COLLEGE LEARNING
WAYS & WHYS

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Contents

Preface

You don't have to be a genius to do well in college. Nor do you have to be a "bookworm." You don't have to be certain about your life goals to become an educated person. Nor do you have to become an "intellectual." It helps if you are at least somewhat above average in intelligence, and it helps if you know how to use your study time effectively. This book is about ways to learn college material.

When I first went to college, my grades were mostly D's with a few F's. But when I returned to college after three years of military service, my grades were mostly A's with a few B's. I surely wasn't any more intelligent the second time around. But I was wiser in the ways of learning and I have learned much more during forty years of teaching and doing research about the learning process. I want to share this knowledge in hopes of sparing others my initial failure.

However, this is not just a "learning cookbook," a list of the recipes for studying different topics. This book calls on the Psychology of Learning/Memory and Motivation to tell you WHY the WAY is effective. It turns out that you are not likely to change your ways if I just tell you about another way to learn. But if you understand why these ways may be better, you are more likely to try them out. Even if you prefer your old ways, you will have more confidence in them after exploring alternatives.

You see, my main goal is to get you to pay some attention to how you learn. We rarely stop to think about things that "come naturally." For example, take a deep breath and pay attention to how you do it. Chances are, you tried to expand your chest as much as possible. But in doing so, you have to suck in your abdomen, which decreases the space available for your lungs to expand. So now take another deep breath by first expanding your abdomen. You'll find that you can take in much more air that way.

The reason you need to know the whys as well as the ways is that what is best for me may not be best for you. Just as a good cook has to add her or his own touch to any recipe, a good student has to adapt any method to his or her own style. The more you know about how you learn, the better you will know how to learn.

Using this Workbook

Insofar as possible, I have written these materials in such a way that they can be studied in any order. However, the major topics follow a natural progression from getting started to taking exams. Accordingly, I recommend that you read the book in the given order, and then plan to study it according to your own interests and needs. Although I believe that everything included in this workbook is important, not everything is equally important for everyone. You are the best judge of what is most important for you.

Even before starting to read this book, however, I recommend that you look through the following Pre-test. The purpose of this workbook is to help you understand WHY each of the statements in the Pre-test is true or false. Your behavior as

a student is guided by your beliefs about these topics, even if you are not aware of it. Let me explain what I mean.

The instructions tell you not to guess. The fact is that most students always try to guess at whether an item is true or false even when they have no real knowledge about it. If you are such a student you are behaving in a way that assumes that guessing is alright, and perhaps even a good thing to do. That may be true in a graded exam, but guessing in most other circumstances is actually very bad.

WHY is guessing bad? In the first place, part of education is knowing what you don't know. Ignorance is not the same as stupidity, and it is much wiser to admit that you don't know something than it is to act as if you do know it. Which is more, we learn our answers, right or wrong! So when you guess the first time, you will remember your answer but forget that it was only a guess. A great deal of what you think you know about the topics in this book was learned by this self-deceiving process.

Instructions: Indicate whether the following statements are True or False. DO NOT GUESS—leave blank if not sure. Explain why they are true or false.

1. In order to get passing grades (C), an average student should expect to spend a minimum of 3 times the number of credit hours being a student (that is, attending class and studying.)

2. Even after completing an assignment, good students continue until they have put in the expected amount of time in order to insure that they don't develop the habit of working too fast.

3. Optimistic students are especially conscious of how much they know.

4. A good way to increase your commitment is to keep reminding yourself of how much you have left to learn.

5. Most educated Americans would be functionally illiterate in Russia.

6. In order to learn how to learn, you need to take a course or study a book about learning strategies.

7. There is a maximum amount that you can learn and remember in any one day/night cycle.

8. In order to be a good student, you should abstain from both sex and alcohol.

9. A feeling of homesickness when you hear a familiar song illustrates the concept of a mental habit.

10. As used in the Principle of Primacy, initial learning refers to childhood experiences.

11. In dealing by yourself with your own personal problems, the most crucial step is to be sure that you have the true facts.

12. According to the Principle of Minimizing Work, the easiest way to do something will usually prevail.

13. Students who understand the Principle of Active Participation try to prevent information processing from becoming automatic.

14. Practicing paying attention can improve one's voluntary control over selective attention.

15. In general, it is better to rehearse course material word-for-word rather than trying to elaborate on it.

16. By and large, general world knowledge is not verbal.

17. Coding information involves making ideas meaningful to you.

18. Good teachers cannot teach incompetent students, but good students can learn from incompetent teachers.

19. In general, knowledge increases most rapidly at first, then gradually slows down.

20. Information processing should culminate in integrating new information with existing knowledge.

21. Intelligent people in positions of power refrain from judging other people by appearance.

22. The more times that you have processed an item of information, the easier you can process it on subsequent occasions.

23. Educated grammar is properly called "good" grammar because it is logical and consistent.

24. Mental time-sharing requires doing several cognitive tasks more-or-less simultaneously.

25. It would be grammatically correct to say that studying this book should be helpful for you and I.

26. According to the Principle of Contiguity, if your writing is illegible, it's because you learned to write illegibly.

27. In general, the lower your endowed intelligence, the more important motivation is.

28. You should only take a few written notes during a lecture, even if you're having difficulty understanding it.

29. If the information in a lecture is stated explicitly, you can learn it without having to process it yourself.

30. Improving one verbal skill tends also to improve the other verbal skills.

31. After a good college lecture, good students leave feeling refreshed.

32. Information conveyed in lecture is more likely to be on tests than information only in the texts.

33. A primary objective of giving exams in college courses is to identify poor students.

34. When reciting the ideas in your lecture notes, it is usually okay to deviate from the words copied from lecture.

35. In trying to understand a new idea, you should be sure to recite precisely what you read or heard.

36. Learning is consolidated during sleep.

37. Using mnemonics to aid memory is undesirable in college-level courses.

38. All exams at every educational level are graded on a relative basis.

39. The objective exam is easier than the essay exam, so you don't have to study for it so hard.

40. The advice to spend at least half of your study time reciting means to put the ideas in different words.

41. You can't have a positive attitude toward an exam until you know you know all the material.

42. It is hard work to prepare for an exam even if you have kept up with your studies.

43. If you are well prepared, you should not be apprehensive about exams.

44. You should study differently for true-false and multiple-choice exams compared with essay exams.

45. You should arrive to take an exam right at the last minute so you won't have time to wait around and get anxious.

46. It is a good idea to mark up the exam sheet liberally.

47. If in doubt, choose an answer that fits best with common sense.

48. A good test-taking strategy is to skip items that you find difficult and return to them later if you have time.

49. Only poor students use some guessing ritual, such as tossing a coin, when they don't know the answer to a multiple-choice item.

50. You should give the answer that you know is correct even if it is different from what the professor said.

51. Overall, most students are more likely to change answers from wrong to right.

You will have to read the text to find out WHY the correct answers to the above items are true for odd-numbered items and false for even-numbered items.

Chapter 1

Introduction

The purpose of this chapter is to help you get started right
... by starting with the right attitude.
You should learn:

1. How big a job it is to be a college student and how to be a *professional student.*
2. The meaning of being functionally literate and how to be an *optimistic student.*
3. The importance of making a *commitment.*
4. The fact that one *learns how to learn.*
5. The hypothesis that *daily learning is limited.*

You should also study the following appendices:

- On Time Management
- Vocabulary Pre-Test
- Commitment by Contract

Going to college is not just going on to the thirteenth grade. Even in subjects like math, where college courses may pick up wherever your high school courses left off, the style is different. In high school, most learning is done in the classroom, with a smaller portion given as homework. In college, most learning is done outside of class. The most important difference between high school and college is that YOU must take primary responsibility for your education.

College courses use the "mastery" concept. This means that the professor sets a criterion level of knowledge or proficiency in the subject and all you need to do to pass the course is to demonstrate that level. Indeed, you can learn the material entirely on your own and then challenge the course. This doesn't mean that professors won't help you learn. College is not you on one side against a professor on the other; it is you and a professor against the subject. They want you to master the subject and they will do what-ever they can to help you learn. After all, teaching (that is,

professing) is their chosen profession. But they expect you to do your part and to do it very largely on your own initiative. Like never before, it is really up to you.

There is a "rule of thumb," or informal guide-line about how much time you should plan for independent study in college. It is this: Average students should spend twice as many hours outside of class as they spend in class in order to get an average "C" grade. Thus, if you have registered for a full 15-hour course load, this rule says that you should plan on spending 30 hours studying, IF you are an average student and IF you are willing to settle for "C" grades. You may need less time if you are an above average student, and you may need more time if you want "quality" grades of "A" or "B". In sum, being a full-time student is at least a 45-hour per week job.

Although this guideline is useful in giving you a general idea about the dimensions of the task, it presumes the wrong attitude toward your role as student. The two-for-one rule treats the student as if s/he were a laborer who works by the hour. I urge you to adopt the attitude of a professional student. Professionals work by the task, not by the hour. (Imagine a surgeon stopping in the middle of an operation and saying, "Well, my hour is up; I'll come back tomorrow to finish removing this tumor.") Accordingly, your first goal is to analyze your assignments and divide them up into units that you can treat as tasks. Then you can be a professional student and complete each task as it comes along.

Of course, you can learn to anticipate the time that each of your tasks will probably require. Also, you are likely to find that working by the task encourages you to work faster and you will have to be honest with yourself in deciding when a task is really finished. Adopting a professional attitude toward your role as a student does not mean all work and no play. It does mean defining the tasks that need to be done and then doing them.

1.1 Vocabulary

Many people are concerned about the number of high school graduates who are still "functionally illiterate." A person who is truly illiterate cannot read or write at all. A person who is functionally illiterate is one who cannot read or write at a level necessary to function effectively in some situation.

A very important aspect of being functionally literate for college is having an adequate vocabulary. You obviously cannot understand a book that uses a lot of words that you do not know, and as I shall explain later, you cannot speak or write well if you do not know the words that will convey the ideas you want to express. For these reasons, a major objective of this book is to increase your vocabulary.

At the end of this book is a list of about 5500 words and your goal should be to know the meaning of ALL 5500 words before you finish this book. These are not bizarre words chosen to display my knowledge of big words that are rarely used. On the contrary, these are the most common words in academic textbooks including college freshman courses. Accordingly, these are precisely the words that you need to know in order to be functionally literate for college. (Note: Although they are technically different "words", plurals such as book and books, or tenses, such as look

and looked were not listed separately. Counting them increases the apparent size of your vocabulary but what is important is the number of different concepts that you know.)

One reason the vocabulary list encompasses a lot of very common words is simply to let you confirm for sure that you do indeed know them. You may find some that you do not know and you should give them high priority for learning. There is a more important reason. You may have heard of one easy way to differentiate between an optimist and a pessimist: When flying out over an ocean, the pessimist describes the gas tank as already being half empty; the optimist describes it as still being half full. In this sense, it is important to be an optimistic student.

The general point is this: No matter how much you know, there will always be more to learn. The pessimistic student focuses on how much s/he doesn't know and how hopeless it is to try to learn it all. In contrast, the optimistic student focuses on how much s/he already knows and how much s/he is adding to that knowledge. Suppose, for example, that you only knew 10 out of 1000 possible items. After studying long and hard, you learn 10 more items. To the pessimist, you only learned about one percent of the material; to the optimist, you increased your knowledge by 100 percent. Be excited about how much you do know and how that knowledge is growing rather than being overwhelmed by how much you don't know.

You probably do not remember your own childhood experiences, but surely you have heard a child calling out, "Watch me," when s/he is about to perform some act such as diving into a swimming pool. To the child, it doesn't matter that it is not an Olympic performance. . .s/he is proud to show even a little accomplishment. Most of us lost that excitement in learning probably as older kids told us how bad we were. But try to regain enthusiasm for learning just for the sake of learning. You don't have to know it all to be proud of how much you are learning.

This vocabulary assignment is a good place to start learning to be an optimistic student. Be impressed with how many words you know. (Actually, you probably know about 1000 more words that aren't listed because they are rarely used in textbooks.) You can always augment your vocabulary; educated people keep learning new words throughout their lives. Never mind that there are still thousands of words that you don't know. Take heart that you do know several thousand words and that you can easily add a few hundred more in order to be able to handle college-level studies.

The vocabulary lists words that you should have learned by high school (level 3) and words that are common at the college freshman level (level 4). You probably already know many of these words but you can benefit from greater familiarity with them. For this reason, I shall use many of these words in the text of this book in order to provide a context in which to practice them. My objectives are to illustrate how these words are useful and to insure that they are a part of your vocabulary.

1.2 Commitment

A commitment is a public pledge to do something. A commitment may be as mundane as a promise to clean your room, or it may be as dramatic as General Douglas

McArthur's famous line, "I shall return," when he was driven from the Philippines by the Japanese early in World War II. At either extreme, or anywhere in between, a commitment is one of the most powerful motivators of human performance.

Most college professors simply assume that students are committed to doing their best. This is another difference in style from high school. If you don't want to go to class, don't go. If you don't want to do your home work, don't do it. More generally, if you want to waste your time and money, your professors want nothing to do with you. So long as you do nothing that interferes with the serious students, you can do just about anything you want. And just about the easiest thing to do is to take advantage of this free style approach to education and let your studies slide. That is why it is helpful to make a commitment.

Making a commitment does not mean dedicating yourself to your studies. A dedicated person has a single goal in life, such as making an Olympic team or being elected to Congress. Dedicated people have a one-track mind; everything else is secondary to their paramount mission in life. Of course, one can be a true scholar and dedicate oneself to learning. But such a strong commitment is not necessary. In fact, a good commitment should be almost certainly attainable. It is much better to commit yourself to "getting at least a C" than to fail at "getting an A." Always make your commitment at a level that is challenging but that you believe diligent effort will produce.

You may not have noticed that I defined a commitment as being a public pledge. Evidence indicates that private commitments, such as New Year's Resolutions, are much less likely to be fulfilled than ones that somehow involve another person. It is therefore important to announce your commitment as a student to someone else and to back your commitment up in a meaningful way.

1.3 Conclusion

There is a similarity between acts of learning and acts of sex: We all naturally manage to figure out ways to do them pretty much on our own but most of us could benefit from some advice in how we might do better. Many people are too proud, too bashful, or too obstinate to admit that they are less-than-perfect in such things. It is not so much that we really need help as that we can use new information.

Laboratory research with animals and humans has shown that we not only learn the tasks we are assigned but that, while we are doing so, we also learn some-thing about how to learn that type of task. As one example, if you are asked to memorize a poem, you know how to do it because you have presumably memorized many poems before. But do you know how best to do it? Should you try to learn it all at once or should you break it up into parts? How should you divide up your time between reading and trying to recite? Is it better to read and/or recite silently or out loud? These are some of the how-to-learn questions that you can try to answer from your own past experiences, but about which you might benefit from some expert advice.

Indeed, expert advice is sometimes surprising. For example, did you know that you can "overlearn" something? If you repeatedly practice something the same way

over and over, you learn it so well that way that you lose the ability to do it any other way. Just stop reading for a moment and try to spell your full name backwards. You've done it so many times forward that it's very hard to change! Similarly, if you study college material too much the same way, you may not be able to recognize it when it's presented in a different way on an exam.

The critical phrase in the preceding paragraph is "in the same way." You can't overlearn material if you vary the way you study it. Knowing a variety of learning tactics can insure that your study time is spent profitably.

I believe that one's attitude toward a task is even more important than one's technique—even poor techniques eventually work. For this reason, this first chapter has described three of the key characteritics of successful college students. These are:

1. Be a professional student. Work to complete assignments and play when they are done. If you have several jobs to do, always start with the one you find least attractive (or most difficult) and always take a break after finishing a job. (I urge you now to study Appendix A.)

2. Be an optimistic student. Be happy to display how much you do know rather than being unhappy about how much you don't know. (I urge you now to study Appendix B.)

3. Be a committed student. Make a public pledge that requires you to do your best job as a student balanced against your other commitments. (I urge you now to study Appendix C.)

These attitudes do not guarantee success in college. You may not have an adequate preparation, and find that you need remedial work. You may even discover that college is not right for you, at least at this juncture in your life. But if you can be a professional, optimistic, and committed student, you can realize your full academic potential.

1.4 On "Having What It Takes ... To Learn"

Biological psychologists have long been searching for the "learning engram," the raw materials of which memories are made. The only thing we can be sure of at this time is that learning must result in some biological change in the body. Rather than waiting until that perplexing mystery is solved, I recommend that you take the following hypothesis to be true

The biochemical material for learning is produced more-or-less continuously by the brain; you use it or you lose it.

To understand this hypothesis, you might imagine that the material is analogous to audio-visual tape for a television camera. Imagine further that a factory can produce the tape at a fixed rate, that if the tape is used, a reasonably permanent recording is made for future play-back, but that if the tape is not used within a day or two, it goes bad and has to be purged as no longer usable.

The major weakness in the tape analogy is that the material of which memories are made includes not only sounds and sights, but also smells and tastes and touches, as well as emotional feelings that may have accompanied the scenes. That is to say, our memories are much richer in content than television, but the logic of the analogy applies. It has several very powerful implications.

1. You cannot remember what you study if there is no fresh memory-matter available in your brain at the time. You can learn just so much of any one kind of subject in any one day. In particular, you cannot cram a semester's assignments into a few frantic days and nights of study. On a more positive note, when you have done a good day's work studying, you can really enjoy your leisure activity knowing that you have learned all you can learn in a day.

2. Any day you let pass without spending some time at your studies wastes some of your potential for adding knowledge to your memory bank. The memory capacity is unbounded; the limit is only in the amount that you can add each day. Which is more, a memory bank gets richer every time the knowledge is used.

In sum, the bad news is that no amount of study now will ever make up for all the wasted opportunities to learn; we can never know as much as we could have known had we learned to our limit every day. The good news is that it is not too late to learn enough to become a well-educated person within the foreseeable future. It is even possible that the amount of memory-matter that is produced by the brain factory every day is greater when it is used on a regular basis.

Chapter 2

Personal Problems

The purpose of this chapter is to help you do your very best
... by coping with distracting non-academic problems.
You should learn:

1. The Priciple of *Habit Formation* by contiguity and that habits result from practice.
2. The fact that everyone has a one-track mind and the Theorem of *Mental Habits* .
3. The Principle of *Behavior Modification* but that old habits never die.
4. The *Pragmatic Approach* to coping with problems based on knowing the facts and alternatives.
5. The Principle of *Behavioral Inertia* and the importance of REM sleep.
6. A number of problem-causing *fallacies and illusions* .
7. Some thoughts on *sexual behavior* including how motivation affects perception.
8. Some thoughts on *mind-altering drugs* (alcohol) and the concepts of addiction/tolerance/dependence.
9. The Principle of *Primacy* in habit persistence.
10. The meaning of *moderation* .

You should also study the following appendix:

- On Logic and Problem Solving

Some people with adequate learning skills do poorly in college for other reasons. The most common example is the person who has to carry another full-time job. Most students can handle a part-time job, especially one that is somehow related to school, but heavy outside commitments inevitably interfere with studies. I have no solution for financial problems, but there are some helpful things to say about the more personal problems that often trouble students.

The range of personal problems is surprisingly large. Indeed, almost every aspect of a person's existence is a potential source of problems. You may feel that this or that part of your body is too big or too little, or you may think that you engage in one or another type of behavior too seldom or too often. Many things that may seem trivial to you may trouble someone else. For this reason, I can only illustrate some of the more common student problems and can only give general approaches toward how to deal with them.

Whatever the problem, a person naturally worries about it. We worry when we know that worrying won't solve the problem, and the more personal the problem, the more likely we are to keep it to ourselves. Which is more, otherwise intelligent people tend to be very stupid in the context of their problem. For example, people who think that they "worry too much" may believe that worrying can cause insanity. So they not only worry about their problems, they also worry about worrying so much.

Now worrying will not drive you crazy, but it does preoccupy your mind with non-academic thoughts. Everybody has a one-track mind, so you can't concentrate on your studies and worry about something else at the same time. Yet many students automatically start to worry any time they try to study. Worrying can become a mental habit that obstructs study habits.

To understand why this is true, you need to know about the basic principle of learning, namely association by contiguity:

Principle of Habit Formation (Contiguity)
An activity becomes associated with any situation(s) in which it repeatedly occurs.

To be "associated" means that the occurrence of one tends to call forth the other. If you brush your teeth when you get up in the morning, you will develop the habit; if you follow some particular route to school each day, that route will become habitual; if you regularly buckle your seat belt when you get into a car, the act of buckling your seat belt will be associated with getting into a car. Habits tend to occur automatically, without any conscious thought. Indeed, you are likely to become aware of your habits only if they are blocked for some reason. In sum, practice is all that is needed to form strong habits.

I used the word "activity" in stating the Principle of Habit Formation, and the examples I have given so far all involve physical acts. Actions that are openly observable to other people are called overt. But the principle also applies to covert activities that are private. Hence, a special case of the principle, which we call a theorem, is this:

Theorem of Mental Habits
States of mind become associated with situations in which they occur frequently.

"States of mind" include being sleepy or awake, being attentive or distracted, and the wide range of moods that we all experience from time to time. . .fearful, excited, blue, lonely, happy, sad, sexy, etc. These are all normal states of mind that occur

in various situations. What the theorem adds to common knowledge is that mental states are learnable: You can learn to feel sleepy not only at your usual bed-time, but also whenever you start to read a textbook. You can learn to feel anxious when taking exams, alert when attending lectures, relaxed when listening to music. Habits include how you feel as well as what you do.

2.1 Coping with Personal Problems

How should one deal with personal problems? One approach is to dig into one's past in search of the cause of the problem. Perhaps the chronic worrier felt unwanted as a child and developed the worrying habit over fear of being abandoned. Or perhaps some sickness led to worrying about death. I have two objections to this historical approach to solving problems: In the first place, it usually takes a long time to ascertain the cause of the problem, and in the second place, finding the cause rarely solves the problem anyway. More often than not, people just go right on living with the problem once they find out that its not their fault that they have it.

I prefer the pragmatic approach in dealing with problems. You may have heard the expression, "If it ain't broken, don't fix it." The pragmatic approach is: "If it's broken, fix it!" Never mind why it's broken or who broke it...never mind why you have a problem or whose fault it is...fix it. The goal is to get results, to solve problems, or at least to confine them to restricted parts of your life.

When the problem involves an undesirable habit of any kind, the pragmatic approach is to change one's behavior to something that is more desirable.

Principle of Behavior Modification
Practicing new behavior in a familiar situation replaces old habits with new ones.

The Principle of Behavior Modification should NOT be interpreted to mean that the old habits are actually erased from memory. On the contrary, the biological changes that comprise learning are essentially permanent. But a new habit can, with enough practice, become stronger than the old one and hence replace it.

If you're a worrier, you need to develop mind control. Because our minds have only one track, we can't feel sad while smiling or singing happy songs, we can't be afraid while whistling carefree tunes, we can't have a negative, pessimistic attitude while reciting positive, optimistic words. Some people call it the "power of positive thinking," but mind-control is simply a matter of doing something or saying something to yourself that produces the desired mood. Of course, that may be easier said than done. . .until you've learned how to do it.

Hence, mind-control is the pragmatic solution to excessive worrying and it also applies to other self-destructive mental habits. Loneliness, self-pity, anxiety, and mild depression are some of the moods that are perfectly normal in moderation, but that may become so habitual that they interfere with studying. In every case, the trick is to find words that create, for you, the desired mood. For example when you feel depressed, force yourself to remember happy events; when you feel anxious, try to

imagine a relaxing scene. It takes practice to develop mind control, but the ability to stop an undesirable train of thought by replacing it with the desired one is a skill that will serve you well the rest of your life.

2.2 On Getting Started

The popularity of the saying "The longest journey begins with the first step," reflects a truism: The hardest part of almost any job is getting started. Very much like swimming in cold water, most jobs are not so bad once you get into them, and I have found that just knowing that fact is usually enough to help me get started. Whether it is painting a room in my home or writing a paper, I usually have to remind myself of this principle:

Principle of Behavioral Inertia
It is harder to start a chain of behavior
than to sustain the chain once it is started.

For many students, this first hurdle is getting out of bed. The temptation to roll over and catch a few more winks of sleep is often so great that they miss a morning class. The first prerequisite to the pragmatic approach to problems is: get the true facts. If you're too embarrassed to ask someone, the college library is functionally a reservoir of information. It is sometimes the case that the true facts show that what you are so worried about is actually not much of a problem after all. In other cases, the true facts point directly toward the pragmatic solution. In any case, you must replace hearsay, superstition, myths, faulty reasoning, and ignorance with true empirical knowledge about the matter.

One reason people have difficulty getting up in the morning is that they want to avoid the aversive realities of life–the work, the tests, the conflicts. Another very common reason is that the person simply does not plan enough time for sleeping. Let me first share a few facts about the need for sleep.

There are several stages of sleep, one of which is REM (for Rapid Eye Movement) or "paradoxical" sleep. It is paradoxical because the body is in very deep sleep but the brain is very active. If a person is awakened during REM sleep, s/he will likely say that s/he was dreaming and perhaps the eye movements indicate watching the dream unfold. This REM stage of sleep usually lasts about 20 minutes and occurs about every 90 minutes during a normal night's sleep.

REM sleep is vital for mental health. People who are allowed to sleep as much as they want, but who are awakened every time they begin to enter the REM stage, soon become irritable, nervous, moody, and generally distressed. Most important for our purpose, a person who has been deprived of REM sleep finds it very difficult to learn even simple new material, and is likely not to remember it later. It is possible that the biological material for learning is produced during REM sleep, but whatever the reason, you cannot do your best as a student without adequate sleep.

The best evidence suggests that five REM cycles each night are normally required for good mental health. Thus, the traditional eight hours sleep turns out to have a solid scientific basis. Therefore, a very important rule is to set a regular bedtime that allows for a full night's sleep. You may be able to get by on less, but you're probably short-changing yourself in terms of your full learning potential.

I cannot overemphasize the importance of regularity in setting one's bedtime and get-up time. Time-of-day/night is a "situation" to which states of mind, such as feeling sleepy or awake, can become associated. If you go to bed at about the same time most nights, and get up at about the same time most mornings, your biological clock will become adjusted to that schedule.

2.3 Useful Tid-bits

Many personal problems can be reduced to one of these causes:

1. The Ima fallacy. Labels like: "I'm a dumb-bell," "I'm a weak person," "I'm a failure," etc., can become self-fulfilling prophecies. If every-one who has taken something that was not rightfully his/hers were a crook, we would probably all be crooks. Instead of labels, use action words: "I'm acting stupid," "I'm learning to...", "I'm going to...", etc.

2. The S-isa fallacy. No tangible object has intrinsic value. Value is something people place on objects, and not everyone values every thing equally. This is true of properties like pretty, delicious, and even pornographic. Always add "to me" when describing your subjective feelings about an object.

3. The R-isa fallacy. Ethical and moral judgments are not really intrinsic properties of behavior. Whether an action is good/bad, or right/wrong depends on current social conventions, not on any absolute truth. It is appropriate to adopt standards for your own behavior but not to judge others by them.

4. The either-or fallacy. Our language habits are such that we tend to think in terms of opposites: white-black, up-down, big-little, etc. This tendency often leads to false dichotomies: Either I'm happy or I'm unhappy, either I'm popular or I'm unpopular, either I'm a success or I'm a failure. Most such factors actually fall on a continuum, with many intermediate shades of grey.

5. The constancy illusion. We naturally tend to see ourselves and the world around us as being the same from one day to the next. Actually, however, everything is always changing. Learn to accept the fact that "you can't step into the same river twice."

6. The size illusion. Things appear smaller when we look up or down at them compared with when we look out horizontally at them. This illusion applies to the moon, to an automobile from the top of a tall building, and to parts of the body.

7. The completion complex. Although the hardest part of a difficult job is usually getting started, the next hardest part is usually finishing. This is because it is when you finish that your work is judged by others. It is easier to complete a number of small jobs than one large one.

8. The inferiority complex. We all spent many childhood years being inferior to adults. Although there are a few designated ages when one is old enough to vote/drink/be-president, the transition to adult-hood is so gradual that few of us ever really shed the feeling of being inadequate. But most of us learn to act self-confident.

9. The insuperiority complex. For some people, there is only one acceptable outcome, namely winning, being best, earning the top prize. Most such people are doomed to failure because there are not very many openings at the very top. It is best to set some realistic criteria for success, and raise them from time to time.

2.4 Sexual Behavior

We are all sexual organisms. The very fact that we exist proves that our parents, our grandparents, and indeed, all of our ancestors were motivated by sexual needs. But even though our sexual nature is normal and natural, sex is a problem for many young people. They may not yet have learned the difference between lust, which is the natural desire for intense physical pleasure, and love, which is the equally natural desire to give pleasure to another person. The difficulty, of course, is that most young people do not yet have a loving relationship and also do not have many approved outlets for their sexual needs.

Sexual Solitaire. Had Mark Twain written about sexual self-stimulation, he probably would have said just the opposite of what he said about the weather: "Nobody talks about masturbation, but everybody does it." Actually that is as it should be provided one accepts the practice as a private means of satisfying the sex drive. However many people have been misled by hearsay, myth, superstition, or false advice. None of the widespread misconceptions about bad effects of masturbation...insanity, weakness, wasting oneself, going blind, etc...is true. You can abuse any part of your body, including your genitals, but reasonable practices are normal, natural, and healthy.

To understand why students should maintain sexual balance, you need to know how motivation affects perception (how we see things). If a word or an object is ambiguous, so that it can be interpreted in two ways, motivation biases the way we interpret it. A hungry person may hear the word, "stake," and think of a "steak." A fearful person may hear "dye" and think "die." In like fashion, a sexually deprived student may be distracted by words used in a text or lecture that could be given an erotic meaning. Be it "date" in a history course, "arousal" in a psychology course, or "climax" in a music appreciation course, our language contains many words that tempt the mind toward non-academic trains of thought. It is harder to study if any of the biological drives (hunger, thirst, sex, pain) is very strong.

In order to avoid controversy, health officials are reluctant to recommend masturbation as the safest way to satisfy one's biological need for sex. However it should be clear that those who favor abstinence as the best way to prevent venereal disease and unwanted pregnancy are advising you to abstain from social, not from solitary sex. In like manner, advice to those who choose to be "sexually active" is intended for those who engage in heterosexual or homosexual acts. In sum, do not be driven to seek other kinds of non-marital sexual behavior because of a mistaken belief that sexual solitaire is less acceptable.

Heterosexual behavior. In a sermon given at many colleges, the Reverend Martin Luther King said that the most frequent question asked of him by students was, "How far should I go on a date?" He added that he was disappointed that students had to ask that question because he believed that they should have long since made a decision about what was "right" for them. Actually, in many cases, the intent of the question was not quite what the Reverend King thought. It was whether a person should be expected to go further than s/he wanted. But the answer is the same: Set your own standards according to your conscience, and behave accordingly.

There is a useful strategy for controlling one's behavior in a wide range of contexts. Imagine the types of situations in which you may find yourself, and decide in advance what you intend to do. For example, the best way to avoid "impulse buying" when shopping is to have a list of what you need and never buy anything not on that list. In a gambling situation, set a limit on how much you are willing to bet; in an "all-you-can-eat" situation, set a limit on how much you should eat; and in an inter-personal situation, set a limit on how intimate you will become. It is the spur-of-the-moment decision that is most likely to be one that you will later regret.

One point about sexual behavior is seldom mentioned: Sex is sometimes used as a form of aggression to express dominance over another person. This is obvious in the case of rape, but it is true whenever one person uses another to satisfy his/her lusty desires. I mention this point because either or both people may fail to distinguish between aggression and love. In loving sex, one focuses more on what you can give than on what you can get.

Homosexual behavior. Science has not yet answered the complex question about the origin of a person's sexual preference. There may be a genetic factor, or some very early experience may determine one's orientation. Three facts are reasonably clear: A few homosexual encounters neither cause nor reflect a preference for members of same sex, homosexual orientation is very resistant to change, and one's sexual preference does not affect one's performance in other contexts. The gay/lesbian life style is being accepted by society.

2.5 Addictive Drugs. . .Alcohol

I shall focus on alcohol for two reasons: It is the most widely-used problem drug, and I am an alcoholic. Because of the first fact, some problem that is related to alcohol abuse is likely to affect almost everyone in our society. Because of the second fact, I can fully appreciate the power of addictive drugs. This does not mean that I preach

abstinence. . .nor that I encourage drinking. The pragmatic approach to drugs is the same as any other potential problem area: Make an informed decision based on the true facts.

Alcohol is not a stimulant; it is a neural depressant. Alcohol slows down the nerve signals that control both the mind and the body. If the nervous system is sufficiently depressed, you lose consciousness (pass out); otherwise, you could drink enough to die then and there. Short of that, the depressing action of alcohol is selective. It acts first on the part of the nervous system that produces fear. This is why alcohol appears to be a stimulant; if it decreases one's inhibitions (fears), it may increase performance. However, it concurrently decreases one's judgment leading to a false feeling of doing better when actually doing worse. In any case, alcohol destroys brain cells which can never be replaced.

The loss of inhibition is the most destructive feature of alcohol from a social point of view. When drunk, people may say or do things of which they are very ashamed when sober. Date rape is one example. If you are intent on "tying one on," best you do it in a safe context. Or if you're with someone who is so inclined, either get away before it's too late or be prepared for the consequences. It is not just the driving drunk who is dangerous.

The most insidious feature of alcohol is that it is addicting. One can become dependent on alcohol as a psychological habit and as a physiological need. Let me briefly explain both of these effects. If you are feeling anxious about something, say an impending exam, you can reduce your anxiety by drinking alcohol. When you feel anxious about something else, say an argument with your girl/boy friend, you can reduce that anxiety by drinking alcohol. In sum, alcohol can be the way you learn to cope with anxiety. Usually, drinking alcohol actually makes matters worse. . .the time you spent drinking is time you didn't spend studying for the exam, and the loss of inhibitions may turn a squabble into a real fight. This leads to greater anxiety and greater use of alcohol. It can become a vicious circle of fear then alcohol, more fear then more alcohol, still more fear, and still more alcohol, etc. Psychological dependence is habitual use as a way to cope with problems.

Regardless of one's reason for drinking, one's body responds by compensating. As with any toxic substance, alcohol causes the body to develop greater tolerance to it. What this means is that it takes more and more alcohol to reach the same degree of ecstasy. A person who "can hold his/her liquor" may be admired but is actually well on the way to physiological addiction. This is because tolerance also implies dependence on alcohol. I can assure you that there's no fun in drinking when you have to drink to satisfy your body's needs. Alcoholic withdrawal is painful, and the addict does not drink to achieve ecstasy, s/he drinks to relieve withdrawal symptoms.

Addiction is a long-term effect of excessive use of alcohol, and it is easy to buttress the argument with short-term effects. For example, alcohol interferes with REM sleep which is important to consolidate that day's learning and to prepare the brain for new learning. Abstinence from mind-altering drugs is clearly ideal, in principle. In practice, prohibition doesn't work for many people. For them, responsible use is the realistic goal. Sound knowledge of the dangers of alcohol should lead to moderation.

2.6 The Primacy Principle

Old habits never die, they get suppressed. The habits that are the hardest to suppress are the ones that were learned first in a situation:

Principle of Primacy
The first response learned in a situation is especially persistent.

Please note that the Primacy Principle applies to the first response, which can occur at any age. In the normal course of events, people encounter situations for the first time during childhood. This means that many of our persistent habits were acquired when we were children. Indeed, we may have long since forgotten the specific episodes, and we only know that we like some things and don't like others. But as long as you are being exposed to new situations, be it a new field of study or a different style of cooking, your first reactions shape your future attitudes.

The Primacy Principle is indifferent in regard to the desirability of the response. A person who had happy first experiences in learning how to swim can endure many later discomforts and still love to swim. However, if those first experiences were fearful, the person is likely to avoid water even after some pleasant times. The person who "hates math," "loves rock-and-roll," "can't stand fish," "can't get enough T.V." etc., illustrates primacy in action.

There are two morals to the Primacy Principle. First, you'll have to be constantly alert to keep old bad habits in check. Second, always try to learn the right way first. Start very new venture with a positive attitude and a commitment to make it work.

2.7 Conclusions

Everybody is troubled by something from time to time. Some people are always worrying about their troubles, while others usually appear to be carefree most of the time. Any time personal problems occupy some of your cognitive capacity, they necessarily interfere with academic pursuits. Hence, the purpose of this chapter is to urge you to deal realistically with problems when they arise. The philosophical basis for this pragmatic approach is the saying:

Grant me the serenity to accept things I cannot change,
The courage to change the things I can,
And the wisdom to know the difference.

The first step in solving personal problems is to get the facts so that you know that there really is a problem, how big it is, and whether it can be solved. Because it is unlikely that you have invented a new problem, it is likely that the college library will contain a wealth of relevant information. Replacing fallacies with knowledge often suffices to bring a problem down to a size that can be managed.

A brief introduction to logic and problem solving is given in Appendix. The same strategies apply to personal problems as apply to more practical ones. In every case,

you need to identify the alternative courses of action and follow the one most likely to succeed. Occasionally, the best solution to a problem depends on what caused it, in which case, you have to discover why the problem arose. But in most cases, the best approach is simply to deal with the problem.

There are two classes of solutions to personal problems: change the environment or change your behavior. For example, if you have a neighbor whose loud music disturbs your studies, you have to convince the neighbor to lower the volume or you have to change your own study habits. As a rule, the environment is less susceptible to change and hence problem solution usually requires behavior modification. Note that "behavior" includes your private thoughts as well as your public actions. To change your behavior, you need to practice new behavior.

Do not be misled, however. Old habits are never "broken" in the sense of being completely eradicated; they persist as potential problems in the future. You can keep old habits suppressed by new, better habits. If your undesirable habits are strong, you may need help in overcoming them. Do not be too proud or too shy to seek professional help. Student Health Center and other agencies are available to help you deal with depression, addiction, and eating disorders. There are suicide, rape, and crisis centers to help you survive long enough to regain your own cognitive powers.

Similarly, professors, department chairs, deans and counselors will help with academic problems. Don't miss out on your education because of personal problems. You can sometimes rely on self-help methods if you understand the nature of a problem but you may need a trained person to help you get started.

2.8 On "Moderation"

Conventional wisdom is to enjoy "everything in moderation." Is that really good advice? And if it is, how much (or how often) is "moderate?" Let me try to answer both questions with an illustration based on my experiences when I was a cigarette smoker.

Treating "10" as the value of the most intense pleasures that I have known, the very best cigarette would rate a value of about 5. That would be the first cigarette of a day with a cup of coffee. If I then smoked a cigarette every 15 minutes for the 16-hour day, the value of each one was very small, about .2 at the most. But if I waited 30 minutes between cigarettes, the pleasure from each cigarette increased to about 1. The pleasure was still greater, 3, if I let an hour go by between cigarettes, and up to 4 by smoking a cigarette every two hours. Now let's put these values into a table

Please understand that I am not, repeat NOT recommending that people smoke. The evidence is clear that the long-term detriment to health far outweighs the short-term pleasure to be derived from smoking. If it makes the example more meaningful, you can substitute other activities such as eating a candy bar, drinking a soft drink, or listening to a record. Of course, the time frame will be quite different for some activities, such as going to the movies, eating your favorite dinner, or engaging in sex. But the same basic picture applies to them all. A high frequency results in less

Table 2.1: Table showing how the amount of pleasure I got from smoking cigarettes depended on how long I waited between cigarettes.

Interval Between Smokes	Number of cigarettes per day	Pleasure value of cigarettes	Total amount of daily pleasure derived from smoking
15 min	64	.2	12.8
30 min	32	1.0	32.0
1 hr	16	3.0	48.0
2 hr	8	4.0	32.0

total pleasure than a moderate frequency, which in turn is better than a very low frequency.

So how do you know what is a "moderate" amount? There is no single answer that applies to everything. As a rule-of-thumb, the optimal rate is to do something less frequently than your natural tendency to do it. That is to say, self-imposing a tolerable amount of deprivation between episodes increases the pleasure more than enough to make up for the lower frequency. The only way to find out what is best for you is to try out different schedules.

Chapter 3

Attention

The purpose of this chapter is to explain the most important college learning skill . . .paying attention.

You should learn:

1. The Principle of *Active Participation* and the role of overt-covert attention.
2. The difference between *automatic* attention and *selective* attention to critical cues.
3. The Principle of *Minimizing Work* and the fact that selective attention takes effort.
4. The proposition that selective attention is a *learnable response*.
5. The notion that *world knowledge* is not verbal but that knowledge is learned from words.
6. The way that knowledge increases from novice to *expert*.

When Mark Twain went out to the pasture to teach a mule the difference between "gee" and "haw" (that is, left and right), he began by giving the mule a friendly but solid whack on the rump with a two-by-four. When asked why he did this, he said, "The first thing you have to do to teach a mule anything is to get his attention." It is the same with people. If you are going to learn from this or any textbook, you will have to pay attention. So important is this rule that it can be stated as one of the basic... Principles of Verbal Learning:

Principle of Active Participation
Overt/covert attention/rehearsal is necessary for effective verbal learning.

Overt behavior is publicly observable; it is what a person does openly or says out loud. In contrast, covert behavior is private; only the behaving person is consciously aware of what s/he is thinking. For example, a person may show manifest signs of paying attention to a lecture, such as sitting up and looking at the speaker, but as

you know, attending is really a covert act. We have all learned how to fake doing one thing while thinking about something else. You have probably had the experience of starting to turn a page only to realize that you don't remember anything that you just read. The Principle of Active Participation says that you will only learn from verbal material if you notice it, think about it, actively attend to it.

The Principle of Active Participation is more complicated than it appears at first reading. One complication is that there are two different processes controlling one's attention. (There are also two kinds of rehearsal, which are discussed in a later chapter.) One process is called automatic attention. As the name implies, automatic attention is not voluntary or deliberate. Any strong, unusual, or unexpected event tends automatically to command attention. This is the attention process that Mark Twain used, but people don't (usually) need to be hit with a two-by-four. You tend automatically to attend to the loudest sound in music, to the most vivid color in a picture, or to an insect that is biting you. Events in the external world act to control attention automatically.

The other process is called selective attention. It might better be called "intentional attention" because the process is voluntary and deliberate. For example, if I now ask you whether you are breathing by expanding your chest or your abdomen, you can quickly shift your attention from my words to your body and find out how you are breathing. The important point is that cues from your body are there all along but they are normally in the background rather than at the center of your attention. But you can voluntarily turn your attention to them on command.

In sum, you can only focus your attention on one thing at a time. Salient events in the environment tend automatically to attract attention, but you can selectively attend to less salient stimuli.

3.1 Attention: A Response

The most obvious cause of difficulty in selectively attending to one's studies is distraction by automatic attention. If other people in a classroom are making a commotion, it is hard to listen carefully to a lecture, or if a neighbor is playing loud music, it is hard to concentrate on a textbook. As matters have it, such problems are not the major ones. The disturbing events are usually only temporary and if they persist, there is an adaptation process that makes them seem less powerful. Just as your body gets used to the water after you have been in a swimming pool for a while, so too does your mind get used to background noises. By-and-large, people can maintain selective attention in spite of competition from automatic attention processes.

However, there is a limit and there is a price. The limit is simply that you cannot completely adapt to very potent stimuli. Returning to the swimming pool analogy, if the water is very cold, you will not get used to it. Similarly, you cannot completely ignore a neighbor's music that is very loud. The price is that it takes more mental effort to attend to one's studies in a distracting environment. Even your own music playing softly will make you feel tired studying sooner. Selective attention is an effortful response.

The major challenge for the serious student is to keep selective attention focused on study materials rather than on day-dreams, personal problems, or social activities. Although attention is a covert activity, our best hypothesis is that it obeys the same principles that have been discovered by research on overt behavior. One of these principles is that of minimizing work (least effort):

Principle of Minimizing Work
Other things equal, people tend to choose the activity that requires the least amount of work.

Attending to a difficult lesson is hard work while attending to enticing daydreams is easy. Even worrying about personal problems is relatively easy because you have probably practiced worrying about them a great deal in the past. In effect, these various types of thoughts are competing for your selective attention and the Principle of Minimizing Work implies that your attention will naturally have a tendency to be diverted into the easier response. This tendency for your "mind to wander," even without any external distractions, is inevitable and you need to know how to recognize when this is happening and how to get your mind "back on track."

I believe that the ability to focus and sustain attention on relevant material is the most important trait of a good student. To be sure, an adequate level of intelligence is necessary, as is a full measure of motivation, but selective control of attention is what most separates the good from the poor student. This belief is not original with me. Sir Isaac Newton, whom many consider to be the father of modern science, said, "If I have ever made any valuable discoveries, it has been owing more to paying attention than to any other talent."

3.2 Attention: A Learnable Response

If attention is really such a crucial talent, the inevitable question is whether the degree to which one possesses this talent is genetic or whether it can be modified through practice. The answer is that automatic attention is an inborn reflex (genetically determined), but selective attention is a learnable response. This means that you have acquired whatever talent you have for attending to weak stimuli and you can improve that talent with practice.

As you probably know, young children have a very short "attention span." In the normal course of growing up, we all learned to sustain attention to activities we found interesting. As with every other trait, we undoubtedly differ to some extent in our endowed capacity for developing attention skills, but we probably differ more because of our learning experiences. Parents and teachers who patiently retrieved our attention when it started to wander helped us learn to keep our attention focused on the topic at hand. Although there is no proof of this assertion, it is a tenable hypothesis for our purposes. It implies that a major aspect of learning to "pay attention" is learning to recognize when attention has wandered.

Two contrasting practical examples may be helpful. One is a Deacon standing in the rear of a church with a long mallet that s/he uses to tap the head of anyone who

starts to doze off during the sermon. The other is the child equipped with a buzzer that sounds an alarm when s/he starts to wet the bed. Both examples show the use of "feedback" to alert the person about inappropriate behavior. What happens is that, with practice, the person learns to anticipate when inappropriate behavior is about to occur and takes corrective action.

You have neither a person nor a device to monitor your behavior and alert you when your attention wanders. Hence, the best you can do is start a diary in which to keep a record of your slips. At first you won't be aware of your attention starting to drift from a textbook, but you do become aware at some later time that you have not been concentrating on the text material. Whenever that happens, make a note in your diary of when and where it happened, what you were supposed to be studying, and about how long it seems that you were thinking about something else (or your mind was blank). Your diary can be just a separate sheet of paper, but it becomes your record of lapses of attention.

With practice, you will recognize when your attention is starting to wane, so you can, like the tired driver catching himself starting to doze, snap yourself back to your studies. The tired-driver analogy is a good one to remember. Good drivers know that, if they have difficulty staying alert, they should pull off the road and rest a while. So too, a good student knows that, if s/he is having more-than-usual difficulty maintaining concentration on studies, s/he should take a break and let the mind rest. Having a diary enables you to recognize not only when your attention is straying off course, but also when you are below par. In general, a shorter amount of time in efficient study is more productive in the long run than a longer time of tortured study.

3.3 The Nature of Knowledge

At this point, it will be helpful to digress briefly to say a few things about the nature of knowledge. Now actually, we don't really know what knowledge is, but this much is clear: Most knowledge is not verbal. Knowledge of words and about words is verbal, but such knowledge is logically circular. That is to say, if a word is defined only in terms of words that are, in turn, defined only in terms of words, it goes around in verbal circles without any real tangible meaning. That is why dictionaries have pictures; I can not really tell you what a cat is, but I can show you pictures of various cats and you can form the concept.

Once you stop to think about it, it is obvious that world knowledge is largely non-verbal. Non-verbal animals certainly "know" things; dogs know who feeds them, where they live, and what cats are. For that matter, you know many things without having words for them. A very familiar experience is pausing in the middle of a sentence while searching for a word that correctly expresses an idea. Obviously, the idea itself is not verbal. Indeed, you can usually formulate a number of sentences to express the same idea. In general, words should not be confused with the non-verbal concepts they represent.

Although knowledge is not verbal, it is usually transmitted in verbal form through

Figure 3.1: One person expresses a non-verbal idea in words that another person then translates into his/her own non-verbal knowledge system

books and lectures. The essential nature of the communication process is depicted in Figure 3.1.

For example, when you are in love with someone, you may search around for words to describe your feelings. Your loved one, in turn, tries to construe the meaning of your words. In sum, one person codes an idea into words, and the other person decodes the words into an idea. . .hopefully very much the same idea.

Figure 3.1 should explain why the Principle of Active Participation is true. The only person with access to your knowledge system, to your memory, is you. Nobody, not even the greatest teacher in the world, can teach you anything in the sense of putting knowledge into your memory. YOU have to learn it. Good teachers can express ideas in words that their students can understand. I give frequent examples from everyday life because students have told me that such examples help them "get" the ideas. But in the last analysis, you have to be an active participant and figure out what the words signify.

3.4 Conclusion

In an article written many years ago, I wrote, "a teacher teaches in the same sense that a cook cooks." My point was that a cook does not really cook; it is the meal that cooks. What a cook does is to fix the food so that it will cook. Similarly, a teacher does not really teach; a teacher fixes conditions that enable a student to learn. However, there is an important difference between a cook and a teacher: A meal has no alternative but to cook the way it was prepared by the cook, but a teacher cannot force a student to learn. The best teacher in the world cannot put knowledge into a student's mind. The only person with access to your mind is you.

Active participation by the learner is therefore necessary for verbal learning. This is because practical, useful world knowledge is not verbal. We use words to depict objects and events, to describe experiences, and to express ideas. The fact that we can usually express the same idea in different words is conclusive evidence that the idea is distinct from the words. Some word may express the idea better than other words, and searching for just the right word further indicates that the idea comes before the word. Accordingly, verbal learning is not really learning words. . .it is learning from words.

Because you are the only one who can translate knowledge into our memory system, you have to pay attention in order to learn from words. Occasionally, a teacher's voice will be so powerful that you listen whether you want to or not (that is why TV ads are louder than the program), but as a rule you have to sustain attention voluntarily on the words in a lecture or a textbook. The most critical difference between the good and the poor student is not intelligence, it is the ability to maintain attention on the material to be learned.

The good news is that paying attention is a learnable skill. One aspect of the skill is learning to discern when your attention is starting to wander. Keeping a diary of lapses can help. Another aspect of the attention skill is knowing what it feels like really to be paying attention. Practice listening to soft sounds or reading with distractions. Recall also that competing needs make your mind more distractable. Finally, give your mind a break from time to time.

3.5 On "Your Memory Bank"

There is a similarity between the growth of knowledge and the accumulation of wealth. There are many maxims such as "the rich get richer," "they who have get," "it takes money to make money." One way to make this point is to compare the amount of interest earned on small or large savings accounts. If the interest rate is 10% and you have only $10 in your account, your interest is $1; but if you have $10,000, your interest is $1,000. Another way to make the point is to watch your wealth grow if you simply double it every year 1– 2– 4– 8– 16– 32– 64– 128– 256– 512– 1,024– 2,048– 4,096– 8,192– 16,384– 32,768– 65,536– 131,072– 262,144– 524,288– 1,048,576. Notice that, at first, the growth is very slow and it takes ten years to reach a thousand, but by twenty years, you're over a million.

You can think of your memory as a bank into which you deposit information, and the rate at which your wealth of knowledge grows is illustrated in the graph

What this graph shows is that, when you first start to study some subject, progress is very slow. Indeed, many people quit because they do not seem to be making any real progress. But if you stick with it, learning will get progressively easier. The reason why this is true is "positive transfer". Knowledge that was learned with difficulty earlier is available to facilitate later learning. And if you become an expert, you can pick up in just a few minutes what it may take the beginner many hours to learn.

At least to this time, there simply is no short-cut, no easy way to get past the slow, arduous stage. Some years ago, a person claimed that a worm could "learn" by eating a worm that had been trained for many hours, but this claim proved to be a hoax. Every now and then, a new "smart" pill appears on the market, purporting to speed up the learning process. The fact is that almost everyone gets off to a slow start, but, with perseverance, almost anyone can become an expert.

Chapter 4

Verbal Fluency

The purpose of this chapter is to discuss the most important academic skill. . .LANGUAGE SKILLS.
You should learn:

1. That important people DO judge by appearance, with special attention to verbal behavior.
2. Why some people recommend studying Latin.
3. The steps in processing verbal information, and the importance of elaborative rehearsal.
4. How information processing becomes automatic
5. The steps in generating verbal information, and the role of grammar.
6. The all-important act of mental time-sharing as a learnable skill.
7. The importance of motivation.

You should also study the following appendices:

- On Paraphrasing.
- On Grammar.

When leading educators, business executives, and government officials were asked which academic skills are the most important for success, the overwhelming consensus was: "verbal fluency." For this reason, I can confidently urge you to invest the effort required to develop a reasonable vocabulary and to become facile using it. In contemporary society, verbal skills are of paramount importance.

The familiar expression, "Don't judge a book by its cover," is often applied to people as a warning that appearances can deceive us. For example, a warm, gentle person may hide beneath a very tough looking exterior, and a very insecure person may appear to be the epitome of self-confidence. You don't have to win beauty contests to be "pretty inside" and most of us would prefer to be judged, if at all, by the

"real me" instead of the person we appear to be publicly.

Nevertheless, people in important positions DO judge others by their outward appearance. In many cases, such as the job interview, that's all they really have to go on. But one's clothes and physical features are not the most critical part of one's appearance. . .it is one's verbal behavior that best reveals qualifications for admission, appointment, advancement, etc. Can you read well enough to follow instructions? Can you listen well enough to understand questions? Can you write and speak well enough to express yourself clearly. The one basic skill that stands out as being indispensable for success in very profession is verbal fluency.

Furthermore, verbal fluency (or lack of it) is virtually impossible to disguise. A person can easily change clothes and can also do quite a bit to change one's physical appearance, but one's verbal behavior was learned gradually and it can therefore only be changed gradually. You can recognize the speech of a well-educated person even if s/he is dressed in dirty, tattered clothes, and an uneducated person cannot fake educated speech. A brief sample of the words you use and how you use them is an infallible guide to your general verbal fluency.

The first ingredient of verbal fluency is a reasonably large vocabulary. I pointed out in an earlier chapter that knowledge is not verbal but that we use words to communicate knowledge. Obviously one cannot express an idea unless s/he has a rich enough vocabulary to put that idea into words. And even though an idea can usually be expressed in several different ways, there sometimes is only one "right" word for an occasion. The frequency with which many people use the expression, Y'know," is testimony to their inadequate vocabulary because they do not know a good word to express an idea and so they have to rely on their listener's imagination to try to guess what they are unable to put into words.

This is the reason that I have emphasized vocabulary in this book. To succeed in college and in later life, you need an adequate vocabulary. But vocabulary is not all there is to being verbally fluent. . .you must put the words into meaningful sentences. This means knowing educated rammar.

4.1 Verbal/Formal Discipline

In the decade after the Second World War, many changes occurred in American education. One goal was to purge the system of classic dogmas auch as the Doctrine of Formal Discipline. This long-standing belief was that general verbal fluency, including the logical organization of one's thought processes, could be enhanced by the study of Latin. Many English words are derived from Latin, and Latin is formally precise. In contrast to the many confusing irregularities in English, Latin is logically consistent and orderly. Studying a language that has clearly defined rules might help one recognize the complexities of English.

	singular		plural	
	Latin	English	Latin	English
1st person:	amo	I love	amamus	we love
2nd person:	amas	you love	amatus	you love
3rd person:	amat	he/she/it loves	amant	they love

Table 4.1: Conjugation of the Latin and English verbs meaning "to love."

I do not intend to digress into a study of Latin, but I urge you to study Table 4.1 in order to see the difference between the formal precision of Latin and the irrational conventions of English.

In English we do not change the second-person subject word (you) when going from singular to plural. We indicate that the subject is male, female, or neuter only in the third-person singular (he/she/it). In that same place we also put an "s" on the verb. In contrast, Latin always changes the verb ending, never indicates gender, and always changes from singular to plural. Latin is formally precise and consistent; a Latin-speaking child would never make the logical mistake of saying "they loves you." Studying Latin could help one avoid errors by calling attention to these complexities of English.

The Doctrine of Formal Discipline was never really disproved. It dropped from favor because proponents of the doctrine could not prove that it was true and students could not see its relevance. If the students only learn enough Latin to get a barely passing grade, it wouldn't do much good anyway. Actually, there has been a regeneration of interest in studying Latin in the hope that it will improve verbal fluency indirectly. My own belief is that one's ime is better spent in developing fluency directly in English.

4.2 Processing Verbal Information

Obviously you already know how to learn ideas that are presented to you in verbal form. You have been engaged in such learning for at least twelve years and you wouldn't even be in college unless you were reasonably successful. But being able to do something does not necessarily mean that you know how you do it. For example, you can surely say the word, "information," but do you know how you arrange your vocal chords, lips, and tongue in order to speak the word? Chances are you know how to do it but don't know any more about how you do it than that you just "do it."

The way that you learn from verbal information is by engaging in rehearsal, that is, silent talking to yourself. There are two techniques of rehearsal. One is called maintenance rehearsal because its major function is to maintain information in mind. You do this by simply repeating it over and over again, such as you probably do with a telephone number. You use maintenance rehearsal to memorize material, to learn it "by heart." Although there are some other memory techniques that I shall describe

in a later chapter, repeating verbal material word-for-word is the most familiar way to learn. We call this "rote" learning and it is appropriate when you need to know something verbatim.

The danger of rote learning is that you do not really have to understand the meaning of words in order to memorize them. Indeed, you can learn meaningless material (e.g., "Abracadabra"). People may memorize lines without knowing their meaning (e.g., "Four score and seven years ago..."), and we have probably all learned wrong words, (e.g., "a virgin is chased," rather than chaste). Hence, if you feel that you must memorize something in college, such as a definition or formula, be sure you understand it. Otherwise, you may get a "pullet surprise" instead of a Pulitzer Prize.

The other type of verbal rehearsal is called elaborative rehearsal because it requires more than mere repetition. Elaborative rehearsal is necessary if you want to understand verbal information. You can use maintenance rehearsal to learn (memorize) words, but you have to be more active in order to learn from words. Comprehension of ideas is the principal goal of most college courses, and hence elaborative rehearsal, as described below, is the critical form of active participation.

The words one person uses to express an idea convey information to the other person. As we have seen, it then becomes the other person's job to decode the words, figure out their meaning, and learn the idea. This transformation of words into stored knowledge is called information processing. The word, "process," means to change or convert something into a different form. The digestive process converts food into useful minerals; the learning process converts words into useful knowledge. Although learning is as natural as digestion, it may be helpful to reflect on the steps involved in the processing of verbal information. . .i.e., in "digesting" ideas.

(1) Verbal input must first be interpreted so as to identify the words. This is especially challenging in the case of listening because the sounds of speech appear to be an almost continuous stream of complex sounds. This challenge is most obvious when listening to a foreign language (or a lecturer who uses a lot of words you don't know). In the case of reading, although the words are clearly demarcated by spaces, the meaning of the words is often dependent on the context. Hence, in reading as well as listening, deciphering the signals may require some attention.

(2) The next step involves what is called "chunking" the information into phrases. We do not usually think in terms of isolated words, such as...the...large...red...paperback...book. Instead, we lump all of these words together into a single concept or mental image which becomes the unit for further processing.

(3) It is then necessary to process the chunks of information, by which we mean to determine what is the subject, the predicate, and the object of a sentence. Substantially the same information can be conveyed in a number of different sentences. For example, "John hit Jim with a ball," "Jim was hit with a ball by John," and "It was a ball with which John hit Jim," are different ways of saying the same thing. Parsing means to sort out who did what to whom with what.

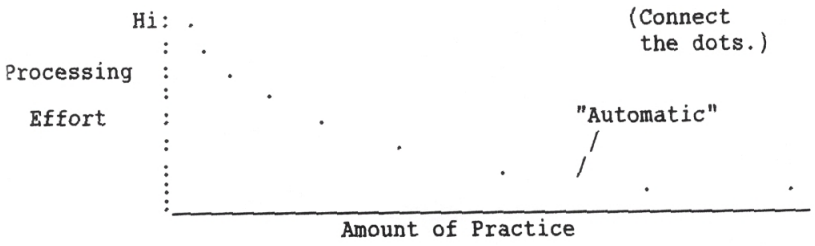

Figure 4.1: The amount of mental effort, or attentional capacity, required to process an item of information (e.g., 2 x 2 = 4) decreases with practice

(4) We use the word "coding" to refer to transforming words into their non-verbal ideas/thoughts/images/concepts. For the preceding sentence to be meaningful, you have to know who John and Jim are, what a ball is, and what it means to be hit with one. Actually, these meanings are somewhat unique for each of us, but verbal input must be coded into the non-verbal form that represents knowledge.

(5) Coded information usually brings to mind other information that is stored in memory and that has been somehow associated with the new information. Continuing the preceding example, perhaps you have been hit by a ball and the sentence may remind you of that experience. You might reflect on the type of ball involved, or where the ball hit Jim.

(6) Finally, the new information must become integrated into your own knowledge system. For example, your opinion of John may be influenced by this act, and your understanding of the relationship between John and Jim will be adjusted to include this new event. More generally, new information may be compatible with your existing knowledge and simply be added to it, or the new information may NOT fit with what you already know. When this happens, the correct solution is to change your earlier beliefs. We sometimes do this but we are more likely to dismiss the new information as being somehow unacceptable, or we distort the new information to make it fit.

When the steps involved in processing information are enumerated as I have just done, the task appears to take on formidable dimensions. Indeed, you may wonder how something you do so casually could be so complicated. The reason for this apparent discrepancy is that each time you process an item of information, it gets progressively easier. For example, when you first started learning arithmetic, the fact that 2x2=4 was probably difficult to process. You even had to learn what multiply means. But as you kept rehearsing that fact and integrating it with related multiplication facts, it became automatic. This idea is showngraphically in Figure 4.1.

Note carefully that, in this context, the word "automatic" does NOT mean an innate reflex, as it did with attention. Information processing becomes automatic when it is so well learned that it no longer requires your conscious attention. It is like riding a bicycle. At first, you had to pay close attention to keeping your balance,

steering, and pushing on the pedals; with practice, all those things became "second nature." This ability to process any familiar information automatically enables you to allocate all of your cognitive capacity to the new information.

4.3 Generating Verbal Information

Processing verbal information into your knowledge system is the input side of verbal fluency. The output side is generating verbal information from your knowledge system. Fluency is partly the ability to understand what you read or hear, and it is partly the ability to express your understanding in writing or speaking. Although in general, the better you are in processing verbal information, the better you are in generating verbal information, they are not quite two sides of the same coin.

The steps required to generate verbal information are the same as processing verbal information except in reverse order. That is to say, you start with the idea, code it into words, and ultimately you organize the words into meaningful sentences. But just as most people can't even spell their name backwards very fast (can you?), most people can't generate sentences about complex ideas nearly as rapidly as they can read them. In both cases, sufficient practice with the backward order leads to fast, automatic performance. However, recall that you learn what you practice. Thus, if you have practiced generating ungrammatical sentences, that is the kind of sentence you have learned to make.

4.4 Mental Time-sharing

The chances are that at least one teacher has asked for your undivided attention. Although this seems like a reasonable request, it is not really a very good strategy. At least insofar as undivided attention means focusing exclusively on the words being heard (or read), the evidence indicates that very little is learned. The most familiar evidence is the skilled typist who obviously attends to each word of a manuscript but later remembers almost nothing about the content. In the laboratory, people have engaged in a shadowing task. This requires them to listen through earphones to a lecture and try to repeat it word-for-word. Although most people can do this task quite well, they learn very little of the lecture. This last evidence is especially relevant because many students diligently listen or read on a word-for-word basis only to find that they don't understand very much.

To learn while you are listening to a class lecture or reading a textbook, you need to process the information concomitantly with listening or reading. And because only one thing at a time can be at the center of your attention, you need to divide attention between the words themselves and processing their meaning. This is called mental time-sharing ...switching your attention back and forth between two (or more) on-going tasks.

Mental time sharing is pervasive in everyday life. You frequently carry on a conversation while walking, you probably listen to the radio while driving a car, and you may even sing in the shower. However, there is a limit to how rapidly a

person can process information. You get confused if several people are talking to you simultaneously, or for that matter, if one person speaks too fast for you to follow what s/he is saying. You can carry on a conversation while driving a car unless the traffic is very heavy but you can't carry on a conversation while writing a theme or balancing a checkbook. The fact that we have a limited capacity for processing information constrains our ability to time-share several mental tasks.

Nevertheless, I believe that mental time-sharing is a learnable skill, one that can be improved with practice. By analogy, you might think of mental time-sharing as "juggling ideas." Now the reason you probably cannot juggle two or more balls is that you have never taken the time to learn how to do it. If you watch carefully, you will observe that a juggler only catches and tosses one ball at a time; the trick is to keep track of where the balls are, and to shift attention rapidly from one ball to the next. So too, the trick of mental time-sharing is to focus on one idea while keeping the other idea close to consciousness so that you can shift back to it rapidly. Although you have inadvertently developed some skill at doing this, deliberate practice at various tasks such as alternately counting and saying the alphabet will not only improve your skill in this particular task but also your general mental time- sharing ability.

Mental time-sharing is the secret to effective reading and listening. Do not just repeat the material word-for-word unless you need to memorize it. If you need to understand the material, you have to process the words while you are reading or listening so that the ideas will be meaningful to you.

4.5 Conclusions

"Were there a power, the gift to 'gee' us, to see ourselves as others see us." This quote from Robert Burns expresses an impossible wish; even the face looking back at you in a mirror is reversed from what others see. Your voice sounds different to you because it gets to your ears partly through the bones of your head. Nevertheless, it is important to try to envisage the way we appear to others because they tend to evaluate us largely by appearance.

Although physical features are important, the most critical feature of your appearance is verbal behavior. The fluency with which you use language is an almost fool-proof clue to your educational level. The classic way to improve verbal fluency was to study Latin because it was believed that "formal discipline" would transfer to English. Although that doctrine has never been disproved, it is probably more efficient to work directly on English. My hypothesis is that all of the verbal skills—listening, reading, thinking, writing, speaking—are inter-related so that effort spent improving one tends to improve them all.

Because world knowledge is non-verbal, college learning is not as much learning words as it is learning from words. That is to say, the words used in a college course represent thoughts or ideas, and your job is to learn those thoughts or ideas from the words spoken in lecture or written in the text. Words convey information, but you have to "process" the words in order to understand the information.

Processing verbal information is analogous to "digesting" words. Instead of merely

mimicking the words verbatim (maintenance rehearsal), you need to interpret the signals as meaningful units (words), chunk the words into larger units (phrases, clauses), parse the chunks into parts of speech (e.g., subject, predicate), code verbal information into nonverbal ideas and then associate the new ideas with old ideas that are already in memory. Elaborative rehearsal requires dividing attention between receiving and processing the information. This ability to time-share one's limited attentional capacity is learnable.

If the new information contains familiar ideas, these are processed automatically and hence require very little of your limited processing capacity. This is the reason why, in general, the more you already know, the easier it is to learn. The exception to this rule is when the new information is incongruous with your existing knowledge. In that case, it is not only more difficult to learn, but you may distort the new information so as to make it fit better with your old knowledge.

Processing verbal information is the input side of verbal fluency. The output side (speaking and writing) is equally important. Your mind would be a black hole if it could only absorb knowledge and not express it. To be sure that you have really processed an idea, rather than simply memorized it, professors usually want you to "put it in your own words." To evaluate your skill at paraphrasing ideas, you should do the exercises in Appendix.

In putting ideas into your own words, you will be judged not only by what you say but also by the way you say it. Educated people pay attention to their own grammar and hence will notice yours. You should review the points on grammar made in Appendix. Learning to recognize and avoid grammatical errors is an important aspect of verbal fluency.

4.6 On One Role of Motivation

A person may know very well what s/he should do and may also know how to do it reasonably well, and yet still not do it. As one example, this chapter has tried to focus your attention on the great importance of verbal fluency. The ramification, of course, is that you should devote a substantial amount of time and effort in trying to improve all aspects of your verbal skills. But something else is needed actually to get you to study and to practice. That something else is motivation.

Motivation refers to one's need or desire for something. Hunger and thirst are very primitive sources of motivation, but people in our society are more often motivated by fear of social disapproval or desire for wealth and status. Although I believe that people are motivated to learn just for the sake of learning, most students are also motivated to receive grades that lead to a degree and perhaps admission to graduate or professional school. Whatever its source, including pressure from parents and peers, motivation is the impetus that converts good intentions into action.

We can depict this view of motivation in an equation

$$Performance(R) = Habit(H) x Motivation(M) \tag{4.1}$$

where "habit" is one's knowledge of "know-how." When Thomas Edison was asked

why he was successful in inventing so many things, he said that "Invention is 1 part inspiration and 99 parts perspiration." I think that Edison understated the importance of good habits, but a good compromise formula for success would be

$$R = HM_10 \tag{4.2}$$

This formula says that both habit and motivation are necessary; you may be motivated to improve your verbal skills, but you can't do it if you don't know what to do. And, of course, the better that you know how to do something, the less time and effort, and hence the less motivation that may be required to accomplish the same goal. However, a little bit of knowledge can go a long way if you have enough motivation.

In principle, I could motivate you to practice verbal skills. I might attach a couple of wires to your body so that I could give you an electric shock any time you said, "Y'know." With that set-up, I am sure you would work on your vocabulary so that you could express yourself better. But in our society, you have to motivate yourself. The chances are that your parents have tried to bribe you from time to time in an effort to motivate you to do your best, but in the last analysis, you have to shock yourself into trying hard.

Chapter 5

Learning from Textbooks

The purpose of this chapter is to discuss how to use a textbook as a LEARNING/STUDY AID.

You should learn

1. The ultimate value of your textbook as a course overview.
2. The importance of a survey.
3. The critical difference between reading and studying.
4. The importance of marking up a textbook.
5. An alternative study sheet tactic.
6. Why frequent review is critical.
7. Why the place to study is important.

You should also study the following appendices

- On Reading/Redundancy.
- On Vocabulary.

You can think of an area of knowledge as being analogous to an area of the earth such as the Rocky Mountain area. An introductory text is like a relief map of the whole area. Its objective is to give you a comprehensive idea about the prominent features, the interesting views, and the challenging things to explore further. Your teacher will be your guide, but your textbook will be your principal source of information. You must get to know your textbook very well.

The analogy between a text and a map is a good one for several reasons. Most importantly, just as a map gives a picture of what is known about an area, a text describes the knowledge available at the time it was written. If the field is a relatively

new one, the text will be like those old maps drawn by early explorers. They are much better than no map at all, but they may not match the real world very well. Texts are more accurate in well-explored areas, but research is constantly changing our knowledge about them. Hence, bear in mind that a text is a fallible map of an area of knowledge.

One thing this means is that a textbook is not archival; texts become obsolete quickly. Whereas you should treat reference works and literature books with care, texts are intended for heavy but temporary use. Buying a book that someone else has already marked up and keeping your book clean so that you can sell it are ill-advised ways to economize. If at all possible, start with a clean book and mark it up liberally.

Before describing some useful tactics in learning from texts, let me describe the goal. Imagine this: In about an hour shortly before the final exam in the course, you should be able to turn though the pages of the text, notice at a glance what the important points are, and very quickly assure yourself that you understand those points. If you're not sure you understand, other marks on the page should amplify the ideas. You will spend many hours marking up the book while you are learning the material, but you should be able to review the whole course in less than one hour.

Step 1. Survey.

If you were going to lead an expedition through a new area such as the Rocky Mountains, you might just take off in the right general direction and hope all goes well. A better tactic, however, would be o send a scout ahead to search for the best route and alert you to possible difficulties. Similarly, it is a good idea to survey the entire text at the beginning of the course, to survey each chapter when it is assigned, and to survey each section before you start to study it. A survey gives a preliminary overview of the "lay of the land."

During a survey you read the headings and sub-headings, take notice of any italicized or bold-faced words, look at the figures or tables, and then read the summary if there is one. Ideally, a survey tells you what you need to learn. Insofar as possible, try to think up questions that you hope to answer from studying. Having specific objectives in mind guides study just as it guides an expedition.

Step 2. Read.

The importance of reading the text assignment before studying it depends on the difficulty of the text, the instructor, and your familiarity with the topic. Reading is an extension of the survey and is useful when you are not able to formulate your study objectives from a brief survey. It is also crucial that you at least read the assignment before class. For most courses, I found the first sequence shown in the following Table to be best. This is because most of my professors were very good; I found it easier to learn from them first and then study the text.

The second sequence shown in the above Table is preferable when you find the text relatively easy and the professor more difficult to understand. I have included the third sequence because it is a common one with students who have not yet learned how to learn efficiently. If you wait to study the text until just before the exam, you will learn less because you have missed out on the facilitating effect that the class and the text have on each other.

College learning requires a lot of reading. In preparing assignments, professors

Survey 1	Read 1	Class 1	Study 1	Survey 2	Read 2	Class 2	Study 2	Survey 3	Read 3	Class 3	Study 3
Survey 1	Read 1	Study 1	Class 1	Survey 2	Read 2	Study 2	Class 2	Survey 3	Read 3	Study 3	Class 3
Class 1	Class 2	Class 3	Survey 1	Read 1	Study 1	Survey 2	Read 2	Study 2	Survey 3	Read 3	Study

Table 5.1: Table showing several possible sequences of studying the textbook in relation to attending class. Note that all sequences have the same number of steps but some sequences may take less actual time

tend to be guided by the two-for-one rule (twice as many study hours as class hours for an average grade). In doing so, of course, they have to make some estimate of how fast you can read. If you read more slowly than they expect, their assignments will seem very long to you. Reading skill is therefore very important in college.

There are exercises in Appendix that should help you evaluate your overall reading skill. Because reading skill is heavily dependent on vocabulary, Appendix deals with the critical process of learning new words. I urge you to study these two appendices and follow through with whatever additional practice you may find that you need. Improving your reading skills now will be rewarded many times over.

Step 3. Study.

Reading is largely automatic which means that it doesn't require much mental effort. Reading is fine for literature or the newspaper but it is not enough for college learning. Verbal learning requires active participation. . .which is what we mean by studying. To study a text is to process and understand the information in it. To be sure that you are doing so, stop and paraphrase the main idea of every paragraph.

Marking up your textbook helps insure that you are processing the information and your markings also personalize the text for your future use. Recall that your goal is to be able to scan through the book, recall to mind all of the major ideas, and refresh your mind about any ideas that have become fuzzy. So you should mark up the book with that goal in mind.

The best way for you to mark up a textbook is one that you devise for yourself. To the best of my knowledge, there are only two important guidelines: Don't over-mark. To underline everything is the same as underlining nothing. Use several marking levels. Be able to distinguish key words, main ideas, useful points, and your own thoughts.

I can illustrate these points with my own system, but because I developed this system before highlight pens were invented, you can do much better today. I use multiple, heavy underlines for key words. This makes them conspicuous from everything else on the page. I use they are if I don't remember them when I read the key words. I use single black underlines for useful points, if they are short; for longer sections of useful points, I put brackets in the margin along the lines. Finally, I try to write something in the margin of every page. It may be a question, it may be an insight, but it is usually a succinct summary of what I learned from the text. The only thing about this illustration that I think you should emulate is that it makes me actively

interact with the text. I have to decide which are the key words, what are the main ideas, which points will be useful, and what I was thinking while I was processing all that information.

Step 3A. Study Sheets

Some students get excellent grades without marking in their textbooks at all. The alternative study tactic is to make written notes keyed to the pages of the text. Specifically, you can copy the material that you would have underlined on to study sheets in a loose-leaf binder. Obviously, it takes more effort to write than to underline but there is increasing evidence that the more mental effort required to learn verbal material, the better it is remembered. This may be simply because you spend more time thinking about the ideas while you are writing them down. But for whatever reason, a little more effort when you first study a text may save a lot of effort later.

There are several other advantages to this study sheet tactic of learning from textbooks.

1. In addition to color coding your notes, you can use different size letters to emphasize key words. And, of course, you can underline, circle, and draw arrows within your study sheet.

2. You can coordinate your textbook study sheets with your lecture notes on the same general topic. By using different color paper, you can merge all of your notes together in one binder and still know which is which.

3. Study sheets are very efficient for both learning and review. You can thumb through them just as well as a textbook, and they are more concise.

4. Writing study sheets may help you notice incidental things such as the spelling of words or the labels on graphs. You don't learn things you don't notice.

If you have never tried this alternative study sheet tactic, it will take a bit of practice to learn to use it to best advantage. But I strongly urge that you try it because it is the best method in some situations, and it is the only proper method in the case of studying library books.

Step 4. Review. . .review. . .review.

Perhaps you know that a "half-life" is the time it takes for half of something to disintegrate. For example, the half-life of wastes from nuclear power plants is many thousands of years, which is why it is difficult to dispose of such materials. In contrast, the half-life of original learning is approximately one day. About half of what you learn for the first time from studying a text today will be forgotten by tomorrow. Then half of the remaining half will be lost by day-after-tomorrow, and so on. You will never forget it completely but if you don't relearn it from time to time, you won't remember very much.

Increases with the number of times of relearning. Suppose the increase is equal to the square of the number of relearning trials. Then, if you review (and relearn) the text material for a second time, the half-life is now 4 days. After reviewing it a third time, the half-life is up to 9 days. This is why relearning the same basic ideas

gets easier and easier. As you remember more, there is less to relearn. Note that you simply can NOT learn it well enough the first time to remember it all. You have to keep relearning it through periodic reviews if you want to be sure to remember it some time later.

I cannot overemphasize the importance of including several review steps in the sequence given on the preceding page. An ideal time to review old materials is right before studying new material. If you take just a few minutes to page through the previous assignment, using your markings to help refresh your memory, you will find that your memory of the material is increased very substantially.

Step 5. Retrieve.

The last step in learning from textbooks is to prepare for the exam over the material. That topic is covered in a separate chapter but it assumes that you have already followed the other steps.

5.1 Where to Study

In general, college learning requires giving verbal answers to verbal questions. For example, if you were asked to paraphrase the Principle of Contiguity, you might say (correctly) that, "things that happen at about the same time become associated with each other." If I further asked you what you meant by "things," you would hopefully be able to explain that they could be stimuli that you see, hear, or feel, or they could be responses that you do, think, or feel. Great! That very principle implies that the likelihood that you will be able to remember those answers depends on where you learned the principle in relation to where you are asked the question. You will do best if you re tested in the same place that you learned.

The context—the room, the people and objects around, your own physical and mental state, even the time of day—is contiguous with the verbal material being studied. The context becomes a part of what is learned. How big a part depends on how well you can keep your selective attention focused on the verbal material, which in turn depends on how distracting the contextual environment is. This rule applies to BOTH the learning and the testing environments. That is to say, your score will be lower if the learning context is distracting while the testing context is not distracting, or vice versa. Furthermore, if both are distracting, your score will be lower if the type of distraction is different. Specifically, if you study with background music playing, and if you are tested in a cold room, learning while being distracted by sounds will not help your score when tested while being distracted by cold.

Accordingly, you should set up one study context that is as comparable to the test context as feasible Classroom chairs are not very comfortable, so use a hard chair in your study context. As a rule, there will be some moderate noises in the test environment so you don't need absolute quiet while studying. You wear street clothes when taking an exam, so don't wear pajamas when studying. Also, consider all peripheral sources of distraction such as center-fold pictures on the walls when designing a study environment.

Then, don't do anything but study in your study context. Recall that your mental

state can become associated with a context. If you don't develop competing habits, sitting down in your regular study environment will lead to attentive study behavior. So never permit yourself to day-dream, write personal letters, or doze off while you are at your desk. If you feel such mental activities coming on, get up and take a break until you can return intent upon studying. Soon, study habits will become strongly associated with your regular study context.

There is a diametrically opposite recommendation: Don't study only in your regular study context. In some—hopefully many—cases, the goal is more than just remembering the material when taking a course exam. The information might be useful in various later contexts and studying just to do well on the exam is usually poor strategy. To insure that verbal knowledge is context-free, so that you can remember it in any context, study in a variety of contexts. If you learn something in various contexts, you will know it in various contexts.

5.2 Conclusions

You may have heard that people who are drowning see their whole lives "flash before their eyes" in a few seconds. Although that may be an exaggeration, it shows how fast our minds can work. Your textbook (or your study sheets) is the way the whole course can flash before your eyes right before the final exam. For it to do so, however, you must have prepared your book and your mind for the occasion.

Imagine a page in a new textbook. The first time through, you made a cursory glance at the page doing your survey. The second time through, you read the material rapidly in order to get a general idea of what it's about. The third time through, you studied the page and distinctively marked a few key words, one or two phrases that summarize the main idea, and one or two sentences that explain and/or illustrate the main idea. Then, during review, you first look at the marked word(s), then the marked phrase(s), and then the sentence(s). With practice, a glance at the word will instantly refresh your memory of the page.

I have never found a freshman who hit upon this study tactic independently, and I have never found a student who really tried it and didn't like it. Periodically, at least once a week, start at the first page of the textbook and page through it up to the new section you are studying. The number of pages you must review gets larger as the term passes, but the time required for each page gets shorter the more times you've done it. Near the end of the term, you should be able to go through the early pages as fast as your fingers can turn the pages.

There is a subsidiary advantage to this textbook study tactic. Although authors try to arrange the material in a coherent order, so that each idea builds up to subsequent ideas, later ideas often help improve your understanding of the earlier ones. Hence during regular review, you are integrating the ideas into a more comprehensive view of the whole subject.

Most students get a chuckle out of one of my true-or-false exam items: "One should not be naked while studying." It could be a false statement IF one were willing to be naked when taking the exam! This item makes the important point that you

remember what you learn best the more similar the learning context is to the testing context. At the same time, if you study in a variety of contexts, you are better able to remember in various contexts. Also realize that the context includes your internal state such as hunger and test anxiety, as well as time-of-day and the seat you sit in during lecture.

One final note about your textbook. Sometimes what it says is different from what your professor said in lecture. Which should you believe? Recall that even the most current textbook was written over a year earlier and new discoveries may have occurred in that time. Your professor should have up-to-date knowledge, and therefore her or his statements are likely to be more correct. However, if the professor doesn't point out the discrepancy in class, he or she will be happy to answer your question about it. Even so, you should be ready to answer exam items that begin, "According to the text..."

5.3 On Imitation

You have probably heard the saying, "You are what you eat." In one sense, that saying is obviously false; you could not really become a chocolate-chip cookie no matter how many of them you eat. But in another sense, the saying is obviously true; your body can only make cells from the raw materials it is provided. It is now well established, for example, that malnutrition in childhood has devastating effects on the development of the brain. The saying is also true in yet another sense; the body must somehow dispose of everything it is fed. Whether it be a toxic substance such as alcohol or an excess of a nutrient such as sugar, your body somehow processes whatever you eat (or drink).

Even more than the body is what you eat, "the mind is what you learn". A classic view is that a mind begins life as a tabula rasa (a clean slate). A more contemporary view is that the mind begins with a number of pre-dispositions to develop in one way or another but even according to this view, the mind is primarily a result of the experiences the person has.

In contrast to the hard mental effort required to learn the kind of verbal material covered in college courses, other forms of learning are remarkably rapid and durable. Acquiring an emotional reaction of liking or disliking something can happen from a single experience. In such cases, learning results from mere exposure to the situation. Which is more, the experience does not have to be real. Beginning very early in life, we humans acquire most of our attitudes, beliefs, values, styles, and dispositions vicariously, from observation of others. Some psychologists think imitation is an innate human tendency; others contend that it is learned. Both agree, however, that a large part of socialization is derived from observational learning (imitation).

This means that your mind is whatever is has been "fed" in the past, and it will become whatever you feed it in the future. You feed your mind by the kind of books

you read, as well as the kind of music you listen to and TV you watch. There is simply no doubt that exposure to sex/drugs/violence begets sex/drugs/violence. It equally follows that exposure to love/health/benevolence begets those qualities. Some people conclude from this fact that socially undesirable activities should be banned from the public media. My own belief is that attempts to proscribe behavior will not work in modern society, and that knowledge is a much more powerful weapon than rules and regulations.

Accordingly, it is your choice whether or not to consume junk foods and obscene publications. It is not so much an occasional bite as your regular diet that determines who and what you are.

Chapter 6

Learning from Lectures

The purpose of this chapter is to discuss ways to maximize learning in the CLASSROOM.
You should learn:

1. That listening is an effortful response.
2. The importance of being prepared.
3. How to be mentally active in class.
4. Why you should rewrite and reduce your lecture notes.
5. The importance of review and recitation.
6. When learning may be consolidated.

There are very good reasons to learn how to learn from lectures. Most professors are, at least to some extent, egocentric. What this implies is that they tend to consider the information given during class to be more important than that in the text or other sources. Furthermore, most professors want to reward the students who attend class regularly by asking questions that can only be answered from information given in lecture. For both of these reasons, exams usually lean heavily toward lecture material.

Many educational theorists are critical of the lecture method of teaching. They generally consider a one-on-one tutorial arrangement ideal, and a large lecture class is diametrically opposite. The critic's image of a lecture was captured in a cartoon showing, on one side, the podium with the lecture being given by a tape recorder rather than by the professor in person, and on the other side, the lecture being recorded on tape instead of by the students in person. Insofar as that is an accurate image of a real lecture class, it would indeed be an inferior method.

However, a good lecturer does not rigidly follow a script but instead continually reacts to feedback from the class, sometimes slowing down to repeat a point, sometimes digressing from the main theme to give the class a mental rest, and frequently referring to current events of interest to the class. For their part, good students do not attempt to record everything the lecturer says but instead engage in what we

called divided selective attention. A lecture should require hard mental effort from everyone. Just like your body, your mind gets tired from doing hard work. Hence, one of the ways you can know whether you have been doing your job is to ask whether you feel mentally exhausted after listening to a lecture. If so, you have earned a break.

How does one improve his or her skills at learning from lectures? It is tempting to say that all one needs is practice, that proficiency will come naturally with experience. However, the Principle of Contiguity implies that practice only perpetuates whatever behavior is practiced, which means that one can only learn better skills by trying them out. The purpose of this chapter is to describe some steps in learning from lectures that I can recommend.

In doing so, however, I would emphasize again that the optimal learning strategy is to some extent idiosyncratic. We each have our personal style based on our unique composite of learning experiences. Hence, my real purpose is to encourage you to try out various alternative learning strategies in order to discover the one that is best for you. It may turn out that your current method is best, but even so, you will have benefited from trying out different techniques.

My recommended learning strategy requires ten steps. As usual, I will tell you why I think each step is important. You probably already know many of these ideas, but it is better to repeat them than to leave the picture incomplete.

Learning from Lectures Step 1: READ. The Scout motto, "Be Prepared," applies to students attending a lecture. Professors vary a great deal in how closely their lectures follow the text readings, but most professors presume that the students have at least read the assignment before class. Hence, the steps in getting the most out of lectures begin well before the lecture itself: Read the Text.

One reason that preparation is important in learning from lectures is to get past the awkward phase of being introduced to new ideas and concepts. Meeting a concept is something like meeting a blind date in that there are a number of superficial things to learn before you begin to find out what it really means. How a word is spelled, how it is pronounced, and how it is used in sentences are all tangential to understanding its meaning. A lecture is very much easier to follow if you are already acquainted with the terminology.

There are other reasons to prepare for a lecture by reading the assignment in advance. It may lead you to ask helpful questions in class, especially if the professor appears to say something that differs from the text. It may give you a general framework with which to organize the lecture, especially if the professor tends to ramble. It may also reduce your note-taking activity because you do not need to copy definitions and graphs that you know are in the text. The point is that lectures and texts are reciprocal learning aids. First, read the text to prepare yourself for the lecture, and then attend the lecture to prepare yourself for studying the text.

Learning from Lectures Step 2: READY. One way in which your mind is like a muscle is that your mind needs to "warm-up" before engaging in hard work. But warming up your mind is not quite the same as warming up your body because you need to set your mind for a particular subject. Engaging in a discussion on financial affairs does not prepare your mind for a lecture in Chemistry. Warming up your

mind is called "priming," and involves recalling old knowledge about a subject in preparation for adding new knowledge.

You can think of knowledge that is stored in your memory as being in a dormant state, available but inactive. Whenever you think about something, you activate those ideas into consciousness and also activate associated ideas into a near-conscious state. They do not revert directly to the dormant state but instead they gradually fade. Ideas that have recently been activated are easier to recall than ones that have been idle for a long time. It is less work to process a lecture if you have primed your mind by reviewing related ideas.

It is easy to get the basic idea of priming. Read each of the following words slowly, thinking briefly about their meaning to you: dollar...loan ...money...wallet...gold...bank. Now I would be very surprised if the word "bank" in the preceding list led you to think of the bank of a river. Having primed your mind with ideas related to fiscal matters, you are most likely to think along the same lines when new ideas are introduced. It is for this reason, by the way, that many people are concerned about violence on T.V., ads for alcohol, pornography, etc. If you prime your mind with sexy thoughts you will likely think of sexual interpretations of neutral stimuli.

My strong recommendation is that you arrange your schedule so that you can arrive at class a few minutes before the scheduled start of a lecture and prime your mind by reviewing your lecture notes from the last class. There may not be close continuity from one lecture to the next, but the important thing is to get your thoughts directed toward the relevant subject matter. Your mind will then be ready to start processing the new ideas you hear during the lecture.

Learning from Lectures Step 3: REACT. It is easy to listen passively to a lecture, and it is hard work to listen actively, with your attention divided between receiving information and processing it. The time to learn the ideas presented during a lecture is during the lecture itself. Many students think that their goal is to record as much of the information as possible so that they can study and learn later. There are two things wrong with this approach. In the first place, if you don't understand the ideas when they are presented in the lecture, it is very unlikely that you can figure them out later from your notes. In the second place, it is a waste of time.

In most lecture situations, active participation means only covert listening and thinking. But if the lecturer says something that you do not understand, then it is your job to ask for clarification. Recall that the lecturer is using words to try to explain a non-verbal idea. If you were paying attention and didn't understand what was said, it is the lecturer's fault, not yours. It is her or his job to put the idea into meaningful-to-you terms. . .assuming, of course, that you have a college-level vocabulary. You can't expect a professor to "dumb-down" an idea to words at a childish level, but you can expect different words and different examples aimed at clarifying the idea. Never leave a lecture confused. When active listening-thinking isn't enough, ask questions during or after class.

Learning from Lectures Step 4: RECORD. Almost every other book on college learning advises students to take lots of notes during a lecture, as many as three or four pages an hour. My advice is just the opposite: Take few written notes. I

hasten to remind you that the best learning tactics are idiosyncratic, and you must determine for yourself how many notes you take. The answer will probably not be the same for every course. But I recommend that you don't try to be neat, and take only as many written notes as you think you will need to remind you of what was said.

Why do I advise against taking lots of written notes? Because your mind can only think of one thing at a time; you have a limited capacity for time- sharing among different activities. Writing requires a lot of sustained attention. Take a moment to try this little exercise: Start tapping your non- preferred hand regularly on the desk at a rate of about two taps per second. Now try to keep tapping while you write anything that comes to mind. You will find that writing requires so much attention that even tapping becomes irregular. Similarly, unless the lecture is very slow and redundant, writing is incompatible with listening-thinking.

Taking notes IS NOT active participation. It takes much less mental effort to copy what the lecturer is saying than to process it. Many students don't understand a drawing that I put on the chalkboard because they are very busy neatly copying the drawing instead of listening to what I am saying about it. Learn first, then write notes. You may have noticed that I referred to "written" notes in the preceding paragraphs. Writing is the slowest of the verbal skills. If you write neatly for an hour, you can read what you wrote in five minutes or less...and you can think it in two minutes or less. Hence, my advice is to take lots of mental notes during the lecture, and only jot down enough written notes to remind you of what was said. In this context, don't worry about neatness, spelling, or grammar, and use any shorthand symbols you know or improvise. The lecturer may deliberately pause to give you time to write, but more generally, you need to keep your limited attentional capacity focused on the lecture and not diverted by the mechanical act of writing.

Learning from Lectures Step 5: Re_WRITE. If you do as I have advocated, you will probably find that your scribbled notes would not be very meaningful several days or weeks later. The ideas you learned in lecture immediately begin to fade from memory, and you will need more complete written notes in the future. Accordingly, sometime shortly after a lecture, and certainly that day or evening, you need to re-write your notes. I don't mean just copying them over neatly. I mean using your written notes to remind you of your mental notes, reconstructing the lecture in your mind, and then writing down in your own words as much as you think you will need when it comes time to prepare for the exam. You are not graded on your notes. Just be sure that you will be able to read and understand them later.

This re-write step pertains even if you decide to take a lot of written notes in class. A half-hour to refresh your memory now can be worth several hours of study later. This is because you not only have to get knowledge into your memory, you also have to be able to get it out, to remember it later. If you re-write your lecture notes in the way I have elucidated, recalling what the lecturer said and summarizing the ideas in your own words, you are completing the input-output cycle. In the process, you may find out that you really didn't understand something very well and you should ask the professor about that before the next class. But the main advantage is that you will have begun to practice remembering the information while it is still fresh in your

mind and hence it is relatively easy to recall.

Learning from Lectures Step 6: REVIEW. You may sometimes combine this step with the preceding one, but the ideal procedure is to re-write your lectures notes soon after the lecture and then review them again shortly before going to bed that night. The reason for this is given in the note at the end of this chapter on consolidation of learning. Of all the suggestions I have about learning, the cheapest in the sense of pay-off per minute, is to review your notes before sleeping. Just five minutes spent with your notes before bed-time can greatly enhance your memory of the material.

Learning from Lectures Step 7: REDUCE. Your notebook should become a second text for the course material. For it to serve that purpose, you need to have written your notes in such a way that you can mark up your notebook much as you do a textbook. As you can probably anticipate by now, I do not believe that there is any one best way to transcribe your notes. The most common method is to write in longhand in a spiral notebook. Because I had learned to type much faster than I could write legibly, I preferred to re-write on the typewriter. If you have a word-processor and a printer, using a personal computer could be an ideal technique. Any method with which you feel comfortable is as good as any other for you.

There is one important guideline in re-writing your notes: Be sure to leave plenty of blank space to write "short summaries" of the main ideas. The reduction step, condensing ideas into fewer words, is the real essence of mastering a subject. This is because we think in units called "chunks" of information. There is no fixed size of a chunk of information; the size depends on learning. But you can only hold in mind about seven chunks at a time, and so the larger the chunks, the more information you can process.

For example, if you are a baseball fan, the term "triple-play" is a large chunk of information. You not only know that it means to get three outs in a single play, but you have clear ideas of the most likely ways that this can happen. It may also mean a few unusual or very critical triple-plays in your experience. All of this is wrapped up in the single concept (chunk), but only if you have learned that much. The process of chunking happens automatically as you keep going over your notes, but you can facilitate the process by reducing your notes to concise summaries of the ideas.

Learning from Lectures Step 8: RECITE. There is one aspect of learning that all experts agree is very important but that only a few students practice: Recitation. In common usage, "to recite" means to repeat the material word for word, and that is appropriate if you are required to memorize something so that you can give the answer verbatim. As we use the term, "to recite" means to recall the material from memory, not necessarily verbatim.

Indeed, in most cases, word for word recitation is ineffectual. This form of recitation is called "maintenance rehearsal" because it holds the information briefly in your mind. This is what you do when you keep repeating a telephone number while waiting to dial it. If you repeat it enough times, you memorize the number. However, for most college learning, the best form of recitation is to put the material into your own words. This is called "elaborative rehearsal" because it requires you to recapitulate/describe/ explain the idea. Indeed, you should try to say it in a number of different ways, and where appropriate, you should try to give original examples

of the idea. Furthermore, you should spend at least half of your total study time rehearsing the material. "Going over your notes" should not mean simply re-reading them. You need to close your eyes or look away from your notebook and rehearse the ideas elaboratively.

This is the one stage in learning where studying with someone can be conducive to better understanding of the material. After you both have completed the preceding steps and are ready to practice recalling your knowledge from memory, you may find that having another student criticize your summary, and you, in turn, criticizing her or his summary, will sharpen your understanding of the subject. Because you bring different backgrounds to the subject, your thoughts may be somewhat different. Collaboration works best when you are approximately equally good students. You not only practice recalling ideas from memory, but you both gain new ideas.

However, recitation does not require another real person. . .an imaginary person will do very well. Those of us in the business all attest to the fact that the very best way to learn a topic is to try to teach it. Hence, one of the most beneficial ways to rehearse what you have learned is to imagine yourself teaching it to someone else. Which is more, you can conjure up different types of students: first a child to whom you must explain the idea in simple terms; next an educated lay person with a good vocabulary but little knowledge of the subject; then a fellow student who, for legitimate reasons, did not attend the class; finally, your professor who already understands the idea and wants to know that you also understand it. In this last case, your very brief summary will probably suffice. In my experience, reciting material in these various ways is an excellent context to learn to become your own worst critic. If you listen to yourself while you are reciting (or better yet, record your recitation so you can listen later), you can learn to grade your own performance. No one knows better than you whether you were trying to fake it or whether you really understand it but are having difficulty remembering it or finding words to express it. In the former case, you need to return to the review/reduce steps to learn it better. In the latter case, you need additional practice at recitation.

Learning from Lectures Step 9: Re_REVIEW. The basic principles of learning apply regardless of the source of the information. Thus, the arguments given in the last chapter about the need for frequent review apply to lecture notes as well as to the textbook. One of the most common tactical errors is to wait until an exam is scheduled before reviewing lecture notes. Even the best notes will have lost some of their meaning if you have not refreshed your memory of the ideas from time to time between the lecture and the exam.

One excellent time to review lecture notes is just before the next class, and one of the best places to review is in the classroom. Reviewing before class primes your mind for the next lecture, and doing it in the classroom where the exam will be given associates the recall of knowledge with that context. You get double benefit from getting to class a few minutes ahead of schedule and reviewing notes. When there is time to do so, my advice is to review all of your notes from the beginning of the term. As with the text, doing so will help you synthesize ideas from past lectures with the current one.

Learning from Lectures Step 10: RETRIEVAL. To a large extent, the antecedent

steps have gone a long way toward preparing you for an exam. However, there are a few additional tactics to consider. These are described in the succeeding chapter.

6.1 Conclusion

The most common teaching method used in college freshman courses is the lecture. Few professors were trained in how to prepare and deliver lectures and hence there is some justification for being critical of the method. However the lecture is here is stay and good students know how to get the most out of it. This chapter focused on ten steps involved in "getting the most" out of lectures:

1. Read. A good lecturer does not repeat the information written in the text, but s/he does assume that you have at least surveyed the assignment and read it enough to know the terminology.

2. Ready. Your mind can function best if it has been primed for the task by reviewing related material right before class.

3. React. The critical aspect of learning from a lecture is active participation. This must entail covert attention divided between hearing the words and processing them; it may also entail overt acts such as asking and answering questions.

4. Record. Your eventual goal is to process the information in the lecture and the more processing you can do in class, the better. Because writing uses a lot of your limited mental capacity, you should take lots of "mental notes" and only enough written notes to remind you of what was said.

5. Re-write. As soon as possible after class, while the ideas are still fresh in your mind, you should expand and organize your written notes so that you will be able to reconstruct the information accurately at a later time.

6. Review. Evidence suggests that experiences are not fully fixed in your mind immediately but require some time without disruption in order to be consolidated. Accordingly, a good tactic is to review your lecture notes shortly before going to bed.

7. Reduce. A key step in processing information is chunking a lot of information into a single unit. Analyzing, organizing, and condensing lecture notes should be a continuing activity.

8. Recite. At least half of your study time should be devoted to reciting the information. This may mean word-for-word memorizing of names, dates, and formula, but usually means expressing the ideas in your own words.

9. Re-review. In keeping with the Principle of Distributed Practice, it is very desirable to review your notes periodically. An especially judicious time to review is immediately before the next lecture; this also constitutes a mental warm-up.

10. Retrieval. This step refers to preparing so as to be able to recall it on an exam. Knowledge that you can't think of when you need it might as well not have been learned.

6.2 Consolidation Hypothesis

When, in the normal course of events, can we say that something you noticed is learned? Is an experience immediately stamped in your memory at the instant it occurs? If the "memory matter" is like a tape recorder, recording would be instantaneous. But if the biological substance is like camera film, it would need to be developed, and the image could be distorted or lost if it were re-exposed before being developed. There is reason to believe that this latter view is closer to the truth.

There are a few situations in the laboratory in which an animal can normally learn in a single trial. In one of these a rat is given an electric shock to the paws if it steps off of a small platform; in another, a rat is nauseated by being poisoned shortly after it has eaten a novel food. One experience in such situations is enough for the rat to learn to stay on the platform or to avoid the food. However, if within an hour or so after the initial learning experience, the rat is given electric shock through the brain, it later acts as if the earlier experience has been completely obliterated.

Lest you think this phenomenon is peculiar to laboratory rats and electric shock, let me mention two human experiences. One is pre-traumatic amnesia. A person who is involved in an accident that involves some head injury often cannot remember events shortly preceding the accident. The other is the alcoholic black-out. If a person drinks a lot one night, s/he may have no recollection of what happened that night.

The term "consolidation" has been given to the presumed process whereby learning experiences become fixed in memory. Although the evidence is not yet conclusive, many psychologists now believe that new learning is initially a very fragile process that is vulnerable to being modified by subsequent events. With the passage of time, and especially with repeated practice, the learning becomes more and more durable. One immediate implication of this hypothesis is that you should try to avoid doing anything that might clutter your mind with contradictory ideas right after a lecture or a study session. Engage in physical or social activities while what you have learned begins to consolidate.

One version of this hypothesis proposes that the consolidation process is effected most critically during the dream stage of sleep. I suggested earlier that memory matter may be produced by the brain during dream sleep and perhaps consolidation is a complementary kind of process. In any event, I advise students to spend a few minutes before going to bed in a brief review of that day's lessons. Doing so will refresh those ideas so that they can be fixed in memory when you are sound asleep.
NOTE: You may wish to use the space on this page to write comments/questions

about the contents of this chapter.

Chapter 7

Preparing for Exams

The purpose of this chapter is to describe some useful tactics to improve MEMORY. You should learn:

1. The distinction between learning and memory.
2. The purpose of exams in college.
3. How organization improves memory.
4. When mnemonics can be useful memory aids.
5. How to rehearse for essay exams.
6. How to learn negatives for objective exams.
7. The meaning of cognitive relativity.

You should also study the following appendix:

- On Mnemonics

Being tested is an inevitable fact of life in our society. Not only are there exams in college courses, there are tests that determine admission, placement, employment, advancement, etc. Hence, you had best adopt a positive attitude toward being tested. A good analogy is the marathon runner who has trained for months and now anticipates the payoff, the big race. Similarly, after you've spent many weeks and months studying a subject, a test is your chance to show how much you've learned. The only reason for you to be intimidated by an imminent exam is if you have not been learning your lessons.

I wish that I could say at this point that, if you have been keeping up with the assignments, preparing for an exam is easy. But the truth is that it is still an appreciable amount of work. To see why this is so, refer again to the fact that knowledge is not verbal:

What I hope is apparent in the figure is that the learning process in which you have been engaged is all for naught unless you are able to remember the information when called upon to do so. Now how many times has an answer been on the tip of

Figure 7.1: Learning is deriving non-verbal knowledge from words; memory is being able to recall that knowledge when taking an examination

your tongue such that you know you know it but just can't think of it? How many times have you remembered an important point, but not until after you have already left the exam? How many times have you given a good answer, but to the wrong question, or kept coming up with the wrong answer when trying to recall the right one? All of these familiar experiences illustrate problems of memory, the ability to remember nformation that you have learned.

The task of preparing for an exam, then, is one of finding ways to insure that you will be able to recall information quickly if you need it during the exam. It is NOT a matter of learning the information; it is too late for that. Nor is it a matter of reviewing the information as you presumably have been doing right along. What is now required is to devise techniques that will insure that you have ready access to the knowledge you have already learned.

It is worth repeating the marathon analogy to point out that very few of the runners who start in a marathon have any expectations of winning. For most of them the goal is simply to finish the race, and possibly to set a new personal best time. Likewise, your goal is just to do your very best to demonstrate how much you have learned.

7.1 Why give exams in college?

There are a few academicians who oppose giving exams in college courses. Their argument is that students should learn for the love of learning and that fear of exams creates an adverse, threatening atmosphere. I agree that learning can be intrinsic ally rewarding, but I also believe that there are several cogent reasons for giving exams in college.

The most obvious function of an exam is that of assessment. I earlier pointed out that most college courses are based on a mastery concept and an exam is most efficient way for the professor to find out whether your knowledge of the subject satisfies the criterion level for that course. This assessment function is also important to you because it provides feedback that may influence your future plans. For example, your career goals could be changed if you do well in a subject that is new to you, or poorly in a subject that is critical to some professions. At the least, feedback from exams is important in deciding whether you are prepared for more advanced work in a discipline. Even if the news is not always good, it is best to know your strengths and weaknesses.

Another important function of exams is that of a stimulator/motivator. What I mean is that almost everyone needs a clear signal that it is time to shift attention from learning to memory, and also some added motivation to do the additional work. You may know that organizing and integrating facts into a coherent body of knowledge is

important, but it is easy to convince yourself that you know you know the material, so you don't need to spend the time preparing to prove it to others. But in fact, learning something now is futile unless you can remember it in the future, and hence the incentive to prepare for an exam helps insure that you complete the learning-memory cycle.

To me, the most important reason for giving exams is to reward good students for having mastered the subject. Many students think that the teacher's goal is to detect students goofing off and to give obscure questions that most students will fail. There may be a few teachers like that, but most of us want you to learn, want you to do well, and want to give you a good grade as recognition for your accomplishment. You might prefer some other prize, but quality grades are the only tangible tokens that college teachers have to reward students who deserve them.

Most college professors would gladly give quality grades to every student in a class provided every student showed a high level of achievement. That is very unlikely, however, at least in typical freshman/sophomore courses. Now if good grades are to have their intended reward value for good students, poor students have to receive poor grades. A prize that all students receive regardless of their performance is not much of a prize at all. Students who earn low grades have to receive low grades if high grades are to function as rewards for students who earn high grades. Hence, a meaningful grading system will lead to a distribution of grades that corresponds to the distribution of student performance levels.

7.2 Preparing for Exams: Tactic 1: Organization

The most helpful thing that a student can do to prepare for an exam is to organize the pertinent information in some way. Although your mind is not designed like a filing cabinet, it can function that way when appropriate. If your knowledge about a topic is arranged in your memory systematically, you can search for it efficiently. On the other hand, if your mind is like a "junk drawer" into which you have put things haphazardly, you may know that it's in there somewhere but have difficulty finding it. Any kind of orderly arrangement of the information helps remembering it.

It is easy to show the efficacy of organization for memory. Do these simple exercises: Slowly read the following list of 12 numbers once, then close your eyes, wait about 3 seconds and then try to repeat the list in order: 3-8-1-1-6-2-3-9-5-4-6-2. Try another similar list: 4-2-5-8-1-2-9-3-4-6-5-1. Very few people can repeat a list of twelve random numbers.

Next, try to repeat a 12-digit list that has a simple, irrelevant type of organization. Read the following list as 4 sets of 3 digits: 838-572-614-691. Try another: 324-549-478-821. Although you probably cannot repeat all of these group-organized lists, most people do noticeably better than with the random lists.

Because I have used digits for these exercises, a relevant type of organization would be numerical order. Next, try to repeat a list of 12 digits that is numerically organized: 1-1-2-2-3-3-4-5-6-6-8-9. Try another of this type: 1-1-2-2-3-4-4-5-5-6-8-

9. You probably did much better on those lists (which, incidentally, are the same numbers as in the first two random lists, re-organized). Now, try to repeat a list that are organized both numerically and group: 112-345-667-889. Try yet one final organized list: 122-344-457-889. These last two lists are the earlier grouped lists put in numerical order, and you probably found them easiest to repeat. Organization helps.

Why does organization help memory if your mind is not really designed like a filing cabinet? Because you recall information from your memory by giving yourself recall cues. A recall cue is any stimulus that can elicit from your memory the information you are trying to remember: S (cue) –¿ R (information). Most of the time, the exam item itself serves as a recall cue: S (item) –¿ R (answer). It is when you can't immediately think of the right answer that you have to search your memory for the desired informa tion. Rather than just sitting there hoping that it "comes to you," you can remind yourself of the way you had the information organized and search for it in a systematic way:

S (item) –¿ search S (cue) –¿ R (answer).

There are many forms of organization and I shall illustrate some of them. They all share the property of showing how main ideas are related to each other.

One familiar and versatile form of organization is an outline. A good study outline organizes information under headings and subheadings. For example, let us outline the contents of this chapter thus far:

7. Preparing for exams

- A. Introduction
  - a. Positive attitude (show results of effort)
  - b. Learning vs memory (acquiring vs recalling knowledge)
- B. Purpose of Exams
  - a. Assessment (important regardless of outcome)
  - b. Stimulator/motivator (shift from learning to memory)
  - c. Reward (grade distribution)
- C. Tactics
  - a. Organization

* 1. Value (when need to search memory)

* 2. Types (outline, ...)

Note that the study outline includes the main ideas. Hence it not only organizes the key terms, it summarizes the important nformation. If you have studied the above outline, you are prepared for questions such as, "Why is it important to have a distribution of grades?" or "When is organization of knowledge valuable?" You hould have learned the answers from the text, but the outline can help you remember them on the exam.

Graphic means of organization are especially helpful because one can usually remember pictures better than words. Diagrams, figures, charts, and graphs can be used to organize many kinds of information, especially if it has several facets. Let me give one example: If you were preparing for a final exam over the material in this book, you might combine the figure shown in chapter 3 with the one at the beginning of this chapter. The aggregate figure would look like this:

Now connect the dots and end with pointed arrows first from knowledge up to speaker-writer, then down from listening/reading to knowledge, and then up again to examination. Next, let us add memorization to the figure. Because memorization doesn't require understanding, you can draw an arrow at the verbal level directly from listening/reading to examination and label it "memorize".

Further, the chapter on information processing pointed out that interpretation of what one hears or reads depends importantly on what one already knows. Hence, you can draw a return arrow back up from understanding to listening/reading to depict this bilateral relation. Label that return arrow, "interpretation." Finally, any new knowledge has to be integrated with old knowledge, so draw a circular arrow from understanding back to itself; label that arrow "integration."

What I hope you see is how a picture can organize information by showing the relationships among many of the ideas that were presented separately in a text. It is therefore valuable to develop skill in devising graphic techniques of organization. But remember,any kind of organization is helpful. Alphabetical, chronological, numerical, and hierarchical are other useful methods in the organization rubric.

7.3 Preparing for Exams: Tactic 2: Mnemonics

You may have had teachers who advised you against using mnemonic "devices." One of my teachers called them "vices" and equated using them to cheating. He was the type who believed that, because he had learned to do things the hard way, so should we! A much more reasonable view is that today's students need to know every trick they can in order to cope with the ever-expanding world of knowledge. You can use mnemonics as a recall cue to intervene between a question on an exam and your knowledge of the answer.

A brief introduction to some mnemonic techniques is given in Appendix. Skill in using them will serve you well not only in college but throughout your life. I therefore

urge you to practice using them at every opportunity.

7.4 Preparing for Exams: Tactic 3: Rehearsal

One age-old example of a good essay exam item is: "Make up a question and answer it." I tried using that item...once, and most of the students objected vehemently that the item was unfair, that they did not know how to make up good exam questions. Their job, they said, was to answer questions, not ask them! From that time on, I have required my students to write exam items as a part of their assignment. I assure you that writing and answering items is a very valuable tactic in preparing for exams.

Why should you write and answer questions over the material on an up-coming exam? The answer to that question lies in understanding the way we remember information. Something "comes to mind" when some cue that is associated with that information occurs. By writing exam items, you are making up various cues that will later help you recall the information. And by answering the items, you are practicing the very behavior required on an exam, namely recalling information from memory. Every time you recall something, it is easier to recall it again in the future.

Furthermore, making up items often forces you to think about the topic more completely. For example, this chapter began with the distinction between learning and memory. The most obvious exam item would be, "What is the difference between learning and memory?" You should first rehearse the answer, "Learning is getting information into your knowledge system, memory is getting it out."

Can you think of other questions the professor might ask to determine if you really understand the distinction? Making up and answering alternative items is what best prepares you for the exam. Let me suggest a few illustrative questions:

Why is the distinction between learning and memory important?
Which is more important, learning or memory?
Give an original illustration of the difference between learning and memory.
Why might a student not be able to answer an exam item?
Give an analogy to the difference between learning and memory.. . .Etc.

What I hope is clear is that "rehearsal" does NOT mean repeating the same thing over and over in order to memorize it. Rehearsal means to practice answers to various possible items over the same information. The more ways you have thought about it, the less likely you are to be baffled by the professor's item.

7.5 Preparing for Exams: Tactic 4: Negatives

There is a very good reason that you need to know what kind of exam you will be given: You should prepare somewhat differently for essay exams than for multiple-choice exams. In most essay exams, you are expected to be able to state/describe/explain what something IS. The rationale for multiple-choice (and true-false) exams, is that you are also required to be able to recognize what something IS NOT. If all of your preparation has been devoted to rehearsing what things are, you may be thrown off by alternatives on multiple-choice exams that illustrate negatives.

Imagine with me that you are teaching a young child what a dog is. You show pictures of various breeds of dogs, various sizes and colors, and various perspectives. You supplement the pictures with a verbal description about having four legs, a tail, a hairy coat, etc. After doing all that, you wait a few days and then ask the child to tell you what a dog is. The child could probably point to some dog pictures, and give some of the descriptions. But how well does the child know what kinds of animals are not dogs.

To find this out, you present pictures of several animals that look something like a dog: coyote, wolf, dingo, and a dog picture not previously shown. Quite likely, the child will be confused. In order to learn fine discriminations, people have to learn to identify negative instances (things that are not) as well as positive ones. I like to include multiple-choice exams in my courses because they make students learn such discriminations. Students who have not prepared properly will have to learn at the time of the exam but good students have already practiced negatives.

You cannot practice negatives by studying the text or lecture notes. Those are sources of positive information; both writers and teachers concentrate on explaining to you what something is. Rarely do we spend time or space illustrating what something isn't. However, that is a very important part of the learning process and one you need to do for yourself.

The best way to learn negatives is to learn how to write true-false and multiple-choice exams. Then you can prepare for such exams by trying to anticipate the kinds of items the professor might write. But be forewarned: Writing good multiple-choice items is hard mental work. Let me describe how to write multiple-choice items by writing one about such items.

A good multiple-choice item begins as a true statement. Indeed a multiple-choice item is actually a multiple-true-false item except you know one alternative is true and the others are false. In this example, the true statement is, "Multiple-choice exams are difficult because they...require identifying negatives." Now try to think of alternatives that are false, but that are plausible. Some possibilities:

Multiple-choice exams are difficult because they
a. require identifying negatives.
b. permit guessing
c. are ambiguous
d. test memory, not comprehension
e. involve speed as well as accuracy
f. deal with minute details
g. can be tricky
h. cover more material
i. . . .etc.

What I hope you notice is that, as you generate more and more false alternatives, you sharpen your understanding. Thus multiple-choice exams do permit guessing, but that is not what makes them difficult. They may be ambiguous, but any kind of ambiguous exam item is difficult. All exams test memory, and good multiple-choice exams also test comprehension. As you think through why the other alternatives are false, you should get a better grasp of why the critical feature is identifying negatives.

You should also notice that the difficulty of a multiple-choice item depends on how close to being true the false alternatives are. Think back to the child's task of picking out a dog. If, instead of similar animals, I had used a snake, a rabbit, and an elephant as the foils, the child would easily be able to identify the dog. So you see, the difficulty of a multiple-choice exam depends on just how plausible the foils are. Usually, when students malign an item as "tricky," they mean that one of the false alternatives seems to be very nearly true, and it requires a very fine discrimination to identify the correct answer. Usually, that is what the professor intended (like knowing the difference between a dog and a coyote).

7.6 Conclusions

Conceptually, the distinction between learning and memory is as straightforward as the difference between putting money in a bank and taking it out. Learning is the acquisition of knowledge, memory is the recall of that knowledge. There would be no reason to make the distinction if we could recall everything that we have learned. But the truth, of course, is that we forget things that we once knew very well. (Can you still name all of your elementary school teachers?) Hence, education is not just learning; it is also trying to insure that what you have learned will be accessible in the future. Preparing for an exam means going that extra step to improve memory.

The ideal fruition of college learning is doing well on a final exam. With that thought in mind, wise students start preparing for a final exam even while they are learning. Because organization is the most useful memory tactic, one can begin organizing information while engaged in periodic reviews. One does not need to wait until just before the final to start making up mnemonics for important material. And the third memory tactic, rehearsal, is also an inherent aspect of the learning process. Thus, memory can be incorporated into learning.

Conversely, one continues to learn when engaged in tactics for improving memory. Organization often reveals new relationships, and rehearsal of potential exam items enriches one's understanding. When preparing for a multiple-choice exam, searching for negatives should sharpen one's discrimination among similar concepts. Accordingly, it is also the case that additional learning accompanies memory tactics.

Even though the "putting in versus getting out" distinction is an over-simplification, the fact remains that preparing for exams is an important part of college education. Some colleges designate the week before finals as "closed week," meaning that no new material is to be introduced. Even without such external pressure, experienced professors usually conclude a course with a review and an overview of the material intended to help students prepare for the final exam.

An upcoming exam serves to alert students to the need to devote time to the memory tactics. The most appropriate tactics depend to some extent upon the nature of the exam. For essay exams, making up items and rehearsing answers in one's own words is the best preparation. In this process, one should try to write several different items over the same material in order to broaden one's perspective. This tactic practices recall of information as required on essay exams.

For multiple-choice exams, making up items is also the best way to prepare. In this case, one should try to make up as many sensible alternatives as possible in order to practice recognizing negative as well as positive foils. Multiple-choice is the preponderant method in freshman courses because it is an expedient way to assess learning in a large class. Hence, skill in detecting subtle differences is an essential one for success in college.

One final word. Ask the professor if there will be names/dates/places on the exam. If not, don't waste time with rote memorization of trivial details.

7.7 Cognitive Relativity

"Measurement" is any procedure used to find out how much of some- thing a person has. We measure your height by counting the number of inches from the bottom of your feet to the top of your head. This is an absolute measure because we know what zero length means and we have a fixed unit like the inch to use in measuring length. To say that you are six feet tall means that you stretch out 72 inches from bottom to top.

We could be interested in a relative measure of height. How tall are you compared with others of your age and sex? How tall are you relative to the other people in your family or in your social group? Relative measures compare you with other people; six feet would be tall in a college sorority, but it would be short on a men's basketball team.
In contrast to height and other physical properties that can be measured both absolutely and relatively, there are no absolute measures of cognitive attributes.

Principle of Cognitive Relativity
All measurements of cognitive factors are relative
(i.e., one can only measure individual differences.)

To illustrate the principle with intelligence, we don't know what zero intelligence would mean and we don't have units of intelligence to measure how many you have. The only way to measure intelligence is relative to other people. To say that your IQ is 100 means only that you have average intelligence; the higher your IQ, the smaller the percentage of people who are as intelligent as you are.

Knowledge is a cognitive factor. Accordingly, a test can only measure how much you know about a subject relative to how much other comparable students know. Students sometimes ask whether an exam is graded "on a curve," and the answer is that exams are always graded on a relative basis. Experienced teachers write exams at the level that is appropriate for a given class based on knowledge of what the students in previous classes have done. In some situations, it may be possible to state, in advance, that scores in a particular range will receive a particular letter grade. Even so, the grading "curve" is based on tacit expectations from past experiences.

Once you understand that the purpose of exams is to measure how much you know relative to other students, it should be clear that an item that everyone gets right (or wrong) is of no measurement value. A good exam will have some items that only the worst students should miss, and other items that only the best students should get right. Your goal is to get a few more right than the other students do.

Chapter 8

On Taking Exams

The purpose of this chapter is to describe the nature of an EXAM-TAKING STRATEGY.

You should learn:

1. The importance of surveying the exam.
2. A way to insure that you read carefully.
3. The value of marking-up the exam sheet.
4. Why you should skip items.
5. A number of multiple-choice tactics.
6. When to change answers.
7. When and how to guess.
8. A number of essay tactics.
9. The role of test anxiety.

You should also study the following appendix:

- Appendix On Writing

It was a familiar routine to me: Stay up very late trying to cram for an exam, catch a few hours of fitful sleep, get up at the last minute, arrive at the exam late, and then race through it in order to get it over with as quickly as possible. There is no better formula for failure. This chapter is primarily concerned with the last step–taking an exam–but let us first review the earlier steps.

1. The night before an exam is too late to learn the material. Spend your normal study time insuring that you will likely remember however much you have already learned.

2. A full night's sleep is critical for consolidating your mnemonics and for supplying your brain with the substances that you need to think creatively during the exam.

3. Your brain requires at least an hour or so after sleep to reach peak efficiency; don't nap before an exam and get up in plenty of time to be wide awake and alert to the complexities of the exam.

4. Recall that your mind needs to warm up by being primed with words that are relevant to the exam. As with a lecture, the best place to do this priming is in the room where the exam will be given.

5. When you get the exam, follow those tactics that you have found work best for you. The following advice is just that; you will need to adapt these tactics to your own style and to the special circumstances of an exam.

Your overall strategy is determined by the goal of using the exam to demonstrate your knowledge of the material. An exam has a time limit and can only sample some of the relevant information. For your part, you probably understand some ideas better than others. Although there may be some luck involved in how closely the items on the exam correspond with the ideas you know best, the chances are that if you understand X percent of the material, you will be able to answer about X percent of the exam items. This correspondence implies the first test-taking tactic.

Survey the exam. Before beginning to answer items, you should get an overview of the structure of the exam so you can plan on the allocation of time. Does the exam generally follow the sequence of topics covered in the course? If there are several sources of items, are they organized separately (such as text items distinct from the lecture items)? Are there different types of items, and what weights are allotted to them in computing your score? How long is the exam? If there is a time limit, how fast will you have to work?

The point is that you do not have to answer items in the order in which they appear on the exam. Especially if there is any chance that you might run out of time, you should start on sections of the exam that deal with material you know best. In general, you should first survey the exam so you can pace yourself while taking it.

Read carefully. The most common error made by typical students is giving the right answer to the wrong question. If you mis-read an item, you are going to miss it no matter how good your reasoning. An excellent antidote to this ever-present danger is to force yourself to paraphrase the item in your own words and then re-read the item to see if it still means what you thought the first time you read it. With multiple-choice items, if you think that there are several potentially correct answers, you have a strong reason to re-read the stem carefully.

The most frequent reading error on exams is leaving out a critical word...usually a negative word such as not, none, least, fewest, and the like. For reasons that are not well understood, it is much more difficult for people to process negative sentences. Some scientists believe that we always treat a sen tence as being positive, and we put a little mental tag on some to remind us that they really were negative. Then we forget the tag. Hence, reading carefully means in particular to be alert for negative terms.

Mark up the exam sheet. For some reason, most students tend to treat the exam sheet as if it were a valuable document. Actually, it is a throw-away that is exclusively for your use. You not only can but you should mark it up extensively. One reason was given in the preceding tactic; if you make it a point to underline the key word(s)

in each item, you are less likely to mis-read them.
Here are a few more ways you can profitably mark up the exam:

1. If you think you might forget a formula, or some other important information (such as which date goes with which historical event), you can prime you mind with it just before getting the exam, and then jot it down before starting to survey the exam.

2. When there are both essay and multiple-choice/true-false items, read the essay items first and then make notes of ideas about them as they occur to you while working on the objective part.

3. If you can keep the exam, be sure to make notes of your answers. Then as soon as possible after the exam, look up the correct answers to those items about which you were in doubt. (If you cannot keep the exam, ask the professor if you can use an extra sheet of paper to jot down questions you need to check.)

Skip items.

If you had an unlimited amount of time to take an exam, it might make sense to answer the items in order. If they are arranged in some logical order, answering each item could help you in answering later items. Even in this case, however, I believe that the arguments favoring skipping difficult items should prevail. One reason is that your answer to a difficult item may be wrong and it could then "help" you to the wrong answer on later items. Another reason is that you can get mentally tired trying to figure out the answer to difficult items and then be less alert for the easier ones. As a general rule, therefore, it is best to skip items that you find difficult and return to them later as time permits.

There is a more positive way to state this tactic. Answer the easiest items first. On multiple-choice exams, for example, you can mark your answer on the exam sheet but only mark it on the answer sheet if you are reasonably sure it is correct. Answering items that you feel confident about first is like putting money in the bank; it gives you a more secure, positive attitude toward taking the rest of the exam.

Multiple-choice tactics: Students sometimes refer to multiple choice exams as "multiple-guess." To be sure, such exams do give you an opportunity to guess when you do not know the answer, but one can guess on any kind of test. As I pointed out in the preceding chapter on preparing for exams, the reason some students find multiple choice exams difficult is that students are liable for knowing what is wrong as well as what is right. There are a few special tactics to follow when taking multiple choice (and true-false) exams:

1. The person-on-the-street foil. An exam is intended to determine how much you have learned from a course. This implies that a random person-on-the-street who has not taken the course should not know the answer. Why give credit for something that "everybody knows?" This also implies that, if one of the alternative answers is one that any person-on-the-street would choose, it is wrong. Common knowledge is not always wrong in life, but it is wrong on college exams.

Accordingly, when an answer seems so easy that it's "too good to be true," it is almost certainly false. In some disciplines, one of the major goals of an introductory course is to counteract some of the popular misconceptions about the field. In any event, the correct answer should be something you learned from your studies, rather than something you "picked up" somewhere.

By-the-by, a person-on-the-street foil is quite likely to be the first alternative in a multiple-choice item. A good exam writer knows that poor students often simply choose the first good answer to appear, without bothering to read all of the alternatives. Hence, be especially suspicious if the first alternative is "obviously" right. (One of the best antidotes to this tendency is to read the answers in reverse order!)

2. The gambler's fallacy. Most of us have a very bad habit. It is the belief that the Law of Averages applies in the short run so that if something has gone one way several times in a row, it is due to go the other way to even things out. For example, if you flip a coin and it comes up heads three or four times, you start to feel that it's got to come up tails next. Actually, the true odds do not change regardless of how long a run of heads has been flipped (assuming that it is an honest coin), but our hunches are influenced by knowing that the coin will turn up tails half of the times...in the long run.

Almost certainly you have had that feeling taking a multiple choice exam. If you notice that you haven't marked a "D" alternative for a while, you begin to think that a "D" is due. On a true-false exam, if you mark a series of items "true," you begin to think that a "false" is due. BEWARE. In the first place, good exam writers do not worry about having every alternative position equally-often correct. And in the second place, you might have missed an earlier item and be guided by the gambler's fallacy to miss a later item.

3. Negations. As I said earlier, everyone has difficulty with negative statements. Perhaps that is because knowing that something is wrong usually doesn't tell you what is right. (For example, "Don't do it too often," doesn't tell you how often you can do it.) The most difficult type of exam item is when you have to recognize that a negative statement is true. Hence, searching for the correct alternative in an item such as, "Which of the following is not...?" requires very special caution. For me, the best approach is to rephrase the item into a positive form, "Which of the following are..?" and then find the negative alternative by eliminating the positive ones.

4. Some tactics depend upon the professor's knowledge about writing multiple-choice items. Very few of them had any actual instruction in constructing good items, and you can sometimes use their weakness to your advantage. Here are a few tips:

A. Longest foil. It frequently takes more words to write a true alternative than a false one. While you are answering the easy-to-you items, note whether the correct alternative tends to be longer than the others. If so, you might profitably favor the longer alternative on more difficul items.

B. Asymmetrical foils. When there are several parts to answers, the alternatives may not be symmetrical. For example, with 3 choices from A-and-B, A-and-C, D-and-C, note that A and C occur twice while B and D occur only once. Very probably the answer is A-and-C. This is because the professor wanted to make the item equally

difficult if you knew only one part. (If you knew "A" it could be B or C; and if you knew "C" it could be A or D.)

C. Sequenced foils. Sometimes the alternatives fit a numerical or other logical sequence. Professors have a tendency to list answers on both sides of the correct one; hence, the extremes are usually not correct. For example, "water boils at: (a) 192 degrees, (b) 209 degrees, (c) 212 degrees, (d) 222 degrees." The correct answer is most likely 209 or 212. Note further that there are 3 2's in position one and 3 2's in position 3. The asymmetry thus favors 212! (The exception to this rule is when the correct number is much smaller or much larger than the uninformed person would think likely.)

D. Cop-out foils. Because it is sometimes very difficult/impossible to write enough really plausible alternatives, some professors resort to the "all-of-the-above," "none-of-the-above," or "a-and-c-above" foils. A professor who does this will occasionally make such an answer correct but the percentages are definitely against it. (If a cop-out foil is correct, it is most likely "none-of-the-above" because the other cop-out foils are easier to recognize when they are correct.)

E. Ultimate foils. In the real world, it is very rare that truth is ultimate. Hence, words such as only/every/none/always/never seldom appear in a correct alternative. Similarly, correct answers rarely contain words such as exactly/perfectly/ identical. (Again, the usual exception is when the uninformed person would not think it likely. For example, it is hard to believe that a light pebble falls exactly as fast as a heavy metal block.)

5. To change, or not to change, answers? Conventional wisdom says that you should not change answers on true-false or multiple-choice exams. You may have been given such advice and accepted it without asking "Why?" If you have missed some items that you originally had right, you may believe in the no-change rule without exception. The truth is that a never-change rule is better than an always-change rule, but there is a still better rule to follow.

First, let me explain why the never-change rule has merit. We all have a strong, innate alternation tendency. Try this exercise: Close your eyes for about 30 seconds and say numbers between 1 and 9 in a random order. Please do it before reading further. Now think back and try to remember how you were coming up with numbers. The chances are that you never, or almost never, repeated the same number twice in order. Actually, you should repeat numbers one-tenth of the time, but our natural inclination is to alternate among any choices that are nearly equal in value. If for whatever reason you have said one number, you are likely to say some other number next.

This alternation tendency is widespread. We tend to vary what we choose from a menu of things we like to eat, we rarely play the same record over and over, we get bored by TV programs that seem to repeat the same basic plot, and as the saying has it, the grass always seems to be greener in the other yard. Similarly, if two alternatives on a multiple-choice exam look about equally attractive to you, after you choose one of them the first time through, the other will look better the next time through.

Changing answers can result from this natural tendency to alternate choices.

Now even when you are not really certain about an answer, your first choice is likely to be based on some knowledge about the topic. Insofar as that is true, then changing answers because of alternation tendencies is a poor tactic. Now that you know why the never-change rule is popular, you can follow the best rule: Change answers ONLY when you find something you overlooked the first time. If you review the exam with the benefit of having taken the rest of it, you may see some different perspective on an item. The rule says to change your answer if you have a better reason than simple alternation.

My evidence is that students who understand this rule are about twice as likely to change answers from wrong to right as vice versa. It is easy to see where a student has erased an answer, and I find that almost all of the better students do change a few answers, and do so correctly most of the time. But beware of the grass-is-greener tendency to change just for the sake of alternating.

6. To guess or not to guess? I recommend that you guess when you are not sure of the answer. Even if there is a correction for guessing, you should at least break even if you guess intelligently. And when you can eliminate one or two alternatives, guessing should improve your total score. But the secret is to really-guess, not pretend-guess. Really-guessing is to make the choice without regard to the content of the viable alternatives.

You must guess by rule, not by intuition. Intuition usually leads to the person-on-the-street wrong answer, and that form of guessing" leads to learning your guesses. I have already given you several potential guessing rules, such as the longest alternative, the asymmetrical alternative, or the intermediate alternative. When these do not apply, you need some other consistent guessing rule if you want to guess intelligently. As one example, I usually guess "false" on true-false exams. My reasoning is that there are many ways for an item to be false but only one way for it to be true. (For example: Columbus discovered America in 1492; he did not discover America in hundreds of other possible dates.) However, some professors prefer to accentuate the positive, and it is easier to write true statements than plausible false ones. Hence, before guessing, it is a good idea to scan back over the items you have answered. If there are noticeably more true items, then the best tactic is to guess "true." In any event, it is best to leave the answer blank while taking the exam, and guess without even looking back at the item.

Another good guessing rule is to toss a coin. If you can reduce the viable alternatives of a multiple choice item to two, don't guess your "hunch," but leave the choice up to chance. Any rule that you decide upon in advance is fine. For example, the first viable answer on odd numbered items, and the second on even numbered items. There are a few supplementary rules that I have found helpful.

I rarely "guess" either the first or the last alternative in a multiple choice item. As I noted earlier, when there is a person-on-the-street foil, it is likely to be given first. Furthermore, it is sometimes impossible to construct enough really good alternatives, and the last one is frequently simply a sensible-sounding filler. Accordingly, I usually choose a middle alternative, and toss a coin when both viable alternatives are middle

ones.

Essay items. The most important thing to bear in mind when you are writing an answer to an essay item is that grading is subjective. Professors can devise reasonably objective ways to score answers to essay items (for example, by simply counting how many relevant points are included), but basically, grading essays is a personal judgment. For this reason, anything you can do to create a positive reaction will tilt the grade in your favor.

The first thing to do with an essay item is to locate the action word. Next, identify the objects of that action, and then reflect on what the professor might want. With some action words, there is no doubt about the intention while others are less directive. In every case, remember that the professor wants you to show what you learned in this course, not common knowledge.

"Define" asks you to give a general statement of what a term means. You can give a memorized definition, or you can usually paraphrase it into the vernacular. Note that "define" is not the same as...

"Illustrate" (or "Give an example of), which asks for a specific context to which the term applies. Thus, the "gambler's fallacy" is defined as the belief that the odds that a chance event will occur increase the longer the time since it last occurred. An illustration of this is the tendency to favor "true" after having answered a series of items "false." If the item calls for an original example, you will get, at best, partial credit for one given in the text or lecture.

"Compare" and "contrast" are general action words. To compare tends to focus on the similarities of the objects whereas to contrast focuses more on their differences. You can feel confident if, in comparing objects that seem very different, you can identify some interesting similarity, or if, in contrasting objects that seem to be similar, you can identify some interesting difference. Always indicate both sides, but focus on what the item asks.

"Describe" and "discuss" are the most general action words; they ask for a narrative about the object. To describe tends to focus more on objective features whereas to discuss focuses more on your subjective evaluation. In describing an object, you should give more than its definition; tell why it is interesting. In discussing an object, give some rationale for your opinion.

"How," "Why," "What," "When," "Who," etc. are common action words for short essays. Their meanings are familiar in the vernacular, and it is important to answer the question asked. Once you are certain that you understand what the professor wants, you are ready to take the following steps:

1. Plan the essay. Under the pressure of taking an exam, one's natural tendency is to start writing the first thoughts that come to mind as soon as you finish reading the question. Rarely is your first impulsive answer your best answer, and even when it is, you can often state it better if you have thought it through before starting to put it in writing. It is harder to change your mind after words are down on paper and it takes a lot more precious time to write than it takes to think.

Accordingly, a very important tactic in answering essay items is to plan your

answer before you start writing. Organize your thoughts and if it is a long essay, make an outline. Then, after thinking through your potential answer, re-read the question to be sure that you have really answered it. Only then are you ready to write.

2. Be direct. Short, definite statements make the best answers in a test situation. Remember that the professor (or the grader) has a number of exams to grade, which means s/he will resent having to try to figure out the meaning of long, rambling sentences.

3. Be concise. Brevity is the hallmark of a good essay answer. In particular, cut out the bull! It is not the case that graders are impressed by long answers; on the contrary, they may grade you down if they feel you could have said everything you had to say in many fewer words. Again, don't make the reader think you are wasting her or his valuable time with meaningless or redundant verbiage.

The length of an essay should correspond to the number of points it is worth. It is always important to be as concise as possible, but if an essay counts a lot, the professor thinks you should have a lot to say. Conversely, don't overkill a low-point item.

4. Be pertinent. Some students use a shotgun approach to essay items. They try to write down everything they know about a topic in hopes that something they say will answer the question. You may lose some credit for including information that is true but not pertinent.

5. Be literate. Professors realize that you are under time pressure when taking an exam. Hence, they do not expect "perfect prose" in your essays. At the same time, they can't help noticing sloppy sentences, poor paragraphs, and incomplete ideas. A literate essay will not earn you a good grade for a wrong answer, but an illiterate essay may lower your grade for a right answer. This is true in all courses, not just those in English composition. A few points about literate writing are contained in Appendix. You should review those points not just for the purpose of writing essay exams but as an important aspect of general verbal fluency.

6. Good appearance. I have said that grading an essay involves a subjective judgment. Even if the grader tries to be objective when reading your essay, s/he will be influenced by the appearance of your essay. Always use a dark pencil or pen, and write legibly. Be neat. Try to avoid erasures or cross-outs, and especially changes that you try to crowd in between lines. If you need to insert something, put an asterisk in your essay and put the inserted material at the bottom of your essay.

7. Re-read your answer carefully. Sometimes, students ask me to re-grade an answer. It usually turns out that they have mis-read the answer even knowing that it received a low grade. When I point out what they actually said, the response is, "What I really meant was.." To which my response is that all I know is what you wrote, not what you intended to write. It is always difficult to proof-read one's own writing, but it is an important skill to develop.

8.1 Feedback

At first I thought it was amazing. I would give an exam one day and go over the answers the next meeting of the class. Especially if a number of students missed an item, I would review the material in order to explain the correct answer. Then I would give the same item on the final, and many students would still miss it! They remembered their first answer better than my correction of it.

Since that time, I have always left time to go over the correct answers immediately after the students finish taking an exam. Doing so presumably interferes with consolidation of the wrong answers, and it also gives the students some immediate feedback about their score. However, very few professors understand the importance of correcting errors right away, and so you will have to make special efforts in an attempt to insure that correct answers supersede your initial wrong ones. The best way to do this that I know is to try to remember both answers.

8.2 Cheating

Try not to expose your work in such a way that your neighbor can see your answers. Everyone naturally glances around during an exam, and even if a person doesn't intend to cheat, s/he sometimes can't help seeing what you wrote. If you see someone deliberately cheating, report the fact to the professor. (You don't need to accuse anyone.) Remember that your grade is based to some extent on what other people do, so people who cheat are cheating you. They should be treated with the contempt they so richly deserve.

8.3 Conclusions

As is also true for most activities, attitude is very important to your performance on an exam. An apprehensive, positive attitude will help you do your best....and your best is all that you or anyone else can reasonably expect. Get a full night's sleep, get up in time to be fully alert, prime your mind with relevant ideas, and expect to show what you know. Survey the exam so you can decide how to allot your time (writing "time" because you couldn't finish gets no credit, just a low mark for poor planning). Then follow the instructions!

As you read an item, try to figure out what the professor had in mind when s/he wrote it. Each item is intended to find out whether you understand some idea covered in the course. If you see what the item is trying to get at, you usually know how to answer it. In the process, don't commit academic suicide! Answer the item the way the professor wants, even if you think it is wrong. It is much like not stepping into a crosswalk when a speeding car is headed your way; it is better to be wrong than to be dead right. Always try to give the answer that the professor wants.

Carelessness is a major cause for doing poorly on exams. It is easy to misread material in any stressful situation, and it is also easy to mis-mark an answer sheet or mis-write an answer. Good test-taking habits include underlining the key words in an item, paraphrasing items, and saving time to re-check the answer sheet and re-read your essays, More generally, an exam is a context in which haste can make waste because it requires careful, thoughtful behavior. Deliberately be deliberate when taking an exam.

Multiple-choice and true-false exams require you to recognize the correct answer and to discriminate it from wrong answers. They are called "objective" because they can be scored by any person or even a machine. No real judgment is involved in counting how many of your answers match those considered by the professor to be correct. No one can accuse the grader of being biased in scoring an objective exam, but it takes a great deal of time and effort to write good multiple-choice or true-false exams.

In contrast, essay exams require you to recall the correct answer and some subjective judgment is involved in deciding how closely your answer to an essay item corresponds to what the professor wanted. The essence of writing good essay answers is to be "reader friendly." Essays that are organized, concise, pertinent, and neat are more likely to elicit a positive subjective response in the grader and a good grade.

Because recognition is generally easier than recall (you recognize a person you have seen before but you can't recall her/his name), some people think that multiple-choice exams should be easier than essay exams. This is not necessarily true. The difficulty of a multiple-choice exam depends on how plausible the foils are. Especially if you have not studied negatives, the multiple-choice exam may be much more difficult than recall aided by mnemonics.

Remember that you do best on a test if you have rehearsed the material in the test environment. If you are having some difficulty recalling something while you are taking a test, try to imagine yourself back in the place where you studied. Close your eyes and conjure up the study environment. The answer may come to you in that context.

Let me end with a by-now-familiar story. It is about two men who were fishing near the shore of a lake. They hear a noise, and see a bear coming at them across the meadow. One man stoops down and begins to take off his wading boots. The other man says, fearfully, "Why are you doing that? Don't you know you can't outrun a bear!" The first man replies, "I figure I don't have to outrun the bear. I just have to outrun YOU!" Similarly, when taking an exam, outrunning the bear would be having to know everything. You can't do that. All you have to do is know more than most of the other students. That's the way to survive in college.

8.4 On Anxiety Motivation

In an earlier postscript, I emphasized the essential role that motivation plays in getting us to work hard, to strive for goals and to persevere in spite of difficulties. In that

context, I was concerned with motivation as an energizer of action. The message was that knowing what to do and how to do it is not enough; actual performance also requires a large measure of desire. But motivation is actually more complicated than just energizing behavior.

Principle of Motivation

Motivation serves both to energize and to guide behavior.

This principle says that motives not only arouse us to act, but they help determine which action we choose to make. For example, when you get hungry, you are not just motivated to do anything; your behavior is directed toward some kind of food-getting action. Alternatively, you may be equally motivated by thirst but now your behavior is directed toward getting water. In general, you tend to do something that is relevant to whatever motivates you. But of course, you had to learn what actions are relevant to which motives.

One source of motivation is fear (or anxiety). Two very common responses to fear are to freeze or to flee. To freeze is to stop ongoing activity and to become immobile. In some situations, such as when a bee is flying nearby, freezing is adaptive. To flee is to to run away and this is also often a successful way to escape from a dangerous, fearful situation.

Although we have all learned both the freeze and flee responses to fear, they are sometimes maladaptive. These are times when the best response is to fight, to face the feared situation head-on. Consider, for example, a stage performer. To freeze would be to "draw a blank" and be unable to remember one's lines. To flee would would be to run away from one's responsibilities. The appropriate response is to get out on the stage and let one's fear mobilize a a good performance. Even the most experienced entertainers have butterflies in their stomachs before a show but they have learned to go on with the show. Indeed, a performer could not put on a very good performance without being aroused by anxiety.

In this regard, taking a test is like putting on a show. It is appropriate to be apprehensive about an exam because your grade and, to some extent, your whole future are tied to your performance. The goal is not to cure yourself of test-anxiety; your goal is to cure yourself of the freeze or flee tendencies and learn to direct your energy toward relevant test-taking responses.

Chapter 9

General Conclusions

The purpose of this chapter is to highlight some of the learning tactics and strategies described in previous chapters and to add a few generalizations.

Nobody has to learn how to learn. Simple forms of learning are automatic and may even begin in the womb. Every normal person is born learning, and mentally active people die learning. "To be living," is nearly synonymous with "to be learning," and the evidence suggests that when one stops learning, one's mind starts dying. Yet nobody learns nearly as much as one could.

Some learning requires mental effort. You can listen passively and learn to recognize and perhaps to enjoy a Mozart concerto. But if you want to understand musical composition, you need to study that subject by attending lectures and reading books. To become an expert requires years of study. The result may not be that you enjoy Mozart more, but you would certainly appreciate him more. College learning is a form of verbal learning that requires a lot of mental effort.

The more you learn about a subject, the easier it gets to learn more about it. In part this is because knowledge is cumulative, with old learning providing a framework on which to add new information. Learning also gets easier because we learn how to learn. For example when you study a foreign language, you not only learn the meaning of foreign words, you also learn something about how to study vocabulary lists. If you learn that "mesa" in Spanish means "table" in English by repeatedly saying "mesa-table, mesa-table...," you are learning to learn foreign words by the method of rote repetition. Your skill in using that method may improve the more you practice it, and you are likely to use that same method when learning other foreign words.

There are usually several ways to learn verbal material. You couldn't even get to college without having learned some of the successful ways to learn. Because the ways you have learned how to learn work, you are not likely to try out other ways unless you make a deliberate commitment to do so. And even if the other ways are better, they usually require more than just token practice. Faced with the practical realities of classes and exams, most students quickly revert to their "tried and true" ways. That is as it should be. This workbook will have achieved its purpose if it has raised your awareness of the fact that the way you learn verbal material is itself learned, and is therefore subject to new learning as opportunities arise.

Return to the rote repetition method of learning mesa-table. You should now

know that such rehearsal does not build a very strong reverse association from table to mesa. You should now know to make cards with English on one side and Spanish on the other. Not only can you use such cards in both directions, you can rehearse them at times that would otherwise be wasted. You should now know that cards require you to practice the test response, namely recalling the answer from memory. You should now know that learning tends to dissipate over time, so you must review the words that you have learned from time to time. You should now know that knowledge is non-verbal, so you need to associate mesa with an image/idea/thought of a table, not with the English word table. In doing so, you should now know how to use imagery in such learning, for example, by imagining a messy-looking table. In sum, even if you revert to rote repetition when faced with a last-minute effort to learn, you should know that there are other, more effective ways.

9.1 Why college?

When I ask freshmen why they are in college, the most common answers are, "My folks wanted me to go," and "It just seemed like the thing to do." Anyway, it beats getting a job. Some freshmen have definite career goals, but most are undecided. The result is apathy, often leading to poor performance, failure, and dropping out.

Whatever your reason for being in college, the first imperative is to take it seriously. If you are the traditional college freshman right out of high school, you probably have many other things on your mind besides academics. Non-traditional students going to college after several years of non-academic pursuits have a real advantage. They tend to be more mature, more self-confident, more committed to success. Whichever, don't short-change yourself. As long as you are in college, resolve to do your very best. The stakes are too high to treat it as a game where you win some and lose some.

The day I graduated from high school, my aunt, who was a college professor, said to me: "You'll never feel as smart as you do today." How right she was! The more I have learned, the more I have become aware of how little I know. I think that the most unique feature of a college education is that it can open one's mind to the infinite reaches of knowledge that are known or waiting to be discovered. In the early grades of education, each topic was finite. You learned the alphabet, and once you knew it, that was that. You learned the multiplication facts, and once you learned them, that was that. Even in high school, if you studied Shakespeare, it seemed as if you learned all there was no know about his work. Each subject had a beginning and an end.

In college, every subject you study should begin to reveal an endless domain of knowledge. Your professors have spent many years studying their subjects, and they are at best experts in only a small aspect of their fields. The greatest value of college education is not in the actual content of what you learn. A college education prepares you for a lifetime of continuing education. It is not an education that you can "use" in the sense of technical and vocational skills. It is an education you can use to achieve a quality of life that goes beyond the necessities of life.

Coping with college life. Everyone has problems from time to time. If you are a "traditional" college student, by which I mean a person in the 18-22 age range coming directly from high school, college comes at a pivotal time of your life. It is a time of striving for maturity, independence, identity. If you are a non-traditional student, the problems associated with late adolescence are replaced by others that are appropriate to your status. Whichever, your first challenge is to resolve your personal problems or to insulate yourself from them enough to attend to your studies.

The key to successful coping with college life is self-discipline. If you completed the time-management schedule given in Appendix, you know that there is time to do everything but not much left over to waste. One component of that schedule is attending class, and some students infer from the fact that college courses are based on the mastery concept that class attendance is optional. In one sense, it is. If you can manage to pass a course while cutting many classes, perfect attendance is not necessary. But you can not learn a subject as well if you skip classes, and you are also developing bad disciplinary habits. After all, going to class is a major part of your "job" as a college student. Even if you are paying full tuition, you are paying only a fraction of the cost of maintaining the institution. Good discipline implies good attendance.

If you have not already developed good self-discipline habits, it is imperative that you do so as quickly as possible. The best technique for acquiring self-discipline is called "contingency management." The essence of this technique is to list the various things that you need to do, and also the things you want to do, and arrange them in an order from the least to the most enjoyable. Then, working around your fixed commitments such as attending class, start doing them in that order...hardest to easiest, least liked to most liked. Along the way, include plenty of self-reinforcers. Whenever you complete a task, be it attending class or doing a homework assignment, take time to do something you really like. "Managing" the contingencies means to reward yourself for doing the things that need to be done.

In developing self-discipline, I urge that you NOT attempt to use self-punishment when you do what you shouldn't do, or fail to do what you should do. It is certainly appropriate to withhold rewards that you might have enjoyed, but do not inflict pain or discomfort on yourself for mis-behavior. It is well beyond the scope of this book to explain the effects of aversive punishment, but you are likely to do more harm than good with self-punishment. If you concentrate on rewarding yourself for doing what is right, such behavior will prevail without trying to punish yourself for doing what is wrong.

9.2 Creatures of Habit

Whatever we do in any situation is what we are most likely to do the next time we are in that situation. As this happens repeatedly, the behavior becomes more and more habitual. This is fine if the behavior is optimally adaptive. For example, the habit of arising at an early hour in the morning is great. Many other habits are desirable because that way of doing something is just as good as any alternative. For example,

it really doesn't make any difference which leg you put in your pants first. Being a creature of habit has many advantages in coping with everyday life.

However, sometimes our well-established habits are not optimal and it is good practice to try out new alternatives from time to time. For example, I recall resisting shifting to an electric typewriter because I felt I was so proficient with a manual machine. Then, after become adept with an electric typewriter, I was reluctant to shift to a word processor. Each shift required some period of adjustment, but the ultimate advantages are enormous. As I now recall writing my first book on a manual typewriter, with erasers and carbon paper, I am amazed that it ever got written. Hence, just because your old way of doing something works doesn't mean it is the best way.

In this book, I have focused on old versus new ways of learning. But the point I am making applies more generally than that. We are all creatures of habit and undoubtedly miss out on many ways that we could improve our lives were we only to explore new and different ways of doing routine things. I urge you to keep your mind open to new solutions to old problems. I can almost guarantee that there is now, or will someday be, a better way to do virtually everything that you now do habitually.

9.3 Primacy

College learning often involves new information that is counter-intuitive or contrary to what you believed before. This conflict between old and new ideas tends to have one of three consequences. First, there is a tendency to distort the new ideas in such a way as to make them somehow fit with the old ideas. This consequence is that you never really understand the new idea. Alternatively, your mind may simply reject the new idea and you never really learn it at all. Finally, you may succeed in learning the new idea, but it is easily forgotten and your memory reverts to the old idea. None of these consequences is conducive to success in college.

Unfortunately, there is no foolproof antidote to the primacy principle. Early learning is extremely resistant to change. But if you are aware of that fact, you can take precautions to minimize its effect. Whenever you realize that something is contrary to what you thought before, make extra effort to see how the ideas are different. Realize that you may not fully understand the new idea yet. Then try to keep the ideas separate. Eventually, as more and more new ideas come along, you will have that "aha" experience of finally getting the point. But you will always have to be ready to recognize your old ideas when they recur.

9.4 The Wandering Mind

Paying attention is the most critical skill for college learning. Assuming that you have an adequate vocabulary to understand what you are hearing or reading, attending to the words and processing the information they convey is the essence of verbal learning. Doing so is hard mental work, and we are all afflicted with the tendency for

our minds to wander to easier, more pleasant thoughts. It is therefore important to learn to recognize when you are paying attention and when your mind is wandering.

The tendency for a student's mind to wander off from academic subjects is largely a result of word associations. As I like to put it, your mind has a mind of its own...namely, that part of your mind that is unconscious. It seems that your unconscious is always alert for any word that may occur in a book or a lecture that is in some way associated with any non-academic topic that may be troubling you. If you are concerned about money, health, sex, loneliness, inter-personal relations, etc., your unconscious keeps trying to bring these to the fore. Unless you are alert to the temptation, your mind can easily wander from physics to your love life.

There is no cure for your mind's wanderlust. It may help if you set aside some time in your daily schedule to think about your troubles. By satisfying the need to worry, to reminisce, to day-dream at other times, you can better resist those thoughts when you are studying. Otherwise, the best you can do is to learn to recognize when your mind starts to wander so you can bring it back on course.

9.5 Overshadowing

Whenever a person is exposed to several things at the same time, s/he may not learn about all of them. If one aspect is more noticeable, more familiar, or more interesting than some other aspect, it may capture most of one's attention and therefore most of what one learns. Everyone remembers best the unusual sight, the dramatic climax, the unexpected happening. Routine events are "overshadowed" by more conspicuous ones.

Overshadowing is important to the college student because the important information that you must learn is often overshadowed by its context. One common example is a professor who tells lots of jokes in class. Many students remember the jokes, but do not remember the professor's points in telling the jokes. Another example is a textbook (such as this one) that includes many familiar illustrations of the main ideas. It is easy to remember the illustrations but fail to learn the main ideas. You must be alert not to let jokes and illustrations distract you from attending to the really important material.

Let me give an analogy. Most football fans keep their eyes on the ball, following the exciting aspects of the play. However, if you want to be a student of the game of football, you will quickly learn that most games are won or lost by the less spectacular action on the front line. In similar fashion, you may enjoy the jokes and the illustrations in a college course but you must learn to keep your attention focused on the basic ideas being presented.

For learning's sake. Some people say they want to climb a mountain "because it is there." That is the ideal attitude to take toward learning: Develop a desire to learn because knowledge is there to be learned. Even if a course is a required part of a degree program, try to approach it because of its intrinsic interest. Learning is easier and better if it is done for the sake of learning rather than to satisfy some requirement.

The human brain is surely the most marvelous thing in the world. Its most marvelous feature is the capacity to learn. Nothing else in the whole universe (except intelligent life on another planet) can acquire knowledge from experience. Another of its marvelous features is the fact that millions of brain cells die every day of our lives, but the remaining cells are able to carry on without any significant loss of brain power. For them to do so, however, one must remain mentally active. Increasingly, the evidence shows that you are most likely to "lose your mind" through disuse. The most valuable advice I can give you, or that you can give those you love, is this: Never stop learning. The expression, "use it or lose it," applies more to the mind than to the body!

POSTSCRIPT: Appendix (Science and Behavior) and Appendix (Statistics) are not directly on the topics of learning and memory. However, they provide some relevant background for courses in the behavior sciences and hence should be a part of your general preparation for college. I therefore recommend that you study them whenever time permits.

I also urge you to take the open-book final exam. In doing so, remember the importance of being correct lest you learn your errors. If you are not sure of an answer, go back to the text and check yourself. The value of this book to you is dependent on how much you have learned of its contents.

Chapter 10

Appendices

Appendix A

On Time Management

". . .If you can fill each unforgiving minute with sixty seconds worth of distance run. . ."

The above quotation is the last and probably the most difficult of Rudyard Kipling's criteria for being a successful, mature person. In one sense, if you live for eighty years, you can afford to waste a few of your forty million minutes of life. But in a larger sense, now is the only time that you can live this particular "unforgiving" minute of your life, and a mature person has learned to cherish each and every one of them.

This does NOT mean always keeping your "nose to the grindstone". A perfectly balanced life would be one-third sleeping, one-third working, and one-third playing. For those of us fortunate enough to get paid for doing what we enjoy doing, "work" is mostly "play." And many of us like to spend some of our play time doing things that many others do as work. Hence, the goal of managing one's time is as much to insure that you get to do things you want to do as that you do the things that you have to do.

How often have you felt that there just isn't enough time, that you can't seem to catch up with all the things that need to be done? This exercise in time management is intended to make you more aware of how many minutes there are in your life each week, and to help you use more of them to your advantage. Please understand that a weekly schedule is NOT a rigid program that has to be followed right to the letter. Think of a schedule as a flexible guideline that you probably will never follow exactly, but that can better organize the routine aspects of your life with give-and-take for events that come along.

A.1 A weekly schedule

I urge you to plan a weekly schedule using the form provided in this workbook. For it to be a worthwhile project, you must be honest with yourself. Don't plan a schedule for an ideal person without any weaknesses. For example, don't plan to get up at six every morning if you know from experience that it's tough enough just getting up by eight. The best schedule for you is one that isn't very different from what you're already doing. Remember that you can always plan a new schedule after you have

lived with this one a while.

The first decision is when to get up in the morning. As I said, be realistic. However, you should know that the adage about early to bed and early to rise has a lot of merit. The reason is important to understand. Cognitive capacity varies during the day. By "cognitive capacity," I mean the speed and efficiency with which you can process verbal information. Your thinking is sharper and clearer at certain times of the day. For most people who have a regular get-up time at somewhere between six and seven in the morning, peak mental ability occurs during the middle hours of the morning. It usually takes well over an hour to reach this peak, and it begins to wane an hour or so before noon.

In many cultures, midday is siesta time as cognitive capacity is somewhat diminished. It reaches a second peak during the middle of the afternoon although not as high as in the morning. Another period of diminished capacity occurs during early evening, with a third and still lower peak during mi-evening. The lowest level of cognitive functioning is during the hours one normally sleeps.

Insofar as possible, you should take this up-and-down cycle of cognitive capacity into account when planning your weekly schedule. Try to put as many of your mentally demanding activities into times when you are likely to be at your best. Although you are constrained by the available class schedule, you can adjust your own sleeping and eating schedule to accomodate to things you can't control.

Begin by entering into your weekly schedule all known obligatory events. These will be your class hours, your work hours, and perhaps other regular commitments such as attending church services. You may wish to darken the lines around those hours to make them stand out in the schedule. Then set a regular get-up time that is at least an hour before your first regular commitment. Your get-up time establishes a normal bedtime to allow for eight hours sleep. You now are ready to make tentative plans for the remaining time periods.

Assuming that being a student is your primary obligation, you should next identify potential study times. Follow the rule-of-thumb that schedules twice as many study hours as you have class hours. If you complete your assignments in fewer hours, you will have more time to play; if your assignments require more time, you'll have to borrow from your play time. Remember that the weekly schedule is flexible and you're only setting some general guidelines.

In identifying potential study times, I urge you to take into consideration a very well-established principle of learning, namely:

Principle of Distributed Practice
Learning/memory are best if study time
is distributed over several shorter sessions.

This principle strongly advises against setting up long sessions in which to study. If you do have periods of several hours in which to study, plan frequent breaks and do not spend too much time on any one subject. Most students tell me that they need at least 10 minutes in order to get "into" a subject and that 30-50 minutes is about as long as they can sustain intense study of a subject.

Accordingly, there are two things to keep in mind when locating study times in your weekly schedule: Try to choose times when you are likely to be in high mental gear, and distribute your study times throughout the week. Right before and after classes are particularly appropriate times, but include other times that are separated by lots of play time. Times of high cognitive capacity on Saturday and Sunday mornings are also good (except when you party on Friday and Saturday nights!). Most importantly, set a schedule that is reasonable.

Many students stop filling out their weekly schedule after they have completed their obligatory class and work hours, and their study times. However, I recommend that you continue with the exercise such that you very clearly set aside some time for other activities that are important in your life. One such activity is day-dreaming. Many students have been caught day-dreaming in class and have been led to believe that doing so is wasting time. To be sure, one should listen attentively in class but one also needs time for day-dreaming. In my own personal experience, my favorite private time was when mail was delivered. Even when I didn't get a letter, I'd re-read an old one and let my mind enjoy thoughts of family, friends, and hopes for what the future would bring.

In addition to body-maintenance activities, there may be other things that you may want to plan in your weekly schedule. Television shows that you like to watch, time to read poetry or fiction instead of textbooks, practicing sports/hobbies/talents, and time for social activities. As you get closer to filling each minute with the "sixty seconds worth of distance run," there really is enough time to do all those things you want to do.

A.2 Wasted Minutes

There is one very valuable trick that you cannot explicitly put into your written weekly schedule. It is recognizing that there are many minutes when you are engaged in some highly routine type of act, one that really doesn't require very much of your cognitive capacity. My favorite example is brushing your teeth. Now you probably spend about 1-2 minutes twice a day brushing you teeth, and it surely isn't a drain on your mentality to do so. Yet almost every student admits that s/he thinks of nothing but brushing while s/he is brushing.

If you put some vocabulary words on cards and put the cards near the sink, you can glance at a card and rehearse a word at the same time that you are brushing your teeth. By doing just that, you added over a half-hour study time at no expense. And I hope it is obvious that tooth-brushing is only one illustration of the notion of getting full mileage out of each minute. If you plan ahead, many otherwise wasted minutes can be filled with productive learning. While you are waiting in line, walking across campus, nd performing other bodily functions are opportunities to learn.

I urge you to try this trick. To do so, you first need to find some materials that you have (or want) to learn and that are amenable to short learning episodes. Any task involving associating two items is especially appropriate: vocabulary (including foreign), capitals of countries, dates of events, names of important people, and various

special items such as chemical symbols. Make up slips with the items on front and back. Then put these slips in appropriate places and/or carry some around with you for use when opportunities arise. I can almost guarantee that this trick will pay off very handsomely because it is an essentially painless way to increase the time that you spend learning/thinking/remembering. Which means more time to play!

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
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Appendix B

Vocabulary Pre-Test

B - Vocabulary Pre-test Instructions: Check the best definitions, but DO NOT GUESS.

01. ABSTAIN refrain from go forth take away show off	13. COINCIDENCE hiding place happy scene equal value chance event	25. DEFICIENT incomplete little effort without cause contrary	37. EXTRAPOLATE add people extend data give more jump over
02. ABSTRACT part of a yard take away only in the mind put aside	14. COMMUTATIVE out of town in any order over the hill at another time	26. DENOTE point out take back hold on write off	38. FALLACY fancy lace delicate feature false reasoning weak link
03. ACCORD heavy string harmonious agreement authority	15. COMPILE collect associate decay put forth	27. DEPLETE smooth out make empty run over pull under	39. FORMIDABLE made to order put to test shaped to fit hard to handle
04. ADVOCATE announce find out argue for discourage	16. COMPONENT piece of music time of opening part of whole unit of weight	28. DEVIATE consume differ misplace wonder	40. FUTILE hidden useless shiny hard
05. ALLEVIATE raise up forgive make lighter improve	17. COMPOSITE distinct parts another piece written out musical	29. DIVERSE various poetic jump in pass out	41. GENERALIZATION inference commander excuse creation
06. ANECDOTE hang around neck brief true story tall, leafy tree small, noisy dog	18. CONCISE minimal words exactly right extremely sharp easy way	30. DOCTRINE stated as belief act as one fixed as ordered think as another	42. HAPHAZARD dangerous place without any order beside the point strange event
07. APPREHENSIVE almost finished very grateful dread future handle carefully	19. CONSISTENT agreeing troublesome come up empty make up whole	31. DOMAIN curved roof open sea major point area included	43. HEMISPHERE half a sphere form a circle like a ball with a ring

08. ARRAY	20. CONSPICUOUS	32. ELABORATE	44. IMPERATIVE
empty, hopeless	with enthusiasm	work hard	barely enough
point, meaning	easy to see	spend wisely	very necessary
order, grouping	secret plan	easily seen	certainly true
bright, visible	good for nothing	highly detailed	easily missed
09. ASSERT	21. CONSTITUTE	33. ENDOW	45. INDIFFERENT
give off	take in more	finish completely	without interest
declare	break in pieces	call loudly	not changed
imagine	come up empty	handle carefully	without notice
increase	make up whole	given naturally	not welcome
10. BENEVOLENT	22. CONVEY	34. ENHANCE	46. INGENUITY
loud, angry	carry	hold in hand	not genuine
soft, comfortable	pieces of paper	put in order	bright object
kind, generous	cheat	stand in way	clever invention
easy, simple	see with mirror	raise in degree	working motor
11. CHRONIC	23. CRUCIAL	35. EVOKE	47. INHERENT
heavy/bulky	smooth	bring together	natural part
short/sharp	decisive	call forth	female relative
lasting/frequent	painful	send away	monthly payment
bright/shiny	vigorous	put aside	pretty scene
12. CHRONOLOGICAL	24. DECISIVE	36. EXCERPT	48. INHIBIT
logical order	slices meat	other than	declare
time order	settles question	without	include
order of size	raises doubts	passage from	restrain
order or color	removes weight	annoy	display
49. INSTINCT	61. NOMINAL	73. QUERY	85. STIMULATE
developed sense	for one time	question	help recover
natural odor	with feeling	different	give relief
learned skill	in name only	uneasy	cause action
inborn impulse	by chance	pit	make delayed
50. INTENSIVE	62. OBJECTIVE	74. RANDOM	86. SUBSEQUENT
large number	complaint	with pleasure	enough
high degree	pointed	without merit	around
strong defense	weapon	with haste	following
deep thought	real	without design	beneath
51. INTERACT	63. OBSCURE	75. RATIONAL	87. SUBTLE
act on each other	not clear	by authority	clear, shining
come between	not cured	with reason	closed, locked
contained within	not careful	for certain	fine, cunning
be in favor	not square	in portions	under, buried
52. INTRICATE	64. PERSPECTIVE	76. RECIPROCAL	88. SUSCEPTIBLE
very small	hiding place	by the rules	easily affected
very easy	ship-shape	out of step	wrongly placed
very sure	searching	old time's sake	badly beaten
very involved	size-wise	to each other	hardly noticed
53. INVERSE	65. PHENOMENON	77. REFRAIN	89. SYMMETRICAL
backwards	observed event	do it again	sides equal
inward	strange person	fill up	half circle

54. LEGITIMATE in favor of strange person by the rules with two legs	66. PORTRAY describe carry injure deceive	78. RELENT more broken lend again less severe take back	90. SYSTEMATIC fair deceiving orderly self-controlled
55. LIBERAL generous happy demanding written	67. PREDOMINANT encircled childish earlier superior	79. REQUISITE questioned located required desired	91. TACTICS turn toward wind use of resources part of insect game with squares
56. LITERAL easily seen exact wording whole group very messy	68. PRESCRIBE guide action before starting write down give forth	80. RESPECTIVELY done w/grace part of story shown to elders each in order	92. TANGIBLE can be eaten can be believed can be felt can be used
57. MAGNITUDE beauty size shape temperature	69. PREVAIL gain dominance first layer early days hidden glance	81. RITUAL accident ceremony belief fight	93. TERMINATE station finish dispose instruct
58. MANIPULATE make by hand go forever take up slack use with skill	70. PREVALENT widespread hopeful attractive early	82. SENSORY of the senses in the mind for well-being with pleasure	94. TRANSITION agreement portion change gears
59. MODERATE about right not extreme very new average grade	71. PROFOUND great knowledge strong argument very wealthy early discovery	83. SIMULTANEOUS without delay at same time for all time many sided	95. VIRTUAL of morality by nature with skill in effect
60. MONOTONOUS single person unvarying tone barely enough widely known	72. PRUDENT studious sensible proper deep scar	84. STATIONARY place to stop not moving very impressive writing paper	96. VITALITY weight healthfulness importance liveliness

Check your answers against the following key. These are the least familiar high-school level-3 words, but you need to know all of them.

abstain...refrain from
abstract...only in the mind
accord...agreement
advocate...argue for
alleviate...make lighter
anecdote...brief true story
apprehensive...dread future
array...order, grouping
assert...declare
benevolent...kind, generous
chronic...lasting/frequent
chronological...time order
coincidence...chance event
commutative...in any order
compile...collect
component...part of whole
composite...distinct parts
concise...minimal words
consistent...agreeing
conspicuous...easy to see
constitute...make up whole
convey...carry
crucial...decisive
decisive...settles question
deficient...incomplete
denote...point out
deplete...make empty
deviate...differ
diverse...various
doctrine...stated as belief
domain...area included
elaborate...highly detailed
endow...given naturally
enhance...raise in degree
evoke...call forth
excerpt...passage from
extrapolate...extend data
fallacy...false reasoning
formidable...hard to handle
futile...useless
generalization...inference
haphazard...w/out any order
hemisphere...half a sphere
imperative...very necessary
indifferent...w/out interest
ingenuity...clever invention
inherent...natural part
inhibit...restrain
instinct...inborn impulse
intensive...high degree
interact...act on each other
intricate...very involved
inverse...backwards
legitimate...by the rules
liberal...generous
literal...exact wording
magnitude...size
manipulate...use with ski
moderate...not extreme
monotonous...unvarying tone
nominal...in name only
objective...real
obscure...not clear
perspective...size-wise
phenomenon...observed event
portray...describe
predominant...superior
prescribe...guide action
prevail...gain dominance
prevalent...widespread
profound...great knowledge
prudent...sensible
query...question
random...without design
rational...with reason
reciprocal...to each other
refrain...keep from doing
relent...take back
requisite...required
respectively...each in order
ritual...ceremony
sensory...of the senses
simultaneous...at same time
stationary...not moving
stimulate...cause action
subsequent...following
subtle...fine, cunning
susceptible...easily affected
symmetrical...sides equal
systematic...orderly
tactics...use of resources
tangible...can be felt
terminate...finish
transition...change
virtual...in effect
vitality...liveliness

Appendix C

Commitment by Contract

One of the best ways to make a real commitment to do something is to sign a formal contract with another person. Such a contract should require you to put up something of value as "honest money." Such contracts have become popular in self-improvement clinics such as weight-loss or stop-smoking programs. The evidence is clear that people who put up some money that will be refunded if they fulfill their signed contract to attend the meetings are much more likely to complete the program and to attain their goals.

There may be occasions when making up your own contract can be helpful. For example, suppose you frequently fail to get up in time to make an early morning class. You can put money in an envelope addressed to some charity, and write on the back of the envelope the commitment that it should be mailed if you miss another class. Sign the commitment and give it to the professor, with the understanding that you get it back if you attend every class. You will find that when your good intentions are not enough, a contract will help.

Appendix D

Logic and Problem Solving

We say that a conclusion is "logical" when it follows from what we already believe. If we believe that all people are created equal, then it follows logically that there should not be kings or slaves. If we believe that light travels faster than sound, then it follows logically that we should see lightning before we hear thunder. If we believe that the only way women can get pregnant is by having sexual intercourse, then it follows logically that a pregnant woman is not a virgin. In everyday life, logical conclusions simply make explicit what is already implicit in one's beliefs.

Notice that logical conclusions may or may not be true. In the preceding examples, one could argue that humans are really like bees with queens and workers, we probably accept the scientific evidence about the speed of light and sound, but a virgin woman could become pregnant through artificial insemination (and perhaps through divine intervention). Hence, our beliefs are really premises, statements from which we draw conclusions. A conclusion that follows logically from the premises is VALID, but it is TRUE only if the premises are true. Conversely, faulty logic could lead to a true statement.

A good way to illustrate these ideas is with the hypothetical syllogism. A "syllogism" is composed of three statements: A major premise, a minor premise, and a conclusion. In the "hypothetical" syllogism, the major premise is an "If" hypothesis. For example:

Major premise: If you study hard, then you will get an "A".
Minor premise: You have studied hard.
Conclusion: You will get an "A".

There are two parts to a major premise in the hypothetical syllogism. The "if" clause is called the antecedent and the "then" clause is the consequent. In the preceding example, the minor premise affirmed the antecedent (said it is true). Whenever the minor premise affirms the antecedent in a hypothetical syllogism, the conclusion is valid, but it is true only if the major premise is also true. Because we know that studying hard does not guarantee getting an "A", we arrive at a false conclusion even though the reasoning is sound.

If the minor premise denies the antecedent (says it is false), then one cannot logically draw any conclusion. Continuing the above example:

Major premise: If you study hard, then you will get an "A". Minor premise: You have NOT studied hard. Conclusion: None

As you know, there are ways to get an "A" other than by studying hard, including improper ways such as cheating. People frequently make the mistake of thinking that "if" means "if and only if," and do draw a conclusion from denying the antecedent. Logicians often use the Latin expression, non-sequitur, for an expression that does not follow from the premises. For example:

Major premise: If she's at home, she's not out with someone else. Minor premise: She's not at home. Conclusion: She's out with someone else. (NOT VALID)

Hence, affirming the antecedent affirms the consequent, but denying the antecedent does not deny the consequent.

There is another minor premise that does lead to a logical con- clusion, namely denying the consequent. Return to the first example:

Major premise: If you study hard, then you will get an "A". Minor premise: You did not get an "A". Conclusion: You did not study hard.

Again, the logic is valid even though the conclusion is false because the major premise is false. Although denying the consequent implies denial of the antecedent, affirming the consequent does not lead to any logical conclusion:

Major premise: If you study hard, then you will get an "A". Minor premise: You got an "A". Conclusion: None

This is an even more common source of faulty reasoning:

Major premise: If he's out with someone else, he won't be home. Minor premise: He's not at home. Conclusion: He's out with someone else. (NOT VALID)

It is well worth your time to make up a number of hypothetical syllogisms, and practice the four possible minor premises. Use the following table to structure your examples:

Major Premise: If antecedent ¿¿¿ then consequent

: Affirm-Valid : Affirm-Not Valid: Minor Premise: :Deny-Not Valid : Deny-Valid :

In making up syllogisms, try to think of other ways to state the major premise. For example, "You can't pass calculus unless you can pass algebra" is another way to say, "If you can't pass algebra, then you can't pass calculus."

Let me summarize this section by distinguishing between the two words "infer" and "imply." You, the thinker, draw inferences; you infer conclusions from the premises. For their part, the premises may or may not imply a conclusion. You may fail to infer conclusions that are actually implied by the premises, or more commonly, you may infer conclusions that are not implied by the premises. Reasoning is valid only when you infer conclusions that are indeed implied by the premises. Whether or not a valid conclusion is true depends on whether or not the premises are true.

On Probability

The probability of an outcome is determined by the ratio

number of positive outcomes divided by: number of possible outcomes

For example, the probability of drawing an ace from a deck of cards is $4/52 = 1/13 = .077$. The probability of drawing a spade is $13/52 = 1/4 = .25$. The probability of drawing a black card is $26/52 = .50$. These figures are objective probabilities

determined from the actual numbers of positive and possible outcomes.

In like fashion, there is a fifty-fifty chance that a coin will turn up tails. It is interesting that most people call heads when a coin is tossed. If that call is correct, about half of them will call heads again for the next toss. If that toss is also heads, most people will now call tails for the third toss. During this time, the coin did not change; the chance of a tails was fifty-fifty on every toss. But most people have acquired guessing habits that are, at best, wrong, and at worst, very expensive.

Actually, there is nothing "wrong" with having a preference for calling heads. Indeed, a very good strategy is always to call heads (or tails) because you can't do better than fifty-fifty anyway. What is wrong is changing your call depending on what happened on the last toss or series of tosses. The true odds don't change, and the belief that they do is known as the "gambler's fallacy."

Suppose you had a jar containing ten marbles, five white and five black. You shake the jar and draw out a marble; the odds are 5 out of 10 (50black marble and then shake-and-draw again without putting the first marble back, the odds have now changed to 4 out of 9 (about 44drawing another black marble. If you draw a second black marble, and shake-and-draw a third time without putting either marble back in the jar, the odds have changed to 3 out of 8 (about 37continued until you happened to draw out all 5 of the black marbles, the next draw would have to be white.

Suppose instead that you put the marble back after each draw. Obviously, the odds wouldn't change even if you happened to draw five black marbles in a row. On every draw there would be five black and five white marbles in the jar. This is what it's like when you are tossing coins, rolling dice, or spinning wheels. It is very hard to resist the feeling that, after several blacks in a row, a white is "due," but it is an important lesson to learn about probability.

The general point is this: People base decisions on their subjective probability of the outcomes which is often different from the objective probability. Most of us tend to overestimate the likelihood of low-probability events (people bet on long-shots at the race track when there is almost no chance of their winning); conversely, we tend to underestimate the likelihood of high- probability events (people drink and then drive thinking nothing will happen to them).

On Problem-Solving

What makes a problem a problem? In general, a problem is when you start in some condition/position, you want to move to some other condition/position, and the solution is not immediately apparent. It would not be a problem, for example, to weigh out any number of grams of sugar (up to 30) using a simple balance scale if you have thirty weights weighing 1, 2, 3, etc. grams each. But suppose I confine you to using only five weights. You now have a problem because you must decide which five weights will enable you to measure any number from 1 to 30.

It is obvious that you will have to combine weights in some way and you quickly see that you don't need a 3-weight because you can get 3 by combining 1+2. If you then have a 4-weight, you can get weights up to 7 grams (4, 4+1, 4+2, 4+2+1), so next you need an 8-weight. If you are familiar with number sequences, you will probably now figure out that each required weight is double the preceding one, so that your five chosen weights are 1, 2, 4, 8, and 16-grams. If you were carrying these

around as a salesperson, that would be quite a saving in number of weights to carry.

Can you do it using only four weights? To solve that problem, you will have to break your cognitive set. A cognitive set is simply a way of thinking about a problem that may hinder seeing all of the possible alternatives. In this case, your cognitive set is likely to be that you always put the weights on one side of the scale and sugar on the other side. But, there is no rule against putting weights on both sides of the scale, so that you can use subtraction of weights as well as addition. For example, you don't need a 2-weight if you have a 1 and a 3, because you can put the 1-weight on the sugar side and balance that side against the 3-weight.

Cognitive set is one common reason that people may fail to solve problems. A parent whose child misbehaves may have a set to punish misbehavior and never even think of the alternative of rewarding good behavior. A person who takes pills to treat an ailment may never try out alternatives such as exercise or better eating habits. Students having difficulty in school may think that they have to spend many more hours studying rather than searching for better learning methods and strategies. Sometimes there is only one way to try to cope with a problem, but usually there are alternatives that are obvious once a cognitive set is broken.

Research on problem-solving has not been very instructive about how to solve problems. In general, we draw on past experiences with similar problems to generate possible solutions and then try them out in the present situation. When one hypothesis fails, we search for another alternative and so on until we "hit upon" the solution. When that happens, we often have the familiar "Aha" experience. Most of what I have to say concerns natural tendencies that frequently block us from hitting upon the solution. This does not guarantee success, but it does serve to minimize failure.

Impulsive Action. Just being in a problem situation arouses a degree of tension or uneasiness that encourages impulsive action. We are so eager to solve the problem that we start testing hypotheses before we have really analyzed the problem. The adage, "look before you leap," is good advice when attempting to solve a problem. There may be information that is not immediately obvious but that can be derived or determined and that might lead one toward the solution.

To the right is a well-known —- —- —- problem. Think of the adjacent : : : : four dots/dashes as being sticks. : : : : You are to move two sticks, and —- —- —- —- replace them in the picture so as : : : to end up with four squares instead : : : of the original five. No tricks. —- —-

Most people just start right off moving sticks around, which is what is meant by impulsive action. Knowledgeable problem-solvers are able to inhibit that impulse and analyze the problem before making any moves. They first review the instructions to be sure that there are no ambiguous words. They may ask questions such as, "Do all of the squares have to be the same size?" In this problem, there are no ambiguous words and the resulting four squares are all the same size.

One heuristic (problem-solving strategy) that is useful in many types of problems is to count the number of objects. Frequently that number will lead you away from bad alternatives and toward good ones. In this case, there are 16 sticks. Knowing that there are 4 sides to a square, we know that we could make 4 completely separate squares. We therefore know that we cannot let any one stick be a part of two squares.

Now look back at the picture and count the number that are parts of two squares. All 4 of the inside sticks count.

Because we can only move two sticks, each one must undo two of the four problem sticks. This may take a bit of searching, but you now know precisely what you are looking for; as a result, it is much more likely that you will remove the sticks as shown on the left and replace them as shown on the right.

—- —- —- —- : : : : : : : : : : : : : : : : : : —- —- —- —- —- —- —- —- : : : : : : : : : : : : : : : : —- —- —-

The advice to avoid impulsive action, and to analyze the problem by looking for ambiguities and counting the objects, has generality. Another familiar puzzle is this: Three people each give a minister $10 to go to the market and buy them a turkey. When he got there, he found that a turkey only cost $25. Because he couldn't divide the $5 change into 3 parts, he gave $2 to charity and returned $1 to each of the three people. This means that each person actually paid $9, for a total of $27, which added to the $2 for charity makes $29. What became of the missing dollar?

I have known people to wrestle with that problem for hours over many days without solving it because they impulsively begin searching for the "missing dollar." There must be some ambiguity somewhere. If you stop to count, you ask yourself what happened to the original $30? You will see that $25 went to the market, $2 went to charity, and $3 was returned. The $2 that went to charity is thus seen to be a part of the $27 that the people paid, not something to be added to it. You can subtract the $2 to get the $25 that went for the turkey, or you can add the $3 that was returned to get back to the $30.

Working backwards from the goal. We have defined a problem as a situation where you are in one position and want to move to another. The former is the start position, the latter is the goal position and the problem is to find a way to get there. Very frequently, there are many fewer alternatives to be explored working backward from the goal toward the start than in working forward toward the goal. Hence a useful heuristic is to reverse the order of solution.

On the top half of the adjacent page is a maze consisting of a number of T-shaped choice points. Trace your path through the maze using some rule. For example, you might alternate turning right, and then left, then right again, and so on. . .retracing your steps when you get to a dead end. Repeat this top maze using some other strategy such as turning right (or left) at every choice point. What you will see is that you make many errors going from the start to the goal.

This same maze is repeated on the bottom half of the page. This time, work backward from the goal with a single rule: Turn at every opportunity. You will chart the correct path on the first try. It is not always that easy to work backward from the goal in everyday types of problems, but it is frequently a good heuristic to try it in reverse order. Find a position where you can say, "If I were at that place, I could get to the goal; how can I get there?" If you can get there from some other place to which you can get from the start, you have found one solution to the problem.

Here is an example: You enter your sophomore year knowing that you have to take a very difficult-for-you course X sometime in order to graduate. Should you take it now or later? Suppose your goal is to get into a professional school, and to do so,

you have to take a course Z when you're a senior. A prerequisite for Z is course Y as a junior and X is a prerequisite for Y. There is no longer any problem; you have to take X now so you can take Y and then Z to reach your goal.

Wrong question. The problem about the missing dollar illustrated asking the wrong question. Another example is this: "How can one build a house with an all-southern exposure?" You are not likely to get to the solution so long as you put the question that way. But if you will simply change the question to, "WHERE can one build a house with an all-southern exposure?" the solution becomes obvious: at the North Pole. Hence, another heuristic is to re-examine the question if you are having difficulty answering it. Perhaps it is the wrong question, sometimes one that can never be answered directly.

Another familiar fable: A king has three sons, all of whom are very intelligent. Still, he wants to leave his kingdom to the most intelligent son. So he slips into their bedroom one night while they are all asleep and paints a spot on each of their foreheads. He then awakens them and says, "If you can see at least one spot, raise your hand." Of course, all three raise their hands because they actually see two spots. The king then says, "If you can figure out rationally whether or not you have a spot, lower your hand and explain your reasoning. If you're right, you will inherit my kingdom." After a few minutes of thought, one son lowers his hand, says he has a spot, and justifies his answer. How did he figure it out?

In this case, you will never solve the puzzle as long as you ask the question, "Do I have a spot?" If you have a spot, the other two would have their hands raised, which they do, but they would have their hands raised anyway because they could see each other's spots. The sooner you realize you cannot solve the problem that way, the sooner you are likely to ask an answerable question: "Do I NOT have a spot?" If you do not have a spot, the others would have raised their hands, to be sure, but they would quickly figure it out. That is because there have to be at least two spots for everyone to see at least one, and if they saw that I didn't have one, they would surely know that they did. Since they have not figured it out right away, I can answer "Do I not have a spot?" in the negative. If I do not-not have a spot, I do have a spot.

Many questions are easier to answer by rephrasing them in some way. "Should I ask for help?" can be changed to "Is there any reason not to ask for help?" "Can I afford an expensive coat?" may be harder to answer than, "Is there something else that I'd rather do with the money?" It may be just as easy to answer, "Do I have to take the harder course?" than, "Should I take the harder course?" but you will have a better attitude answering the latter question. And in many situations, you may not be able to answer, "Is this the right thing to do?" but you can answer, "What are the wrong things to do?"

Functional fixedness. Let me just briefly mention one more good heuristic for solving problems. We tend to see objects as useful for their intended purpose, and fail to think of other uses to which they could be put. This is a "fixedness" of our perception of an object's function. The classic problem is to tie two strings hanging from the ceiling together, but they are too far apart to reach one while still holding the other. On a table is some paper, glue, and scissors. Do you see at least three solutions?

You could tie the scissors to one string as a weight, start it swinging as a pendulum, grab the other string and catch the swinging one when it comes back. You could use the table as a platform, or you could make a paper chain. The general point is to be versatile in seeing ways in which familiar objects can be used for alternative functions. A pen, for example, is a good weapon for gouging at the eyes of a person who is attacking you. A dime can often be used as a screwdriver, and you can bend a coat-hanger into a bookrest. Many things should be used "only as directed" but most things can function in many more ways than we customarily recognize.

Appendix E

On Paraphrasing

Background: The prefix "para-" means nearly, similar, beside. For example, parallel lines go in the same direction. To paraphrase a sentence is to use different words to express (phrase) the same idea. Two of the techniques used in paraphrasing a sentence are changing some of the words to their definitions or to synonyms. These techniques do not usually require changing the structure of the sentence, but they do require some understanding of the meaning of the sentence.

Paraphrasing Exercise 1: Simple Sentences

Some examples of paraphrasing with synonyms:

1. "My car needs gasoline." a. My automobile needs fuel. b. My wheels need gas.

2. "The U.S. government has an enormous debt." a. The federal government has an extremely large debt. b. The national government has a huge debt.

Some examples of paraphrasing with definitions:

1. "A college student usually has homework to do." a. A person going to college typically has to study at home. b. People taking college courses usually have assignments to do

2. "Alcoholics drink more and enjoy it less than social drinkers." a. A person who is addicted to alcohol consumes more but gets less pleasure than a person who drinks just to be sociable. b. People who really need to drink have a high level of intake but a lower level of satisfaction than people who can take it or leave it.

DIRECTIONS: Paraphrase the following sentences by replacing the CAPITALIZED words with a definition or synonym. (If necessary, you may rephrase.)

1. The way to a MALE'S heart is through his TUMMY. 2. A FLYING ANIMAL in the hand is AS VALUABLE AS two in the bush. 3. There's a FOOL WITH MONEY born every SIXTY SECONDS. 4. TO HELL with the torpedoes, full speed FORWARD. 5. A rolling ROCK COLLECTS no moss.

A. A penny SAVED is a penny EARNED. B. Valuable GIFTS often come in SMALL packages. C. You can't teach an OLD dog new TRICKS. D. A BOY'S best friend is his DOG. E. A fool and his MONEY are soon PARTED. F. The EARLY bird GETS the worm. G. HASTE makes WASTE. H. HONESTY is the best POLICY. I. You can't MAKE a silk purse OUT OF a cow's ear. J. Better LATE than NEVER.

Think of other familiar sayings and paraphrase them in several ways.

Paraphrasing Exercise 2: Complex Sentences - A

Background: The simplest sentence is the SAAD sentence. Those letters stand

for Simple, Active, Affirmative, and Declarative. An example of such a sentence is, "Juan is reading the book." An alternative to declarative is the question, "Is Juan reading the book?" An alternative to affirmative is the negative, "Juan is not reading the book." An alternative to active is the passive, "The book is being read by Juan." And the sentence is simple because it has a single subject/predicate/object.

We speak to very young children using simple sentences. "Please bring me the book. The book is on the table. The book is green." However it is often more efficient to use a single, more complex sentence: "Please bring me the green book that is on the table." Although a few people seem to delight in using unnecessarily complex sentences, most educated people try to balance simplicity with efficiency. In any event, in order to understand a complex sentence, you have to extract the ideas and paraphrase them as simple sentences.

DIRECTIONS: For each of the following complex sentences, extract three ideas and state them separately.

Example: Although our human ability to communicate is genetically determined and hence is a part of our biological nature, speech devopment is importantly affected by the environment.

a. The ability for human communication is biologically based. b. The ability for human communication is transmitted through genes. c. Environment also influences how human communication develops.

1. Learning to talk occurs in similar ways and on similar schedules for all normal children, with little effect of differences in training or practice.

2. Although a bad environment can retard language development, children can learn to speak in any environment where other people speak, but they need a supportive environment to learn to speak eloquently.

3. There is a limited number of possible sounds of speech (which are called phonemes, the building blocks of language) which can be combined in various way to make up words.

4. Nonverbal means of communication can be useful in expressing emotions and feelings, but they are narrower than the verbal system which can express abstract concepts and help in problem solving.

5. Human nonverbal communication is not unique and indeed is no better than that of other primates, but our verbal system sets us apart from other animals because it gives us the ability to express cognitive as well as emotional thoughts, and to share complex ideas with others.

Paraphrasing Exercise 3: Complex Sentences - B

One form of paraphrasing sentences is to use some different words and rearrange the order in which the parts of the sentence are given. The result is still a complex sentence, but it may be one that is easier to understand. Good writers often re-write the same sentence several different ways in order to find the particular version that seem to communicate the idea best.

DIRECTIONS: Paraphrase the following statements in two different ways. You may find it helpful to imagine rephrasing the statements as if you were speaking to different audiences, such as another student, a parent, or a teacher. Two examples are provided:

Example 1. "Even though many species of animals communicate, human verbal communication is by far the most complex system." a. While people are not the only animals who communicate, our system of communication is the most complex. b. Other animals besides humans communicate, but their systems of communication are less complex.

Example 2. "By shifting the physical quality of one's voice, a person can express varied emotional states." a. A person can change the physical quality of his or her voice to express different emotions. b. To express different feelings, people may use different voice tone, volume, or emphasis.

1. "When speaking, a person combines sounds into complex structures, andeach different structure is a meaningful unit."

2. "Even dogs can express emotions, as when they growl at a postman or bark to be let in or out of the house."

3. "One of the complicated ways animals describe their environment is the dance done by bees to tell other bees where there is nectar."

4. "Many bird species sing long sequences of different songs in a way that is analogous to humans combining words into sentences."

5. "Other animals can express emotions, describe the environment, or combine sounds into strings, but only humans can do all of these."

6. "It is possible to teach a chimpanzee to use sign language, but no chimpanzee has proven able to construct a new sentence in the way that humans do routinely."

7. "Nevertheless, there are still many mysteries of communication among animals, including the 'songs' of whales and dolphins."

Do you think that any of your paraphrases are "better" sentences than the original? Can you think of a still better way to express the same idea?

Paraphrasing Exercise 4: Paragraphs - A

Background: Just as a complex sentence can be paraphrased by extracting the ideas and expressing them as separate simple sentences, a paragraph can be paraphrased by extracting each idea in each of the sentences. The difference between this form of paraphrasing a paragraph and paraphrasing a sentence is that some of the ideas may be repeated or clarified in parts of different sentences.

However, a perfect paragraph has a topic sentence (the main idea of the paragraph), supporting sentences and a summary or transition sentence. Insofar as possible, the perfect paraphrase highlights these points.

DIRECTIONS: Paraphrase the following paragraphs by stating each idea in a separate sentence.

Example:

"Natural languages follow various rules and it is reasonably clear that humans inherit an innate cognitive capacity to learn these rules. As a result of normal maturation, this capacity of language acquisition reaches a stage of 'readiness' before the age of two, and continues on through the childhood years until puberty. The actual nature of this universal readiness for language is still unknown. Some scientists think that humans are preprogrammed with the basic rules of language, but others believe that humans are innately prepared to learn these rules."

(1) It is likely that the capacity to learn language rules is innate. (2) Readiness

to learn language depends upon maturation. (3) The period of language readiness is from age 2 to about 14. (4) No one knows for sure what the nature of this readiness is. (5) It could be that language rules are instinctive. (6) Or it could be that humans are predisposed to learn a language.

1. "Verbal communication begins as a one-word utterance that seems to serve as a complete sentence. That is to say, one word is sufficient to express the child's idea. Indeed, most parents can readily translate a baby's one-word utterance into an adult sentence."

2. "In language development, we see a progression from nothing at birth to one-word utterances at one year, to actual grammatical sentences at three years. It is not clear why children change toward more and more complex grammatical structures nor do we know how the child 'knows' what changes to make. What is clear is that no special training is needed to enable a child increasingly to approximate adult language."

3. "There are some 'language universals' such as the distinction between nouns and verbs. Even if these universals are innate, the child must learn the specific way they appear in the particular language that the child is acquiring. For example, some languages put adjectives after the noun while others put adjectives before the noun. One theory is that every normal child has an innate grammar that maps onto the sentences the child hears.

Paraphrasing Exercise 5: Paragraphs - B

Background. The most critical paraphrasing skill in college is usually described as "putting the main idea into your own words." The very best evidence that you really understand some material is if you can identify the important parts of the material and summarize them in a few original sentences. You may use some of the same words, if they are especially appropriate, but your summary should not be a direct quote.

An especially valuable skill is successive paraphrasing of a paragraph (or other large unit). By paraphrasing your paraphrase, you focus in on the core of the main idea. Once you pack a lot of knowledge into a short summary, you can later unpack it whenever the topic comes up.

DIRECTIONS: First, summarize each paragraph in one or two sentences. Then, summarize your summary.

Example: "What do people gain from language development? Verbal communication offers many advantages: greater ability to describe one's experiences, greater ability for abstract thought, greater ability to express complex ideas to others. Combined with memory, verbal communication provides the basis for the accumulation of knowledge. In sum, our ability to cope with large amounts of information is dependent on our possession of verbal language system."

Language development enables a person to handle a lot of information efficiently. This includes describing experiences, expressing ideas, and even thinking. . Language helps organize knowledge.

1. "Human language is dependent on a single structure in the brain; if this structure is destroyed through injury or stroke, language is lost. During early childhood, brain processes develop very much in parallel with language acquisition. Accordingly,

most scientists believe that language results from biological maturation as well as environmental influences."

2. "It is clear that a child must learn to speak. This apparently happens through experimentation. All normal infants innately produce many sounds such as crying, cooing, and gurgling. As the child gets accustomedto sound-making, babbling becomes a frequent form of practice. The child at an early age produces all the sounds in all the languages in the world, some of which may be lost because they are not in the language the child will learn. Increasingly, the child imitates sounds that are heard during normal speech of older children and adults."

3. "Of course, intelligible speech is more than making sounds, and the child must somehow learn the communication code of his or her society. Some scientists contend that language is acquired in the same way that any other behavior is learned: Specific utterances by the child are rewarded or not according to how closely they fit with adult rules. Others contend that the rules of language are much to complex to be learned piece-meal in this fashion and that the human infant is innately equipped for language.

Appendix F

Grammar

By "grammar" we mean the rules by which words are put together to form sentences. By-and-large, grammatical rules are arbitrary and are not necessarily guided by logic or reason.

There is therefore no "good" grammar in the sense of an intrinsic right and wrong. Grammar is whatever rules a group of people follow, often unconsciously, in verbal communication. There are rules that are generally accepted by educated writers/speakers of English, and it is important to know and obey these rules insofar as you want to present yourself as being an educated person.

The point deserves emphasis: Grammar is whatever linguistic rules a group of people follow. Black grammar, the language of the street, and teen-talk, are all okay and it is not wrong to say "they hates grammar," in a context where that is the accepted form. Indeed because English is a living language, educated grammar is changing. Before 1960, students were taught to say, "I shall" but increasingly since that time, "I will" has become the preferred style. So it is not a question of good or bad, but what is considered correct by educated people.

Ernest Tucker of the Chicago American summarized some of the important rules of educated grammar by illustrating the errors. They are well worth rehearsing:

1. Just between you and I, case is important.

"Case" refers to whether a word is the subject or the object in a sentence, and the most frequent error is in the misuse of "I" and "me" when combined with another person. Instead of "Me and Joan are. . .," one should say, "I and Joan are. . ." And instead of ". . .between Joan and I," one should say, ". . .between Joan and me." This is an easy rule to keep straight because all you have to do is try the sentence without the other person or with the order reversed. If it doesn't sound right to say, "Me are. . ." or "between I," then it isn't right with another person in the sentence.

This is an excellent rule to illustrate the inconsistency in the English language. We use the same word as subject and object for another person, namely "you." Hence, we say, "You and I are. . ." and ". . .between me and you." Then again, we have different words for the third person: "She and I are. . ." and ". . .between me and her." But most of the grammatical errors are like, "Me and my sister used to fight a lot," or "You can't separate my sister and I." It is well worth the effort to be on the lookout for such errors.

2. Don't use no double negatives.

The most common negative words are no, not, none, and never, and common negative prefixes are un-, in-, non-, and dis-. A "double negative" is a sentence with two such words or prefixes. This is one grammatical rule that is based on logical reasoning because two negatives combine to make a positive. (Mathematically: 2 - (-1) = 3.) Hence, to say "I didn't do nothing" literally means that you did something. Better to say that you did nothing, or you didn't do anything, if that's what you mean. It may seem as if two negatives should emphasize the negative, but they cancel each other out.

Of course, you can use a double negative if you intend for one to cancel out the other. For example, there is a somewhat different meaning if you say, "I don't dislike you," rather than, "I like you." But for such sentences to be interpreted the way that you intend, it must be clear to the other person that you know better than to use a double negative incorrectly.

3. Try to not ever split infinitives.

An infinitive is a verb form when used as a noun, which we do by preceding the verb with the word "to." The result is an indivisible unit. For example, if you like to watch T.V. frequently, "to watch" stands as a single word and you should not say that you like to frequently watch T.V. It may help you get a feel for this rule by pondering why Hamlet said, "To be or not to be," rather than, "To be or to not be." It is only when you hear an infinitive as a single unit that you can be confident of not splitting them in your verbal behavior.

4. Prepositions aren't good to end sentences with.

Prepositions are words that combine with nouns/pronouns to make a phrase. A phrase, in turn, is a group of words that express a single thought or idea. In a prepositional phrase, the preposition logically comes at the beginning: "at the store," "on the table," "with much interest." Ending a sentence in a preposition requires the listener/reader to reconstruct the idea. Compare: "The store we saw the coat at," with "The store at which we saw the coat." Again: "The table you left my book on," with "The table on which you left my book."

Winston Churchill is said to have asserted that this is a rule "up with which I will not put," but the reason for the rule is clear if one ends a sentence in several prepositions: Consider:

What reason did you bring the topic up for? What reason did you bring the topic we disagree about up for? What reason did you bring the topic we disagree and fight over about up for?

The best way to avoid getting tangled up in sentences that are hard to untangle is to avoid ending sentences with prepositions.

5. Make each pronoun agree with their antecedents.

We are prone to mixing up singular and plural pronouns, especially when the sentence contains conflicting cues. For example, you may think of a number of people when I say, "Every student in the class. . ," and so use the plural ending, "had their eyes shut," but student is singular and so the ending should be, "had his or her eyes shut."

6. Verbs has got to agree with their subjects.

This rule is similar to the preceding one, and is most difficult when the verb and

subject are separated by a conflicting phrase. For example, if you realize that "none" is a contraction for "no one," you will be careful to say that "None of these rules is difficult to obey."

It is important to know that some words such as "data" are plural and that some words such as "wages" may be singular or plural.

7. Finally, there are some frequently-used words that many people have difficulty distinguishing. I have tried to illustrate these in their correct usage, and if these sentences do not make the point clear to you, you should consult your dictionary for additional clarification.

The effect of learning these rules is to affect your verbal behavior.

The sender may or may not imply what the receiving person infers.

I think that I can do it, so may I try.

Don't keep them between the two of us; spread them among more people.

Who is doing what to whom?

Bring it when you come here; then you take it when you go there.

The principle of reinforcement is the principal basis for performance.

You count the number to see if there are fewer; you measure the amount to see if there is less; there may be more in either case.

If you lay a book on the desk, it will lie there; if you laid it on the desk yesterday, it lay there ever since.

It is a person who writes about a thing that is interesting.

May the better person win this match; may the best person win the championship.

If you are not sure which word to use, use "that."

Two plus two are four.

The data are impressive.

Regardless of what you may think, irregardless is not a word.

Appendix G

Reading and Redundancy

We all began to learn how to read as young children, and we are still learning. Formal instruction in reading as a skill in its own right usually ends by the fifth grade, but the presumption is that reading ability continues to improve as a result of continued reading for other purposes. However, there is no better evidence that only perfect practice makes perfect. If you acquired poor reading habits as a child, as most of us did, you have probably practiced those ways of reading so much that they are very well learned.

Improving reading skills is important for success in college, and it is also important for everyday life. It is true that you can hear the news on the radio and see it on television, and it is also true that some books are now available on audio cassette, but you are short-changing yourself as far as understanding the news and enjoying most good literature if you cannot read well. Regardless of how good a reader you are now, it would be advisable to buy a paperback book on some topic of interest to you, and use it to improve your reading skills.

The purpose of this appendix is to help you determine how well your present reading skills match up with what most educators believe is appropriate for college students. I have also included a few exercises that should show you some of the ways you can practice skills that are required for efficient reading. The college bookstore has a number of excellent books devoted entirely to reading skills, and you can decide for yourself whether you need remedial work.

You need to remember two things:

It is never too late to learn and correcting bad habits requires time and effort.

I have listened for many hours to recordings made by students reading standard texts, and if you can arrange to do so, you might profit from making a tape so you can hear yourself read. Some people usually skip words that they don't recognize, while others mis-read unfamiliar words as being familiar ones. In the particular text I used, the word "causality" was frequently mis-read as "casualty," even though that completely changed the meaning of the paragraph. Students who have developed such poor reading habits will have to learn to stop when they see a doubtful word. If they are not sure of the word, it is best to look in a dictionary while hey are overcoming self-deceiving tendencies.

On the following two pages are two sections intended for timed reading. Please use a watch that enables you to record both minutes and seconds so you can time

yourself as accurately as possible. The first page is to be read silently, and as fast as you can while being sure that you at least get the general idea of what is written. The second page is to be read out loud, with the same objective. I urge you to read as you normally would because the goal is to find out for yourself how your reading skills compare with good standards.

(Note: Try to ignore the small carat-marks between the lines during these first readings. I will explain their purpose later.)

Timed Reading 1. Rapid, silent.

Appendix H

Vocabulary

I have put together a list of about 5500 words. If we don't count slang expressions and "four-letter words," these are the most frequently used words in the English language. They are words every high-school graduate should know and they occur in textbooks written for college freshmen. I can say that with confidence because I went through dozens of introductory texts and counted the non-technical words. These are words you simply have to know in order to succeed in college.

Most children know several thousand words before they start going to school. We can call these Level-1 words. They learn several thousand more words in the elementary grades and we can call these Level-2 words. About 4000 of these Levels-1-2 words are listed in the vocabulary. Level-3 words are ones that should have been learned by the tenth grade. About 900 such words are listed in the vocabulary and they can be identified because they are printed in lower-case letters but they have a very brief definition included. More advanced words at Level-4 are printed in capital letters in the vocabulary. These are ones college professors assume that you know.

To summarize: Level 1 Preschool Level 2 Elementary School Level 3 Middle School Level 4 High school Graduate

Some students ask why, if they already know several thousand words, they need to learn still more. A good answer is by analogy of adding lanes to paved roads. A 1-lane road is certainly much better than a path, but it doesn't handle two-way traffic very well. Adding a second lane is therefore a great improvement, but may still pose problems when cars want to pass. Adding a third lane reduces this problem somewhat, but it is adding a fourth lane that is necessary to permit a smooth flow of traffic in both directions.

Vocabulary is like a road that carries information between people. Level-2 words are like a 2-lane road, and you can get along pretty well with that for many everyday purposes. But if you want to deal with heavy traffic of information, if you want to deal with complex ideas efficiently, you need a super-highway vocabulary. That means knowing words at levels 3 and 4. Good college professors do not use "big" words where little ones will do just as well. But we do use Level-4 words when it would take a long phrase of lower-level words to try to express the idea.

(Beware of sources that count "words" instead of "ideas" and make the size of your lexicon seem very large. I have counted words like know/knew/known/knowing as only one idea. By adding prefixes (unknown) and suffixes (knowingly), one could

make it seem that you know many thousand more words. To me, it is the number of non-verbal ideas that best measures the richness of your vocabulary.)

H.1 Enlarging your lexicon

A "lexicon" is a dictionary; your lexicon is the set of words that are meaningful to you. If a word is in your lexicon, you can recognize it immediately, and dull as the assignment may be, I urge you to go through the vocabulary list at the back of this workbook and highlight every word that you do not know. Then, put a check-mark beside each of those words as you learn them.

The definitions given in the vocabulary list are much too brief to be used for learning the meaning of the words, but they should be enough to remind you of the meaning once you know it. I recommend that you select ten or a dozen words that you do not know and that seem like ones you would find useful. Put each word on a small slip of paper, look up the word in a college dictionary, and put some cue to its meaning on the back of the slip. Then carry these slips with you to study when you would otherwise be doing nothing mental. Once you have learned a word, put the slip in a separate pile for later review and replace it with a new word to be learned.

When you are deliberately learning new words, do NOT simply try to MEMORIZE their verbal definitions. Recall that the real meaning of words is non-verbal and a definition is useful only if it is, in turn, meaningful to you. For example, if I define ethereal as the feeling one has when regaining consciousness after being knocked out, you could memorize the words but still not know what ethereal means if you have never been knocked out. The point is that you need to associate a word with its non-verbal meaning, not with its definition.

Learning new words requires MENTAL IMAGERY. . .visual, auditory, tactual, gustatory ideas. First, use the verbal definition to bring that idea to mind; then try to find some feature of the word that you can readily associate with that idea. Then make up a sentence using the new word. This added bit of cognitive effort will probably be enough to effect learning then and there. However, do not put that slip in your "learned" pile until you have once used the word. It is when you have spoken or written the word in the normal course of your everyday life that the word is a part of your lexicon.

I am going to give a number of illustrations of this method in order to help you get the hang of it. But the method works best when you create the images yourself. This is simply because ideas that occur to you once are more likely to occur to you again. So please read these examples for their method, not their content.

ABERRANT=not normal. Imagine a nest of ants running around, one of which is shaped like a tiny bear. "A bear ant" represents the non-verbal idea of something that is "not normal." A common football score of 21-20 would be aberrant in baseball.

ABUSE=improper use. Say to yourself, "AB-use is BAD-use," while thinking of a good example such as a knife with a bent tip because it was used (improperly) to pry open a can. Making a dog-ear of the corner of a page is one way to abuse a good book.

ACCELERATION=increase rate. Think of the accelerator in your car and imagine feeling the car take off when you step on the gas. I used to burn rubber to feel the fast acceleration.

ACUITY=see clearly. Perhaps there's a "dirty old man" cleaning his glasses so that he can see "a cutie" more clearly. Newborns have very poor visual acuity.

ADAGE=saying. For "age," think "old," and then try to recall an "old ad" that has a line (saying) you remember. . .such as, "Be all that you can be, in the Army." You can probably find a fitting adage for almost any occasion.

ADAPT=fit conditions. Something that is "apt" is "suitable." Think of an ad that was changed to make it an "apt ad," such as, "If you smoke, please try this brand." You have to be able to adapt to each professor's style.

ADHERE=stick to. Try to think of something that makes you want to stick an "ad here." Possibly a picture of a fat person that you stick to the refrigerator door to remind you to eat carefully. Wise shoppers adhere to their budgets.

ADMONISH=scold gently. Sometimes I can't make a connection, but just forming an image and studying the word is often sufficient. For example, imagine a parent explaining to a child why something the child did was wrong, and try out possible cues such as "bad-monish," "monastery," "punish." Even unsuccessful cognitive effort helps. It is often better to admonish a child rather than to punish.

ADVENTITIOUS=accidental. This word sounds like, "adventurous," and leads to imagining an episode of venturing into a new part of town and accidentally running into someone you know. You can enjoy a prize even if winning is adventitious.

After just reading the illustrations, you may have no trouble in reading this paragraph:

Learning new words is usually adventitious. Sometimes you hear an aberrant word in an adage, such as one that admonishes you about abusing your eyes lest your acuity is decreased. You do not have to adhere strictly to my method of learning but should adapt it to your own style. You will soon see an acceleration in your learning words.

Once you make a commitment to learn these words, you may find it helpful to put a few of your word-slips in places where you might have a chance to study them: the bathroom, the dining table, the car seat, etc. In this way, you can build your super-highway lexicon by using time that you would otherwise waste. Count up how many words you would learn if you added one every time you brush your teeth!

1. . 2 . .3 . .4 . . Associations

To say that you know the meaning of a word is to say that you have learned an association between the word and the non-verbal idea that it represents. However, there are two contexts in which you may encounter the word, namely when you hear it spoken or when you see it written. For most words in your lexicon, if you know the word in one of these contexts, you also know it in the other. However, for words with which you are not very familiar, you may do better when reading than when listening. This is because you can stop reading while you search your memory for the meaning of a word, whereas when listening, the lecture or conversation usually continues without regard to your awareness of the meaning of the words.

Hence, your reading lexicon is probably somewhat larger than than your listening

lexicon. Symbolically,

Association 1. Written word —-¿ Nonverbal idea (meaning) Association 2. Spoken word —-¿ Nonverbal idea (meaning)

Association 1 may be stronger than Association 2. Furthermore, these associations are not symmetrical. That is to say, the following two associations are very probably weaker than the first two:

Association 3. Nonverbal idea —-¿ Written word Association 4. Nonverbal idea —-¿ Spoken word

Association 3 is required when you are writing, and again, you often can pause long enough to try to think of the word the represents the idea you have in mind. Association 4 is required when you are talking and most people don't like to stumble around while searching for just the right word.

The asymmetry in associations is familiar. For example, we all know the frustration of knowing a person's name but not being able to think of it at the moment. Thus, the association name—¿person is stronger than the reverse association, person—¿name. Similarly, most high school graduates recognize the names Madison, Polk, Hoover, and Wilson as presidents of the United States, but few of them recall those names if asked to name presidents. In general, it is usually more difficult to generate the word than to recognize it.

The reason that I said generating the word is "usually" more difficult is because the strength of an association depends on how frequently it has been practiced. There is nothing inherently more difficult about associations 3 and 4 compared with 1 and 2; we simply don't normally use as many words when we are speaking as we see when we are reading. In one study, it was found that a vocabulary of only 200 words would enable a person to understand over 95that was said in a college student union building!

In order to increase your functional lexicon, you must practice all four kinds of associations. Being able to think of a word during normal conversation is the best sign that the word is truly in your lexicon. The next few pages provide some helpful verbal exercises.

Vocabulary Matching

Indicate the definition below that fits the capitalized words:

___ 1. One characteristic ASCRIBED to professors is absentmindedness.
___ 2. The soldier pledged ALLEGIANCE to the country.
___ 3. The scientist ASSIMILATED the idea into her theory.
___ 4. The CONCEPT of learning is described in "Ways and Whys."
___ 5. The COHENSION of the group was remarkable in that situation.
___ 6. The roads CONVERGED at the race track.
___ 7. Good multiple-choice exams require difficult DISCRIMINATIONS.
___ 8. It is difficult to DETER a determined child.
___ 9. Imagery FACILITATES learning the meaning of words.
___ 10. The students were asked to GENERATE questions in class.
___ 11. Teachers sometimes give away answers INADVERTENTLY.
___ 12. The product was INFERIOR to what we usually receive.
___ 13. The LITERAL meaning of the statement caused confusion.

___ 14. The pilots try to MINIMIZE flying into bumpy air.
___ 15. The engineers took PRECISE measurements.
___ 16. Coal is one our country's natural RESOURCES.
___ 17. Learning strategies has a SIGNIFICANT effect on memory.
___ 18. The student's STATUS in class was uncertain.
___ 19. There may only be a SUBTLE difference between our opinions.
___ 20. The doctor SYSTEMATICALLY tested the patient.

Definitions:

a. the act of perceiving differences
b. to produce
c. hardly noticeable
d. to reduce
e. to make a part of
f. not deliberate
g. asset
h. lower in quality
i. considered as belonging to
j. prevent/restrain from proceeding
k. an idea or general notion
l. position in rank
m. approach a common point
n. methodically
o. loyalty
p. make easier
q. accurate
r. union, held firmly together
s. in a basic or strict sense
t. full of meaning

Make up several sentences using these same words. If possible, make up sentences that contain two or more of the words (e.g. "A soldier's allegiance is sometimes more ascribed than real.")

Appendix I

On Mnemonics

A *mnemonic* is any method that helps you remember something that you have learned well enough to recognize, but perhaps not yet well enough to recall. Almost all of us frequently see someone we know we have met, but we can't think of her/his name. Almost all of us have sat taking an exam knowing that we know an answer but it just won't come to mind. Almost all of us have had the problem of knowing that one thing is called "X" and the other is called "Y" but we can't keep straight which is which. For these and a wide variety of other potential memory failures, mnemonic techniques can be helpful.

In the above examples, the person, the question, and the object are *stimuli* calling for learned *responses* from you. If the response is well learned, you simply give it straightaway. For example, if I ask you when did Columbus discover America, you may be able to answer "1492" immediately and confidently. When you were first studying the history of the world, you may have learned: "In fourteen hundred and ninety two, Columbus sailed the ocean blue." If so, when asked the question, you could recite the little poem to remind you of the date. Thus you were introduced to one of many mnemonic techniques.

In general, a mnemonic mediates between the stimulus and the response. Instead of S –¿ R, you have S –¿ mnemonic –¿ R. It is often the case that the mnemonic does NOT produce the response that is required. It may be just a hint, but enough to prompt your memory of the answer. For example, a woman with a wild hair-do may make you think "hairy" in recalling that her name is "Mary." You may remember that the ordinate of a graph is the vertical axis and the abscissa is the horizontal axis by noticing that your mouth opens up-and-down when you say "ordinate," and it stretches out sideways when you say "abscissa." Thus, a mnemonic helps you produce an answer so that you can recognize it as being correct.

Mnemonics are of NO value for comprehension.

Knowing the names of the axes of a graph does not explain how graphs are constructed or how you should read information from them. You might just call them "vertical" and "horizontal," and still have difficulty when trying to remember which is which unless someone pointed out that the horizon runs flat across the sky. In any event, a mnemonic can help with re calling information but you have to know what the information means.

Like any other skill, using mnemonics is a learned behavior that requires lots of

practice. To be sure, anyone can learn the specific examples that are used to illustrate mnemonic techniques. But if you want to include mnemonics in your memory repertoire, you will have to spend a reasonable amount of time learning how to recognize those situations for which mnemonics might be useful, which of the various mnemonic techniques best suits that situation, and then devising some mnemonic that is likely to work for you.

One final point: a mnemonic drops out with repeated use.

After a response is mediated a number of times, it comes to mind directly. At the same time, ou can always fall back on the mnemonic when you have a lapse of memory and the answer doesn't come directly to mind.

I.1 Acronyms

An acronym is a short name formed by combining the first letters of the complete name. UCLA, NYU, and UNM refer to universities, and IBM, AT&T, and GM refer to companies. We sometimes sign our initials instead of our complete signature, and we are familiar with messages such as RSVP, BYOB, and TGIF. This basic idea can be used to devise a mnemonic for things you want to remember.

A common example is the acronym "HOMES" to help you remember the names of the Great Lakes. Of course, you have to know the names for the mnemonic to help, but if you know them, their first letters spell HOMES. This is a good place to remind you that the mnemonic may only give a hint of the answer (in this case, just the first letter), and the mnemonic offers no understanding. Information such as where the Great Lakes are located, how they were formed, and what cities lie on their banks is not included in the mnemonic. You already have to know what you're trying to remember for a mnemonic to help.

Acronyms do not have to be perfect. Suppose we adopt the rule that vowels do not count, and we need to remember to get milk, bread, potatoes, and tomatoes at the store. The first letters are MBPT. If you can think up a word (or phrase) that contains those four letters, adding only vowels, you can remember one thing instead of four. When order is not important, you can rearrange the letters in any way. My first mnemonics are "bump-it," and "be empty." I like the second one because I can make the sentence, "I don't want to 'be empty' when I return home," as an easy-to-remember mnemonic for the occasion.

I.2 Acrostics

An acrostic is essentially the opposite of an acronym. It begins with letters and makes words that start with those letters. Ideally, the words combine into a sensible sentence or phrase because words are much easier to remember than sequences of letters. Acrostics are popular ways to remember order.

For example, many automobile license plates begin with 3 random letters that can be made into an easy-to-remember acrostic. DHP can "Darned Highway Patrol" and LDT might be "Look Don't Touch" or "Let's Drive Tonight." A more challenging

example arose when we were in the Kimberly Mountain area of Outback Australia. Another tourist told me about a good book that described the early days when Australia was a British colony. The author's name was Durack. Having nothing with which to write down her name, I devised the acrostic, "Down under, Read About Colonial Kimberly" as one way to recall her name later.

There are no constraints in creating mnemonics. You can combine the acronym and acrostic methods. The first four (inner) planets, in order from the Sun, are Mercury, Venus, Earth, and Mars. The acronym MVEM is not very helpful. The other (outer) planets, again in order, are Jupiter, Saturn, Uranus, Neptune, and Pluto. That acronym JSUNP is also not very helpful. Now consider the acrostic: "My very easy mnemonic. Just spin us nine planets." You can memorize two sentences and use the first letter of each word to help you think of planets.

I.3 Mental Imagery

A "picture in your mind's eye" can be an especially good way to link up ideas. If the ideas are combined into a single mental image, then recalling that image brings both ideas to mind. Notice that the essential feature of the method is seeing the ideas interact together in some way. Let me illustrate the use of imagery in remembering the same name that I used earlier, Durack. My first thought involving a "rack" was a rack of lamb. I then imagined a rose garden with a tiny roasted rack of lamp instead of a flower on a rose bush, with dew drops covering the bush. Hence, "dew" and "rack" could remind me of the name when I reconstructed the mental image in a book store.

I started with this example because the suggested mental image is somewhat bizarre. Some people find it helpful deliberately to try to come up with strange, unusual mental images. However, research on this issue indicates that the important feature is that the ideas are seen as interacting in some way. If the image has to be bizarre in order to accomplish that feature, then so be it.

Although it usually takes extra time to think up an image that reminds you of the items, the result is a lasting memory that you can repeat with confidence. Suppose you want to learn the capital cities of the United States. Here are a few of my own mnemonics:

Santa Claus in a broad-rimmed Mexican hat: New Mexico - Santa Fe A garden with unusually tall flowers over my head: Florida - Tallahassee The Ark filled with animals and rocking in high seas: Arkansas - Little Rock A pair of scissors cutting a Valentine heart in half: Connecticut - Hartford A pretty girl named Ida holding hands with many boys: Idaho - Boise

Mental imagery is at the heart of two popular mnemonic methods. One is called the Method of Loci because it depends on a mental image of the locations (loci) of items to recall. Can you recall your last family Thanksgiving dinner? Can you place the people as they were sitting around the table? Can you mentally look around each room in your home and count the number of lamps? Can you construct a mental image of the floor plan of your high school so that you can trace your usual path from

one room to another? If you can do these things, you can learn to use the Method of Loci.

(Parenthetically, I believe that skill at forming mental images is learnable. That is to say, you can improve the ease and clarity with which you get a picture in your mind's eye. As in all other skills, what is required is practice. Look around the room for a minute, and then close your eyes and try to reconstruct as much of it as you can. Then open your eyes, look around again searching for any objects that you had not imagined. Close your eyes again and repeat. If you practice this in different contexts, including pictures and ads in magazines, you will improve your mental imagery skills.)

To use the Method of Loci, you imagine the to-be-remembered items in a series of familiar places. Let me use a house in which I once lived to recall the countries in Central America. I first enter the hallway where I hear the doorbell (Belize) ringing. In the living room I put a picture of people fishing who got a marlin (Guatemala). The den is a converted garage, and I imagine a car there (Honduras). I have to open the door to the bedroom and see a tube of salve on the bedside table (Salvador). In the bathroom, I see the mirror with my face nicked from shaving (Nicaragua). On the dining room table is a large bowl of cooked rice (Costa Rica), leading to the kitchen where the sink is full of pans (Panama). Of course, your home is probably not arranged that same way, but you can construct your own images as you think of walking through seven rooms.

The other popular mnemonic that uses mental imagery is called the Pegword method because it involves first learning a series of objects that are then used to associate with the to-be-remembered items. The first learning is easy because the words rhyme:

One is a gun.	Six is a stick.
Two is a shoe.	Seven is an oven.
Three is a tree.	Eight is a plate.
Four is a door.	Nine is a wine.
Five is a knife.	Ten is a pen.

You do not have to use those words ("one" could be a "bun"), and you can follow any familiar sequence such as the alphabet (apple, box, car, dog, etc.) The important feature is that you can easily form a mental image of the pegword.

Using the Pegword method again involves visualizing the pegword and the to-be-remembered item interacting in some way. For example, the first four (inner) planets are Mercury, Venus, Earth, and Mars. I formed an image of one person aiming a gun at another person who is pleading for mercy (Mercury). Next came an image of a well-dressed person who is minus (Venus) a shoe. A scene containing a tree must be the Earth. Finally, I imagine a cell door with bars (Mars). Thus I can quickly answer such a question as, "What if the fourth planet from the sun?" by saying to myself, "Four is a door" and then getting the image of a door with bars leading me to the answer.

Mental imagery can be helpful in learning a foreign language. The basic idea is to find some part of the foreign word that sounds like an English word that you can link with the English translation in an image. For example, the Spanish word for table

is mesa. If you form an image of a "messy table" you can remember the meaning of mesa. The Spanish word for glass is vaso. Imagine a glass being used as a vase with flowers in it. The Spanish word for pen is pluma and you can visualize an old-time quill pen with a long feather or you might see a plum being used as the cap for a pen. It is always the case that your images will be better for you than my images and I encourage you to spend a few minutes practicing more Spanish words.

cama - bed	ventana - window	zapato - shoe	silla - chair
perro - dog	cuchillo - knife	gato - cat	suelo - floor

I.4 Verbal Mediation

It is said that a picture is worth a thousand words, which is why the mnemonics involving mental pictures (images) are popular. But there are many situations in which it is easier to use words to mediate between the stimulus and the response. In learning foreign words, there may be a similar English word that you can immediately relate to the correct translation. Again using Spanish (with the verbal mediator in parenthesis):

casa-(castle)-house	libro-(library)-book	agua-(aquarium)-water
mujer-(mother)woman	campo-(campus)-countryside	taza-(tea)-cup

Verbal mediators can involve several words or a sentence. If the stimulus starts a series of associations that eventually leads you to the desired response, it can be better than simple repetition of the words. For example: calle-(call a cab in the)-street. Yet another example: ciudad-(see you down town)-city. Although a long series may seem inefficient, you can race through those thoughts in a split second, and they will eventually drop out as you learn. Coding

A code uses one set of symbols to stand for another set. One familiar code is the Morse code that uses combinations of dots and dashes to stand for letters of the alphabet. (Actually, letters of the alphabet are themselves codes for sounds we make in speaking and you know that every product sold in a supermarket is coded by a set of lines of varying widths.) The reason that coding is a potentially useful mnemonic technique is that coded information may be easier to remember than the original form.

There is a wide range of possible codes. Let me illustrate a widely-used coding technique that uses letters to stand for other letters. In this technique, there is an arbitrary "code word" that tells you how to make the translation. You start with the code word and then finish listing the remaining letters of the alphabet. For example, if the code word is, "help":

Coded:	H E L P A B C D F G I J K M N O Q R S T U V W X Y Z
Alphabet:	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

an H stands for A, and E for B, etc. If I send you the message:

PNYNUCATTDAFPAH? you decode into DOYOUGETTHEIDEA?

which you can readily separate into "Do you get the idea?" Note that if we agreed upon a different code word, say "forget," and further agreed that we would finish listing the alphabet backward, the same message would code quite differently:

Coded: F O R G E T Z Y X W V U S Q P N M L K J I H D C B A
Alphabet: A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
Message: GPBPIZEJJYEXGEF? I hope so.

The preceding code used letters for letters, but the codes used as memory aids typically change from one type of symbol to another. For example, I sometimes find it easier to code numbers into words by using the length of the word to represent the number. Consider that a telephone number is 296-2428. The sentence, "My telephone number is easy to remember," has seven words with the lengths standing for the numbers in the telephone number. If you can make up a sentence such as that one, you can be sure people will remember your number.

Let me help you get started. First, count the letters in your name (e.g., Frank = 5) and see if that number is in your telephone number. Next, worry about the number 1 because that will have to be either "I" or "a" in your sentence. If possible, try to work some relevant word (call = 4, telephone = 9, number = 6, phone = 5) into the sentence. "To phone Frank, just dial a number" = 255-4416.

One good way to practice this mnemonic is to combine it with the acrostic method to remember an automobile license number. You know that the number has 3 letters and then 3 numbers, so you make up a six-word sentence, with the first three being an acrostic for the letters, and the last three being coded by word length. For example:

BFG 266 = Big fish grow in little rivers.
CRD 140 = Children rarely drive a real automobile.
DLS 532 = Drive like Satan wants you to.
DLS 532 = Don't let some child get it.

It could be well worth your while to take the time to memorize this sentence: "I know what numbers to think because one counts a word length." That sentence decodes into 144725736146. Now if you number the days of the week like the calendar does with Sunday as day 1, the foregoing string of numbers tells you the day of the week that is the first of each month in a non-Leap-year beginning with January first on a Sunday. In just a single sentence, you can memorize the entire calendar!

For example, in such a year, on what day of the week does the Fourth of July fall? July is the 7th month, so you recite, "I know what numbers to think because," to learn that July 1st is the 7th day (Saturday). It is easy enough then to figure that the 4th is on a Tuesday. When is Christmas? The 12th word (length) has 6 letters, so December 1st falls on a Friday. Succeeding Fridays would be 8th, 15, and 22nd. If the 22nd is a Friday, Christmas falls on Monday.

Actually, you can use that same sentence in any year except for Leap years. All you have to do is make a mental note at the first of the year as to what day it is. Then you adjust accordingly. Thus, if New Years Day falls on a Tuesday instead of a Sunday, you will have to add two days to your figuring. Thus July 1st falls on Monday (rather than Saturday), and the 4th is therefore on Thursday. Such is the power of mnemonics.

Coding is a versatile mnemonic device because you can fabricate a limitless number of diverse ways to transform information. You can fill many otherwise wasted minutes

devising mnemonic codes.

Appendix J

On Writing

Writing is conceptually a recording of speech into tangible sym bols. The alphabet is intended to be a set of symbols for the sounds of speech. Once you have learned the mechanics of writing, you can simply write down the words that you would say. Although that is the fundamental basis of writing, it is not the whole story.

There are many facets of face-to-face communication in addition to the actual words spoken. In speech, some information is conveyed by tone of voice, accentuation, pacing of sounds, pauses, inflections and pitch. We also use "body language" in posture, facial expression and gestures. Furthermore, the listener is present to give signs of understanding or confusion. Thus, a mere record of the words that one might speak is a very incomplete report of verbal intercourse.

A good writer tries to make up for these missing ingredients in various ways. Instead of using the first word that comes to mind, the writer can take time to search for just the right word. Writers may use more words to express the non-verbal information in speech, and can use more complex sentences to build in redundancy. A writer uses form and structure to help the reader locate the main ideas and follow their development. When possible, a writer may work through several drafts to clarify ambiguities and to fill in missing information. In general, speech tends to be casual and informal where good writing tends to be precise and formal.

According to my hypothesis of verbal discipline, the better you are at speaking, the better you will be at writing. The converse is also true. But good writing requires more than good speaking. The best way to learn good writing on your own is through imitation. Read good literature, and pay some attention to the form and style as well as content. Take time to parse some of the sentences and analyze some of the paragraphs. Try to figure out why the author put thoughts into that particular sequence. The more you carefully read good writing by various authors, the better your own writing will be.

As with any skill, practice in writing is what leads to learning to write. Also as with any skill, practicing poor writing leads to learning poor writing! To improve your writing skills, you need to have a good writer edit your writing. Hopefully, you are enrolled in a course in English composition that provides such feedback. As your weaknesses are pointed out and corrected, you will learn to become your own critic.

Because learning to write well requires corrected practice, no one can tell you how to do it. What I can do is point out some of the most common weaknesses that I have

found while editing students' writing. They are also weaknesses that were found from time to time in my own writing and which were corrected by editors. Improvement in all aspects of verbal fluency should be a continuing self-imposed objective. Being able to write clearly, concisely, and effectively is an essential aspect of a good education.

What is a sentence? A complete sentence should express a single thought. It must have a subject and a predicate (verb). If the verb is transitive, the sentence must also contain an object. The corner-stone of good writing is formulating good sentences. . .neither too long nor too short, neither too simple nor too complex. When I write text material, I usually construct three or four (or sometimes more) mental sentences that try to express the thought I have in mind. And then, even after writing one down, I usually have to edit it several more times before I let someone else read it.

Consider, for example, that I want to be sure my reader knows what a "transitive" verb is. I could simply define it as a verb that "takes an object." But will the reader know what an "object" is in this context? And what does it mean to "take" an object? Perhaps I should illustrate transitive and intransitive verbs (Now I lay me down to sleep; Now I lie down to sleep). I could point out that the word "transit" means to "carry across," so that a transitive verb is one that carries its action from a subject to an object. Of course, I could simply hope the reader will look it up in a dictionary.

What I hope you see is that writing a sentence is really a mini-problem solving situation. Recall that a problem exists when you are in some condition, you have a goal in mind, and the route to the goal is not immediately obvious. In this case, you have a non-verbal idea in mind, your goal is to express it such that a reader will be likely to "get" that idea, and the problem is to find the words that will be effective. Sometimes the appropriate sentence is obvious, but there are usually several alternatives from which to choose. Therefore, the problem-solving tactic to inhibit impulsive action applies. Do not just write down the first thing that comes to mind. Mentally generate several sentences and then choose the best one.

With that background, here are some guidelines: (I have again illustrated some errors thanks to Ernest Tucker. These are indicated by quotation marks.)

A sentence should express a single thought. Each sentence must be a complete sentence. "About them sentence fragments." Write the simplest sentence that expresses the thought. Use punctuation to help the reader parse the sentence, but "don't use commas, which aren't necessary." "Don't write run-on sentences they are hard to read." "Join clauses good, like a conjunction should."

What is a paragraph? A complete paragraph should express a single idea. As I use the terms, an "idea" is larger than a "thought." I think of paragraphs as the meat and potatoes of writing. Meat and potatoes are made up of several bites (sentences), they are part of a main course (a theme), which is part of dinner (the thesis). A thesis is one's message to the reader. It usually contains several themes, or trains of thought, each made up of several ideas. Hence, the paragraph is the conceptual unit of writing.

Mark Twain gave a formula that applies to a paragraph, a theme, and a thesis. He said, First, tell 'em what you're going to tell 'em. Then tell 'em. Then tell 'em what you told 'em." According to this rule, a paragraph must have at least three sentences:

a topic sentence, a supporting sentence, and a summary sentence. Of course, there may be several supporting sentences. Although it may not always be possible or desirable to write perfect paragraphs, it is important to know how to write one.

As practice, write twelve perfect paragraphs on the topics given below. I have written an illustrative paragraph for the first four, and you should change the example in writing your perfect paragraphs. In each case, start by stating your point, then support it in one or more ways, and then wrap it up.

Favorite pet My favorite pet is a bird. Birds require little care, and they repay their owner with happy songs. All kinds of birds can learn to do tricks, and some birds can even learn to talk. I like all animals, but I think a bird makes the best pet.

A means of transportation A bicycle is a good way to get around town. It causes no pollution and it provides good exercise. A bike may not be as fast as a car, but it also doesn't need as much care. Every healthy person should own and ride a bicycle.

T.V. show Television game shows are good entertainment. You can imagine yourself playing along, trying to beat the contestant. There should be more challenging game shows on T.V.

Spectator sport I like to watch football. On every play, there's a chance for a great play. That's true whether your team is on offense or defense. Then there's time between plays to review the last play and get ready for the next one. As spectator sports, basketball is too busy, baseball is too slow, but football is just right.

Best time of day/night If I had one wish What is a friend The smartest thing I ever did Favorite flavor of ice cream Why I like Christmas How to brush your teeth The importance of winning

With that background, here are some guidelines:

A paragraph should express a "single" idea. Don't write run-on paragraphs that change ideas. A paragraph should have at least three sentences. The "topic sentence" should be first, or be easy to find. A paragraph over 12 lines long is too big; break it up. Try to provide some logical transition between paragraphs.

Referents. Make it easy for the reader to know the referent for words such as he, she, it, that, etc. For example, if you wrote the sentence, "Maria talked to Emily about her problem," the reader can't tell whose problem it is. If I now write, "That is a common error in writing," do you know what "that" refers to? The point is that you, as the writer, may know to whom or to what you are referring but your reader may have difficulty if you write carelessly. It is much better to repeat a referent (Maria talked to Emily about Emily's problem) than to leave it ambiguous to your reader.

Dangles. A word, phrase, or clause that is set off by a comma at the beginning of a sentence typically modifies the first noun after the comma. Like a lost kitten, the expression tries to latch on to the first words that come along. Without an appropriate word to modify, the expression is left "dangling" without an anchor. In order to illustrate this concept, I have now written three correct sentences. Ernest Tucker illustrated the concept with an error: "When dangling, watch your participles."

Spelling. "Correct speling is essential." We would all be good spellers if our alphabet were a perfect code for sounds of speech. Instead, there are many inconsistencies. For example, "A rough cough and a hiccough plough me through," is a

sentence with five words with an "ough" spelling, all pronounced differently. Many differences are strange: dear and fear versus bear and pear; meat/great/threat versus suite/straight/debt; dread versus heard versus beard; and dose versus rose versus lose; etc. Our ancestors certainly made this aspect of our lives difficult.

As a self-test, underline the correct spelling or, if you think that neither is correct, place your spelling to the right.

absence	abscense
neccessary	necessary
arguement	argument
ninety	ninty
baloon	balloon
occurence	occurrence
believe	beleive
priviledge	privilege
catagory	category
preceed	precede
climn	climb
proceed	procede
defenitely	defenately
proceedure	procedure
description	discription
professor	proffessor
essential	essensial
repitition	repatition
forty	fourty
rediculous	ridiculous
grammar	grammer
separate	seperate
holaday	holiday
sertain	certain
illegitimate	ilegitimate
supprise	surprise
leisure	leizure
truly	truely
license	lisence
twelfth	twelvth
morgage	mortgage
until	untill

Indeed, even one of the familiar spelling mnemonics is sometimes wrong. You probably know, "i before e, except after c, and for sounds of an a, as in neighbor and weigh." Among the exceptions are either, leisure, and seize. Accordingly, to be a good speller, one has to learn a large number of special cases.

Nevertheless, correct spelling is essential if you want to present yourself as an educated person. This does not necessarily mean that you have to be a good speller. What it does mean is that you have to learn to look up the spelling of a word when

you are not completely certain of it. It is much better to be certain than sorry. Many's the admission, job, or advancement that has been lost because of a few misspelled words. If you find that you have to look up the same word frequently, it is worth your while to make up a mnemonic.

At one time, I had difficulty remembering that the "u" in four drops out in forty but returns in fourth, while the "e" in nine stays in for ninety and drops out in ninth. By making up verbal mediators, "I have looked up forty for the last time," and "There are nine tees on a golf course," I am able to recall the correct spellings without having to look them up. I now remember how to spell "precede" and "proceed" by the mnemonic, "There are only two e's before the d." I was taught that stationery and paper have an "er" while stationary does not. Some children learn to spell "arithmetic" by the acrostic, "A rat in the house may eat the ice cream." In sum, when phonetic spelling fails, mnemonic spelling succeeds.

Citations. The cardinal sin in writing is plagiarism, copying someone else's writing without citation. If you submit a composition as your original work, it must be original. Certainly you can quote other writers, but you must indicate the source of any quotation. A few short quotations may make your composition appear scholarly, but it is wise to avoid extensive quotations. Remember that professors want to know if you understand something, and the best way to show them that you do is to say it in your own words.

Finally, "proofread your writing to see if you any words out." Writing is so much slower than thinking that it is easy to make mistakes while trying to keep up. Like the other verbal skills, writing is a mental time-sharing task, with attention divided between the mechanics of putting marks on paper and the cognitive processes that generate the words to write. Errors are especially likely if you are already thinking about the next sentence while writing this one down. It is best to focus on the sentence that you are writing, but proof-reading is the best safeguard against submitting a paper containing writing errors.

absence	description	license	precede	separate
argument	essential	mortgage	proceed	certain
balloon	forty	necessary	procedure	surprise
believe	grammar	ninety	professor	truly
category	holiday	occurrence	repetition	twelfth
climb	illegitimate	privilege	ridiculous	until
definitely	leisure			

Appendix K

Science and Behavior

Every educated person in today's world needs to understand the nature of science. . .its fundamental assumptions, its basic methods, and its limitations. Science has brought many changes to the quality of life; college students of today can hardly imagine a world without automobiles, boom boxes, and television. There is certainly much more to come. Whether you plan to be a scientist working on the cutting edge of knowledge, or whether you are just going along for the ride, you should know what science is, and is not.

Scientists spend a lot of time reading and writing about results of research, but science is not knowledge. Knowledge is the result of science, not science itself. Scientists often work with complicated apparatus and instruments, but science is not equipment. Equipment is the tool of science, not science itself. Pared to the bone, science is method. Science is a way of thinking, a way of asking and then answering questions, a way of understanding events taking place in our bodies and in the world around us. Science is not the only way to do these things; it may not always be the best way. But it is a way with powerful implications.

During the last fifty years, the methods of science have been extended to the mind and behavior. Some of the results of this enter prise have been the principles of learning and memory stated in this book. An even greater outcome will result if you can learn to adopt a scientific attitude toward yourself and others. You don't have to be a scientist to think scientifically. Science cannot answer all of your questions about life; there is need for philosophy, religion, art, and the humanities. But where the scientific method applies, it replaces ignorance, myth, and superstition with empirical knowledge.

To begin adopting the scientific attitude, you first become a skeptic. You don't believe anything just because it was written in a book or because some important person said it. You don't even accept things that seem intuitively obvious. You become, first and foremost an empiricist. . .a person who is convinced only by evidence based on objective research. You may say, "According to so-and-so, something is true" but you don't necessarily believe so-and-so unless the claim is back up with empirical facts.

K.1 Popular Misconceptions

There are many popular misconceptions, old wives tales, familiar sayings, proverbs, and rules-of-thumb. Indeed, there are so many that it would take several very large books to try to dispel all of them. I shall illustrate a few for the purpose of convincing you that being a skeptic about "common knowledge" is appropriate. You may or may not believe the following propositions, but you have probably heard about them and perhaps wondered about the truth.

1. You "can" teach old dogs new tricks. It is difficult to teach anyone of any age a new trick that requires changing a well-learned habit, but learning ability normally survives to a very old age.

2. High sexual activity in youth does not diminish future sexual activity. Indeed, people whose sexual needs are high in adolescence, tend to remain that way.

3. Practice "does not" make perfect. Because you learn what you practice the way you practice, only perfect practice makes perfect.

4. You "do not" catch a cold from being wet and cold. You catch a cold by contact with a virus transmitted from another person.

5. One "does not" contract a venereal disease from a toilet seat. Unless an open sore makes contact with an infected seat, VD is trans mitted only by sexual activity.

6. As a rule, girls "are" better in verbal skills, and boys "are" better in math skills. Both girls and boys can be good (or bad) in both, but there is some biological relationship with gender.

7. Traits do not always balance out. Pretty/handsome people also tend to be healthier and more intelligent.

8. Remembering trivial facts "does not" waste space in memory. Memory capacity is unlimited, but trivia may sometimes interfere with recalling important information.

9. Sexual activity "does not" use up an especially vital energy. Record performances in races and games have occurred shortly after a sex act (masturbation or intercourse).

10. People "are not" especially bad at remembering names. Memory is as good (or bad) for names as for other information. Many people are especially bad at attending to and hence learning names.

11. Slow learners "do not" remember more of what they learn than fast learners. If anything, the opposite is true.

12. Having superstitions "is not" a sign of stupidity. Everyone tends to infer causality from observed correlations.

13. Alcohol "is not" a stimulant, even in small amounts. Alcohol may lower one's inhibitions, making one appear to be stimulated.

14. High motivation "does not" help one solve complex problems. The more difficult the material, the lower the level of motivation that is optimal for learning and problem-solving.

15. People of the same gender are more concerned about the size of your genitals than people of the opposite gender. To the latter, it is what you do with your equipment that matters most.

16. Eating chocolate and junk food "does not" cause one to have a poor complexion. Blemishes are a result of hormonal condition and/or poor habits of skin care.

K.2 Determinism

The most fundamental assumption of science is determinism. . .the belief that everything that happens is determined by other events. A scientist assumes that there is a natural cause that explains why this thing happened in this way at this time. Sometimes, the explanation is obscure, and sometimes an element of chance has to be included in understanding events. For example, your very existence was caused by the fertilization of an egg in your mother's body by a sperm from your father's body. However, that particular egg and sperm were only one of many millions that your parents could produce, and hence the fact that you are the particular person you are was determined by chance.

It is this element of chance that distinguishes determinism from pre-determinism. This latter is the belief that everything that ever has or ever will happen is somehow programmed in advance. According to such a view, we are all simply acting out our pre-determined roles while our destinies unfold from day to day. Science does not demand such a fatalistic view of life.

What science does demand is the belief that nature is lawful and that, as scientists discover the laws of nature, we will be able to predict the consequences of various events. Scientific laws are of the form: If event A, then event B. If the law is true, then you can predict the occurrence of B whenever A happens, and you can control the occurrence of B if you can control the occurrence of A.

When a scientific law appears to have very wide generality, it is called a principle. For example, one well established principle of behavior is this: If reward is scheduled at a regular time, organisms tend to postpone responding until shortly before the next scheduled reward. This principle was first clearly demonstrated in research on hungry rats responding for food reward. But it applies to all species of organisms with all kinds of responses for all kinds of rewards. A relevant instance is the behavior of most students. Exams (rewards) are usually scheduled at regular times; hence studying (responding) is typically put off until shortly before the exam.

The behavior sciences attribute behavior to some combination of three general factors: genetic nature, past experience, and present circumstances. The goal of such sciences is to discover what factors are responsible for some behavior of interest. Consider, for example, that I am now interested in your survival as a college student. What are the factors that determine the likelihood of your success? There is no denying that native intelligence is relevant; obviously, educa tional preparation is critical; and various features of the college environment (e.g., size of classes, living arrangements) importantly affect performance. Scientists seek to discover those factors.

K.3 The Experimental Method

In their quest to discover what is caused by what, scientists frequently use a basic experimental design. The logic of the design is very simple, but doing it is sometimes very difficult. It begins with an hypothesis, which is a statement that factor X is one of the causes of event Y. To find out if the statement is true, a scientist conducts an experiment in which there are two conditions. One condition includes factor X, the other does not. If event Y occurs only in the condition including factor X, one can conclude that the hypothesis is true, that factor X does indeed cause event Y.

The difficulty in using the experimental method is in insuring that factor X is the only difference between the two conditions. Let me illustrate the method and the difficulty with a common question by students: Should one study with background music playing? We first state the question as an hypothesis: Background music is beneficial to learning. To test that hypothesis, we need to have students study with music and without music, and then somehow measure how much they learned. Conceptually, the design is clear; practically, it is very difficult.

First we must be sure that the material being learned with music is equally difficult as that being learned without music. Perhaps the hypothesis is true for some kinds of material and not for others, and so we probably should include several kinds. Perhaps the effects depends on the type of music, so we should also include several types of music. The result may depend on whether the student usually has music playing while studying, so we will need to take past experience into consideration. For that matter, some students may be biased in such a way that they work harder with music in order to prove that it is beneficial. Then there are many other factors to be balanced: the time of day, state of hunger, importance of the material, etc.

The fact that it may be difficult to satisfy the everything-else equal requirement of the experimental method should not dissuade one from trying to use it. It is the best way to avoid superstitious beliefs. For example, you may have seen a commercial that some cereal will improve your performance. You may then try the cereal and, by chance, do better than usual. Should this happen more than once, you may be firmly convinced that the commercial was true. Perhaps it is true but as a scientist, you would want to compare several cereals under nearly-identical testing conditions. You can learn a lot about yourself and the world around you by adopting the scientific method.

K.4 Objectivity

One critical feature of science is objectivity. To be objective means to be free of personal biases, to evaluate an event without any prejudice one way or the other. We all have subjective, this is, internal, private feelings and desires. In many ways, our subjective selves are the true essence of life. But these are not in the realm of science, because science can only deal with publicly observable events. True science is a public enterprise in which anyone else can repeat the same experiment and obtain the same results.

Hence in adopting a scientific attitude, you need to learn to be as objective as possible. I can recall when I was trying to justify my alcoholic behavior. I managed to convince myself that I could do almost everything better after having a few drinks than when I was sober. This was mostly wishful thinking. Although there really are a few things where the fear-reducing effects of alcohol can improve one's performance, in most cases, alcohol only makes one think s/he is doing better. That is why a scientist seeks objective measures, ones that are not influenced by subjective biases.

Now here's the twist: You can adopt the scientific attitude toward your own subjective experiences. Because no-one else can observe them, they are not a part of true science. But nevertheless, you can attempt to be objective about your thoughts, feelings, and beliefs. For example, in the first chapter of this book, I urged you to make a commitment to learn these materials. Regardless of whether or not you sign a contract, you are the only one who knows just how committed to doing well in college you really are. Being objective in the context of your subjective feelings means not kidding yourself.

There is an important psychological reason to "know yourself." As first pointed out by Freud, unconscious desires, intentions, and opinions frequently surface as slips of the tongue, accidents, missed appointments, and forgotten information. The best way to avoid such embarrassing and potentially dangerous consequences is to understand your true inner self. As one example, a woman who realizes that she really hates her father is less likely to "lose" a watch that he gave her. More dramatically, a man who realizes that he is really down in the dumps over being jilted is less likely "accidentally" to fail to make a curve at high speed and end up a traffic fatality. Science as method has personal relevance for everyday life.

K.5 Correlational Evidence

Two things are correlated if they tend to vary together so that the more there is one, the more (or less) there is of the other. The Appendix L explains correlation in greater detail and I recommend you read that if you are not familiar with the concept. The basic idea is simple enough. Height is correlated with weight because taller people tend to weigh more. Grades are correlated with intelligence because smarter people tend to do better in school. Smoking is correlated with lung cancer because people who smoke tend to die early from lung cancer. Whether you call it that or not, you are undoubtedly familiar with many natural correlations.

In many cases, scientists cannot use the experimental method because of practical or ethical limitations. Suppose, for example, that I wanted to find out if marijuana impairs learning ability. To do an experiment would be not be legal and not possible because some people would not be willing to participate. As another example, suppose I wanted to find out if there are racial differences in basic learning ability. There is no way to do an experiment that insures that every thing except racial heritage is equal. In these and many other cases, the best one can do is look for a correlation.

There are two important scientific points about correlations. A correlation does not establish causality. The correlation may be due to some other causal factor. Nevertheless, a correlation is useful to make predictions. It makes no difference why the events are correlated, if they vary together, you can use one to predict the other.

K.6 Conclusions

Some people characterize science as a kind of game. To play the game, one begins with the assumption that nature is lawful, that some elegant set of principles "makes the world go round." The object of the game is to discover those laws so we can better understand the things that happen. Thus, early humans naturally believed that the earth was stationary and the sun moved around it. What could be more intuitively obvious than that? The first scientists met with great opposition to their evidence that days and nights were caused by a spinning earth.

Much of the opposition, then and now, comes from the mistaken belief that science is incompatible with religion. Science can never answer, even in principle, ultimate questions about the meaning and purpose of life. Science does not resolve moral and ethical issues. Specifically, if your religion condemns eating certain foods, working on Sunday, masturbating, or dancing, your beliefs override scientific knowledge about the natural effects of such behaviors. Science sometimes steps on the toes of certain religious beliefs, but it poses no threat to the essence of religion.

For example, the scientific theory of evolution is incompatible with the Biblical story of creation. However, evolution doesn't explain creation. Scientists may believe that the human species did not result from a separate act of creation, but the material of life and the process of evolution had to be created somehow. Science can relieve religion of having to ascribe natural events to miracles.

The quest for scientific knowledge is the search for causality, for cause and effect. A scientific hypothesis is a guess that some event of interest (the dependent variable) is caused, at least in part, by some other event (the independent variable). If conditions can be arranged to observe the dependent variable both with and without the independent variable, the hypothesis can be tested. If there is a causal relationship, the outcome will show a difference.

You can use this method in order better to understand your own behavior. In doing so, you need to learn to be objective with regard to your subjective experiences as well as your actual performance in any task of interest to you. In order to get some practice, you may wish to do the experiment described in the boxes 8.10.9 and 8.10.10. You need to try to control everything except the time of day (and the things

normally associated with time of day, such as hunger, fatigue, drowsiness). If you normally lead a fairly regular life, it is quite probable that you will discover a stable, cyclical biorhythm that identifies you as a "morning person" or an "evening person."

You do not have to be a scientist to notice correlations. When you are performing well (poorly), you naturally look for things that could account for it. . .your mood, the presence of others, whether you have been "good," the weather, and perhaps even your horoscope. A scientist starts with the same observations, but then tries to find out whether there really is a causal relationship. As a result, many popular misconceptions, adages, and superstitions are proven false.

K.7 On Self-Control

Most of us were taught early on that we were responsible for our actions, that as adults, we possess a free will with the power to choose between right and wrong. Of course, animals, children, and the insane are not held responsible for their actions; we view their behavior as being determined by natural forces, so they can not be expected to show self-control. But civilized adults should have the will power to behave in an ethical and moral manner.

A belief in determinism is contradictory with the notion of a free will. If your behavior is completely determined by genetic nature, past experience, and present conditions, there is nothing residual left for you to make an autonomous decision. Indeed, it is not even clear how you could know whether a decision was really "yours." To be sure, you may feel that you decided to do something, but perhaps the decision was actually determined by natural forces as surely as actions by animals, children, and the insane.

One of the invaluable hallmarks of science is recognizing when a question cannot be answered empirically. If there is no way to substantiate the existence, or non-existence of free will, it is a matter of belief. Whether or not you are predisposed to believe in free will, you should understand how you control your own behavior.

Theorem of Self-Control
A person can control one's own behavior by
learning to emit and obey cue-producing responses.

A "cue-producing response" is anything you can do to tell yourself what to do. The most common cue-producing response is language. For example, when you buy something, you count out enough money to pay for it. When following directions, you tell yourself first to turn this way, then that. Voluntary self-control is simply giving yourself orders and then obeying them.

This means that self-control is learned. Although it may seem that voluntary control of your fingers, arms, legs, and even the muscles used in speaking just "come naturally," you actually had to learn how to make your body do what you intend. Where you have not yet learned self-control, you can still learn! As with all habits, you learn self-control by practicing self-control. By all odds, the most important advice I can give anyone is this Never disobey yourself. If you tell yourself to do

something, do it! If you tell yourself not to do something, don't do it! To make this rule practicable, you should never give yourself an order you can not obey. Always ask a lot of yourself, but never too much.

Appendix L

Statistics

Appendix L. . .Statistics

On Describing Data:

Some information is in numerical form. Your height, weight, age and scores on tests are numbers that convey some information about you. If we have such information on a group of people, we need some way to describe that set of numbers. This is done by using statistics but you only need to know a few very simple things in order to understand the way that numerical information is described in introductory textbooks.

Suppose, for example, that the 27 students in my class took the vocabulary pretest given in the preface. If you wanted to know how well the class did, you could look at the list of their scores in my grade book where the students are listed in alphabetical order. You might see the following numbers:

85 79 52 64 62 79 53 46 64 84 76 49 64 68 61 55 73 41 88 58 74 65 93 59 53 73 36

Although reading those numbers might give you some general idea about how well the class did, it would be better if the scores were listed in numerical order: 36 41 42 49 52 53 53 55 58 59 61 62 64 64 64 65 68 73 73 74 76 79 79 84 85 88 93

Such an arrangement of the scores enables you quickly to determine that they range between 36 and 93, and that the middle score is about 62 or 64. A still better picture of this set of scores emerges if we stack the identical scores:

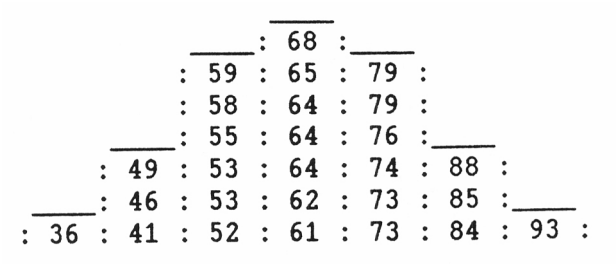
64 53 64 73 79 36 41 42 46 49 52 53 55 58 59 61 62 64 65 68 73 74 76 79 84 85 88 93

For greater convenience and clarity, it is helpful to lump scores into five to seven class intervals. I have chosen a set of scores so that the numerical decades provide good class intervals, and the results of this lumping of the scores are shown in two ways:

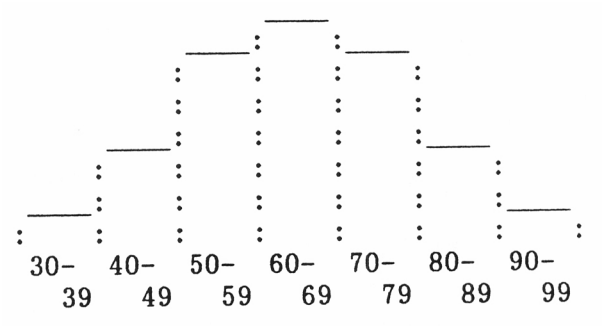
Score Percent Interval Frequency Frequency 68 30-39 1 3.7 59 65 79 40-49 3 11.1 58 64 79 50-59 6 22.2 55 64 76 60-69 7 25.9 49 53 64 74 88 70-79 6 22.2 46 53 62 73 85 80-89 3 11.1 36 41 52 61 73 84 93 90-99 1 3.7

The table on the left above is called a frequency distribution; it is the most common method of presenting statistical information. As a rule, only the percent frequencies are displayed because, if you know the total number of scores, you can compute the actual frequencies if they are of special interest. The disadvantage of a frequency distribution is that one cannot tell "at a glance" what the distribution of scores

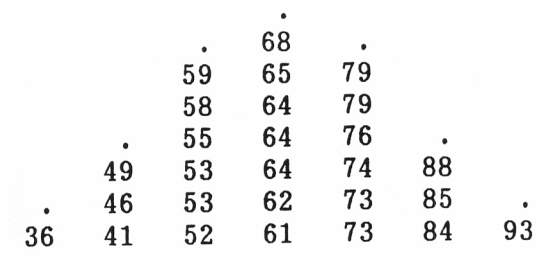
looks like. For this purpose, graphic means of presenting statistical information are preferable. To illustrate such methods, let us put boxes around the stacks of numbers, as follows:



In practice, we leave the actual numbers out, but display along the baseline the range of numbers in each stack:



This graph is called a bar graph. The height of each bar depicts the number of people with scores in the range shown along the baseline.

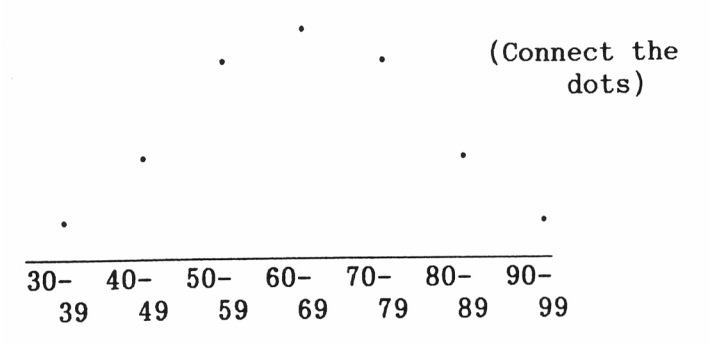


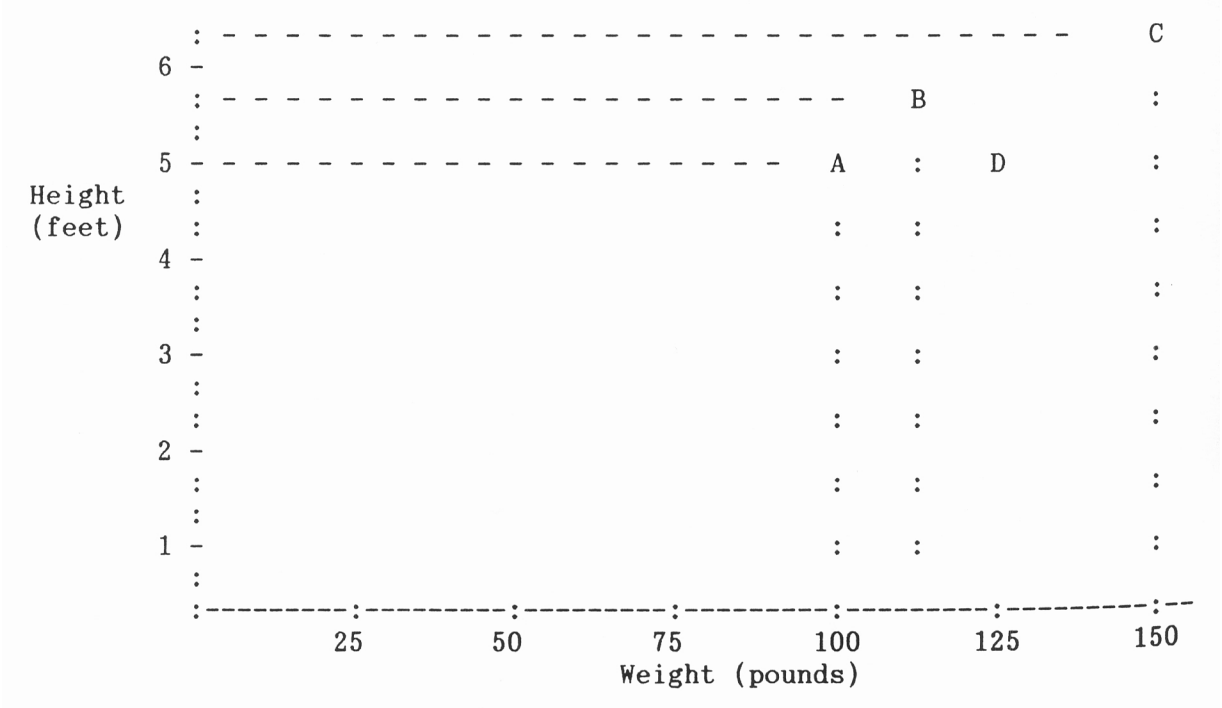
Another very similar procedure can be illustrated by putting a dot above each stack of numbers.

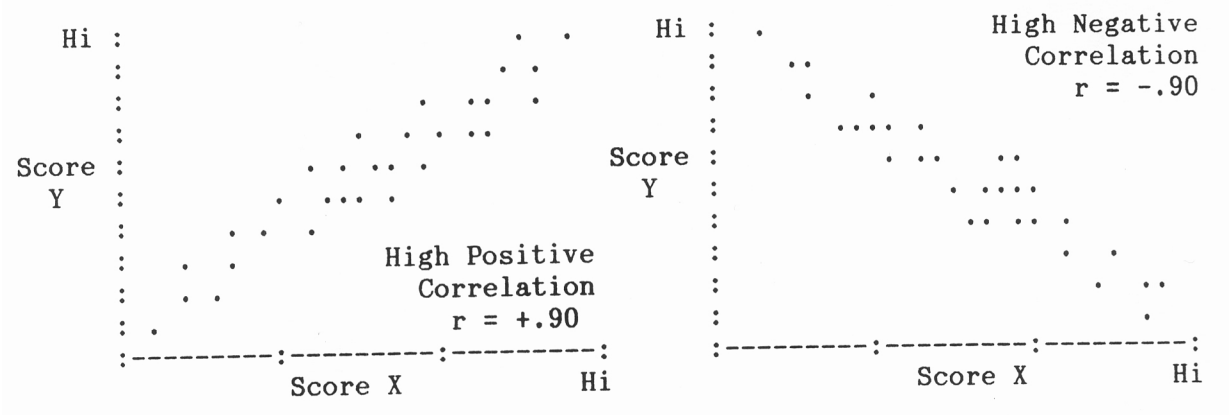
Again in practice, we leave the numbers out and connect the dots:

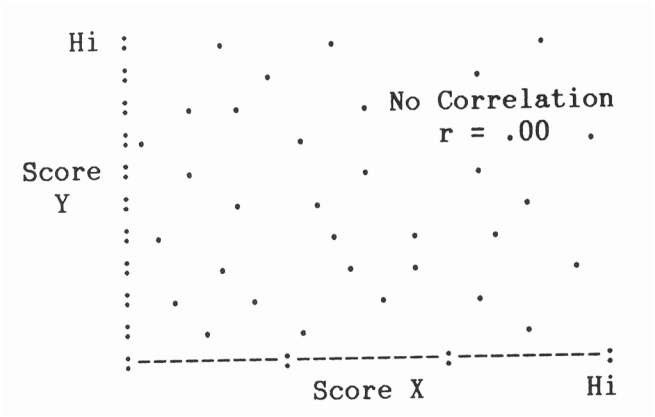
This graph is called a frequency polygon, and again the height of the curve above the baseline represents the number of people who scored in the indicated range.

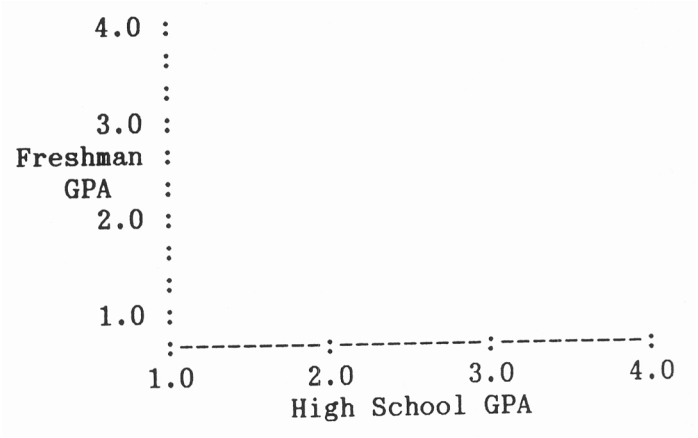
Why do we have both bar graphs and frequency distributions? The answer is that there are two fundamentally different kinds of data. Some things come in discrete, indivisible units. With such things, you should, and normally do, ask the question, "How many are there?" and you count them in order to find out. The number of children in families, of seats in classrooms, of rooms in dormitories, of people at

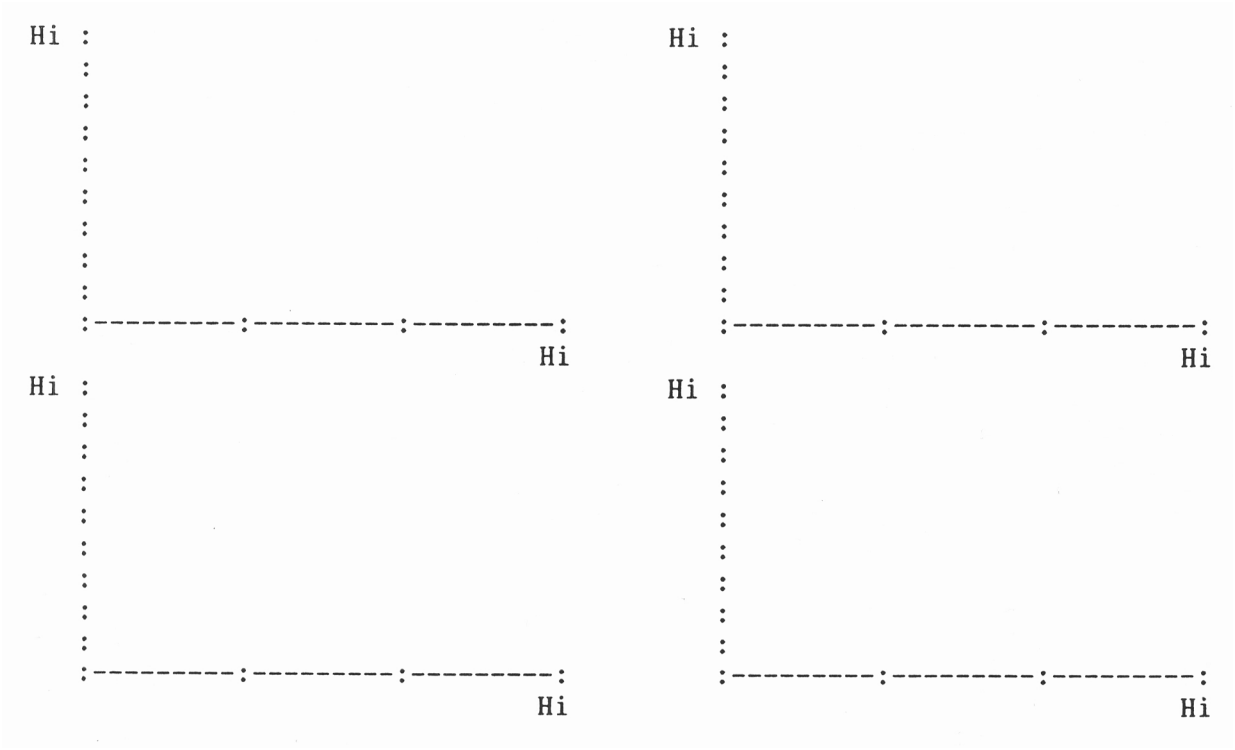

(Connect the dots)
30- 40- 50- 60- 70- 80- 90-
39 49 59 69 79 89 99


C
B
A
D
Height (feet)
6
5
4
3
2
1
25 50 75 100 125 150
Weight (pounds)


Hi
Score Y
High Positive Correlation r = +.90
Score X
Hi
Hi
Score Y
High Negative Correlation r = -.90
Score X
Hi


Hi
No Correlation
r = .00
Score
Y
Score X
Hi


4.0
3.0
Freshman
GPA
2.0
1.0
1.0
2.0
3.0
4.0
High School GPA


Hi
Hi
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Hi
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Hi

parties, of pieces of puzzles, etc., illustrate discrete data. With such data, we normally use bar graphs.

Other things are continuous in nature, at least conceptually. With such things you should, and normally do, ask the question, "How much is there?" and you measure in order to find out. The amount of gasoline in cars, of weight of people, of height of buildings, of the temperature in classrooms, of distance between cities, etc., illustrate continuous data. With such data, we can use a frequency polygon because the lines connecting the points imply continuity.

There would be no confusion except that numbers themselves are discrete even when used with continuous things. If I ask, "How much do you weigh?" you will answer with a number of pounds. But we know that weight is continuous in nature. A person probably doesn't weigh exactly 125 pounds, and my home is not exactly 10 miles from campus. If may be less obvious, but the scores on the vocabulary test are measures of a continuous trait, namely knowledge of words. The amount of knowledge can't be counted, but we can measure it by the number of items a person answers correctly.

On the "Average"

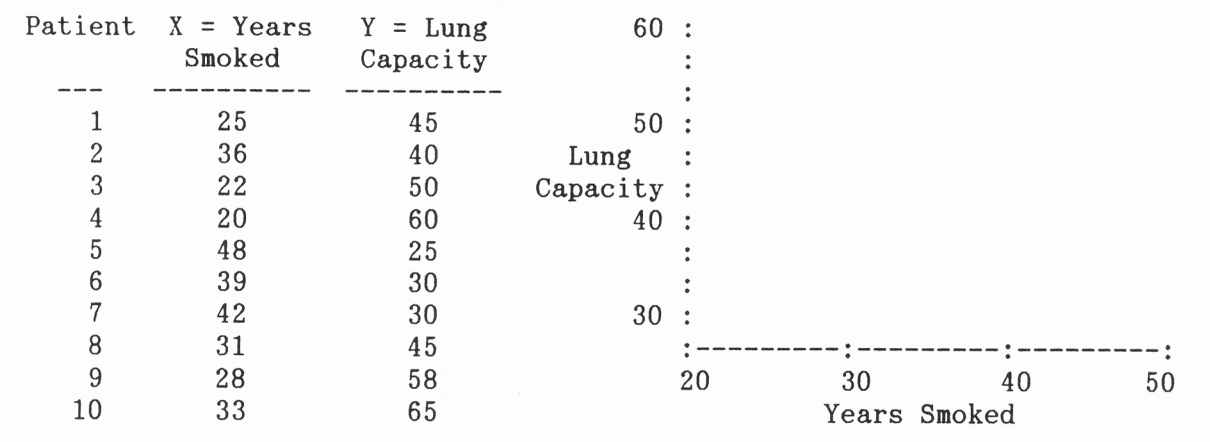
You undoubtedly already understand the concept of an "average." It means typical, usual, normal, common, middle, expected, central. In the vernacular, "average" is not so much a single, exact number as it is a range of values that fit most people. For example, I might say that "the average student registers for somewhere between 15 and 18 hours of course work." A 12-hour course load would be considered to be somewhat "below average."

Statisticians have devised three different ways to compute a numerical average. These are defined and illustrated below with a set of nine scores where the three statistical meanings of "average" yield the same answer:

You may have heard the expression, "Statistics don't lie, but statisticians do." One way to deceive people is when the three statistical averages differ, and you choose the one that best suits your purposes. Consider another set of 9 scores:

Now if those numbers represent something that is undesirable, such as "How many times a day do you exceed the speed limit?" I might answer, "About once a day, on the average." In this case, the mode gives the smallest "average." However, if the numbers

Patient	X = Years Smoked	Y = Lung Capacity
1	25	45
2	36	40
3	22	50
4	20	60
5	48	25
6	39	30
7	42	30
8	31	45
9	28	58
10	33	65



represent something that is desirable, such as "How many times a day do you brush your teeth?" I might say "More than twice a day, on the average." Now I chosen the mean because it gives the largest number. Accordingly, by taking advantage of the ambiguity of the meaning of "average," one can tilt the picture one way or the other.

Fortunately, good scientists have no intention to deceive anyone. They will tell you explicitly which statistical average was used to summarize their data. If the answers are substantially different, it is customary to report them all. This should permit you to get a very clear picture of the data. There is no one best statistical average; each is a legitimate way to represent the average score. As long as you know how each one is computed, you should not be misled.

On Variability

An average score can be thought of as a representative score; it attempts to represent the entire set of scores with a single number. If almost all of the scores are the same, or clustered very close to the middle, then the average is a very good representative. However, if there is a lot of variability in the scores, then the average does not give enough information. Accordingly, in addition to an average, you need some indication of the variability.

The most common measure of variability used in textbooks is the standard deviation. There is no need for you to know how to compute the standard deviation. (If you're interested, it is the square root of the mean of the squared deviations from the mean.) What you should know is that, in a symmetrical distribution, about two-thirds of the scores fall in the range between one standard deviation above and below the mean. For example, if the mean is 100 and the standard deviation is 10, two-thirds of the scores are between 90 and 110.

On Correlation

Two measures are correlated when the amount of one tends to vary with the amount of the other. Some familiar correlations are: tall people tend to weigh more than short people well-educated people tend to earn more than uneducated people intelligent people tend to be healthier than stupid people In each of the above examples, the correlation is positive because larger amounts of one measure go together with larger amounts of the other. But in many cases, the correlation is negative: fat people tend to live shorter lives old people tend to have poor memory happy people tend to get fewer ulcers Notice that there is nothing "bad," or "wrong," or undesirable about negative correlations. The sign (positive or negative) of a correlation simply shows whether big numbers go with big numbers or whether big numbers go with little numbers.

The degreeof correlation is symbolized by "r" and is measured on a scale ranging from zero (no correlation) to 1.00 (perfect correlation). There is no need for you to know how to calculate "r" but it is important to understand what it means if you hear that the correlation between hours of study and grade point average (GPA) is +.6 among college freshmen.

One way to learn about correlations is to construct scatter plots. Each person's measures on two variables can be plotted on a graph as follows: Suppose person A is 5' tall and weighs 100 pounds. Person B is 5'8" tall and weighs 112 pounds, and person C is 6'2" tall and weighs 150 pounds. All of this information is displayed in

Figure 1.

Figure 1. In a scatter plot, each person's two scores are represented by a single point in the graph. Person D is 5' tall and weighs 125 pounds.

When a number of points are plotted, you can get a good idea about both the degree and the sign of the correlation by just looking at the way the dots are arranged (each dot representing one person's scores).

A high correlation does not necessarily mean that one variable causes the other. Both may be caused by some other factor(s). For example, studies have usually found a correlation of about +.60 between one's grades in high school and one's grades as a college freshman. To see how this is determined, plot the following data in the graph:

Grades in both high school and college are probably caused by factors like intelligence, amount of effort, and the quality of instruction. Try to think of reasons why the correlation is not perfect (like class size). Even so, a It is very unlikely (albeit possible) that a person who got mostly C's in high school will get straight A's as a freshman. For the purpose of prediction, a negative correlation is just as useful as a positive one. Plot the following data:

In the preceding example, the correlation is about -.80 because smaller lung capacity is associated with larger number of years smoking. But we can safely predict that the longer a person has smoked, the smaller his/her likely lung capacity.

In general, the degree to which two sets of scores are correlated is indicated by a number between 0 and 1. The sign of the correlation tells whether it is a big-big or a big-little relationship. Both of these can be displayed in a scatter plot. In the graphs below, make a scatter plot that represents each of the following correlations and describe in words what you can say about the correlation: (Be sure to put labels on the axes.) (a) amount of rain and time the sun rises is r=+.01 (b) number of miles per gallon and speed of driving is r=-.80 (c) amount of alcohol drunk and time to react is r+.90 (d) level of income and number of children is r=-.50

Hi Hi

Appendix M

Final Examination

Appendix N

Vocabulary

Listed on the following pages are the (about) 5,500 words that occur most frequently in textbooks for college freshman courses. They are not specialized words for any particular subject; rather, ...