which the episode took place.

The student had attempted a particular Class V compacted gold several times in technique and failed it. A faculty member was assigned for one-on-one remedial teaching.

02. Specify the rule that is applied in this episode.

Make student aware of his motor activity and its relationship to its consequences. (From the exercise at the end of Unit 10. Classified as 6.4 B in model.)

03. What exactly did the clinical teacher (or you) do or say that was consistent or inconsistent with the application of the rule?

The instructor worked outside of the regular session with the student and reinforced each small step of the procedure when it was completed successfully.

04. Describe the three part contingency that may be in effect in the situation, or describe the respondent behavior that may be occurring.

The cues were the endpoints of each step. The responses were stopping at the right point. The consequence was praise for each step in the chain done correctly.

05. Describe the verbal or nonverbal behavior of the learner that indicates an effect resulted from the faculty behavior in the situation.

The student stated how much time and effort he felt the faculty member had put into helping him and how much he appreciated it. The student then went on to pass the test.

Episode Report Form

Think of a time during the past week when you either observed a situation involving you or another clinical instructor in which either the application of a clinical rule facilitated clinical teaching, or failure to apply the rule may have interferred with learning. To be important enough for reporting, you should have observed some indication of the effect on the learner.

Be specific:

01. Describe the situation in which the episode took place.

While treatment planning with a second year student, I asked him to comment on what radiograpically was "apparent" angular bone loss. I asked student if it was angular bone loss and if it was something to be concerned about.

02. Specify the rule that is applied in this episode.

Ask students to identify the cues that indicate the presence or absence of a particular condition. (From exercise in Unit 9, classified in the model as 6.1.)

03. What exactly did the clinical teacher (or you) do or say that was consistent or inconsistent with the application of the rule?

When the student related that this was not an example of angular bone loss because of discrepancy in the level of the cemento-enamel junction of the two teeth and that the crestal bone level paralleled the CEJ of these two teeth, I told the student that his response was correct and that he had reognized the important cue related to this situation.

04. Describe the three part contingency that may be in effect in the situation, or describe the respondent behavior that may be occurring.

The student is recognizing a cue previously learned and connecting it to the mediating response (not angular bone loss). I was reinforcing that mediating response.

05. Describe the verbal or nonverbal behavior of the learner that indicates an effect resulted from the faculty behavior in the situation.

The student smiled after my response and expanded on his knowledge regarding this situation.

Mackenzie 1988

Episode Report Form

Think of a time during the past week when you either observed a situation involving you or another clinical instructor in which either the application of a clinical rule facilitated clinical teaching, or failure to apply the rule may have interferred with learning. To be important enough for reporting, you should have observed some indication of the effect on the learner.

Be specific:

01. Describe the situation in which the episode took place.

Student was treatment planning a MOD amalgam for a very carious primary molar.

02. Specify the rule that is applied in this episode.

Ask student to give the delayed consequence of errors or activities. (From exercise in Unit 9, classified in model as 3.3).

03. What exactly did the clinical teacher (or you) do or say that was consistent or inconsistent with the application of the rule?

Instructor asked the student what undesirable outcome might result from this plan. After some probing, the student responded that the tooth structure might fracture leading to loss of the tooth and then loss of space in the arch. This was followed by the suggestion for a stainless steel crown.

04. Describe the three part contingency that may be in effect in the situation, or describe the respondent behavior that may be occurring.

The cue was the large carious lesion with thin walls of tooth remaining. The mediating response was that the tooth might fracture. The consequence was the potential for fracture and the undesirable results for the patient.

05. Describe the verbal or nonverbal behavior of the learner that indicates an effect resulted from the faculty behavior in the situation.

With a subsequent patient, the student correctly planned a stainless steel crown for a large carious lesion.

Appendix E: Behavioral Checklist.

Directions: The faculty members should supply their chairperson (or other authorized person with evidence that the behavior to be checked has been carried out. To meet minimal standards for successful completion of the course the faculty member should have carried out at least three of the behaviors in the three months to a year following completion of the didactic portion of the course. Three to five checks is a good response to the course; six to eight checks is very good; eight or more is an excellent response.

Behavioral Checklist

- ☐ Developed instruction for first year clinical experiences in which the student assessed the outcomes of dental treatment.
- ☐ Provided dental examples and dental context to basic science teachers for at least five specific areas of basic science content.
- ☐ Developed set of models to determine students' ability to recognize acceptable endpoints of steps in a dental procedure.
- ☐ Collected and analyzed data to determine whether principles learned in this course had an impact on student learning.
- ☐ Served as a discussion leader at two or more sessions for several other faculty who took the course subsequently.
- ☐ Used student evaluations as a source of information to improve performance as a clinical teacher to such an extent that evaluations improved in at least two target areas specified in advance.
- ☐ Use peer or chairman observations of clinical teaching as a source of information for improvement.
- ☐ Used tape recorder for at least two weeks to assess the application of principles in instructional clinical encounters with students.
- ☐ Identified at least two cases of serious performance problems in students, analysed the problem, made corrections, and demonstrated improvement on the part of the students.
- ☐ Identified and corrected, at least once, contigencies arranged inadvertently that interfered with the learning or progress of a class

- ☐ Identified and corrected, at least once, contigencies arranged inadvertently that interfered with the learning or progress of a class of dental students.
- ☐ Kept and used a notebook containing records of individual clinical learning problems identified in a class of dental students.
- ☐ Kept records on the type and distribution of clinical instruction given to a class of dental students.
- Carried index cards into the clinic for several months and used these as external reminders of the principles to be applied during clinical teaching.

Source of Evidence for this checklist:

Audio or videotapes produced after instruction was completed.

Personal logs or diaries.

Completed evaluation forms from students, peers, departmental chairperson.

Documented case reports.

Research protocol for evaluating impact on student learning of the application of principles.

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GLOSSARY

Analyzing: The process of breaking down a situation into component parts.

Anxiety: An emotional state characterized by autonomic nervous system activity. The state functions like a negative stimuli that reinforces behavior that escapes or avoids it.

Arranged Contingency: When a target response occurs, a positive or negative stimulus (consequence) is presented, removed, or prevented.

Assertive Behavior: The person asks for and expects those things which are his right according to social custom. When things are not their right, the insistance is termed aggresive behavior.

Attention: Focusing on portions of all possible stimuli that are present and noticeable at any given moment.

Authenticity: Genuine, not a professional facade, acknowledges errors, refers to similar experiences, speaks of hobbies and feelings, and does not mislead or behave inconsistently with stated ideas.

Automatic Behavior: Responses that occur without attention. In order to alter these responses, attention must be focused and change consciously directed.

Aversive stimulus: This is a negative event (noxious, unpleasant) that is punishing when added and reinforcing when escaped or avoided.

Avoidance Contingency: A relationship producing learning that results from the avoidance of an expected negative event following a response. The contingency increases the likelihood of the response being emitted in the future situation containing the functional stimulus.

Behavior: Any kind of response, either observable or unobservable.

Behavioral chain: A skilled performance is linked together by a series of responses and response generated cues. The cues serve to bring forth new responses and to reinforce the preceding response. The cues gain reinforcing power from association with the reinforcement

associated with completion of the task. The cues closest to the end of the task gain strength first.

Behavioral effect: A stimulus change or lack of change that follows a response. It is another term for consequence.

Behavioral trap: A detrimental arrangement of contingencies in which two people are caught. The undesirable behavior of one is reinforced by the second person. The behavior of the second person which reinforces the first is supported by escape from an aversive condition. The escape of the second is supported by negative reinforcement. For example, failing student threatens law suit, instructor raises grade. Student finds threatening law suit is easier than studying. Instructor is relieved not to have court procedings.

Caring: This inference is conveyed by greeting, reassuring, helping, sympathizing, congratulating, personalizing, concern for success, and not by arbitrariness, injustice, unfairness, self-interest.

Certainty Principle of Contingencies: The higher the degree of certainty that a consequence will follow a response, the more effective the contingency.

Class of Behaviors: Several actions that accomplish the same result.

Clinical Teaching: Instructor that occurs in settings involving a student and a patient. It usually involves guiding skill development and application of knowledge. Skills include both motor and cognitive and knowledge includes both basic and applied.

Clinical Understanding: An interconnected network of information that relates to clinical cues and to clinical decisions and actions. The more relevant associations one has to a clinical event the better the event is understood.

Coaching: A technique for guiding performance that is used when the natural consequences are not readily associated with the responses that produced them. The coach helps the learner make the association and thus gain control of the performance.

Cognitive Behavior: Responses made in mental form including perceiving, thinking, valuing, deciding.

Cognitive control: Thinking and other mental processes are used to exert an influence on behavior.

Concept: A category into which similar stimuli are placed and non-similar stimuli are excluded. The categorization depends on the possession of critical attributes and requires the processes of discrimination between those entities that belong and those that do not, and generalization across all those that do belong to the category.

Competency: This is an inference about the ability of a person to perform in the future under given conditions. It is usually based on previous observations of the individual and knowledge based on wider experience of the predictability of the desired behaviors by the observations.

Competing Contingencies: At any one time in a given situation, contingencies are competing for which response will occur. The strongest results in producing and maintaining the related response.

Conditioning: The learning of behavior within a situation, or context.

Consciousness: The state of being aware of ongoing processes such as the relationship of all parts of a contingency during learning.

Consequence: A stimulus change or lack of change (positive, negative or neutral) that follows a response.

Contingency: A three part relationship between a cue, a response, and a consequence.

Contingency governed behavior: Behavior is influenced predominantly below the level of awareness by arranged contingencies. It is characterized by slow increments of learning and is not readily adaptable to changed conditions unless much practice with changing conditions has occurred.

Controlled Conditions: In searching for relationships, a person uses certain techniques to prevent other factors from exerting an influence on the factor being measured other than the factor that is being studied.

Corrective feedback: Knowledge of the results of an incorrect response plus an indication of how to prevent or improve the results. This approach supplies mild punishment for the response emitted and strengthens a potentially competing response that is correct.

Counter-control of Contingencies: The usual effects of external consequences do not work because the learner has arranged internal

competing contingencies. This phenomenon is facilitated by a negative emotional tone.

Critical attributes: The relevant cues or stimuli of an object or event that determine its classification. An acceptable cavity preparation must have all critical attributes in the acceptable range before being classified correctly as acceptable.

Deadline Contingencies: An effective arrangement of conditions that usually uses an avoidance contingency in conjunction with an increasing degree of immediacy to influence behavior.

Delay Principle of Contingencies: The greater the delay of the consequence the less effective the effect is on the response. Past a certain point there is no effect unless mediated by another response such as a private verbal statement.

Descriptive Contengencies: These are descriptions of contingencies that may be applied at sometime in the future. They are the basis of expectations and usually control present behavior by avoidance contingencies, or by matching. Examples are laws, directions, instructions and so forth.

Differential reinforcement: A reinforcement technique used in discrimination training in which responses are reinforced or not depending on the presence of the discriminant stimulus.

Discrimination learning technique: Method to accomplish discrimination learning. Objects are presented to the learner that are either correct or not correct. The learner gives his opinion and receives immediate feedback. The instructor reinforces correct responses and gives corrective feedback for incorrect responses until the critical features (or SD) are recognized consistently.

Discriminant stimuli (SD): A term used in research that is equivalent to nominal stimuli. It is the essential cue necessary for the correct responses in a given situation.

Discriminating Learning: Learning to judge which portions of the total situation are relevant to the task, thus, separating relevant from irrelevant portions of the stimulus. Discrimination is usually accomplished by presenting a series of situations containing or not containing the relevant stimuli. The student learns by responding to these presentations and receiving feedback.

Emotional reactions: States of arousal that include feelings of anger, fear, anxiety, frustration, depression, elation. These are mediated by the limbic system and frequently serve as stimuli, changes in which serve as effective consequences in contingencies.

Emotional Tone: The firing of positive or negative circuits in the limbic system that produce related feelings that may or may not be conscious.

Empathy: Communicates an understanding of the feelings of others by paraphrasing expressions of feelings, by describing feelings that are likely occurring in the situation, by acknowledging feelings of self-doubt, worry and discouragement and offering help.

Endorphin: A neuropeptide released by cells in the brain and connecting to opiate like receptors in several locations in the CNS, but predominantly the limbic system. Function in the placebo effect and acupuncture. They reduce fear, anxiety, and pain.

Ethical Behavior: Behavior that is consistent with a set of values. Matching behavior to the set of values is reinforcing for most people, and not matching behavior is punishing. Thus values guide behavior.

Excessive Punishment: Any operation of the punishment contingency that triggers a negative emotional response. The negative emotional response is detrimental to learning because it reinforces escape and avoidance behaviors.

Expectation: Based on experience, a person comes to anticipate events and their consequences. Expectations are the basis for the function of the avoidance contingency, preventive punishment contingency, described contingencies, and deadline contingencies.

Extinction: A response to a situation is followed by no relevant consequence. This relationship decreases the probability that the response will recur in that situation.

Extinction Contengency: A relationship producing learning that results in no relevant change in the event (stimulus) following a response. The contingency decreases the likelihood of the response being emitted in the future situation containing the functional stimulus.

Extrinsic Motivation: The performance of an activity is supported by consequences external to the person and usually arranged by others or the environment.

Fading: The process of reducing prompts so that the cues natural to the situation come to control the response.

Feedback: This is a consequence following a response that gives information about the response. It may provide only information as to the correctness or incorrectness (consequences). It may provide additional information as in corrective feedback.

Functional Stimuli: Is related to the nominal stimuli, or discriminant stimuli in that it is the cue that is learned by the student in association with a response. However, the functional stimuli the student perceives may be correct, partially correct or incorrect.

Generalization: A process by which the associative powers of one neural pattern are transferred to similar neural patterns whether the pattern represents a cue, a response, or a consequence. The closer the similarity, the greater the generalization.

Immediacy Principle Contingencies: The closer in time the consequence, the more powerful the effect on the response. Half a second is the optimal period.

Incompatible response: When two responses in a situation cannot occur at the same time, like sitting down and standing up, the reinforcement of one decreases the probability of the other.

Incremental Learning: Learning that progresses in small amounts. This means that the probability of the response to a cue increases slowly. Stimulus control progresses slowly from no control toward complete control.

Inference: Arriving at an opinion from incomplete data.

Intrinsic Motivation: The performance of an activity continues even when no external consequences are arranged to support the activity. The consequences are usually arranged internally so that the activity appears to support itself.

Intuitive Control of Behavior: The learning of cue-response associations below the level of awareness. Learning is usually small increments and thus not readily adaptable to change. Awareness may occur in the form of unexplainable feelings or hunches. It is mainly contingency governed behavior.

Labeling: A technique used to increase the distinctiveness of cues so

that they generalize more readily and have more meaning. Sometimes labeling can be detrimental as when students are labelled as "lazy" and no further explanation of behavior is sought.

Learning: The process of strengthening the association of a response to a given situation (stimuli, cue, or context).

Limbic System: A network of neurons in the brain that contain independent circuits that fire when an event is perceived as either positive or negative.

Maladaptive Behavior: Responses that are not in the long range best interest of the person who performs them. The responses are not consistent with long range goals.

Mathemagenic behavior: These are behaviors that are necessary for learning. They include orienting, attending and processing of information.

Measurement: The quantifying of a factor by assigning numbers to the factor in a way that represents varying amounts of some attribute.

Mediating Responses: Mental images, values, guiding rules, thoughts or chains of thoughts that lead to action or inaction. (They are not directly observable, but may be inferred from actions taken, or the ability to answer questions).

Mental Practice: A motor skill can be improved by thinking through the skill. Some initial experience with the motor skill is necessary for mental practice to be effective. It is particularly important events that have limited practice opportunities such as State Board examinations.

Misconception: The inconsistent inclusion and exclusion of items as belonging or not to a category. This usually occurs when the learner is focusing on one or more attributes that are not critical.

Modeling Behavior: Copying or initiative behavior which is facilitated by positive emotional tone.

Motivation: An internal state that energizes performance. One indication of the degree of motivation is the amount of effort put forth on a task. It is influenced by internal or external consequences.

Negative Emotional Tone: The firing of limbic circuits, which when termi-

nated, reinforce physical or mental escape or avoidance behaviors.

Negative Punishment Contingency: A relationship producing learning that results from the subtraction of a positive event (stimulus) following a response. The contingency decreases the likelihood of the response being emitted in the future situation containing the functional stimulus.

Negative reinforcement contingency: A relationship producing learning that results from the subtraction of (escape from) a negative event (stimulus) following a response. The contingency increases the likelihood of the response being emitted in the future situation containing the functional stimulus.

Nominal Stimuli: A term used in research that is equivalent to discriminant stimuli. It is the essential cue necessary for the correct response in a given situation.

Operant Conditioning: A form of learning in which a response to a situation is followed by a consequence. The effect of the consequence changes the probability of the occurrence of the response given the situation again.

Orienting Responses: Muscular responses that change direction of vision, maximize hearing, and prepare for reception of other senses.

Overgeneralization: The inclusion of items into a concept that are not members of that concept. For example, including cavity preparations as acceptable when they are not. This may mean they are not applying one of the critical attributes.

Paraphrasing: Rephrasing information in own words to verify understanding.

Perception: The organization and interpretation of incoming stimuli that results in classification. Perception is influenced by such factors as labels, recent experiences, learning, beliefs and emotional tone.

Positive Emotional Tone: The firing of limbic circuits which reinforce contact behaviors.

Positive Punishment Contingency: A relationship producing learning that results from the addition of a negative event (stimulus) following a response. The contingency decreases the likelihood of the response being emitted in the future presence of the functional stimulus.

Positive Reinforcement Contingency: A relationship producing learning that results from the addition of a positive event (stimulus) following a response. The contingency increases the likelihood of the response being emitted in the future situation containing the functional stimulus.

Positive stimulus: This is a positive event (desired, pleasant) that is reinforcing when added and punishing when removed or prevented.

Practice: Going over the same performance in order to learn the many facets of cues and varieties of conditions that may influence performance and to strengthen the association of the controlling cues with the appropriate responses.

Preventive Punishment Contingency: A relationship producing learning that results from the prevention of a positive event (stimulus) following a response. The contingency decreases the likelihood of the response being emitted in the future situation containing the functional stimulus.

Private Verbal Behaviors: These are mediating responses that are influenced by the same contingencies as other responses. Usually they provide the consequences for behavior by being matched by the behavior (usually reinforcing) or not (usually punishing). The learner applies these contingencies to himself as part of his self-control techniques.

Private Verbal Statement: This is a saying, rule, or guiding principle that a person repeats to himself in order to influence his own behavior.

Prompting: A process by which additional cues are added to a situation in order to bring forth a response that can be reinforced.

Punishment: A response to a situation is followed by a consequence that decreases the probability that the response will recur in that situation.

Punishment Contingency: Any relationship between a functional stimulus, response, and consequence that decreases the probability of the response given the functional stimulus.

Reinforcement: A response to a situation is followed by a consequence that increases the probability that the response will recur in that situation.

Reinforcement Contingency: Any relationship between a functional stimulus, response, and consequence that increases the probability of the response given the functional stimulus.

Rephrasing: A technique used to test the students' understanding of what they have been told. If students can rephrase, then the chances are much higher that they understand the message.

Respect: This inference is conveyed by listening carefully, paying attention to, paraphrasing statements, acknowledging opinions, and not by ignoring, belittling, making fun of, derogating character, or interrupting.

Respondent Conditioning: A form of learning in which the pairing of two stimuli causes the automatic response to one to be attached to a second, otherwise neutral stimulus.

Response: A reaction to stimuli at the muscular, glandular, or neuronal level.

Response-generated cue: A stimulus that results from an action. It may be the consequence for one response and the stimulus for another.

Rule governed behavior: Private verbal rules statements that influence behavior through matching. If behavior matches the rule, then the behavior is reinforced. A mismatch is punished. Anxiety or guilt ensues until the behavior can be changed to reduce anxiety.

Rule Statements: A form of private verbal behavior that serves as a guide for behavior. They describe contingencies and provide matching conditions for cognitive arranged contingencies.

Salient: The portion of the background stimuli that are conspicuous or stand out for the perceiver.

Science: A systematic process of accumulating valid knowledge by trying out, evaluating and communicating. Tryouts are based on theory derived from shared accumulated experience which depends on careful, reliable, objective controlled observations, rigorous decision criteria, and cautions generalizations.

Scientific Method: The procedures that help a person learn about relationships in the world in an unbiased and valid fashion. It is a procedure that lessens the natural tendency to draw invalid conclusions

from observations.

Secondary reinforcer: This is a stimulus that requires reinforcing properties through association with a reinforcer. The reinforcing properties are transferred from one stimulus to the other through respondent conditioning. This concept is important for understanding ways to improve the teaching of complex motor skills.

Shaping: A technique used to guide responses toward a final form. This approach is used when directions to perform do not produce the desired response. Since the desired response does not occur, it cannot be reinforced. Responses that are more and more like the desired response are successively reinforced until the desired response is attained.

Shaping: If a response is not emitted when requested, the response may be learned through a series of reinforced responses that become more and more like the desired response as the criteria for reinforcement is changed. Response generalization produces variety and the more desirable forms are selected for reinforcement until the final desired response is obtained.

Simulated Performance Tests: These are examinations that require demonstration of many of the skills that occur in the natural setting without requiring the natural setting, but only similar situations.

Stimulus: A feature of the total environment which leads to the firing of neurons.

Stimulus control: The degree to which a stimulus calls forth a specified response. If the probability of happening approaches every time, the stimulus control of that response is very strong.

Technical Punishment: Uses a wider variety of stimuli for decreasing responses. Usually is employed in a mild way so as to avoid an emotional response with its potential side effects of escape and avoidance.

Transfer of Learning: Generalizing the learning that occurs in one situation to another, in order to facilitate learning or performance in that new situation.

Transfer of Stimulus Control: In clinical situations, the natural cues in the situation do not elicit the responses learned in didactic instruction. To transfer the control of the response to clinical cues, the instructor

prompts the response in the presence of clinical cues and then fades the prompts until only the clinical cues elicit the response.

Undergeneralization: The exclusion of items from a concept category that rightfully belong as members of the concept. For example, calling acceptable cavity preparations unacceptable. A consistent error of this type usually means the criteria for one or more critical attributes is too strict.

Values: Private verbal statements that function as rules to guide behavior. They usually support long term goals and oppose the immediate contingencies that produce behavior that interferes with goal attainment.