Douglas L. Hintzman

The Psychology of Learning and Memory

The Psychology of Learning and Memory

Douglas L. Hintzman
University of Oregon

W. H. Freeman and Company
San Francisco

Library of Congress Cataloging in Publication Data

Hintzman, Douglas L.
The psychology of learning and memory.

(A Series of books in psychology)
Bibliography: p.
Includes index.
1. Learning, Psychology of. 2. Memory.
I. Title.
BF318.H56 153.1 77-16295
ISBN 0-7167-0035-2

Printed in the United States of America

2 3 4 5 6 7 8 9

Preface

This book encompasses the fields of both animal conditioning and human memory. Anyone writing such a book encounters a problem the author of a more specialized text does not face: How should material from these two largely independent areas be combined? I have attempted to turn this apparent difficulty to my advantage, since it provides a rationale for the discussion of important issues that might otherwise be ignored. These issues fall into three general categories: (1) Historical: How did the two fields develop historically? How have they influenced each other? How are their relationships changing? (2) Philosophical: How do the behaviorist and cognitivist approaches to learning differ and in what ways are they alike? What are the limitations of either approach? (3) Evolutionary: How is human learning related to conditioning in animals? More generally, in what ways did the ability to learn develop as more and more complex organisms evolved? Discussions of these broad issues are scattered throughout the book, although the historical material tends to be concentrated in the first three chapters and Chapter 13, while evolutionary issues are confronted most directly in Chapter 7.

From the very beginning, the psychology of learning and memory has undergone change. It has continually been shaped and reshaped by theoretical controversies. A major purpose of this book is to give the student, through many examples, some appreciation of this dynamic process—to show how theories determine the way experiments are performed and how the results of experiments influence

theoretical ideas. I hope the naive seeker of truth will come to appreciate more fully how elusive the truth really is. Scientific progress—in any field—is a process whereby the "truth" is continually being redefined.

An earlier draft of the manuscript of this book was read, in whole or in part, by several persons. I am especially grateful to Alice Healy, Steven Keele, Roberta Klatzky, Robert Leeper, Alexander Polatsek, Howard Rachlin, Mary Rothbart, and Richard Solomon. Their criticisms have been most helpful. In revising the manuscript, I have attempted to take most of them into account.

Douglas L. Hintzman
March 1977

Contents

1

Introduction

Of all the animal species that inhabit this planet, we humans are truly exceptional. Our uniqueness finds expression in many ways: We use fire, build machines, domesticate animals and cultivate crops, communicate through spoken and written language, legislate our own social controls, visit such inaccessible places as the surface of the moon and the floor of the sea, and alter the face of the earth itself. Central to all these accomplishments is our great flexibility—our unparalleled capacity to change our behavior to suit the circumstances we are in.

Underlying the flexibility of our behavior are the processes we call learning and memory. *Learning* is a change in an organism, due to experience, which can affect the organism's behavior. *Memory* is the persistence of that change over time. The flexibility of human behavior rests on our ability to profit from experience—that is, on our unsurpassed ability to learn.

Very simple animals behave only in rigid, stereotyped ways. They are limited to genetically pre-programmed responses which can be changed by experience little, if at all. Moderately complex animals can learn, but for many of them learning requires direct experience. Being rewarded or punished will change an individual animal's behavior, but seeing a companion rewarded or punished will not. Still more complex organisms, particularly the higher primates, can learn "vicariously" from the successes and failures of others. They are, however, restricted in this learning to direct observation—that is, to the here and now. Human beings are free from even this limitation.

Through the use of language, we can learn from the experiences of others. The experiences we learn about may concern events that were observed, inferred, or even imagined. Thus, we are freed in our learning not only from the here and now but also, to some extent, from reality.

The flexibility of human behavior has enabled us to adapt to an incredible variety of physical and social environments. Allowed free reign, human flexibility produces the great variability we see in the diversity of languages and social customs, and within cultures, among social roles, occupations, and individual interests. Given direction, human flexibility can produce remarkable accomplishments such as the exploration of the solar system and the conquest of disease. It seems clear that an understanding of learning and memory—the processes that give human behavior its great flexibility—would be a major step toward understanding the nature of intelligence itself. While learning and memory are topics that have provoked much speculation by philosophers and experiments by scientists, the mysteries of their nature and function are still largely unsolved.

THE IMPORTANCE OF LEARNING AND MEMORY

To psychologists in particular, the problem of learning is a central one. Hardly an area of psychological investigation can ignore it. The differences among individuals that we call personality are believed to be strongly influenced by experience. Girls and boys adopt the sex roles modeled for them by adults. Whether a person is violent or peaceful, anxious or confident, gregarious or solitary, thoughtful or impulsive, deceitful or candid—all depend to some extent on learning. Early childhood experiences, such as weaning, toilet training, and interactions with parents and siblings, may exert a strong influence on emotional and cognitive development. It may even be—if one controversial hypothesis is to be believed—that a person's ultimate level of intellectual ability is determined by what happens to him during the first few years of life.

The aspects of social behavior we place under the heading of "culture" are primarily learned: language, sex roles, occupations, religious beliefs, and attitudes toward the family, neighborhood, community, and nation. Prejudices regarding race, social caste, and sex are acquired by experience; and it is through experience that they can

be changed. The nature of modern society reflects, in large part, the speed with which humans adapt. We are absurdly easy to indoctrinate, which accounts for the variety and instability of political and religious views. And technological developments—which affect the ways we relate to work, to leisure, and to each other—produce a never-ending spiral in which learning-produced changes necessitate further learning, which brings about further change.

Clinical psychologists and psychiatrists have a strong interest in an understanding of learning. Many mental and behavioral problems are assumed to result, at least in part, from experience. Phobias, social anxiety, depression, psychosomatic symptoms, and habits such as smoking are examples. And most methods of psychotherapy are designed to provide an experience that will bring about a change in the patient—either in his mental state or in his behavior. Many therapists have looked directly to the psychology of learning for hints as to how therapeutic techniques might be improved.

Even perception—the way things look and sound to us—depends partly on learning. One might suppose the perception of stimuli to be entirely unaffected by past experience, but this is not the case. A person who is reading will perceive an "important" extraneous stimulus such as the mention of his own name, even though other words spoken by the same voice are easily ignored. A conversation that sounds like jabbering to someone unfamiliar with the language sounds quite different to one to whom the language is known; what looks like a series of random squiggles to a nonreader is immediately recognized as a coherent message to one who can read; and chess pieces on a board, arranged as in a position from a game, look quite different to a novice than they do to a chess master. A once-blind person whose vision is repaired sees things very differently than you or I. There is even some evidence, from experiments with cats, that normal development of cells in the visual areas of the brain depends on visual stimulation during infancy.

Physiological psychologists also have an interest in learning. The biological basis of learning and memory remains one of the great unsolved problems of science. Psychological investigations should play a crucial role in solving this problem. The search for a solution cannot be conducted exclusively at the level of neurochemistry, neurophysiology, and neuroanatomy, since it is only by observing an organism's behavior that we can determine that it has learned. In addition, the physiological psychologist is likely to find clues to the nature of

the learning mechanism he is seeking in the results of behavioral experiments.

Areas outside psychology also are deeply concerned with learning and memory. The philosopher reflecting upon the nature of knowledge can hardly ignore what is known about the process by which knowledge is acquired. The physical anthropologist concerned with human evolution must take into consideration the remarkable capacity of humans to learn, and must ask not only what ecological pressures brought this ability about, but also how the developing ability may have exerted its own influence on evolution.

Many computer scientists, in the field called "artificial intelligence," are concerned with building machines that can duplicate or even exceed human abilities. How does one construct a computer that can translate languages, play games such as chess, think creatively, generate and follow its own elaborate plans, read handwriting, control skilled acts, and retrieve complex information quickly from a vast and efficient memory? Computer scientists attempting to answer such questions cannot, rationally, ignore the fact that a device that does all these things already exists, in the human mind, and that a general ability underlying all such special ones is the ability to learn.

Educators, of course, have always had a practical interest in learning and memory, and the application of learning principles to educational practice has always been regarded by learning psychologists as an ultimate goal of their work. How can instruction and training be made more effective and efficient? Can forgetting be slowed or prevented? How should teaching methods be matched to subject matter and to the abilities of students? What special methods should be used in training the retarded, the blind, or the deaf? How is knowledge acquired through reading? And how is this remarkable skill itself learned? Educators have looked to psychology, perhaps too trustingly, for answers to such questions; and psychologists have attempted, sometimes too readily, to comply. Applications of learning principles to education have not always been successful—but this should not be surprising. There is much about learning and memory we still do not understand.

Practical interest in learning and memory, of course, is not restricted to clinical psychology and education. Professional animal trainers and ordinary pet owners want to teach their animals good habits and eliminate bad ones; ranchers and farmers want to cure wild animals of their destructive behavior; and wildlife managers want to

keep animals from endangering themselves. Parents want to influence the behavior and beliefs of their children. Corrections officers want to rehabilitate their prisoners. Athletes and musicians want to improve their respective skills; coaches, military officers, and factory managers want to improve the skills of those under them. Public speakers and entertainers want to improve their own memories; politicians, advertisers, and propagandists have messages they want people to remember and facts they want them to forget. Each of us, in his own way, curses his faulty memory when important names and faces, shopping lists, routine appointments, urgent deadlines, bizarre dreams, creative ideas, and even trivial facts are forgotten. In one way or another, learning and memory touch on nearly all human activities.

THE PRESENT STATUS OF THE FIELD

Given the potential impact of an accurate understanding of learning and memory both inside and outside psychology, the uncertain accomplishments of the field may be viewed with disappointment. An outsider who asks a physicist about falling bodies, electricity, or nuclear reactions will receive a definitive reply. Further, if he asks another physicist the same question, he can be confident the answer will be essentially the same. One who asks a psychologist how repetitive drill contributes to learning or what causes forgetting should expect either a discussion of several competing theories or a single, coherent analysis with which other psychologists will not fully agree. If he asks enough different psychologists, he will discover that not all of them agree even on how one should go about seeking the answers to such questions. Some explain effects of past experience on behavior in terms of mental, or conscious, events; others prefer theories based on the "machinery of the brain"; still others argue that the investigator should simply describe observable behavior and not attempt to explain it at all. Such theoretical and methodological disputes often strike the layman as unscientific. They are not what the "hard sciences" have led him to expect. Several things should be said about this attitude.

In the first place, it is a mistake to think of science as a body of agreed-upon knowledge. Science is, instead, a method by which knowledge is acquired. What distinguishes science from other modes of thought such as religion is not general agreement but the way the