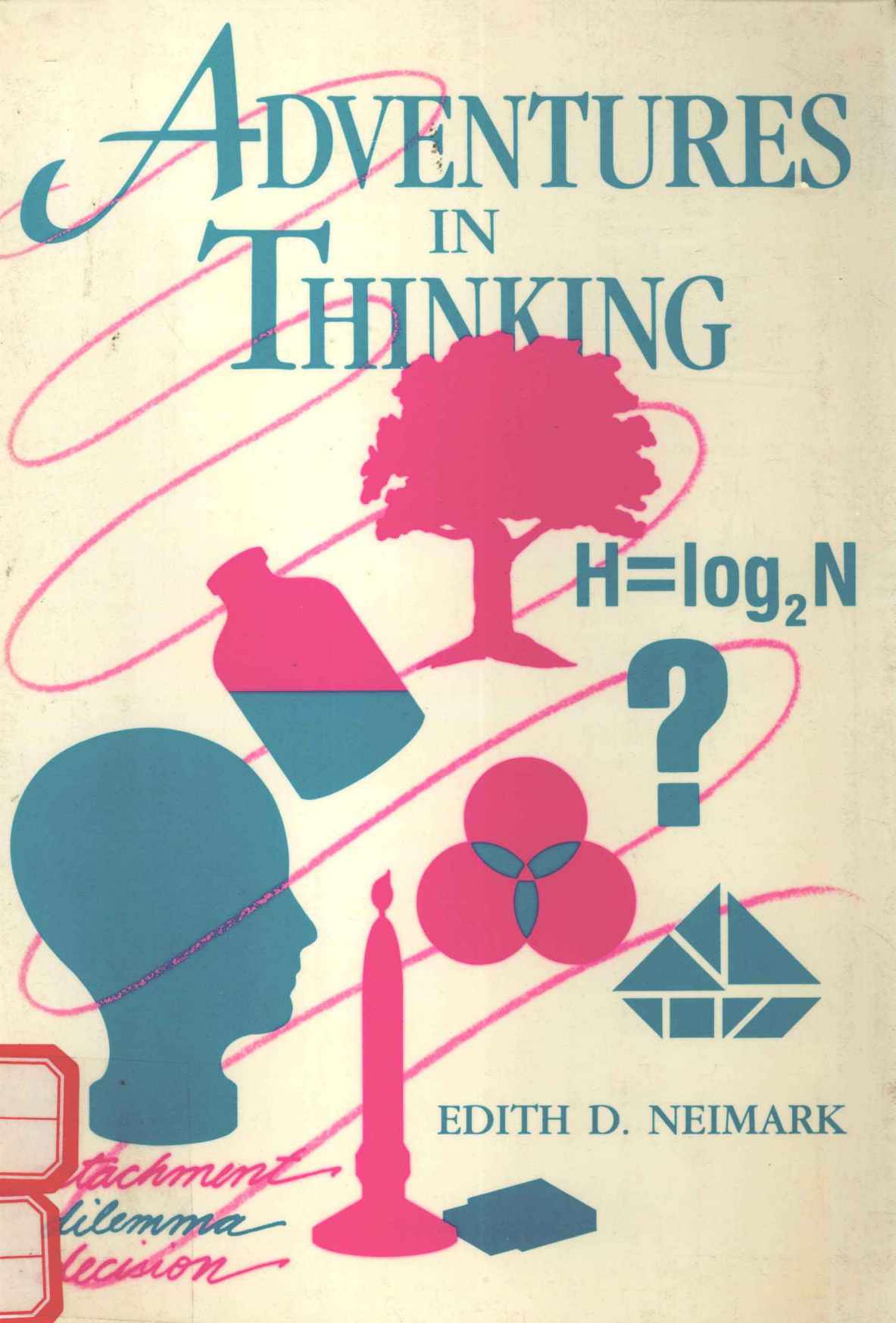
ADVENTURES IN THINKING



EDITH D. NEIMARK

ADVENTURES IN THINKING

EDITH D[illegible]RK
Rutgers University

Under the General Editorship of
JEROME KAGAN
Harvard University

HBJ
HARCOURT BRACE JOVANOVICH, PUBLISHERS
San Diego New York Chicago Austin Washington, D.C.
London Sydney Tokyo Toronto

Dedicated to the memory of my brother,
Joshua E. Neimark, and my parents,
Solomon J. and Regina Stein Neimark—thinkers all.

ISBN: 0-15-501895-7

Library of Congress Catalog Card Number: 86-82226
Printed in the United States of America

Preface

Instructors today are concerned with the perceived decline in thinking skills of American students and are seeking ways to reverse that decline. One attempt at correction has been a new crop of texts proposing simple remedies. As every good teacher knows, there are no simple remedies for deficient thinking. What is required is a change in attitudes and values as well as an augmentation of skills. The development of a thoughtful person is a long and difficult evolution that must be undertaken by the individual student. Nevertheless, a good teacher, armed with a good textbook, can facilitate the development of sound thinking by providing occasions to stimulate thought, by giving constructive criticism and direction, and by offering rewards for achievement along with encouragement when the going is rough. This book is designed to assist the instructor in fulfilling those facilitating roles. One hopes that after students have acquired a taste for the delights of intellectual pursuits nature will take its course and inspire them to continue on their own.

This book differs from similar texts in a number of ways. First, it deals with a greater variety of topics than the traditional texts because I believe that thinking is an integral component of an individual's approach to life. Training in thinking should help the student outside of the classroom as well as within it. For that reason, I have covered such topics as dealing with emotions, taking the perspective of another person, and the processes of evaluation and judgment.

Second, I have tried to address some of the serious issues confronting the young person entering adulthood. Students are deeply concerned with such issues and welcome help in confronting them. For this reason I have included discussion of social and ethical issues as well as exercises drawn from everyday experience.

Third, I have drawn upon a broad range of subject matters in order to emphasize that thinking applies to all realms of human endeavor and to appeal to a broad spectrum of student interests. Some skills that are fundamental to the sciences, such as model building and hypothesis testing, are equally valuable to the nonscientist as well. Although these skills are best taught within the context of a specific discipline, I have tried to present them in a relatively content free manner. Some basic concepts of statistics, probability, and logic have also been included with the same rationale—that an understanding of these topics is nec-

essary for an educated citizen. Similarly, illustrations from art and literature have been included for the student who has evaded contact with the humanities.

Acknowledgments

Writing a book is always something of a voyage of discovery to new ideas and new material. That process has been advanced by the help of many colleagues, whose assistance is gratefully acknowledged. My greatest debt is to Ruth Gottdiener, who urged me to teach the course that inspired the book. I also wish to thank the Rutgers Committee on Instructional Development for supporting a research component of that first course. I would like to thank the following colleagues to whom I am indebted for advice, comments, and education: Richard D. Ashmore, Charlotte Avers, Anna Benjamin, Jean Burton, Rae Carlson, George Erdos, Carol Gilligan, Sandra Harris, Richard Henson, David Krantz, Michael Kubovy, Richard Lore, Lorraine McCune, Elliot Noma, Larry Pervin, Richard Quaintance, Ellin Scholnick, Beatrice Seagull, Fadlou Shehadi, Heather Strange, Lillian Troll, and Janet Wyckoff. A special thanks to Jean Natereli, who typed the manuscript in record time and with real devotion.

I would also like to thank the following reviewers, who offered critical evaluations as well as instructive suggestions: Jerome Kagan, Harvard University; Barbara Nodine, Beaver College; Susan Nummedal, California State University at Long Beach; and Finbar O'Connor, Beaver College.

Edith D. Neimark

• Contents •

Preface v

PART 1

THE BASICS 1

CHAPTER 1

What Is Thinking and How Does One Become a Thinker? 2

What Is Thinking? 2
Training in Thinking 12
Summary 19
Exercises 20

CHAPTER 2

Getting the Information In: Attending and Encoding In the Creation of Meaning 23

Paying Attention 23
Encoding 24
Foundations of Encoding 25
Carriers of Meaning: Their Creation and Effect 28
Selecting an Appropriate Encoding 40
Summary 48
Exercises 49

CHAPTER 3

Using the Information: Communication and Understanding 53

Communication 54
Writing a Paper 59

Promoting Understanding 72
Summary 79
Exercises 80

CHAPTER 4

Detaching 82

Overcoming Impulse 83
Depersonalizing 88
Detaching from Context 95
Summary 99
Exercises 100

CHAPTER 5

Judgment and Evaluation: Establishing Perspective and Priorities 102

The Nature of Evaluation 103
Considerations in Setting Criteria 107
The Evolution of a Judgmental Framework 117
Summary 124
Exercises 126

Summary of Part 1 128

PART 2

THE TOOLS OF THOUGHT 131

Summary Table Comparing Kinds of Thinking To Be Reviewed in Part 2 132–33

CHAPTER 6

Evaluating Assertions 135

Classifying Assertions 135
Evaluating Factual Assertions 145
Statistical Characterization of Evidence 149
Summary 154
Exercises 155

CHAPTER 7

Evaluating Arguments 158

Categorical and Conditional Syllogisms 159
Everyday Arguments 169
Errors of Reasoning 175
Summary 181
Exercises 182

CHAPTER 8

Foundations of Induction: Causation, Chance, and Information 186

Causation and Determinants 187
Probability and Chance 199
Information and Uncertainty 205
Summary 207
Exercises 208

CHAPTER 9

Model Building and Hypothesis Testing 211

Theories and Models 212
Experimentation and Hypothesis Testing 220
Summary 233
Exercises 234

CHAPTER 10

Problem Solving 237

Definition and Taxonomy 237
Restructuring Self-contained Problems 241
Problems Requiring Additional Information and Structure 249
Stages of the Solution Process 256
Summary 262
Exercises 263

CHAPTER 11

Decision and Choice 266

Some Simple Heuristics 267
Decision Making under Conditions of Risk and Uncertainty 270

Dealing with Complications 278
Problems of Applying Decision Models 281
Summary 284
Exercises 285

CHAPTER 12

Creativity and Imagination 287

Approaches to Creativity 288
Fostering Creativity in the Narrow Sense 294
Fostering Creativity in the Broad Sense 303
Summary 309
Exercises 309

CONCLUSION

Thinking as a Way of Life: The Pursuit of Understanding 314

Understanding Revisited 314
Alternatives Are Always Possible 316

Appendix on Probability 319
Notes and Selected Answers to Boxes and Exercises 323
References 339
Copyrights and Acknowledgments 349
Index 352

PART

1

The Basics

You are about to embark on a lifelong adventure. As with all voyages, you will get more from the journey if you are prepared for it and are open to the experiences you encounter along the way. In visiting a new country, for example, you go prepared with the expectation that you may have to learn a new language, that the native customs will differ from your own, and that you will have to seize opportunities that may never reoccur. So, too, with becoming a thinker. You will not derive much from the journey if you stay within the confines of your room (in this case, your old habits), venturing forth only when the situation demands and then returning quickly. Start with a commitment to learning the new language and new ways of behaving. Examine your accustomed practices and beliefs in light of your new experiences with the expectation of modifying them to better conform with your emerging status as a thinker. While this may be difficult at first, and you may find that you need help on occasion, it should become easier and more enjoyable as you go along. Stick with it.

This book is divided into two parts: the first part attempts to provide a general orientation, while the second focuses on specific skills and conceptual machinery. The general orientation suggests ways of looking at and labeling your experiences and directing your own cognitive activities. Try to carry these suggestions beyond the confines of the course and its assignments into your everyday life. Make them part of your own habit and belief system. As you become more aware and directive of your own thinking, you will find yourself classifying occasions requiring thought and kinds of problems. You will become more attuned to seeking systematic means of dealing with them. The second part introduces you to a variety of existing classifications and systematic procedures. Although those introductions are, of necessity, brief and compressed, they should provide the basics for you to pursue on your own. Bon voyage.

CHAPTER

1

What Is Thinking and How Does One Become a Thinker?

This introductory chapter will acquaint you with some of the essential ingredients of thought and some current views as to how it is promoted. As emphasized throughout this book, formulating one's purpose is always a good first step toward its attainment. Your purpose is to become a more effective thinker; my purpose is to help you attain that goal. In the final analysis, you will have to do all the work because thinking is an individual activity that no one else can do for you. All that any instructor can do is to provide occasions for engaging in thought, to suggest how to proceed, and to correct inadequacies. By way of preparation for your endeavor, get a notebook in which to record your progress and keep it handy as you proceed through this book, using it regularly. Exercises will be suggested throughout each chapter as well as at the end. Do them. As you do the assignments make marginal notes for yourself on the likely purpose of the exercise as well as the steps you go through in the course of completing the exercises. This will assist you in becoming more aware of the nature of thought and of your practices as a thinker. It will also provide a record of your development in the form of field notes and observations from which to derive hypotheses about where you are having difficulty as well as successful strategies to be used in the future.

With that essential equipment in hand, you are now ready to examine in more detail the nature of thinking and some of the ways it is promoted.

WHAT IS THINKING?

Starting off with a definition is so conventional as to be taken for granted. As an apprentice thinker, however, you should take nothing for granted. Let us, therefore, consider the function of a definition. Had you taken seriously the injunction to use your notebook, you may have listed some examples of thinking and examined them to identify a common property, or you may have consulted a

dictionary. In either case, you quickly discover that no single common property is immediately apparent. A deeper analysis is required. That analysis is a necessary first step because identifying a defining property, or properties, is a prerequisite to focusing on them, rather than on some peripheral or irrelevant properties. To better appreciate the implications of that assertion, since you are taking nothing for granted, list what you take to be the defining properties of thinking. You may also want to list some clear, as well as some questionable examples of thinking, against which to test these properties.

This book is predicated upon the definition of thinking as a symbolic activity whose goal is understanding. That definition treats thinking as behavior, something one does, that differs from other behavior (such as, brushing one's teeth, running, or constructing a bookcase) with respect to two defining properties or necessary component activities. Those defining properties are (a) the manipulation of symbols (as contrasted with real-world actions upon objects) and (b) the imposition of meaning. Before delving into those properties, let us get some data as a background for discussion.

Five classic problems are presented in Box 1-1 for you to work on. In doing them do not focus exclusively upon the solution but also record your thought processes so that you can later examine them in relation to the proposed defining properties. What did you discover about the nature of thinking? Perhaps you immediately tried a solution and discovered that it did not work; for example, you may have connected the dots at the edge of the figure forming a square that exhausted the permitted four lines without including the center dot, or opened the link at the end of each chain length and discovered that you were opening and closing four links instead of three. After an initial failure, you probably asked yourself some questions, tried reformulating the problem, considered how you went astray, and made notes or diagrams. In the case of the last problem, instead of initial trial and error, you may have realized that there were too many possible solutions and looked for a systematic way to reduce the set of potential solutions to a manageable size. Clearly, you were generating and operating upon symbolic representations of the problem, in this case your notes, or instructions to yourself. You also, with increasingly explicit self-awareness, tried to make sense of the problem and to devise a systematic solution strategy. (For solutions to the problems, see the notes.[1]) All of these are manifestations of the defining properties of thought. In addition, you probably got some insight into a few of the structural features of difficult problems (that is, those aspects that led you astray).

Thinking as Symbolic Activity. Thinking is a *symbolic activity* because objects and events are detached from their presenting context and represented through the medium of ideas, images, words, implicit motor activity, or a variety of notational schemes such as numbers or diagrams independent of the specific context or of environmental supports. Mental activation takes place before, after, or in place of physical activity. Consider any mundane activity such as grocery shopping or rearranging the furniture. The actual conduct of those activities involves locomotion through space in an appropriate place, at an appropriate

BOX 1-1

Five Classic Problems

Do these problems and make notes on how you went about solving them. Include all your steps, not just the ones that led to your success.

1. Without lifting your finger from the paper draw four straight lines so that every dot has a line going through it.

2. A man and his son were involved in an auto crash in which the father was killed and the son received severe head injuries. The son was rushed to a hospital where the neurosurgeon gasped, "I can't perform the operation; he is my son." How could that be?
3. You have four separate lengths of chain, each consisting of three links. Your task is to join them into one continuous necklace as cheaply as possible. It costs 3¢ to open a link and 2¢ to close it. You are allowed no more than 15¢.
4. At a celebration for two fathers and two sons each honoree has a cake. There are only three cakes. Explain how that can be.
5. If a unique number is substituted for each letter in the problem below the answer will be a correct arithmetic sum.

$$\begin{array}{cccccc} & S & E & N & D \\ + & M & O & R & E \\ \hline M & O & N & E & Y \end{array}$$

time, in relation to appropriate objects: for example, walking down the aisle of a supermarket, pushing a cart, selecting items from a shelf, freezer, or bin, or, in the case of moving furniture, pulling out the couch, shoving in a chair, and so on. On the other hand, making up a grocery list or planning the arrangement of furniture can be done anywhere and at any time in a rich variety of ways: for example, with cardboard furniture surrogates on a piece of graph paper. Some obvious instances of symbolic activity include mental calculation of sums, planning daily activities, selecting possible courses of action and rehearsing the one finally selected, explaining some observations, or rationalizing your own behavior. You can, and should, come up with many more examples of your own.

As should be evident from the foregoing examples, representing information and operating upon it is a highly selective process. Certain features of the actual situation, such as the size of the pieces of furniture are emphasized whereas other features, such as the color or texture of the fabric, are ignored. To take

another example, in calculating a total bill you sum digits; actual currency is irrelevant. In planning a daily schedule you ignore routine activities like brushing your teeth, or getting from one place to another. Instead you focus upon the major events (a class, an appointment, a vital errand) and the various constraints of time or place to fit all of them in as efficiently as possible. Thoughts are not a literal copy of reality but an abstract transformation of it. How much transformation or abstraction takes place in any given instance can vary enormously depending on the demands of the task.

In the first four problems of Box 1-1, for example, too literal or too narrow a representation of the problem impedes solution; for example, treating the dots as an enclosed square, interpreting "father" and "son" as mutually exclusive labels, defining "neurosurgeon" as a man while ignoring that every son has two parents, all lead down a blind alley. Similarly, in the third problem transforming the goal into "find three links that can serve to form a necklace" promotes solution. In the last problem the content is already in symbolic form, but you must find a procedure for reducing all the possible letter-digit equivalents to a manageable size for testing. Chapter 2 will delve more deeply into the requisite selection process.

If you have summarized the meaning of this section for yourself as "thinking involves representing information and processing those representations" you are essentially correct. If you are in the habit of identifying main ideas and expressing them in your own words you are also well on the way to being a thinker. It may occur to you that computers also process information. In fact, computers satisfy the requirement of operating upon information with much greater speed and accuracy than do humans. Do computers think? Although most of us would have difficulty in justifying the conclusion, we would be in immediate agreement that computers don't think. What makes them machines in contrast to human thinkers is the absence of the second defining property of thinking: meaning-making.

Thinking as Meaning-Making. What I attempt to convey through that awkward term *meaning-making* is the underlying purpose that directs and motivates information processing. You do not passively register experience willy-nilly, but try to make sense of it so as to understand your experiences. What constitutes understanding? That is a hard question. I pose it to the reader now with the urging that you return to it throughout the course of the semester. You should find that your answer changes as you develop insight into your own thought processes. As a first step towards an answer it is important to note that meaning is not intrinsic to experience. Objects and events simply are; meaning is something that the experiencer imposes upon them. It is a personal construction. Your understanding of your own experience is like no one else's. For example, you may see a tree fall, someone may address you in sharp tones, or you may take your first sip of new Coke. Some possible responses to these examples might be, "The tree fell because of a bad storm, someone was angry with me, or new Coke is sweeter." All events are interpreted through labeling, placing

them in some context, searching for causes, and then relating them to previous experience and existing knowledge.

In trying to describe what it is that you do in the process of understanding, two necessary components should emerge: one is an awareness of your own thought processes and of a deliberate direction of them; the second is the systematic application of procedures to achieve direction and to bring order out of the constant stream of sense impressions. Neither of these two component aspects of meaning-making is manifest in an all-or-none fashion. One is not aware of everything one does nor is one consistently systematic in thinking about it. There are degrees of awareness and of systematic ordering. In identifying these two components of meaning-making, I am suggesting (a) that they are central to a uniquely human characteristic of thought, but (b) they are not neatly separable from each other, and (c) your central purpose in becoming a better thinker will be to move toward a higher level of both continua. With that preface let us consider each aspect of meaning-making in more detail.

Degree of Awareness and Self-Regulation of Thought.[2] To some extent all behavior is self-regulated, but the degree of deliberate conscious regulation varies, in part, as a function of the circumstances. In calling to a friend in another room, how loudly you call is automatically dictated by distance. In picking up a pencil, the direction of reach is determined by the location of the pencil; the grasp applied in lifting it differs from the grasp for seizing a wrench, a mug of beer, or any other object differing in shape and weight. There are countless other possible examples demonstrating that behavior is nicely adjusted to existing circumstances in an ongoing manner. One is frequently unaware of the adjustments. Well-established habits such as signing your name, walking home, or dialing a frequently used phone number are executed automatically. In reviewing your description of your thought process in solving the problems in Box 1-1, for example, you may find sparse reporting of why a particular solution was attempted or, even, of what was done. Such a finding would suggest either that you were behaving in an automatic manner or that you are not yet skilled at monitoring and describing your own thought processes.

As an initial aid to developing greater self-awareness it might be useful to do exercises in pairs. While one member of the pair is doing the exercise, the other member can observe what is being done (preferably, by taking notes) and speculate about the determinants of observed action. Those speculations can then be tested by direct specific questioning of the member doing the exercise: for instance, "Why did you open the end links?" rather than "Why did you do that?" The rationale for this suggestion is that initially it may be easier to examine another's behavior more objectively than your own, especially when examination is the sole task required. From the viewpoint of the member doing the exercise, questioning by an outside observer can help bring into awareness some aspects of the thinking process. More will be said about such dialogues in Chapter 3.

The next step up from regulation intrinsic to the task and unexpressed in consciousness is a level that was probably reflected in your performance on the

problems of Box 1-1. At this level there is some awareness of the determinants of activity and of direction of them, especially when an attempt at solution fails and one tries to understand why. This may lead to a conjecture about the cause of failure and a hypothesis about improving the situation. That hypothesis is then tested and the initial conjecture is revised to encompass observed results. One is, in effect, evolving proto-theories, or theories in action, that develop through a process of trial-and-error accompanied by self-examination. The earmark of this level of self-regulation is that the theories produced are tied to the context of action and inspired by it: action precedes explanation and understanding rather than the reverse. Much of everyday behavior has this trial-and-error quality. One finds what works and sticks with it. Discrepancies, inconsistencies, and failures of habitual approaches or presuppositions often serve to instigate more careful scrutiny.

After mastery of a task in a particular context one may seek new challenges and try to generalize the presumed principle for success to new contexts and tasks. At that point the theory is formulated at the outset and serves to direct subsequent action. For example, in the first two or three problems of Box 1-1, your attention may have been focused on the specific problem, but in comparing them, you may have noted some structural similarity, for example, that in each problem some aspect of wording or material, if accepted uncritically, sent you down a blind alley. As a result of this insight, you may have developed a theory that some problems are difficult because they "set traps"—and approached the next problem with a deliberate search for a trap. If so, you were attaining a third level of self-regulation.

The distinguishing feature of the level of conscious regulation is that understanding precedes and directs action. At this level a newly encountered instance is identified as a likely member of a class of similar, previously encountered instances for which solution procedures are available: "Aha! It's one of those; I know how to deal with them!" (where "those" might refer to a trap-setting problem, determining valence or significance of difference between group means, or soothing hurt feelings). In knowing "how to deal with them" you invoke understanding, that is, a conscious identification of principles and the means for applying them that serve as the basis for a deliberate plan of attack on the new instance. That plan may well include not only a detailing of initial steps but, also, the anticipation of possible outcomes and means of dealing with each of them. To take an example close to home, in consulting an advisor about next year's schedule you don't go in "cold;" rather, you have some idea of your ultimate goal, the requirements remaining to be satisfied, the courses being offered, a tentative schedule, and some alternatives in the event that sections chosen may be closed. Such deliberate planning prior to action characterizes a thinker. Take it as your goal. An example of the levels of awareness is given in the first part of Box 1-2.

To augment your own understanding of levels of self-regulation and of self-awareness, examine some of your own skills (playing a musical instrument; programming a computer; or playing tennis, bridge, or chess) and identify the

BOX 1-2

An Example of Three Levels of Awareness and Instructions from an Expert on Self-regulation in Learning to Juggle

A. Understanding and Nasal Congestion

1. *Autonomous regulation.* You know how to blow your nose and do so when circumstances demand. It's no big deal, although it is a learned response unlike coughing or sneezing, which are automatic. All of these activities produce relief. Lingering longer in the shower, drinking lots of hot beverages and soups, or sleeping with more pillows are other means of producing relief from a stuffed-up head. The defining feature of all of them is that they are done without deliberate prior plan.

2. *Active regulation.* Discomfort inspires active experimentation. For example, if blowing one's nose produces a gurgling in the ear, a gentler blow focused upon one nostril at a time may be tried. Tickling and soreness in the throat lead to use of liquids and lozenges. Several varieties of each may be tried and compared to find which are most effective. Through this process of trial-and-error experimentation, one builds up a repertoire of palliatives for the particular cold and any future ones. You are aware of what works and doesn't as a result of experience.

3. *Conscious regulation.* A theory directs one's action. You plan your attack upon nasal congestion based upon a view of what is wrong and how it must be dealt with. The experienced discomfort is the result of one or both of two conditions: swollen, narrowed nasal passages; too much goo accumulating in those passages. Based upon that analysis there are two general lines of attack: (a) reduce the inflammation of nasal passages through the use of sprays, drops, or decongestants; and (b) promote drainage and reduction of the mucus. The latter goal is attained in a variety of mechanical means such as heat, steam, and other devices to promote flow or direct elimination through flushing with a saline solution, tilting the head, etc. There are also drugs that have some value. This level of understanding differs from the level of active regulation in that thinking precedes and determines action rather than vice versa.

Note that success, in the form of temporary relief, is attained at each level by exactly the same behavior. The difference lies in the determination of that behavior which shifts from involuntary to voluntary to deliberately planned and directed on the basis of understanding.