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AN INTERPRETATION OF SOME METATHEORETICAL ASSUMPTIONS IN COGNITIVE PSYCHOLOGY: MECHANISM AND CONTEXTUALISM

by

Diane Gillespie

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Major: Interdepartmental Area of Psychological and Cultural Studies

Under the Supervision of Professor Royce R. Ronning

Lincoln, Nebraska

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TITLE

AN INTERPRETATION OF SOME METATHEORETICAL ASSUMPTIONS IN COGNITIVE PSYCHOLOGY: MECHANISM AND CONTEXTUALISM

BY

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Chapter I

Introduction

American scientific psychology has recently been the subject of extensive, critical examination. Many commonly held assumptions about the nature of psychological investigation have been so thoroughly challenged that the field itself has often been characterized as in "crisis" (Westland, 1978). The crisis not only involves the viability of long-held psychological assumptions, but it also extends to the nature of scientific inquiry itself. Critical discussions about such a basic concept as causation in research and explanation (Cook & Campbell, Chapters 1 & 2, 1979) and increasing demands that experiments meet new standards such as ecological validity (Gibbs, 1979) have clearly raised questions about what can be claimed as scientific knowledge. Those persuaded by the previously held view of scientific psychology have been so suspicious of any examination of philosophical underpinnings of theoretical views, that one can not but be struck by the growing evidence that it is precisely such matters of reflection that are at issue. An even cursory glance at recent literature reveals a growing emphasis on theoretical

analyses of psychological subject matters; and implicit in many of the discussions is the contention that psychology so needs such rethinking that it can not "go on as usual."

Cognitive psychology has played a central role in this growing reassessment of scientific psychology and its philosophical assumptions. The burgeoning literature on consciousness and cognitive processes (Hilgard, 1980)--subjects long excluded from American psychology's domain--indicates that many American psychologists have revised what can be claimed as "legitimate" subject matter for investigation. The research findings of cognitive psychologists, the interpretation of their findings, and the theoretical discussions surrounding the role of cognition in, for example, theories of learning and behavior have initiated an exciting, if sometimes chaotic, period in the discipline as a whole.

Cognitive psychologists have criticized many of the assumptions which characterize the behaviorist tradition in American psychology, a tradition which, in its most radical form, doggedly adheres to the principle that scientific explanations of behavior should exclude appeals to mentalistic processes. In the sense that cognitive psychology covers terrains previously unexplored by such a tradition, it has stimulated general reassessments of behaviorist theories and models and developed different assumptions about the role of cognition in behavior. The assumptions of both approaches frequently extend beyond the role of cognitive processes themselves, however, and questioning such assumptions leads to more fundamental difficulties about the nature of reality and human behavior. The introduction of new cognitive models and approaches does not, in and of itself, signal the rise of a competing view

of psychological phenomena. Although the research of cognitive psychologists might appear to have instituted new psychological conceptual frameworks, such a conclusion needs careful scrutiny from a more general perspective; namely, a metatheoretical one.

Very broadly speaking, metatheories are the most general vantage points from which one's subject matter is examined. As Johnston and Turvey (1980) define the term, "Metatheory is concerned with justifying the asking of certain kinds of questions in a particular area of inquiry . . . and putative answers to those questions are presented in the form of theories, hypotheses, and models" (p. 149). For example: a group of psychologists might state that they are interested only in mechanisms. Such a claim has metatheoretical import to the extent that it structures what is taken as psychological reality and constrains how that reality can be investigated. Usually, the comparison and evaluation of competing theories compel metatheoretical analysis since the standards for such comparison can not be found within the theories themselves. Certainly proponents of a given theory can examine and interpret the evidence of other theories; but metatheoretical analysis does its work when given theories mutually exclude each other on the grounds that facts conflict and conceptual frameworks differ.

This dissertation will examine, from a metatheoretical perspective, several recent developments in cognitive psychology, especially in the areas of perception and memory. My general purposes are to examine the treatment of cognition in traditional American psychological theories, to analyze the theoretical assumptions of some aspects of recent cognitive psychology, and to contrast competing theories and meta-

theories currently developing within the area of cognitive psychology itself. Before outlining more specifically the directions this dissertation will take, however, I shall describe the historical context from which cognitive psychology has developed and against which it is, in part, reacting. Several key scientific and philosophical issues involved in the most critical assessments of American scientific psychology are closely tied to a general conceptual framework or "paradigm" (Kuhn, 1962/1970)--one shared historically by a substantial community of psychologists. It is this framework or model of psychology that has been described as "breaking down" (Joynson, 1970). The metatheoretical framework which I shall employ in my extended analyses of theoretical and metatheoretical debates occurring within cognitive psychology can be best understood against an examination of the origins of the present situation in psychology as a whole.

The Erosion of the Neobehaviorist Paradigm

Perhaps the most common approach taken in the discussion of the crisis situation in psychology is the application of Thomas Kuhn's (1962/1970) concept of a scientific paradigm. Even if used loosely, this concept compels a certain kind of analysis, one which cuts across more specific issues (e.g., inferences from experimental evidence) and more general theoretical concerns (e.g., concepts and assumptions which direct research). The Kuhnian perspective, applied in several key metatheoretical discussions on psychology (Bolles, 1975; Buss, 1979; Reese and Overton, 1970; Rychlak, 1977; Sampson, 1978), has been instrumental in identifying theoretical assumptions underlying psychological inquiry

and research. The current crisis areas are inextricably tied to the often unexamined theoretical assumptions implicit in the tradition of American psychological research. Thus, for the purposes of this introduction, Kuhn's concept of the paradigm will serve as an organizational tool.

Thomas Kuhn's original use of the term paradigm in The Structure of Scientific Revolutions (1962) has been criticized as ambiguous (e.g., Shapere, 1971). In the second edition (1970), Kuhn, however, identifies two specific meanings in his use of the term:

> On the one hand, it stands for the entire constellation of beliefs, values, techniques, and so on shared by the members of a given community. On the other, it denotes one sort of element in that constellation, the concrete puzzle-solutions which, employed as models or examples, can replace explicit rules as a basis for the solution of the remaining puzzles of normal science. (p. 173)

Scientific knowledge, Kuhn argues, results from the existence of competitive paradigms and practical evaluations. It is not the gradual accumulation of data that accounts for breakthroughs in scientific knowledge but sweeping conceptual revolutions. In Kuhn's analysis, scientific revolutions occur at a conceptual or theoretical level and not within the framework of a given or existing paradigm.

Using Kuhn's concept of paradigm in the natural sciences, several psychologists have identified a paradigm in American scientific psychology. Bolles (1975), for example, discusses the stimulus-response (S-R) paradigm which "covered the psychological world like an umbrella" (p. 253); he points to major failures of this paradigm and claims it is no longer viable. Segal and Lachman (1972) identify what they term a "neo-

behavioral" paradigm whose strong hold on American mainstream psychology lasted from the 1930s to the 1960s. They claim that the paradigm has been so weakened by its critics and competitors that "it can hardly be identified" (p. 54). Making similar but much broader historical arguments than Segal and Lachman, Rychlak (1977) traces a "formal institutionalized paradigm in psychology" (p. 174) back to its roots in the philosophy of John Locke (see Reese and Overton, 1970, for a similar historical analysis). Sampson (1978) bases his identification of "Paradigm I" on the naturalistic conception of science which, he argues, has dominated and continues to dominate psychological research. Regardless of the tenaciousness assigned to the paradigm's hold on psychology today, that a paradigm has functioned in both senses that Kuhn (1970) distinguishes has been forcefully argued by these psychologists. Although differing characteristics of "the paradigm" are highlighted in each of these accounts, they overlap significantly enough to justify the claim that the same paradigmatic framework is being identified. The constellation of assumptions that form what I shall term--following Segal and Lachman--the neobehaviorist paradigm is closely implicated in the current crisis.

If Kuhn's first meaning of paradigm (i.e., "the entire constellation of beliefs, values, techniques, and so on shared by the members of a given community") is applied to American psychology over the past sixty years, what one first discovers in the discussions are "constellations" of -isms: empiricism (atomism, and reductionism); associationism; logical positivism and operationism; and various types of behaviorism (classical, radical, and neo-). An extensive historical treatment of

these terms is beyond the scope of this discussion; however, a brief discussion of the philosophic doctrines will illustrate how they have become connected to dominant psychological theories.

Empiricism and Associationism

An explanation of empiricism will serve as the point of departure. An empirical claim is one which can be justified by an appeal to experience. A problem, however, immediately arises: What is the evidence of experience? Although different thinkers have worked out answers that varied somewhat in detail, those philosophers who have come to be known as the "British Empiricists," represented by such figures as John Locke, David Hume, and J.S. Mill, all take the same general approach in answering this question. For them, experience means that which can be traced to its origins. It can be reduced to the smallest units or elements ("atoms") which are simple and invariant; for example, units of sensation. These uninterpretable basic units do not change; they are the final evidence for the "known" and thus are claimed to be the ultimate indicators for what is "out there," what exists apart from the knower. Empiricism, then, is an epistemological theory which establishes the object of experience as primary to what can be claimed as knowledge. It is based on appeals to ultimate units (atomism) and a reductive method (reductionism). Most of experience, though, is not characterized by the particularistic quality of raw sense data, so another question arises: how do the units (i.e., simple ideas) come together and how do they form groupings (i.e., complex ideas)?

The general answer given to this question by the British Empiricists was the theory of association. Again, Locke, Hume, and Mill differ in their explanations, but their aim is the same: to discover laws by which units form into larger complexes and regularities. A number of different laws were put forth by the British Empiricists. The law of contiguity, for instance, states that elements are associated (undifferentially connected) by simultaneous or successive existence in space and time. Other laws are those of similarity, resemblance, repetition, and cause and effect. As J.S. Mill says in a statement typical of this kind of account: "Our ideas spring up or exist in the order in which the sensations existed of which they are copies" (in Humphrey, 1963, p. 3). Regardless of the specific laws asserted, the British Empiricists describe the formation of associations as a non-rational and mechanistic process. That is, the relation between the elements is based on their random, simultaneous (or successive) occurrence. The connections simply occur; there is no other explanation of that fact. The organism is passive in the process; the elements are associated or mechanically grouped as they are registered in sensory apparatus.

Associationism provided an explanation of learning which complemented empiricist epistemology; it was the mechanism by which basic units came together. Complex ideas can be reduced to connections between simple ideas, and the content of these simple ideas is ultimately rooted in sense impressions. As Humphrey (1963) writes,

> It may be said that the associational theory, where it stands by its own principles, represents all mental events, simple or complex, as collocations of generically unchanged elements resulting from the elementary stimulation of the organism. (p. 7)

Thus, meaning is generated in the external environment; the organism registers units passively, and the units which, Locke argued, are stored in memory as ideas have no organizing or construing potential (cf. Rychlak, 1977, pp. 86-87).

The epistemological and metaphysical assumptions of empiricism and associationism form the most general level of the paradigm in American scientific psychology. Reese and Overton (1970) describe how the general levels within a paradigm affect lower levels:

> At the more general levels, the concepts are generally less explicitly formulated, but they nonetheless necessarily determine the concepts at lower levels. This categorical determinism stretches from metaphysical and epistemological levels "downward" through scientific theories, to the manner in which we analyze, interpret, and make inferences from empirical evidence. (p. 117)

Thus, for example, as Greeno, James, Da Polito, and Polson (1978) and Jenkins (1974b) argue, until the 1960s, almost all psychological investigations of complex behaviors, particularly verbal learning, relied explicitly on the doctrine of association. Although somewhat more complex historically (e.g., Robinson, 1932), associationism significantly influenced behaviorism.

Hull makes a clear connection between associationism and American behavioral psychology:

> During the two and one-half centuries since the beginning of the English association movement there has been a slow but fairly constant tendency for associationism to stress more and more the aspect of physical reaction. This has reached its logical limit in the behavioristic psychology of America, which, despite its migration to another continent, and its general repudiation by present-day English

> psychologists, is a genuine and perfectly natural evolution of English associationism. (in Humphrey, 1963, p. 4)

It is important to note at the outset that the behaviorist psychology to which Hull refers is by no means a monolithic formulation of concepts and theories about human behavior. The evolution of behaviorism historically has been described elsewhere (see Kantor, 1968). For the purposes of this discussion, classical behaviorism will be connected with the system of Watsonian behaviorism; and, adopting Segal and Lachman's (1972) designation, neobehaviorism will refer to Guthrie (1952), Hull (1943), Skinner (1938), Spence (1957), and Tolman (1932). What will be claimed is that even given variations in the conceptual formulation of behaviorism, the doctrines of associationism and empiricism form a theoretical framework coherent enough to warrant its status as a paradigm. This framework can be best elucidated in the works of J.B. Watson, whose theoretical formulations influenced later developments.

The assumptions in Watson's approach to psychology are avowedly associationist and empiricist. As Hull notes in the quotation cited earlier, physical reaction is key in the development of behaviorist psychology along associationist lines. In Watson's system, "the unconditioned reflex takes the place of the sensation, while the conditioned reflex and its elaborations takes the place of associationally derived elaborations of the sensation" (Humphrey, 1963, p. 6). Thus, fundamental in Watson's description of psychological processes is the stimulus of sensory receptors; this stimulation produces simple reflex processes out of which more complex processes are formed. Watson (1924) explains:

> The relationship, theoretically, between the simplest cases of the conditioned responses we have studied and the more complicated, integrated, spaced, and timed habit responses we are considering seems to me to be quite simple. It is the relationship apparently of part to whole--that is, the conditioned reflex is the unit out of which the whole habit is completely analyzed, each unit of the habit is a conditioned reflex. (p. 157)

Explicit here is an atomistic description (i.e., there are smallest parts for all experience) and a reductionist method (i.e., the whole can be known only by its parts). The "rule or measuring rod," Watson (1924) asserts, "which the behaviorist puts in front of him always is: Can I describe this bit of behavior I see in terms of 'stimulus and response'" (p. 6). Finally, as Humphrey (1963) notes, the S-R unit is connected through the mechanism of association (p. 4).

Watson's reduction of all psychological activity to the basic stimulus-response unit justified, on the basis of an empiricist epistemology, what could be claimed as psychological knowledge. The elements of this basic unit are observable. Thus he could dismiss from the analysis of behavior any subjective conditions of the organism. "The time has come," he states, "when psychology must discard all reference to consciousness" (1913, p. 163). Such a position assumes that what is internal to the organism is what is associated "out there." For Watson, implicit habits ("thought") are, like every other acquisition, a product of conditioned reflexes. Psychological processes are mechanistic; as Watson (1924) himself asserts: "Let us try to think of man as an assembled organic machine ready to run" (p. 216). Behavior, from this view, is governed by external stimuli. Rychlak (1977) describes the type of causation necessary in Watson's system:

> If behavior is a function of environmental (and internal) circumstances, it is itself an effect and not a cause. It is under control rather than controlling. (p. 148)

Although many features of Watson's classical behaviorism were modified by the neobehaviorists, his reductionist, atomist, and mechanist assumptions were retained in subsequent formulations of behavioristic psychology in America.

The Scientific Assumptions of the Neobehaviorist Paradigm

It is important to note that Watson does not explicitly state his theoretical views about psychological processes in terms of the doctrines of associationism and empiricism. Rather his concern is with the kind of knowledge claims one can advance in psychology, and here he appeals to the natural sciences:

> Psychology as the behaviorist views it is a purely objective branch of natural science. Its theoretical goal is the prediction and control of behavior. (1913, p. 158)

Reacting against the mentalism of introspective psychologists, Watson shifted the basis on which knowledge claims could be made; namely from unobservable to observable events. The concept of conditioning had built in techniques which were readily transferred into the experimental method characteristic of the physical sciences during the early 1900s. Although the experimental method had already been employed in psychology before Watson, his call for objective and naturalistic views helped open the way for psychological investigation to more directly emulate investigation in the physical sciences. So influential was Watson's view that

scientific psychological investigation has come to be equated with "the objective method of experiment" (Broadbent, 1961, p. 35) and the laboratory test (Bakan, 1967). Westland (1978) states,

> Within psychology the rigid view of a totally objective science is of course exemplified by behaviorism and the concepts and attitudes associated with it. (p. 51)

Since the time of Watson, scientific psychologists have adopted a particular set of procedures in structuring their laboratory investigations (see Kaplan, 1964; Koch, 1971). The assumptions guiding the implementation of these procedures is summarized by Rychlak (1977):

> (1) antecedent Ss [stimuli] determine consequent Rs [responses] in the cause-effect terms of efficient causality; (2) experimental IVs [independent variables] define Ss and DVs [dependent variables] define Rs; (3) for all practical purposes IVs <u>are</u> Ss and DVs <u>are</u> Rs; (4) the relationship between these two "variables" [is] therefore determinate, as proven by the statistically significant evidence of a predicted outcome; (5) the extent of this efficient-cause determination of an antecedent-to-a-consequent can be expressed mathematically as a(n) (S-R) law or function; and (6) theoretical speculations going beyond such empirically observed facts are unwarranted, unless they make direct reference to further variables which can be manipulated (i.e., efficiently caused to vary). (p. 173)

Significant variations exist in the behavioral formulations and methodological procedures of the neobehaviorists (e.g., Kantor, 1968; Kendler & Spence, 1976); nonetheless, common among them is the assumption that the S-R unit--however formulated--can be isolated and studied in the objective experiment (Gibbs, 1979; Joynson, 1970; Mishler, 1979). In addition, as Rychlak's distinctions make clear, such a methodology assumes

that only a certain type of causation can enter into descriptions of behavior.

Until recently, many experimental psychologists looked to the logical positivists and to the principle of operationism (e.g., Stevens, 1939), for the justification of their epistemological and methodological assumptions (Mishler, 1979). "A strict logical positivist would insist that the sole cognitive meaning of any statement is contained in its empirical observationally ascertained consequences" (Horgan, 1976, p. 227). The emphasis logical positivists placed on objectivity in the definition of constructs and their denial of cognition and metaphysics as meaningful in the discovery of scientific knowledge supported the empiricist tenets of the behaviorists and particularly their search for the stimulus-response unit. Kendler and Spence (1976) note this connection:

> Neobehaviorists adopted stimulus-response language because it represented important traditions from which their orientation emerged: British associationism, classical conditioning methodology, and a methodological commitment to objectivity. (p. 514)

The parameters of the objective experiment in psychology are, then, closely bound into the paradigm being discussed.

The aim of laboratory experiments is to obtain knowledge about the objective (usually antecedent) conditions in the experiment. A reductionist method is explicit in the isolation of the stimulus-response unit. (That is, what constitutes psychological activity can be reduced to observable behavior which itself is reducible to a basic unit.) Segal and Lachman (1972) state that the neobehaviorists "(with the exception

of Tolman) believed that the associative connection [between S and R] could, in principle, be measured by instruments which either recorded overt behavior or were hooked up to the muscles or glands" (p. 55). In the process of isolating the basic unit of behavior, the stimulus is extracted, so to speak, from its environmental context and studied singularly. The stimulus, simple (i.e., measurable and controllable) and invariant, remains unalterable during the establishment of an S-R unit. That is, the subject cannot alter the stimulus while processing it, either perceptually or cognitively, since that would make "objective," transituational knowledge claims about psychological functioning impossible. The subject, then, plays no causal role in the experiment and usually is assumed to process the stimulus in a mechanistic way. As Zimbardo (1969) notes, laboratory studies "have typically been designed to render living organisms into passive subjects, who simply convert stimulus inputs into correlated response outputs" (pp. 237-238).

Finally, an assumption made in carrying out objective experiments is that generally the role of theory should be minimized. Of all of the neobehaviorists, Skinner (1950) has continually advanced the nontheoretical nature of scientific analysis of behavior. If functional relationships (lawful ties) between stimulus and response can be established, then these laws can be used to control and predict behavior. As Skinner (1956) states, "When we have achieved a practical control over the organism, theories of behavior lose their point" (p. 231). Those within the neobehaviorist tradition who did set up complex and abstract theoretical frameworks (e.g., Hull, 1943; Spence, 1957; Tolman, 1938) conceptualized psychological activity reductionistically. Spence

(1957), for example, who was influenced by both Hull and Tolman, stated:

> We have chosen to investigate simpler phenomena first because we are of the belief that progress in the formulation of psychological laws and theories will be more rapid in this area than in the case of more complex behavior. We also believe that many of the variables and laws isolated in the study of simpler forms of behavior will be operative in more complex instances, interacting presumably with the additional factors introduced into these more complex situations. If such is the case it would appear to be more efficient in the long run to investigate the simpler phenomena first. (p. 103)

The role of theory in the neobehaviorist tradition, then, was relegated to a particular view of scientific progress; namely that simple bits of behavior such as classical and instrumental conditioning could be eventually pieced together to explain complex processes.

The doctrines of empiricism and associationism, I have argued, formed the theoretical framework for the neobehaviorist paradigm in American psychology. This framework legitimated, albeit sometimes implicitly, the implementation of a particular scientific method in psychology. The determination of methodology by such a theoretical framework is crucial in warranting paradigmatic status (Reese & Overton, 1970; Rychlak, 1977). Rychlak describes it as an institutionalized paradigm which flourished primarily in academic centers in America (pp. 174-175). As stated earlier, it is the viability and efficacy of this paradigm that is at the center of the crisis in American psychology today. Like a building undergoing demolition, the paradigm's foundation as well as the substructures it supports have come under assault from many different areas, both within and without psychology. Although many complex

factors are involved in the criticisms, my purpose will be to briefly discuss those criticisms that have implications for cognitive psychology.

The Scientific Crisis

One of the crucial arguments leveled against the traditional behavioral paradigm is that its model of science is inappropriate and outdated. That model is generally identified with classical physics or the causal paradigm of eighteenth and nineteenth century science. Herbst (1970), for example, criticizes the application of this model to scientific psychology:

> The development of the behavioral sciences has been handicapped in the past by the use of classical physics as a scientific model. Classical physics was based on laws characterized by invariant functional relationships and constant parameters. In the case of behavioral organizations neither the functional relationship between variables nor parameters are necessarily invariant or constant. (p. 3)

Kaplan (1964) states that the issue is not that psychology should "stop trying to imitate physics. . . . What is important . . . is that behavioral science should stop trying to imitate only what a particular reconstruction claims physics to be" (p. 11). The construction attempted by the logical positivists has generally failed, "largely because it has proved extraordinarily difficult to state a precise and unobjectionable formulation of the positivist criterion of cognitive meaning" (Horgan, 1976, p. 227). The key methodological convention of behaviorism, operationism, has been found epistemologically indefensible (Hempel, 1951, 1954, 1966; Popper, 1963). At the same time, other philosophers of science (Kuhn, 1962/1970; Lakatos & Musgrave, 1970; Polanyi, 1958) have

stressed the subjective and theoretical factors in the acquisition of scientific knowledge. The philosophical criticisms did not have much effect on psychological research until recently. Cook and Campbell (1979), who address these issues, conclude:

> The epistemology of causation, and of the scientific method more generally, is at present in a productive state of near chaos. (p. 10)

Behavioral psychologists in the laboratory have been faced the most directly with the implications of the breakdown of the "reconstruction" of science which they have employed. Research methods based on this model, so dominant in psychological research, have been the target of extensive criticisms. Bronfenbrenner (1977) states the main difficulties succinctly:

> The emphasis on rigor has led to experiments that are elegantly designed but often limited in scope. This limitation derives from the fact that many of these experiments involve situations that are unfamiliar, artificial, and short-lived, and that call for unusual behaviors that are difficult to generalize to other settings. (p. 513)

Even though the laboratory studies have had a long, prolific history, several psychologists (Finkleman, 1978; Gergen, 1973; Koch, 1971), cite the dearth of any significant accumulation of scientific psychological knowledge. Those phenomena which are investigated are often viewed as trivial (Gibbs, 1979). Finkleman (1978) writes:

> Rather than illuminate basic processes, the simplification inherent in the experimental situation often results in a focusing on isolated, arbitrary, or trivial aspects of the phenomenon ostensibly under study. (p. 188)

At stake is the generalizability of laboratory results, a problem previously recognized by Meehl (1954), but the more recent and extensive criticisms of laboratory research have more serious implications. As Westland (1978) states,

> Research which abstracts from life and imposes arbitrary constraints may only be capable of producing results which are valid, if at all, for the context within which they are obtained, and can tell us little about what will happen in normal everyday life. (p. 18)

Finally, several critics have noted that laboratory research limits scientific inquiry itself. The kinds of manipulations one can make in the laboratory are too constrictive (Finkleman, 1979; D. Kuhn, 1978; Sanford, 1965), and such constraints can result in the distortion of data (Greeno et al., 1977; Jenkins, 1974b).

A second type of criticism, closely connected to the restriction inherent in the laboratory setting, concerns the assumptions made about the subject in the experiment. The subject is typically viewed as reactive; i.e., he or she must play a passive role in the acquisition of knowledge. Most research on associate learning processes has held this premise (Jenkins, 1974), but Skinner (1971) has perhaps most forcefully continued to assert the reactivity of the subject.

> We can follow the path taken by physics and biology by turning directly to the relation between behavior and the environment and neglecting supposed mediating states of mind. . . . We do not need to try to discover what personalities, states of mind, feelings, traits of character, plans, purposes, intentions, or the other prerequisites of autonomous man really are in order to get on with a scientific analysis of behavior. (p. 15)

In an interview with Evans (1968), Skinner describes his account of mediational processes:

> As a determinist, I must assume that the organism is simply mediating the relationship between the forces acting upon it and its own output, and these are the kinds of relationships I'm anxious [illegible] 23)

A group of psycholo[illegible] commonly referred to as cognitive [illegible] ge this non-mediational [illegible]

The Cogn[illegible] l model [illegible] (1964); [illegible] y, Page (1[illegible] 966) draw fro[illegible] ss as a concept [illegible] e retarded the co[illegible] ent of adequate theory" (p. [illegible] lenge to develop adequate behavio[illegible] er 9) and Brewer (1974) indict the traditional behavioral paradigm and forcefully argue for the role of awareness in both instrumental and classical conditioning. Cognitive behavior therapists have also assaulted this paradigm. Mahoney (1974) exemplifies the dissatisfaction of cognitive behaviorists when he states the objectives of his book:

> We are long overdue for some evolutionary progress in our paradigm. The mediational models which we shall now examine may provide some adaptive conceptual mutations in

In an interview with Evans (1968), Skinner describes his account of mediational processes:

> As a determinist, I must assume that the organism is simply mediating the relationship between the forces acting upon it and its own output, and these are the kinds of relationships I'm anxious to formulate. (p. 23)

A group of psychologists within the behaviorist camp--commonly referred to as cognitive behaviorists--has recently begun to challenge this nonmediational model of the neobehaviorist approach.

The Cognitivist Challenge

Cognitive behaviorists' dissatisfaction with a nonmediational model of behavior can be traced, in part, to the studies of De Nike (1964); Dulany (1962); Spielberger et al. (1963); and, more recently, Page (1972). One of the key conclusions Spielberger and De Nike (1966) draw from their studies is that the "implicit rejection of awareness as a concept has had serious methodological consequences which have retarded the convergence of empirical findings and the development of adequate theory" (p. 323). More recently, taking up the challenge to develop adequate behavior theory, Bandura (1969, Chapter 9) and Brewer (1974) indict the traditional behavioral paradigm and forcefully argue for the role of awareness in both instrumental and classical conditioning. Cognitive behavior therapists have also assaulted this paradigm. Mahoney (1974) exemplifies the dissatisfaction of cognitive behaviorists when he states the objectives of his book:

> We are long overdue for some evolutionary progress in our paradigm. The mediational models which we shall now examine may provide some adaptive conceptual mutations in

> our understanding of complex human behavior. (p. 49)

Similarly, Lazarus (1977, 1979) has stressed the significant role cognition plays in behavior.

The cognitive behaviorists have been avid in their attack on the nonmediational part of the neobehavioristic paradigm, but Mahoney's (1974) hope for "evolutionary" change in the paradigm may not be possible. Using Kuhn's analysis, significant conceptual changes cannot be made in the paradigm without the total metatheoretical framework being altered (see Rychlak, 1977, p. 217, for a critical analysis of Mahoney's position). Although this would warrant a fuller treatment than is possible here, the cognitive processes identified by cognitive behaviorists are often not sufficiently explicated. Bandura (1977), for example, places significant theoretical emphasis on symbolic processes in behavior, yet does not discuss the nature or scope of such "processing." The shift occurring within behaviorist psychology itself is symptomatic of changes occurring in other areas of psychology, and research in cognitive psychology has continued to stimulate this general rethinking.

During the last twenty years, cognitive psychology has attained status as a separate area of study within psychology; and formulations of cognitive processes have increasingly influenced other areas of research. In particular, information-processing approaches have provided conceptual frameworks which attempt to explain complex human behavior (Garner, 1962). Although several behaviorists addressed complex cognitive functioning (Kendler & Kendler, 1962, 1968; Maltzman, 1955; Osgood, 1953), the growth in research in cognitive processes since the late 1960s

has led many psychologists away from the nonmediational assumption of the neobehaviorist paradigm. As many cognitive psychologists have noted, the computer provided a "legitimate" tool for the study of cognitive processes (cf. Haber, 1974; Shaw & Bransford, 1977). As Neisser (1976) puts it: "The coming of the computer provided a much-needed reassurance that cognitive processes were real; that they could be studied and perhaps understood" (p. 6).

Influenced by information theory, a branch of communication sciences, and by computer science, information-processing approaches attempt to describe the internal flow of information; i.e., how mental operations order bits of information sequentially (see Haber, 1974, for an excellent account of the origins and development of information processing). Such approaches are based on an analogy to a digital computer. Since information-processing assumptions will be discussed in more detail in subsequent chapters, I shall only briefly characterize the general nature of this approach to the study of cognition. Taken from visual perception literature, Figure 1 exemplifies the type of flow chart that accompanies most information-processing theories.

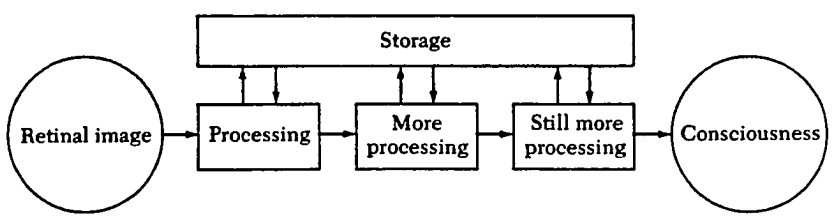

Figure 1. The internal information-processing model of perception. (From Neisser, 1976, p. 17)

Sensory stimulation forms some kind of unit; in this case, the retinal image which then undergoes sequential mental processing. Information previously acquired and stored acts upon the incoming sensory input until it finally emerges in consciousness as meaningful. Such models of processing typically involve data-driven, bottom-up analysis of sensory phenomena (Norman, 1979).

Information-processing models, such as the one illustrated above, call into question the nonmediational emphasis of behaviorism. Behaviorists such as Skinner never pose questions about what happens to the stimulus after it once enters the organism and how the input is changed and stored because these involve hypothetical constructs which Skinner, in particular, wishes to avoid. In Cognitive Psychology (1967), the first full explication of the information-processing approach to the study of cognition, Neisser observes that a generation ago "a book like this one would have needed at least a chapter of self-defense against the behaviorist position" (p. 5); in contrast, he briefly dismisses the inadequacy of behaviorism in accounting for internal events. Thus, early on in the introduction of information processing, cognitive psychology set itself up against the behaviorist paradigm as if it were an alternative paradigm. The clash with behaviorism notwithstanding, cognitive psychology has not really produced an alternative "paradigm"; rather the theoretical efforts in cognitive psychology have tended to explain only isolated phenomena. Hundreds of miniature theories and models have developed in specialized areas such as memory (Nilsson, 1979). In 1973, for example, Newell counted 59 different experimental paradigms current

in the research literature. As a result of such experimental diversity, theoretical analysis has been sketchy and fragmented.

The perceived demise of the neobehaviorist paradigm and the rise of a plethora of miniature theories and models about various cognitive processes have contributed to the feeling that psychology is adrift and in crisis. In 1972, Segal and Lachman suggested that although several key assumptions within the neobehaviorist paradigm had shifted, no alternative conceptual framework could be identified. Since that time, however, a number of psychologists have advanced new paradigms for psychology as a whole (e.g., Buss, 1979; Riegal, 1979; Rychlak, 1977); and within the field of cognitive psychology, established researchers have openly been exploring a number of theoretical and metatheoretical alternatives (Gibson, 1979; Jenkins, 1974b; Neisser, 1976, 1982; Weimer, 1979). Weimer (1979), for example, argues that much in contemporary cognitive psychology does not represent a radical departure from the empiricist and associationist foundations of behaviorism: "A 'cognitive' psychology that makes . . . changes without repudiating the conceptual framework underlying behaviorism (and its predecessors) is no more adequate than behaviorism" (p. 268). In the search for a more comprehensive framework from which to analyze shifts in contemporary psychology, several psychologists (Jenkins, 1974b; Reese & Overton, 1970; Sarbin, 1977) have turned to Stephen Pepper's World Hypotheses (1942/1961) as both a tool to clarify problems being raised in the field and a source for assessing alternative metatheories (see Tyler, 1981, for a brief review of the increasing influence of Pepper's work in psychology).

Pepper's World Hypotheses is a theory of metatheoretical, or metaphysical, systems; and in it, Pepper traces the origins and describes the theoretical structure of four world hypotheses which he claims are about equally adequate and legitimate. Because of the detailed analysis of philosophical perspectives it provides and because it clearly delineates the implications of choosing particular world views, I shall employ Pepper's study as a guide in laying out theoretical assumptions in cognitive psychology. The second chapter of this dissertation will outline fairly extensively the features of his theory; for present purposes I shall suggest that mechanism is the world view which provides the metatheoretical assumptions informing the neobehaviorist paradigm described in this introduction (Jenkins, 1974b; Reese & Overton, 1970). Of the other world views, contextualism has gained the attention of several psychologists seeking an alternative world view to mechanism; and in the field of cognitive psychology, Jenkins (1974b) has forcefully espoused contextualism as a fruitful world view for understanding psychological processes.

My specific purpose in this dissertation will be to examine contextualism as a fruitful world view for cognitive psychology. Given the skepticism toward mechanism as providing (even eventually) totally adequate explanations of cognitive processes and given the trend toward the proliferation of mini-theories, the assessment of a contextualist view of cognitive processes seems warranted. Certainly, cognitive psychologists can not embrace contextualism just because it is an alternative to mechanism. On the other hand, if contextualism is a viable

world view with considerable theoretical and empirical explanatory power, it would provide a framework for interpreting past research findings and guiding future research.

My discussion of the theoretical and metatheoretical issues being raised in cognitive psychology will focus on perception and memory, two fields that have historically developed fairly independent bodies of literature in psychology. As Neisser (1976) points out, "Perceiving is the basic cognitive activity out of which all others must emerge" (p. 9); moreover, any given theory of perception has implications for what can be claimed about memory. Thus an exploration of these two areas will serve to outline some of the basic problems in contemporary psychology and to exemplify the differences for psychology of holding alternative metatheoretical world views.

My method in both chapters will be to trace the mechanistic assumptions which have historically dominated each area of study and then present experimental and theoretical evidence that suggests the development of contextualist assumptions. Although employment of Pepper's theory has not been extensive in the field of perception, many of the developments in the field and, particularly, the recent debate between Fodor and Pylyshyn (1981) and Turvey, Shaw, Reed, and Mace (1981) readily lend themselves to an explication in line with Pepper's framework. Jenkins (1974b) has called for a contextualist world view in the field of memory; his evidence, along with other psychologists', suggests contextualism has come to be seen as an alternative to mechanism. In my concluding chapter, I shall extend my analysis of the fields of perception and memory to the field of problem solving. Such an extension will illustrate

how the basic philosophical assumptions one holds about perception and memory influence more general cognitive functioning.

Cognitive psychology has departed from several of the assumptions which characterize the neobehaviorist paradigm, and such a departure has contributed to a general rethinking of psychological assumptions and scientific inquiry. Whether or not it has developed a viable metatheoretical alternative, however, remains open to question. By applying Pepper's theory of metaphysical systems to the field of cognitive psychology, I hope to be able to suggest the far-reaching implications of espousing an alternative world view and to put in perspective some of the issues causing, what appears to many to be, theoretical and epistemological chaos.

Chapter II

Pepper's Theory of Metaphysical Systems

In the first chapter, I pointed to the cohesiveness of several epistemological assumptions found historically in American scientific psychology and designated them a neobehaviorist paradigm. Such a designation is efficacious as a tool for understanding and analyzing current re-evaluations of psychology, re-evaluations which have addressed issues such as the role of theory in psychology and the status and interpretation of psychological data. The growing body of literature in cognitive psychology has been a contributing factor in this reassessment; more often than not, research on cognitive processes has called into question assumptions and views which underlie the neobehaviorist paradigm. Those psychologists concerned with the kind of theoretical framework most appropriate for research on cognition have been engaged in stimulating metatheoretical explorations, as evidenced in volumes edited by Nilsson (1979), Shaw and Bransford (1977) and Weimer and Palermo (1974). Increasingly influential as a basis for developing psychological theory (Tyler, 1981), Stephen Pepper's World Hypotheses (1942/1961) has provided the philosophical framework for several discussions, not only in cognitive psychology (Jenkins, 1974b) but also in other areas of psychology as well (Sarbin, 1977; Reese & Overton, 1970).

The general purpose of this chapter is to explicate the metaphysical system in Pepper's World Hypotheses. The issues discussed will lay the theoretical foundation on which subsequent discussions of cognitive processes will rest. Pepper's major undertaking in World Hypotheses was the systematic, unbiased clarification of four world hypotheses (i.e., general metaphysical claims about the nature of reality)--formism, mechanism, contextualism, and organicism--all of which, he claimed, have high cognitive value. The chapters on individual world hypotheses have been the focal point of most psychologists who have applied Pepper's system to psychology. Indeed, a careful explication of his chapter on contextualism is an important goal of this chapter, since it is the world hypothesis that has been advocated by Jenkins for cognitive psychology. Throughout World Hypotheses, however, Pepper contends that all four world hypotheses are approximately equally adequate and legitimate. If one adheres to his principle of "tolerance" in the metaphysical arena, then a specific world hypothesis cannot be presented, a priori, as superior for cognitive psychology. Thus any discussion of contextualism will necessitate discussion of the other three world hypotheses. Throughout this dissertation, however, I shall argue that contextualism does offer the best alternative to mechanism for the interpretation of present psychological research.

In addition to understanding the other world hypotheses, there are other grounds for what will be a fairly extensive discussion of Pepper's general theory. The legitimacy of the specific world hypotheses depends upon a series of arguments Pepper makes about the nature of evidence. As Pepper (1956) states,

> [World Hypotheses] is a study of the sources, nature, and organization of evidence, and of the best hypotheses at present available as to what this evidence is about or as to how it is interrelated. (p. 3)

I have spoken to the anti-theoretical (anti-metaphysical) position of psychologists in the behaviorist tradition. Since applying Pepper's system to psychology necessitates accepting the cognitive value of metaphysics, a recapitulation of his theory of the nature of evidence becomes a critical first step toward understanding the world hypotheses. Why should psychologists turn to an explicitly metaphysical system such as Pepper's in the first place?

Generally, Pepper's presentation of various stances toward the cognitive value of metaphysical endeavors clarifies many of the issues which have arisen in psychology recently. Although some of his examples in World Hypotheses have become outdated, his analyses of epistemological issues speak directly to the situation in which many cognitive psychologists have found themselves. Behaviorists turned metaphysics into a specter; it became synonomous with a non-empirical, non-scientific enterprise. Pepper claims his theory of philosophic systems is empirical in the sense that it is grounded in experience, though not in the narrower sense of the term empirical as it came to be used by the British Empiricists; hence his system cannot be dismissed on this ground. Additionally, Pepper's system confirms the high status psychologists have placed on empirical data; however, the narrower view of what constitutes empirical knowledge, a view psychologists adopted from the logical positivists, Pepper rejects as illegitimate. My approach, then, in dis-

cussing the earlier sections of World Hypotheses, will be to focus on the background necessary for understanding contextualism and the other world hypotheses; whenever appropriate, I shall also connect Pepper's epistemological analyses to American psychology and the crisis in which it finds itself today.

The Philosophical Basis of Pepper's Four World Hypotheses

Pepper begins World Hypotheses with an investigation into the claims of skepticism and dogmatism and rejects them both. The utter skeptic, "he who doubts all things," can only, in the final analysis, remain silent; once the skeptic attempts to explain himself, it can be shown, by implication, that the explanation involves a theory about the nature of the world and that must be considered along with other theories. In addition, by his own assumptions, the skeptic must utterly doubt what he says. Of course, the skeptic can hold his position dogmatically, but then the skeptic becomes a dogmatist. Like the position of skepticism, Pepper claims dogmatism holds no cognitive value. The dogmatist, "the dictator of cognition," is "one whose belief exceeds his cognitive grounds for belief" (p. 11). Whether it be dogmatic appeals to self-evident principles or to the immediate certainty of fact, the failure of these appeals stems from their unrelatedness to the evidence. As A.E. Burt (1943) summarized Pepper's position,

> If a principle is evidentially sound it can prove itself to be so whether or no anybody claims selfevidence for it; if a fact is a fact it will stubbornly render itself coercive whether or no anybody asserts that it is immediately certain. (p. 591)

Pepper concludes that "the security of cognition . . . rests on the evidence itself and on its convergence toward belief, not on an intensity of belief in excess of the actual cognitive value of the evidence" (p. 318).

After denying the claims of the skeptic and dogmatist, Pepper argues for partial skepticism: no fact is indubitable and no principle self-evident. Knowledge, for Pepper, is rooted in common sense or what he terms dubitanda; from its common sense base, knowledge is refined hierarchically (up through the most refined evidence of theories). Since "every item of common sense is highly dubitable and subject to criticism and generally greatly altered by cognitive refinement" (p. 320), some means of reducing doubt and refining knowledge must be achieved. For Pepper, the means are through corroboration; specifically "multiplicative corroboration," which "consists in attesting to the repetition of the 'identical' item of evidence in many different instances" (p. 320) and "structural corroboration," which "consists in the convergence of qualitatively different items of evidence in support of a single item" (p. 321).

Multiplicative corroboration, which produces data, characterizes the method used in the empirical sciences. The most refined empirical data "consist of pointer readings and correlations of pointer readings" (p. 52). Structural corroboration, which produces danda, "requires a theory and hypothesis for the connection of the various items of evidence and what is said to be corroborated here by the convergence of evidence is not so much the evidence itself as the theory which connects

it together" (p. 321). Danda refer to facts as they become intertwined into the total structure of a given theory; and, conversely, they are facts that ought to be given if a theory is true. Critical evidence in the field of metaphysics depends on structural corroboration for its legitimacy; a metaphysical theory attempts to account for and be supported by all relevant facts. Theories in astronomy and quantum mechanics gained their validity through structural corroboration. The accrual of evidence through either method of corroboration reduces uncertainty and doubt. Observation is involved in multiplicative corroboration; hypothesis in structural corroboration. Both types of corroboration differ in procedure and produce distinct types of evidence, but both, in Pepper's view, have value and legitimacy.

Pepper's claim about the legitimacy of structural corroboration brings him into conflict with logical positivism (and those behavioral psychologists who relied on that position). The positivist denies the legitimacy of structural corroboration and thus, the value of metaphysics, so Pepper gives considerable attention to the position and his refutation of it. He states,

> The defining mark of a positivist is his bias for refined data, or at least for data--that is, for the principle of multiplicative corroboration [i.e., corroboration of man with man, as in readings of a measuring instrument]. He tends to disparage the principle of structural corroboration [i.e., the corroboration of fact with fact] and reduce it rather plausibly to logical system. (p. 61).

This definition closely parallels how strict behaviorists have often defined themselves. The bias for products of multiplicative corroboration have led positivists (and strict behaviorists) to eschew metaphysics.

> For [the logical positivist], metaphysics is mythology. It may have some aesthetic, emotional, or sentimental value, but no cognitive value, or at the most very little. (Pepper, p. 62)

Certainly the kind of evidence that constitutes knowledge varies from one positivist to another, but generally the positivist ignores or, in the strictest case, disparages structural corroboration.

Multiplicative corroboration has, especially in the physical sciences, gained particularly high status methodologically because it produces very reliable and thus credible evidence. The positivist program argues that precise physical measurements can be gathered and their relations observed. Within the positivist framework, refined data are taken as invariant and as such, ideally become impervious to interpretation. Because they are also based on multiplicative corroboration, logical data are the second kind of refined data accepted by the positivist. This type of data gains its validity through the establishment of logical or mathematical transitions which can be followed and agreed to by all. The positivist theory of knowledge combines both empirical and logical data. As Pepper states,

> It is the conception of knowledge as a deductive system validated throughout by logical data and referring to the empirical data, which are thereby transparently and completely organized. (p. 60)

The strict positivist argues that "all knowledge can attain that form" (p. 61).

Pepper's mostly ahistorical account of positivism closely parallels the description of classical behaviorism (e.g., Watson) and, in varying degrees, neobehaviorism outlined in the first chapter. In behaviorism the cognitive drive toward precision and for completely invariant evidence led psychologists to rely, almost exclusively, on the method of multiplicative corroboration and on the control of external conditions. The stimulus has, historically, functioned pre-emptively in American psychological experiments (cf. Shimp, 1976); in the S-R version of classical behaviorism, stimuli completely determined behavior. Any psychologist who claims that only empirical and logical data, ascertained through multiplicative corroboration, constitute knowledge would fit Pepper's definition of a strict positivist; this position would also represent the neobehaviorist paradigm in its purest form. The positivist theory has worked remarkably well in some fields; and, as Pepper notes, the evidence of multiplicative corroboration has high cognitive value. Why not dispense altogether with structural corroboration as the strict positivist does? "Shouldn't we staunchly maintain," Pepper asks, "that the only legitimate method of cognitive refinement is in the direction of refined data?" (p. 62)

Pepper's whole investigation in World Hypotheses stands as a negative response to the assertion that the evidence of multiplicative corroboration is the only legitimate type of knowledge. He offers, however, two specific criticisms of positivism which I shall recount as they have direct implications for cognitive psychology. For example, much of the

evidence in the field of cognitive psychology cannot be directly translated into purely observational terms, and thus many cognitive psychologists have relied on the products of structural corroboration. The study of cognitive processes through the computer has played an important role in cognitive psychology because the processing can be investigated through multiplicative corroboration, but any analogies of computer processing to cognitive processing are the product of structural corroboration. Thus, for cognitive psychology, multiplicative corroboration will not serve alone.

In his first criticism of the strict positivist, Pepper notes that the fields in which one can rely solely on refined data are limited to certain ones; namely, physics and chemistry. Even in these fields, "the more carefully we study the nature of the development of refined data the less convinced we become of their adequacy to absorb all evidence" (p. 63). Recent philosophy of science, it is important to note, would support Pepper's claim (Polanyi, 1968; Lakatos & Musgrave, 1970); Kuhn's (1962/1970) concept of paradigm insists on the primacy of structural corroboration in investigation. (Indeed these philosophers argue "bare data" are a myth.) The main problem lies in the fact that refined data alone lack significance; there is a limitation to or thinness of refined data when "[they] try to carry on cognition alone" (Pepper, p. 64). The recent criticisms that historically experimental psychology has not produced a significant body of scientific knowledge (Koch, 1971; Finkleman, 1978) and that experiments have often been limited in scope (Bronfenbrenner, 1977; Gibbs, 1979) touch upon Pepper's point about refined data lacking significance in and of themselves. An example from

psychology of the difficulty of working with refined data might better illustrate the problem.

B.F. Skinner has been vociferous in his denial of the value of theory (and thus the evidence of structural corroboration) in psychological investigation. He claims, for example, that "a smooth curve showing change in probability of a response as a function of a controlled variable is a fact in the bag, and there is no need to worry about it as one goes in search of others" (1969, p. 84). Noble's criticism of Skinner's assertion highlights Pepper's argument that refined data are hard pressed to absorb all evidence. Noble (1976) states:

> The picture of a Grand Anti-theoretician in action evoked by this passage may be comforting to radical empiricists, but it does not take account of the highly abstract nature of functional relationships obtained in psychology laboratories. A discovery that R=f(S) is, from my point of view, no mere "fact." It is considerably more general than a percept because several concepts are being interrelated in a proposition involving the quantitative dependency of R upon S in a "causal" setting. If nothing else, a consideration of the unexamined instances of R=f(S) render this so-called "fact in the bag" a frankly hypothetical statement. (pp. 302-303)

Whether one agrees with the specific criticism of Skinner or not, Pepper's point is well taken: restricting cognition to items that are clear, distinct, and simple (i.e., percepts) is extremely difficult. If one agrees with Noble, then in Skinner's account of functional relationships, refined data play a secondary role to that of hypotheses.

The second criticism Pepper makes involves distinctions among undictatorial and dictatorial positivists, and the latter he divides into dogmatic and undogmatic positivists. The undictatorial positivist

holds refined data in high regard but does not judge other types of evidence. Such persons typify the classical ideal of experimental scientists although Pepper acknowledges that such a view often breaks down in practice. "Most of them appear more or less consciously to hold rather extensive theories about their data--so extensive, indeed as, implicitly to involve danda" (p. 64). Unlike the undictatorial positivist whose "interest" is refinement of data and who makes no claims about other possible evidence, the dictatorial positivist sets up "refined data as norms of evidence" (p. 64). To dictate that multiple corroboration and refined data are sole norms of evidence is possible but never in Pepper's view legitimate because it is a dogmatic claim.

> A refined datum is not, in fact, indubitable. Its high cognitive value depends on the precise, or relatively precise, corroboration of many observations, or upon the expectation of such corroborations. Any datum may be in error. Nor is the principle of multiplicative corroboration self-evident. Its cognitive value rests upon the observed reliability of the evidence gained through its use. It may occasionally be deceptive. (p. 65)

Thus the undictatorial positivist creates no cognitive issues, and the dictatorial one makes illegitimate cognitive claims. In applying Pepper's analysis to psychology, it is important to emphasize that the claim that refined data have high cognitive value is not the issue; rather the issue is the assertion "that multiplicative corroboration is the only legitimate aim of cognition, and that only empirical data are reliable factual evidence, and only logical data reliable means of theoretical construction" (p. 322). Such claims, Pepper argues, rest on dogmatism.

The third type of positivist Pepper terms the undogmatic dictatorial positivist, one "who claims that multiplicative corroboration and data are the sole reliable norms of evidence, and who makes these claims as a sound hypothesis on the basis of the consideration of all relevant evidence available" (p. 65). This type of positivist denies interpretation; data and evidence are synonomous. The small range of refined data available, however, forces this type of positivist to "make reasonable interpretations of dubitanda and of danda in terms of the data already observed and of other data which [she hypothesizes] might be observed" (p. 66). In doing this, Pepper counters, the positivist "interprets the evidence that is not obviously data as to make it corroborate the evidence that is. For what are hypothesized 'data' and inferred 'data' but unobserved danda, the sort of evidence that ought to be given, if data are the sole norms of evidence?" (p. 66). In other words, when the positivist claims anything more than refined data, she moves toward structural corroboration along with multiplicative corroboration. Furthermore, Pepper argues that this type of positivist denies the claims of danda resulting from other world theories, and to do this she must arrange and organize data to refute alternative evidence. Structuring refined data as evidence, however, cannot be done through multiplicative corroboration alone, "for it only establishes the evidence it establishes, and neither affirms or denies the claims of any facts other than those, like pointer readings, by which man corroborates man" (p. 69). The reliability of multiplicative corroboration is not evidence against the reliability of structural corroboration. Actually, Pepper argues, the positivist who infers or hypothesizes on the

basis of observed data has developed, in the process, a structural hypothesis, "and a world-wide one, such that fact corroborates fact throughout and every fact is a 'datum'" (p. 69).

Psychologists in the neobehaviorist tradition (e.g., Hull and Spence) might well reply to Pepper's argument that they have avoided making world-wide structural hypotheses by committing themselves to conventionalistic hypotheses--hypotheses which conveniently arrange data but have no cognitive value in themselves. Knowledge is only in data, not in hypotheses. "Ideally," Pepper states, "these [convenient systems of organization] are in mathematical symbols and are deductive in form" (p. 72). Pepper replies to this general argument in this way: "Conventionalism is unquestionably the proper interpretation for hypotheses on the basis of the refinement of cognition in terms of multiplicative corroboration" (p. 72). A conventionalistic hypothesis does not "deny or assert anything" (p. 69); it does not provide evidence for anything; to claim its truth (or falseness) would be meaningless since it claims no cognitive value. The appeal to conventional hypotheses does not alleviate the problem, however, because conventionalistic hypotheses are not contenders for "knowledge." The moment the positivist moves beyond refined empirical data, she engages in structural corroboration, corroboration that involves a world-wide hypothesis.

The only way to establish facts and principles, to summarize Pepper's main arguments, is to confirm them through corroboration of evidence. Two kinds of corroboration, multiplicative and structural, can produce equally legitimate cognitive claims; the reliability of one does not render sufficient evidence to disclaim the other as unreliable.

In practice these two methods often become interdependent, and in theory each tends to complement the other. Each method, however, produces distinct types of knowledge. Difficulty arises when claims of the superiority of one are dictated prior to investigation, and the dictatorial positivist does just that. Pepper argues that such a claim is dogmatic and exceeds the grounds of evidence available (p. 322). Since multiplicative corroboration can legitimately produce only limited, but highly refined knowledge in the form of data, only structural corroboration can produce more general knowledge about the world in the form of danda.

The knowledge claims of logical positivism, which appealed to a few American behavioral psychologists, had the cognitive attractiveness of eventually providing a kind of certainty. But the evidence against their positions far outweighs any advantage in maintaining an anti-metaphysical position in psychology. My contention is that rather than denying the value of theory and metatheory, behavioral psychologists would be on firmer grounds epistemologically by espousing a mechanistic world view, one of the world hypotheses Pepper finds can produce legitimate cognitive claims. In any case, Pepper's theory can be used to lay out the metatheoretical assumptions behind specific views within psychology. Once such assumptions are made explicit, then mechanism becomes one among several metatheoretical contenders. That mechanism should be <u>the</u> world hypothesis for all psychology, though, becomes what is at issue in this dissertation.

Structural corroboration, it should be noted very briefly, does not replace or reject the evidence of multiplicative corroboration. Pepper's recognition of the value of both data and danda is perhaps

best illustrated by the following passage:

> Some world theories rate data high, others rather low. There have been dogmatic metaphysicians who have been as scornful of pointer readings and mathematical logic as dogmatic positivists have been of metaphysics. Data are as susceptible to the jibe of being mere records of the opinions of a vulgar majority, as danda of being mere fancies of a harebrained mystic. Cognition needs both types of refinement as much as a bird needs two wings. (p. 79)

The remainder of Pepper's book focuses on the products of structural corroboration--"world hypotheses"; and in his description of the principle types of metaphysical systems, he establishes criteria for assessing the reliability and adequacy of different hypotheses and their origins.

Pepper claims that the general criteria for the adequacy of structural hypotheses are precision and scope--a precise hypothesis covers exactly the relevant facts, and a hypothesis of sufficient scope covers all relevant facts. Precision and scope align themselves in the process of corroborating evidence: in the first instance one looks "more closely into the dandum" and in the second one looks "more widely about a dandum" (p. 325). These two types of criteria merge in world hypotheses. What Pepper terms a restricted hypothesis, one which covers only a limited number of facts, has only limited cognitive reliability since conflicting facts from outside its area may be brought to bear against it. As Pepper states,

> [Restricted hypotheses] demand, for complete justification, the corroboration afforded by unrestricted structural hypotheses. The problem of the determination of degrees of cognitive reliability in terms of structural corroboration thus comes to a head . . . in world hypotheses--hypotheses of unrestricted scope. (p. 326)

Because of its limited reliability, a restricted hypothesis "pushes toward" comprehensiveness and accuracy.

The task of evaluating the multitude of world hypotheses, each of which has claimed truth, leads Pepper to his theory of the origin of world hypotheses. One can analyze each world hypothesis proffered historically and evaluate its degree of structural corroboration. In fact Pepper rejects animism and mysticism on the grounds that both are inadequate in terms of their precision or scope. Instead of attempting such a tedious process of historical review of systems, however, Pepper presents a root-metaphor theory of the origin of world hypotheses in order to simplify his task and reduce the number of contenders that deserve critical attention.

Pepper's Root Metaphor Theory

Pepper's root metaphor theory is based on the method of analogy. He summarizes it as follows:

> A man desiring to understand the world looks about for a clue to its comprehension. He pitches upon some area of common-sense fact and tries if he cannot understand other areas in terms of this one. This original area becomes then his basic analogy or root metaphor. He describes as best he can the characteristics of this area, or, if you will, discriminates its structure. A list of its structural characteristics becomes his basic concepts of explanation and description. We call them a set of categories. In terms of these categories he proceeds to study all other areas of fact whether uncriticized or previously criticized. . . . As a result of the impact of these other facts upon his categories, he may qualify and readjust the categories, so that a set of categories commonly changes and develops. (1961, p. 91)

For Pepper, the world affords a richness of good empirical knowledge which originates in common sense. Common sense, however, is highly dubitable, and so the work of cognition, carried out through corroboration, secures knowledge on firmer grounds. The world hypotheses that structural corroboration produces originate, according to Pepper, in "a concrete evidential source" (p. 328).

> What I call the root metaphor theory is the theory that a world hypothesis to cover all facts is framed in the first instance on the basis of a rather small set of facts and then expanded in reference so as to cover all the facts. (Pepper, 1935, p. 369)

A world hypothesis, then, is a root metaphor which has become so expanded that it has world-wide scope and a high degree of precision in the application of its categories. The root metaphor never becomes a "fixed" referent; it undergoes change and refinement in the course of interpretation and analysis over time.

Pepper advances four world hypotheses as equally viable, but before turning to them it is important to note briefly the implications of the root metaphor theory for the four world hypotheses. First, if each world hypothesis originates in and "is determined by its root metaphor" (p. 96), then "each world hypothesis is autonomous" (p. 98). Historically, the categories of the four world hypotheses have been highly refined. These categories dictate what come to be taken as facts. As Pepper states,

> It follows that what are pure facts for one theory are highly interpreted evidence for another. This does not imply that there are no pure facts in the universe, but only that we do not know what they are. (p. 100)

Two conclusions follow from the autonomy of each world hypothesis:

1.) one cannot appeal outside the world hypothesis for cognitive justification and 2.) one world hypothesis cannot judge the adequacy of others since that would, in essence, involve a conflict between categories.

Pepper claims that since all four world hypotheses have world-wide scope and a high degree of precision, there are no grounds for rejection of any of the four; any assertion that one is more adequate than another is simply a dogmatic one. On the other hand, Pepper argues attempting to combine world hypotheses results in confusion. "Through our study of their factual conflicts, their diverse categories, the consequent differences of factual corroboration, and--in a word--their distinct root metaphor--we become aware of their mutual exclusiveness" (p. 105). The value of maintaining mutual exclusiveness lies, according to Pepper, in "rational clarity"; he recognizes, however, that since all four have high cognitive appeal, in practice, a "reasonable eclecticism" should prevail.

> In practice, therefore, we shall want to be not rational but reasonable, and to seek, on the matter in question, the judgment supplied from each of these relatively adequate theories. . . . we should be judging in the most reasonable way possible--not dogmatically following only one line of evidence, not perversely ignoring evidence, but sensibly acting on all the evidence available. (p. 330-331)

In theory, the four world hypotheses are mutually exclusive; it is to them that I now turn.

Formism

Pepper describes formism as an analytic, dispersive world hypothesis; analytic because "the basic facts or danda . . . are mainly

in the nature of elements or factors, so that synthesis becomes a derivative and not a basic fact" and dispersive because "on the whole, facts are taken one by one from whatever source they come and are interpreted as they come and are so left" (p. 142). Similarity is the root metaphor of formism; entities in the world can be organized on the basis of their similarities and differences. The process of classification best exemplifies the organizational principles found in formism. Pepper identifies two common sense sources which distinguish two variations of formism theoretically. The first, immanent formism, has as its origin what Pepper terms strict similarity; out of comparison and contrast come classes, and "[a] class is . . . a thoroughly real thing, but what is real is the functioning of the categories" (p. 162). Immanent formism, then, assumes the category of forms and their appearance in nature.

Transcendent formism, the second variation, assumes the category of forms but departs from immanent formism by establishing the existence of a norm. The norm can be exemplified through the root metaphor of the artisan (i.e., the shoemaker or carpenter) who makes different objects according to an ideal plan or through the root metaphor of natural objects which grow according to some plan (i.e., oak trees or sheep). In immanent formism, then, a "thing" in a class is fully embodied in its exemplars; in transcendent formism, a norm departs from its existential references; "a norm is a center of a rather vague extensity, claiming as exemplifications objects which closely approximate it and making lesser and lesser claims toward the periphery and scarcely claiming at all so-called sports or freaks" (p. 164). A formist defines

truth as correspondence or, more specifically, "as the degree of similarity which a description has to its object of reference" (p. 181).

In his article on contextualism, Sarbin (1977) claims that psychological theories derived from the root metaphor of formism are "turn-of-the century structuralists and contemporary personality traits theorists. The first posited structures or dimensions of the mind; the second, structures or dimensions of the personality" (p. 5). In a current book on personality, for example, Scott, Osgood, and Peterson (1979) state in their introductory remarks:

> If people can be characterized in terms of cognitive contents and processes that are general, distinctive, and enduring, these characteristics can provide bases for personality traits; we shall call them personality traits of cognition or, for short, cognitive traits. (p. 30)

Such a task--"grouping together a constellation of cognitive phenomena which is general, distinctive, and enduring" (p. 30)--illustrates the formist's efforts. Another contemporary theory which exemplifies formist assumptions in the area of cognitive psychology is Weimer's (1977). He identifies craftsmanship as the most appropriate root metaphor for his motor theory of the mind (p. 297). Pepper notes that "the work of the artisan" is one of the sources for the root metaphor of transcendent formism (p. 162). Weimer states:

> The motor involvement . . . in the creation of meaning is an instance of skill, and the most fruitful metaphor for the understanding of skill is still Plato's conception of the soul as a craftsman, or artificer, who constructs the entire realm of human participation in the universe. The motor theory asserts that the manifestation of meaning is a product of the skill of the [central nervous system], and thus that the

> way to study meaning is to study the ways in which the [central nervous system] is skilled. (p. 296-297)

These brief examples illustrate contemporary applications of formism in psychology.

Organicism

Organicism, the second world hypothesis I shall discuss, differs significantly from formism. While formism was described as an analytic, dispersive theory, organicism is a synthetic, integrative theory; synthetic in that basic facts and danda are "complexes or contexts, so that analysis becomes derivative" and integrative in that the world can be taken as a system, a cosmos, in which "facts occur in a determinant order, and where, if enough were known, they could be predicted, or at least described" (p. 143). Pepper identifies the root metaphor of organicism with the two terms "organism" and "integration," although he warns that these are somewhat limited.

> Organicism, traditionally known as objective idealism, is the world hypothesis that stresses the internal relatedness or coherence of things. It is impressed with the manner in which observations at first apparently unconnected turn out to be closely related, and with the fact that as knowledge progresses it becomes more systematized. (Pepper, 1956, p. 74)

Unlike formism, which is concerned with the particularity and quality of objects of perception, organicism is concerned with process, organically conceived, that leads to integration and to the structure that such integration yields. The organicist believes that events in the world appear as fragments--containing contradictions or gaps--which

belong to an organic whole. Once this whole is discovered, the coherence of the fragments, in retrospect, become explicit; and when the fragments converge into the whole, it transcends the fragments which seem, in their isolation, contradictory and incoherent. Facts, then, do not exist outside the whole; they both work toward and lead up to integration. Integration occurs progressively, sometimes in stages or series, but always within a completely determinant system, the limit of which is termed the absolute. As Pepper states,

> A datum is a fragment with a nexus [i.e., an internal drive toward organization] which leads to a contradiction that is resolved by an integration. . . . Evidence progressively criticizes itself and exhibits its own degree of reliability and points of itself to the ultimate structural organization of the world. (p. 303)

For the organicist, truth is a matter of coherence; "it is primarily a matter of the amount of fact attained" (p. 311).

Organicism has been given more attention in recent psychological literature than formism has. In his article Sarbin (1977) locates the organicist world theory in "Maslow (self-actualization), Rogers (personal growth), K. Goldstein (the organism), and developmental psychologists who depend on the notion of stages of maturation" (p. 7). In their discussion of organicism, Reese and Overton (1970) state that the organism model (basically derived from the same categories as those outlined by Pepper) "is manifested historically in the 'act' psychology of Brentano and the Wurzburg school. Currently it is represented in such theories as von Bertalanffy's general systems theory (1967; 1968), Werner's and Piaget's theories of development, and the ego psychologists such as Erikson (1950)" (p. 135). Organicism has not surfaced in any explicit

form in recent experimental studies of cognitive processes. Cognitive psychologists have been most concerned with isolating and describing cognitive processes and only very recently with the interdependence of these processes. Organicists view all knowledge as ultimately structured and integrated; how cognitive processes are involved in this integration has mainly been addressed by developmental psychologists.

Mechanism

In the first chapter I described the assumptions and views of the neobehaviorist paradigm in American scientific psychology as falling under a mechanistic world hypothesis. Of the four world hypotheses, mechanism has been analyzed most extensively in psychological literature (Jenkins, 1974b; Reese & Overton, 1970). My purpose here is to recount Pepper's description of mechanism, the root metaphor of which is the machine, by relying on the historical analysis of empiricism and associationism provided in the first chapter.

In Pepper's discussion of mechanism, he differentiates between discrete mechanism, exemplified by the atomic materialism of Lucretius, and consolidated mechanism, which represents a shift in the material root of the metaphor from a lever to an electromagnetic field. This shift, he claims, is really embodied in the two sets of categories mechanism needs to maintain in order to achieve adequate scope. He explains the root metaphor of mechanism through an analysis of the lever, a machine which typifies discrete mechanism. After setting up the three categories for this mechanism; namely, field of location, primary qualities, and laws holding for configurations of primary qualities in

the field (p. 193), he then describes how the internal inconsistencies of discrete mechanism gave way, under impetus from relativity theory, to consolidated mechanism. "Electrons, positrons, neutrons, and the like must not . . . be conceived of in terms of particles like Lucretian atoms, but as structural modifications of the spatiotemporal field, the paths of which can be mapped out and expressed in that symbolic shorthand which we call descriptive laws" (p. 214). One then shifts to a view of a cosmic machine. The basic assumption of mechanism, whether discrete or consolidated, however, can be expressed in the assertion, "Only particulars exist" (p. 198).

In the mechanistic world theory, a particular inhabits a time and place. These elementary substances--atoms, for example--combine to form aggregates or clusters but do not, in the process, lose their individual autonomy. Any system of particulars can be reduced back to its most basic constituents.

> The universe is thus conceived as a huge aggregation or system of essentially separate individuals. These individuals have specific potentialities of association. But the form of an association of individuals never actually takes over the autonomy of the individuals that make it up. (1956, p. 37)

Any aggregation of individual atoms happens by chance, by accident. These assumptions, developed more historically in my first chapter through explanations of associationism and empiricism, form the base of the mechanistic world view. The machine metaphor's aptness becomes clear: the parts of a machine have specified locations which can be precisely defined; each part can be expressed quantitatively (e.g., weight in kilograms in the case of the lever); and finally, the parts

function according to laws which describe the machine's functioning. Lacking in the description of the machine, it is important to note, are sensory qualities; their absence becomes the impetus for the famous mind-body debate (which I note here only in passing).

Pepper (1942/1961) traces the influence of both discrete and consolidated mechanism in psychology. Discrete mechanism characterizes the classic behaviorist position described in the first chapter. Higher complex mental functions can be reduced to a small number of elements: "sensations of color, sound, taste, smell, various sorts of tactile sensations, feelings such as pleasantness and unpleasantness, and possibly a few other elements" (p. 218). These are analogous to chemical elements, and more complex mental functioning results from laws of association which operate on the simple elements. In a further step, the discrete mechanist can claim that laws of association are really internal representations of physiological laws, an assertion which then links mental functioning with the outside physical world and thus with the cosmic machine. Although Pepper doesn't stress this in his analysis of mechanism, others have noted the view of man derived from mechanism which

> has variously been termed the reactive, passive, robot, or empty organism model of man. In its ideal form this model characterizes the organism, like other parts of the universe machine, as inherently at rest. Activity is viewed as a resultant of external or peripheral forces. (Reese & Overton, 1970, p. 131)

According to Pepper, the problems in identifying simple mental elements led the Gestalt psychologists, particularly Kohler, to posit a consolidated mechanism in psychology.

> The conception of the Gestalt itself in mechanistic terms is rather vague except (illuminating enough) as it is correlated with somewhat imaginary electromagnetic fields, which are considered as the physiological correlates of these mental states. (pp. 219-220)

According to several Gestaltists, such as Kohler, configurations or Gestalts best represented mental states rather than discrete, simple mental elements. Experimental results of Gestalt psychologists have greatly influenced cognitive psychology; and, interestingly, they are often interpreted as representing evidence for world views other than mechanism. Therefore, it is crucial to note Pepper's arguments: if Gestalts are viewed 1) as basic building blocks in a determined system and/or 2) as physiological correlates of mental states, then they replace the more basic constituents of the discrete mechanist.

A mechanistic theory of truth must insure the insulation of bodies separate from one another. Given this category, "all data, whether of common sense or science, are private" (p. 224). The difficulty in developing this position lies in specifying what relation exists between the object ("the known") and the idea ("the knower"). Pepper argues that a causal theory of truth is most proper to mechanism because it avoids such a difficulty. "A system of causal connections . . . holds between an environmental stimulus and the response of an organism" (p. 128). Theoretically, these connections can ultimately be explained in physiological terms and thereby incorporated into the spatiotemporal field. "Truth thus becomes a name for physiological attitudes which are in adjustment with the environment of the organism" (p. 228).

As discussed in the first chapter, nineteenth century physical science presented a seemingly perfect model of mechanism, and one might argue that the machine metaphor gave broad impetus to the concept of causality as the theory of truth in many different fields, psychology included.

Within the neobehaviorist paradigm, the following assumptions are examples of mechanism: the environment can be reduced to particular stimuli which can be isolated in a laboratory; only observable behavior can be taken as legitimate psychological subject matter; the results of objective experiments, which establish efficient causation, constitute evidence and knowledge for psychology (i.e., laws of behavior). Mechanism has also influenced research in cognitive psychology, and new metatheoretical alternatives have been developed in contrast to it. Thus, more extensive examples of mechanism in psychology will be provided in subsequent chapters.

Contextualism

For the contextualist, experience consists of total events which are rich in features. Each event has a quality and texture. Its quality is "its intuited wholeness or total character" (Pepper, p. 238), and it results from the interaction of the experiencer with the world. Qualities are characterized by their spread, change, and fusion. The spread of the quality of a given event, often called its specious present, reaches forward and backward in time. Second, continuous change characterizes the event; textures and their tensions change in time and so, correspondingly, do qualities. Nothing in the event is

permanent or immutable. Finally, fusion describes the possible relations between the textures and their quality.

> Where fusion occurs, the qualities of the details are completely merged in the quality of the whole. Where fusion is relaxed, the details take on qualities of their own, which may in turn be fusions of details lying within these latter qualities. (p. 243)

Fusion is an agent of simplification, an organizing factor, within the experience of the event. The quality of the event is thus characterized by its range of spread, its rate of change, and the degree of fusion.

Texture, the other basic category of contextualism, "is the details and relations which make up that character or quality" (p. 238). Texture, like quality, also has three subcategories: strands, contexts, and references. The first two are closely interrelated with texture: "A texture is made up of strands and lies in a context . . . the connections of the strands . . . determine the context, and in large proportion, the context determines the qualities of the strands" (p. 246). Strands never have meaning as separate units; their meaning is always relative to the textures, contexts, and qualities of the given event. For example, Pepper (pp. 246-247) analyzes, from a contextualist view, the writing of the sentence, A period will be placed at the end of this sentence. The quality or meaning of the sentence depends on textures such as "will be placed" or "at the end," and these textures consist of strands or the individual words "at" or "end." But these strands, which fuse into textures and thus lose any individual or objective identity, participate in the surrounding context; namely, the other phrases or words of the sentence. The strands and textures, as contextually

connected, lead to the word "end" so that they fuse together into the quality of the event of the total sentence. Changing any of the strands changes the texture and thus the quality of the total meaning. Further, the sentence itself is part of a larger context, merging out of previously written sentences and pointing toward the to-be-written sentence which will in turn change the quality of the sentence. Pepper's employment of the terms textures and strands is clearly meant to contrast the interwoven nature of relationships in contextualism to the reductionist or analytic relations of mechanism. The contextualist always points to the on-going flux of contextual interrelationships in the given event.

The third subcategory, referent, is a closer consideration of strand. Pepper identifies four kinds of references. The first and most basic reference is linear. "A linear reference has a point of initiation, a transitive direction, and achieves an ending or satisfaction" (p. 252). The writing of a sentence or playing the individual notes in a musical phrase are illustrative since each word in the sentence until the last or each note of the phrase until the last point forward to satisfaction and backward toward initiation. The second kind of reference, convergent reference, accounts for the experience of similarity. It "is a complex linear reference in which there are either several initiations converging upon one satisfaction or several satisfactions derived from one initiation" (pp. 253-254). Similarities do not exist a priori in physical textures but emerge when strands converge; they can be predicted but only as potential similarities.

The third reference, blocking, is not really a reference "but the breaking of a reference," "a fact of disorder" (p. 255). A reference categorically implies a satisfaction, yet not all strands merge together smoothly. Thus a strand can be blocked or held up, usually by a novelty, and this prevents satisfaction and integration. The blocked strand then becomes the focus of analysis. At this point, Pepper introduces instrumental references, the fourth kind of reference. He first defines instrumental action as follows:

> An instrumental action is one undertaken as a means to a desired end and as a result of some obstacle that intervenes between the beginning of the action and its end or satisfaction. Instrumental action accordingly implies a linear reference that has been blocked, and a secondary action which removes or circumvents the blocking. The instrument proper is the secondary action that neutralizes the blocking. And the references involved in this secondary action are the instrumental references. (pp. 260-261)

The instrumental action is a texture on its own terms, but is so interrelated with the initial and terminal points in the linear reference that much of its structure is constituted by it. "An instrumental activity enters right into the texture of a terminal activity, and the structure of any complicated terminal activity is largely instrumental" (p. 263). Thus the obstacles faced in learning to ride a bicycle, for example, are vividly felt, but they become integrated with the total texture as the act of riding becomes one total (terminal) texture with a quality all its own. The blocked and instrumental references provide a theoretical framework for problem solving, an area I shall discuss in my conclusion.

In summary, contextualism holds that the felt quality of the lived event is primary in experiences; any analysis of experience always starts from that given quality and works "down." The quality is determined by the context and strands of the event and does not exist apart from them. In experience, both the subject and the object share a common texture. The subject brings to experience the ongoing capacity for interaction with the environment. What the subject brings to experiences is a conceptual structure. Pepper discusses what the subject knows in absence of perceptual experience as follows:

> What [a given] quality outside of perception is we naturally cannot know, since we intuit a physical continuant only in perception, but we infer that in other contexts where the strands of the texture of an organism do not mingle with those of a physical continuant in perception the physical continuant has other qualities. But though we cannot intuit the qualities of a physical continuant independent of perception, we can make inferences about its texture or relational structure outside of perception. (p. 266)

What textures we hold, outside of perceptual confirmation, are "schemes which satisfy predictions" (p. 267).

Contextualism is commonly called pragmatism and would be the world hypothesis of the functionalist school in psychology, to which Dewey's article (1896) on the nature of the stimulus-response sequence gave birth. Neel (1977) notes that the works of the functionalists, namely, Dewey, Angell, and Carr, were directed mainly at a refutation of structuralism. Because the functionalists addressed only the premises in structuralism with which they took issue and because they originally intended to modify structuralism rather than replace it,

the functionalists did not develop a comprehensive, well-articulated psychological theory (p. 73). The lack of such theories in the functionalist school of psychology is, perhaps, the reason contemporary psychologists have turned to Pepper's description of contextualism, the world hypothesis which would subsume the functionalist school, rather than to a particular functionalist. Although the works of the functionalists are germane to and compatible with contextualism, Pepper describes contextualism as a "world theory," and as such, it synthesizes the works of the pragmatists and lays a broader foundation for application to cognitive psychology. Thus, it would be a mistake to dismiss contextualism out of hand by simply associating it with the functionalist school in psychology.

Unlike formism, mechanism, and organicism, contextualism is a fairly recent world hypothesis. In this dissertation Pepper's description of contextualism will be elaborated through the philosophies of Dewey and, to a lesser degree, Merleau-Ponty. Although these philosophers differ in the details of the development of their philosophic views, they are philosophically the closest in their double rejection of idealism (organicism) and empiricism (mechanism) (cf. Dreyfus, 1979, Chapters 7-9 and Rorty, 1979, Introduction, for similar philosophic distinctions and Kestenbaum, 1977, for a comparison of Dewey and Merleau-Ponty based on their rejection of any kinds of dualism). Those psychologists who have recently written on contextualism (Jenkins, 1974b; Sarbin, 1977; Tyler, 1981) have identified it primarily as an alternative to mechanism. Jenkins focuses his contextual approach on

an analysis of experiments in memory. Sarbin (1977), on whom Tyler's discussion rests, points to contextual elements within Kurt Lewin's field theory and George Kelly's writings, which are the main subject of Sarbin's paper. In his general account of contextualism Sarbin states, "Piaget's theories of psychological functioning illustrate the use of a contextualist paradigm" (p. 6). Sarbin's claim is generally accurate, but an important distinction needs to be made in regard to Piaget's works.

Piaget's developmental theory, taken as a whole, corresponds more accurately to an organicist rather than a contextualist world hypothesis. Pepper notes that contextualism and organicism are very closely allied, "the [former] with a dispersive, the [latter] with an integrative plan" (p. 147). The contextualist would certainly agree to Piaget's explanation of assimilation and accommodation as characteristic of the psychological event, but the contextualist categories give way to organicist ones at the point in Piaget's theory that these processes lead to and produce a series of structures and successive stages of structures.

It is clear in recent discussions on contextualism that no one psychological theory totally represents contextualism; yet, according to Tyler, recent psychology has been significantly influenced by it. Contextualism has gained additional support, although indirectly, from the increasing concern with ecologically oriented inquiry. Although he does not mention contextualism, as such, Gibb's (1979) description of transactivism and ecologically oriented inquiry fits closely with

contextualist assumptions. Similarly, the new line of theorizing called "ecological realism" (e.g., Gibson, 1979) indicates a move toward contextualism.

Conclusion

Pepper claims that the four world hypotheses he describes stand as equally adequate world hypotheses. "We need," he states, "all world hypotheses, so far as they are adequate, for mutual comparison and correction of interpretive bias" (p. 101). Nor is Pepper dogmatic about the number of conceivable world hypotheses. Historically, other viable root metaphors different from those he describes in World Hypotheses are possible (e.g., Pepper, 1966). In the first chapter, I discussed criticisms of the mechanistic assumptions in the neobehaviorist paradigm. Although criticisms of these assumptions will be cited throughout this dissertation, they do not rest on the fact that the paradigm's assumptions are mechanistic, per se. Rather the argument advanced throughout is that serious philosophical (primarily epistemological) questions are arising in psychology, not because psychologists have assumed a mechanistic world view, but because they have often dogmatically asserted it as the only legitimate and adequate one.

The value of applying Pepper's approach to psychology and psychological theorizing lies in his unbiased, undogmatic treatment of different metaphysical systems. Tyler (1981) notes such an advantage for psychological theory in her review:

> [Pepper's world hypotheses] are, after all, hypotheses about the world and its inhabitants, and if a person avoids dogmatism, there is no reason not to accept different hypotheses at

> different times. This attitudes makes Pepper's ideas especially relevant when we think about how to deal with psychology's expanded content. (p. 18)

Pepper's approach, then, provides alternative world hypotheses, and thus alternative views of man and the world. Historically, as I shall illustrate, cognitive psychology has been dominated by a mechanist world view, and this has often prevented theoretical growth. An alternative world view such as contextualism may serve as well psychologists' efforts to understand cognitive functioning. Through an analysis of some of the theoretical issues in the fields of perception and memory, I shall be better able to substantiate such a claim.

Chapter III

Perception

> And God-appointed Berkeley that
> proved all things a dream,
> That this pragmatical, prepos-
> terous pig of a world, its
> farrow that so solid seem,
> Must vanish on the instant if
> the mind but change its theme.
>
> W.B. Yeats, "Blood and the Moon"

In the preceding chapters, I noted that contextualism, as described by Pepper (1942/1961), has been recognized as influential in current psychological theorizing; moreover, it has been identified as a fruitful world view for cognitive psychology. My general purpose in this chapter is to apply Pepper's theory of metaphysical systems to recent psychological investigations in the field of perception. I shall narrow my discussion to visual perception as this aspect of perception has received considerable attention in psychological literature. My approach is both exploratory and analytical. I shall examine the treatment of perception historically, review current challenges to the traditional assumptions which guided both theory and research, and assess various theories in terms of Pepper's framework. The disadvantage of

employing a comprehensive framework such as Pepper's lies in the neglect of the more subtle, discriminating details which have separated various theories historically. Nonetheless, the advantages of such comprehensiveness are compelling. Most important, specification of key concepts and assumptions which implicitly guide theoretical and research efforts greatly enhances the efforts to understand alternative, diverse models and theories; thus Pepper's framework provides a systematic perspective on many of the issues being raised in the field of perception and helps to clarify many of the issues at stake.

More specifically, I shall illustrate how empiricism and associationism--those philosophical doctrines implicated in much of the critical re-examination of psychology generally--have strongly influenced the psychological study of perception (see Swartz, 1956, for extensive analyses of the philosophical issues involved in perception and Royce, 1974, for an analysis of the influence of philosophy on the psychological investigation of perception). I shall claim that, based on Pepper's description, mechanism has long dominated and legitimated the psychological study of perception. Such a designation gains support from the newly emerging study of event perception. An analysis of an experiment (Johansson, 1973) will serve to illustrate the shift away from mechanist assumptions. Additionally, I shall discuss the work of those psychologists currently advancing an ecological theory of perception (see Gibson, 1979; Mace, 1977; Turvey, 1977a; Turvey, Reed, Shaw, & Mace, 1981, for the central claims of this movement). As Tyler (1981) says in her review of this new line of research in the field of

perception: "It is interesting to note that what looks like a contextual sort of theory is in the process of superceding the prevailing mechanistic theory in a field where it has long been dominant" (p. 17). Other than Tyler's suggestion, however, the ecological theory of perception has not been directly identified as contextualistic, and one of my purposes will be to assess this claim. Through an analysis of the recent reactions to Gibson's theory (Fodor & Pylyshyn, 1981; Neisser, 1976) and the development of Gibson's theory since his death (e.g., Turvey, Reed, Shaw, & Mace, 1981), I shall argue that this line of theorizing has been moving ever more closely toward a contextualist world view.

The Traditional View of Visual Perception

Several psychologists in the field of visual perception (e.g., Gibson, 1979; Johansson, von Hofsten & Jansson, 1980; Neisser, 1976; Turvey, 1977a) have identified a traditional approach to perception which, they argue, dominated theoretical and experimental work on visual perception until about 1970. All of these writers describe the assumptions of the traditional approach by contrasting it to radical, new claims they make about perception. In fact, their works constitute a thoroughgoing challenge to the neobehaviorist paradigm described in the first chapter. Not only do these recent theories make clear the inadequacy of the traditional stimulus-response model of behavior, but they also call into question the mechanistic assumptions that have crept, mostly unarticulated, into the study of higher mental processes. Gibson (1979), for example, indicates the pervasiveness of his challenge

to traditional theories of perception when he lists approximately thirteen traditional assumptions about perception and claims they "will not do" and "should be abandoned" (p. 238). From the viewpoint of Pepper's framework, these psychologists have abandoned (or are attempting to abandon) a mechanistic world view.

The origin of the traditional approach to visual perception that Gibson (1979) and others have challenged can be identified with the British Empiricists, and particularly with Berkeley's New Theory of Vision, published in 1709. In many respects the empiricist account of perception, based on association, provided the epistemological base for the neobehaviorist paradigm. Although Watson omitted central processes as a factor in his account of behavior, later behavioral psychologists became concerned with perception through their interest in habits and associations. Hull's (1943) work, in particular, "resulted in a proliferation of hypothetical mechanisms to mediate between 'sensory input' and overt response" (Owen, 1978, p. 519). My purpose in this section is to connect my earlier discussion of empiricism and associationism to the traditional view of perception in psychology. I shall briefly describe Berkeley's philosophical theory of perception and von Helmholtz's psychological one, both of which are associationist. Forerunners to those currently questioning associationist-empiricist accounts of perception were Gestalt psychologists who challenged the associationist account. I shall discuss their assumptions briefly but argue that, unlike the current challenge, their views did not ultimately initiate a metatheoretical shift.

The psychological treatment of perception can be traced back to the philosophies of Locke, Berkeley, and Hume who attempted to establish what constitutes the evidence of experience. These empiricists held that all knowledge is gained through experience and what constituted experience could be derived from basic elements or units (usually of sensation) and then organized or structured through association. For example, Locke (1690/1959) states:

> When I say the senses convey into the mind, I mean, they from external objects convey into the mind what produces there those perceptions. This great source of most of the ideas we have, depending wholly upon our senses, and derived by them to the understanding, I call SENSATION. (p. 123)

Although Locke, Berkeley, and Hume provide differing accounts of perception, central in their accounts is the role of sensation as the basis for knowledge. Since he developed a specific theory of vision to explain perception of depth, many psychologists (e.g., Earhard, 1974; Hochberg, 1978; Koffka, 1930) have claimed that Berkeley influenced psychological theories of perception most directly.

Generally, the empiricists accounted for ideas by claiming they are copies of sensations available from the external world (and held in memory). Perception begins, then, with the registering of sensations (such as color patches) on the retina of the eye. These units of sensation, however, can not account for spatial information such as size, depth, distance, and position. How does the perceiver acquire this information? The British empiricists answered, "through association." Berkeley's theory of vision gives an associationist account of spatial

perception. The retinal image of an object, according to Berkeley, is only two dimensional, so through what means does one come to experience depth?

> For Berkeley, these means are primarily association with touch, and secondarily, the sensations of convergence and accommodation of the eyes. Therefore perception is accomplished by adding to and correcting the stimulation so that, in this case, a three-dimensional world can be perceived from a two-dimensional stimulus. (Mace, 1974, p. 139)

Thus depth, not a given in perception, must be learned. Hochberg (1978) provides a more complete summary of Berkeley's empiricist theory:

> Our experiences of visual space would . . . consist of three kinds of elements: (1) the "purely" visual sensations such as color patches . . . which are nonspatial; (2) the kinesthetic sensations from the muscles of accommodation and convergence; and (3) those memories of the previous kinesthetic sensations of reaching or walking that had become associated with the specific accommodation and convergence sensations, and with visual depth cues, to lend <u>spatial</u> meaning to both of them. (p. 62)

The modification and correction of incoming sensory stimulation, meaningless in and of itself, result solely from past experience; in this type of empiricism the mind is viewed as a blank tablet.

In Berkeley's theory, then, the appropriate objects of perception are sense data; but given the infinite number of data that must combine to form sensory "experience," Berkeley had to hold, to keep the explanation manageable, that such combinations resulted from accretion or, to state it another way, "that our sensory experience is the sum of all our sensations" (Hochberg, 1978). As a result of his emphasis on units of sensation, Berkeley (1710/1929) maintains that the organism registers sensations passively and that the sensations are inert.

> All our ideas, sensations, notions, or the things which we perceive, by whatsoever names they may be distinguished, are visibly inactive: there is nothing of power or agency included in them . . . . there is nothing in them but what is perceived. (p. 137)

In this view, as Rock (1975) notes, "Visual sensations themselves do not provide much knowledge about the world. . . . They are signs or cues to which various associations or images can become attached, supplementing the sensations" (p. 14). Further, Berkeley's theory places singular importance on the retinal image as the determinant for what is perceived. Mace (1974) notes that for Berkeley, "the retina is the picture plane onto which the world's light rays are projected" (p. 139). In other words, point sensations, frozen in time, form a retinal image, which is only an equivocal sign of the external world. These assumptions in Berkeley's theory profoundly affected subsequent psychological accounts of perception, and most notably von Helmholtz's.

As Earhard (1974, p. 102) notes, von Helmholtz (1884) actively sought to construct an empiricist theory of visual perception. Nativists like Hering had claimed that associationist views could not adequately explain spatial organization and argued that innate processes should be invoked to explain perception. In rejecting innate processes to explain three-dimensional space perception, von Helmholtz maintains the atomistic unit of analysis that Berkeley did; elements of sensation could be organized through learning (i.e., association). Like Berkeley, von Helmholtz stresses the role of sensations in visual perception: "[We] always transfer the origin of any light sensation, which arises in [a particular] point of the retina, to the corresponding spot of the

external field of vision" (in Pastore, 1978, p. 360). In maintaining elements of sensation as the basis of perception, von Helmholtz had to account for the organization of sensations into perceptions (i.e., the world is not seen as color patches). He claims, much like Berkeley, that our memories of movement and information from touch (all associated through experience) provide the basis for perception of visual stimuli (Hochberg, 1978, p. 60). Von Helmholtz further separates visual sensations (which stimulated the retina) from the "final" perception by appealing to "unconscious inference."

Given von Helmholtz's empiricist assumptions, some kind of operation had to explain the transformation of the retinal image, which contained inadequate spatial information, to the final perception which contained complete information. Von Helmholtz claims that the store of information learned from past experience operated to adjust the inadequacy through a process like an inference. Gregory (1974, p. 275) states the form of von Helmholtz's inference as follows:

> This retinal shape has (nearly) always occurred when there is an external table.
> This retinal shape is present.
> Therefore there is (probably) an external table.

Of course, in normal perceptual experience the perceiver does not consciously infer; and so, von Helmholtz argues, perceptions appear to be immediately given because associations are learned so well. The inference is unconscious. As Pastore (1978) summarizes von Helmholtz's basic premise,

> We never perceive objects of the external world directly. On the contrary, we only perceive the effects of these objects on our nervous apparatuses, and it has always been like that from the first moment of our life. (p. 357)

Thus von Helmholtz introduced into psychology a kind of mediation--one based on learned associations; unconscious inferences intervened between sensations and perceptions (cf. Turvey, 1977a).

Before relating Berkeley and von Helmholtz's theories of perception to Pepper's account of mechanism, I shall briefly summarize the Gestalt psychologists' reaction against the associationist account of perception. Such a summary will illustrate how resilient the traditional mechanist view of perception has been historically and sharpen my argument that the current challenge by Gibson and others occurs at a metatheoretical level. The interpretation that the Gestalt psychologists' challenge did not go far enough also has implications for those psychologists who advocate that an alternative to mechanism is "a gestalt approach" (e.g., Wertheimer, 1978, p. 744).

The research of the Gestalt psychologists on perception called into question the atomistic view of the associationists; specifically their research attempted to demonstrate that the nervous system did not respond to individual elements which accreted to make up a stimulus pattern, but rather it responded to the configuration of the entire stimulus pattern. Koffka (1930), arguing against Berkeley, for example, states:

> Our space perception in all three dimensions is the result of organized brain activity and . . . . we can understand our space perception

> only in terms of organization, i.e., in terms of actual dynamic processes, and not in terms of mere geometrical stimulus-sensation correlations. (p. 185)

In stressing the form of the objects of perception, Gestalt psychologists pointed to the relationships between configurations in wholes rather than to the reductionistic analysis of wholes into their constituent parts. They asked such questions as: If little mosaic pieces form the configuration perceived, how is it we perceive shifts in patterns of continuity rather than shifts in pieces? As Kohler (1930) claims, "The hypothesis of independent little parts is unable to give an explanation" (p. 148). Thus the Gestalt psychologists attacked the atomistic reductionism in the empiricist tradition. The Gestaltist view still exists. In a recent study on form perception, for instance, Pomerantz, Sager, and Stoever (1977) reintroduce Gestaltist explanations to account for their findings; they develop their explanations in contrast to a still-current associationist view.

As several psychologists have argued, Gestalt experiments only identified serious deficiencies in the empiricist tradition and did not offer a viable theoretical alternative (Gibson, 1979, p. 140; Hochberg, 1974, p. 204; Wertheimer, 1974, p. 87). Shaw and Pittenger (1977) state:

> Thus, while there is good reason to agree with the Gestaltists' claim that the classical view of perceptual space as an inert, absolute space is woefully inadequate and must be rejected, we need not revert to their view of perceptual space as a field of mysterious forces in the cortex where isomorphic representations of physical objects act upon each other. (p. 107)

In Chapter Two, I noted Pepper's similar interpretation of the Gestalt psychologists; namely, his claim that their assumptions kept them within a mechanistic world view. While the experimental findings of these psychologists raised serious doubts about sensation-based theories such as von Helmholtz's, the Gestalt psychologists "never managed to go beyond them" (Gibson, 1977, p. 79).

Within Pepper's framework, the traditional, sensation-based theories of perception, grounded in empiricism and associationism, imply a mechanist world view. According to Turvey (1977a), von Helmholtz's assumptions about perceptual processes "have been filled in to a significant degree by contemporary investigators and theorists but have not been significantly altered" (p. 67). Specifically, the reduction of perceptual experience to particulars, the reconstruction of these particulars into percepts, and the passivity of the organism legitimized investigation in laboratory experiments which isolated static objects or their parts in an attempt to discover the laws governing perception. These mechanistic assumptions need further elaboration.

The traditional associationist view of perception emphasized particulars in perceptual experience; as Pepper stresses, for the mechanist, "only particulars exist" (p. 214). I have already shown how earlier theories of perception reduced these particulars to sensation. To illustrate how this assumption has been updated, I shall briefly summarize Hebb's (1949) account of perception and then Hayes-Roth's theory (1977) which relies on Hebb's account.

Later associationistic accounts such as Hebb's (1949) deemphasize the role of sensations but posit some basic analytic unit

(usually located in the central nervous system) to which perceptual experience can be reduced. Those units, viewed as fragmentary elements of perception, function as building blocks necessary to constitute the object of perception. Earhard (1974) succinctly summarizes Hebb's account:

> Basically, Hebb assumes that repeated visual tracing of the boundaries of figures permits the development of cortical representations called cell assemblies for perceptual elements such as lines and angles, and that these cell assemblies must combine sequentially into 'phase sequences' before even the simplest of visual forms can be identified. (p. 97)

Hebb's theory, then, accounts for perceptual learning through association (and activation) of basic analytic units.

Hayes-Roth's (1977) knowledge-assembly theory exemplifies one of the most recent refinements of a mechanistic view of cognition, a view which places emphasis on reducing experience to constituent particulars. Her explanation of the acquisition, representation, and processing of knowledge directly extends Hebb's assumptions about perceptual learning; she states, "Perception of a stimulus causes activity in the representative cell-assemblies" (p. 262). The basic analytic unit, termed a cogit, is activated directly and "assembled" with associations (p. 261). Her theory, however, provides an alternative to the linear, serial processing characteristics of Hebb's; she notes, "[The knowledge-assembly theory] assumes that the identities of functional units (cogits) change as learning progresses and that any structure imposed on the to-be-learned information influences the evolution of cogits" (p. 265). Thus, Hayes-Roth's assumption that the elements (cogits) have an active construal capacity in higher organizational pro-

cesses departs from the traditional associationist account of perception in which the elements have, to use Berkeley's phrase, "nothing of power or agency included in them." The theory, however, is mechanistic in its insistence on basic units from which experience (knowledge) is constructed. The process by which the cogits alter their character remains strictly associationistic.

A second mechanistic assumption in the traditional view of perception is the passivity of the organism. For Berkeley, as well as von Helmholtz, visual sense data are imprinted on the retina. Von Helmholtz's unconscious inference occurs after stimulation of the retina and after formation of the retinal image, and the kind of mediation (produced by the inference) operates passively; that is, the retinal image is supplemented from past experiences (images, stored in memory). The inference does not involve separate logical or rational processing (see Rock, 1977, for a similar account of von Helmholtz's influence and Pastore, 1978, for a philosophically different interpretation of it). The particularity of the perceptual experience and passivity of the organism in perception had important implications for laboratory research.

As Gibson (1979) notes, psychological investigations into perception traditionally assumed what was perceived were objects or parts of objects. Gibson (p. 206) cites a key passage from von Helmholtz:

> The intent of vision is to see as distinctly as possible various objects or parts of an object in succession. This is accomplished by so pointing the eyes that an image of the given object is projected on the fovea of each retina. The governing of the ocular movements is wholly subordinated to this end; both eyes are adjusted and accommodated together so as to permit this

> light absorptive pointing. Any . . .
> eye movement not having for its end the
> attaining of distinct imaging of an object
> cannot be performed.

If the goal of perception is an object, then experiments in the laboratory could isolate "objects" and control various aspects of them. Such attributes of the stimulus as size, form, hue, location, brightness, and so forth became independent variables (Nafe, 1930, p. 130). From simple objects and their attributes, more complex aspects of perception could eventually be explained in terms of laws. Based on experimental findings, laws that govern perceptual learning could be stated, if not in pure descriptive form, at least in terms of probability (cf. Pepper, 1942, pp. 215-216). And this is the third mechanistic assumption: through measuring the attributes of the object of perception (i.e., multiple corroboration), laws of "the machine" could be discovered. Gibson (1979) claims that the traditional view of perception saw the eye as a camera; this analogy helps clarify Pepper's description of how laws can explain and predict phenomena.

What became a priority in traditional investigations of perception was the object, and this priority had consequences for how perception could be studied. Johansson, von Hofsten, and Jansson (1980) note: "The traditional approach to visual perception to a very large extent has been focused on so-called static perception" (p. 28). Similarly, Gibson (1979) argues:

> The textbooks and handbooks assume that
> vision is simplest when the eye is held
> still, as a camera has to be, so that a
> picture is formed to be transmitted to the
> brain. Vision is studied by first requiring

> the subject to fixate a point and then exposing momentarily a stimulus or a pattern of stimuli around the fixation point. . . . The investigator assumes that each fixation of the eye is analogous to an exposure of the film in a camera, so that what the brain gets is something like a sequence of snapshots. (p. 1)

This "image-cue" model of visual perception, as Johansson, von Hofsten, and Jansson, (1980) describe it, originating with Berkeley and von Helmholtz, assumes a mechanistic world view. Again, the analogy of the eye to a camera perhaps best captures the mechanistic account of perception.

Although the Gestalt psychologists challenged the emphasis the associationists placed on particulars, a much more extensive reaction against the mechanistic view of perception has been emerging recently; and in Kuhn's (1962/1970) terms, it is a "revolutionary" one because it may prepare the way for a new paradigm. As would be expected, such a revolutionary shift in the field of perception has implications for the study of all aspects of cognition, especially memory. Gibson terms the new approach to perception "ecological optics"; Johansson, von Hofsten, and Jansson (1980) term the movement "event perception," a perhaps conveniently contextualist phrase I shall employ as well.

Event Perception

I shall introduce event perception by analyzing an experiment by Johansson (1973); such an analysis will serve to illustrate how psychologists studying event perception have altered mechanistic assumptions about perception. Specifically, I shall argue that Johansson's

experiment challenges the mechanistic assumptions which underlie the traditional image-cue model. Although I shall not discuss the major thrust of Johansson's extensive experimental work, I should note that his experiment (1973) on motion perception was designed to support the principle of perceptual vector analysis. That principle reads: "treat the relative motions in the pattern as a perceptual unit and the common component as a reference frame for the motion of this unit" (Johansson, von Hofsten, & Jansson, 1980, p. 33). Johansson sets forth a projective geometry to replace Euclidean geometry as the basis for perceptual analysis of motion; in his model, "the so-called projective properties, which remain invariant under perspective transformation of a figure, are abstracted" (Johansson, von Hofsten, & Jansson, 1980, p. 31). Thus, elements of the moving stimulus are perceived in relational sets which interact.

In Johansson's experiment (1973) on motion perception, small light bulbs were attached to the main joints (ankles, knees, shoulders, elbows, and wrists) of people who were then filmed walking around a darkened room. The film of those spot patterns was then presented to subjects unfamiliar with these patterns (school youngsters) for very short time intervals. "It came out that 40% of the subjects perceived the dot pattern as a walking person at the 0.1-sec interval and no one needed more than 0.2-sec for this perceptual organization of the moving dots" (Johansson, 1979, p. 100). Johansson (1976) argues that, under these conditions, the perception of the walking person is almost instantaneous. In the experiment (1973), even when cues were removed, subjects

still recognized the pattern but made adjustments. For example:

> [When the camera followed the moving person so that there was no forward motion of the image] some of the Ss also spontaneously described the event as a walking on some kind of moving belt. The [invisible) ground then was experienced as moving backward. (p. 209)

Thus, the basic perceptual experience (i.e., recognition of a walking person) remained fairly resilient to cue modification.

The traditional image-cue model of perception becomes extremely limited in explaining experimental findings like Johansson's. First, the traditional approach to perception treated motion perception

> as limiting cases hard to deal with in a theoretically satisfying way. To a certain degree stroboscopic motion is an exception. Its stimulus consists of a succession of static images, and therefore in the case the image model can be applied after accepting a unique effect of the temporal succession of images. (Johansson, von Hofsten, and Jansson, 1980, p. 28)

Traditionally, the perception of motion was explained as a sequence of snapshots--a static image formed on the retina; and then, as each part of the stimulus moved successively, the position of each element was stored in memory. Perception of motion was conceptualized as a deduction from sequences of static arrangements (Turvey, 1977a). Such an account, however, presents difficulties when other than stroboscopic motion is investigated.

One theoretical objection, for example, similar to the one Gestalt psychologists made about the empiricist account of form perception, concerns the formation of organizational patterns produced by motion. Given the traditional account of the perception of motion, it

is difficult to determine how the sequence of snapshots become joined together to form a meaningful percept (such as a walking person). What makes the elements cohere? Certainly with simple types of motion patterns, association can be appealed to as a viable explanation of organization; however, given the tremendously complex nature of real motion mathematically, such an appeal becomes awkward, particularly in accounting for new perceptual experiences. As I shall illustrate, Johansson's experiment challenges the traditional account on this ground; it is also important to note that his experimental design departed from the traditional experimental approach to motion perception (i.e., stroboscopic motion) because it did not assume that the goal of perception is the registering of a succession of objects or their parts.

A traditional, associationistic account of Johansson's findings would have to assume the following stages: each element (dot) is registered on the retina and its position held in memory; as each new dot is added, a pattern emerges inside the perceiver (i.e., represented in memory); this pattern has been experienced in the past and has become associated with a certain body movement; a deduction or inference is then made and the pattern recognized. Such an account, however, cannot explain Johansson's finding; namely, the instantaneous recognition of the pattern which was of tremendous mathematical complexity. The set of dots in his experiment started out as a meaningless grouping, and within about one second of viewing time, subjects recognized a meaningful pattern accurately. The associationist cannot consistently claim instantaneous recognition of a pattern in present experience because

that would be recognizing a significant unit beyond the particulars of experience. That each dot is registered as a retinal image and then stored in memory becomes an unlikely explanation. As Johansson (1979) summarizes his (1973) findings:

> The experiment described strongly supports the hypothesis that continuous relative change over time in the stimulus pattern is the fundamental type of information in space perception. All the motions of the elements are seen as related to each other from the very first moment of presentation or from the onset of relative displacement. The organization of these displacements to a complex figuration in motion seems to be an initial act in the perceptual response. (p. 101)

This explanation of motion perception requires, as Johnasson also notes (p. 97), a metatheoretical shift because it challenges the validity of traditional, and I shall argue, mechanistic assumptions about perception.

I have already noted that Johansson's experiment departed from the traditional experimental framework by investigating real motion perception. This opposes the more artificially contrived laboratory experiments which were designed to understand how simple motion patterns were perceived so that more complex motion patterns could eventually be understood. Rather than investigating a collection of discrete, static "snapshots" of objects or their parts, Johansson investigated the flow of information over time. Part of the shift involves studying perception and not sensation. Characteristic of the metatheoretical shift in the new study of perception is the focus on biologically natural "events," like walking; "[event perception] denotes perception of any

change of quality, quantity, or position during a chosen interval of time" (Johansson, 1979, p. 94). Thus, the unit for analysis dramatically shifts from the traditional image-cue model to flow models. All those working in event perception stress the biological character of the event as being a much more valid basis for explaining perception than the atomistic basis of the traditional model.

A key mechanistic assumption underlying the image-cue model of perception is that all perceptual experience can be reduced to basic particulars (such as the spots in Johansson's experiment), regardless of their final composition. The flow model assumes that perception begins with the recognition of interrelations among patterns, and thus the model takes into account the final composition in the explanation of perceptual experience. Such a model goes beyond the Gestalt account of form perception: it assumes that perception takes place over time, and the information is not physiologically correlated to some mental state. As recognized by Johansson (1979) and Gibson (1979), the image-cue model of perception is based on units of analysis characteristic of physics (i.e., atomic units) and the flow model on units of analysis characteristic of biology (i.e., ecological units).

> The size-levels of the world emphasized by modern physics, the atomic and the cosmic, are inappropriate for the psychologist. We are concerned with things at the ecological level, with the habitat of animals and [human beings]. (Gibson, 1979, p. 9)

The study of real motion perception, in all its complexity, then departs from the reductionist method inherent in the traditional image-cue model.

The shift in the unit of analysis produces a different conception of the "stimulus" in perceptual experiments as can be readily observed in Johansson's experiment. Given his experimental findings, the explanation that individual stimuli (small dots) cause the response (i.e., recognition of a walking person) becomes untenable. Rather, to use Gibson's term, stimulus information is contained in the patterns of movements and their interrelations as they "flow" over time; and the stimulus information is "picked up" by the perceiver. Gibson (1979) states that "a permanent object cannot possibly be specified by a stimulus. The stimulus information for an object would have to reside in something persisting during an otherwise changing flow of stimulation" (p. 56). It is also important to note that Johansson's experiment suggests that there is a richness of stimulus information available to the perceiver prior to any "processing."

The results of Johansson's experiment also have implications for the role of the subject in perceiving. The traditional image-cue model assumed that the stimuli were registered passively and that association from past experience operated to embellish the stimulus before perceptual recognition could take place. This traditional account of perceptual processing has been referred to as "indirect" perception because the perceiver only "sees" the stimulus internally (i.e., through memorial representation). Johansson's experiment suggests that something other than "a successive remembering and adding" of positions of elements occurs in perceptual experience. Although individual researchers investigating event perception explain the alternative to the

traditional processing model somewhat differently, generally they argue that the information for perceptual recognition exists not inside the perceiver's head but in the flow of stimulus information. Thus, their theory is commonly referred to as a theory of "direct" perception; and in this view of perception, the role of the subject in the perceptual experience is redefined. Johansson (1979) argues that his subjects, in order to recognize the pattern quickly and accurately, had to abstract "relative motions (limb movements) within a group of moving elements" (p. 100). He has offered (1970) a somewhat different account of the organism's role in perception from Gibson's. As I shall suggest later, the role of the organism in event perception literature remains theoretically problematic. What is important to note about Johansson's experimental findings is that perceptual information was contained in the perceptual "event"; the assumption that passive processing alone can account for the organism's role in perception will have to be replaced.

Both the design and findings of Johansson's experiment call into question the following mechanistic assumptions of the traditional model of perception: (a) that the goal of perception is a static image of an object or its parts; (b) that perception can best be investigated reductionistically through artificial laboratory manipulations of attributes of objects; and (c) that passive processing delimits the organism's role in perception. Johansson's experimental findings exemplify contextualistic categories rather than mechanistic ones. The organization and instantaneous recognition of a walking person from a series of movements of small spots indicates that the quality of the

event is noticed rather than elements or details. The textures of the event are the patterns of movement and their interrelations, and these spread over time. Further, as Pepper (1960) notes,

> [Contextualism] denies that a whole is nothing but the sum of its parts. It even denies that a whole is a sort of added part like a clamp that holds together a number of blocks. A whole is something immanent in an event and is so intuited, intuited as the quality of that very event. (p. 238)

In order to more thoroughly explore the compatibility between the literature on event perception and contextualism, I shall turn to Gibson (1979) who has provided an explicit theoretical framework for the study of event perception.

Gibson's Theory of Perception

In his book The Ecological Approach to Visual Perception (1979), James J. Gibson, emphatically abandoning all the mechanistic assumptions I have discussed, identifies his approach to perception as new and significantly different from older theories (pp. 238-239). As mentioned earlier, Gibson questions the appropriateness of the traditional physical sciences model as a basis for investigating perception and argues for an ecological model. "The mutuality of animal and environment," he states, "is not implied by physics and the physical sciences. The basic concepts of space, time, matter, and energy do not lead naturally to the organism-environment concept or to the concept of a species and its habitat" (p. 8). In adopting an ecological model as the basis for investigating and understanding perception, Gibson employs

a new world hypothesis--one very closely aligned to contextualism.

Gibson's general criticisms of other theories of perception and his ecological concerns are similar to criticisms and concerns of contextualists. What is perceived is not objects and their parts or a succession of images, but "events," which occur in the terrestrial environment, and their properties. Recognition of the role of the environment in perception is a crucial factor for the contextualist. Dewey (1938), for example, noting the elevated status of the perceptual object in psychological theory, states, "In actual experience, there is never any such isolated singular object or event; an object or event is always a special part, phase, or aspect, of an environing experienced world--a situation" (p. 67). In the same vein, he states, "The commonsense world includes, to be sure, perceived objects, but these are understood only in the context of an environment. An environment is constituted by the interactions between things and a living creature" (p. 150). In a later work, Dewey and Bentley (1949) carry the contextualist position further:

> Since man as an organism has evolved among other organisms in an evolution called "natural," we are willing under hypothesis to treat all of his behavings, including his most advanced knowing, as activities not of himself alone, nor even as primarily his, but as processes of the full situation of organism-environment. (p. 104)

Gibson's theory of perception similarly emphasizes the environment as context.

In Gibsons' theory, the environment "refers to the surroundings of those organisms that perceive and behave, that is to say, animals" (p. 7). These surroundings include, for example, geographical features of the earth as well as other animals. The environment consists of structured units which are embedded or nested in other units. In his most contextualistic description, Gibson states:

> There are forms within forms both up and down the scale of size. Units are nested within larger units. Things are components of other things. They would constitute a hierarchy except that this hierarchy is not categorical but full of transitions and overlaps. Hence, for the terrestrial environment, there is no special proper unit in terms of which it can be analyzed once and for all. (p. 9)

It is this environment, composed of overlapping and nested units, that the organism's "perceptual system" has evolved to detect. Indeed, Gibson argues senses should be defined as perceptual systems: "a perceptual system is a set of organs, including receptors, which can attend to or explore the environment and detect certain classes of information" (Michaels & Carello, 1981, p. 39). Perceptual systems respond to natural "events" that occur in the environment. "We perceive not [abstract empty] time [as prescribed by the model of physics] but processes, changes, sequences" (Gibson, p. 12). Information available to the organism's perceptual system is contained in an environment which surrounds it, and this information cannot be reduced to sensory stimuli:

> The supposed sensations resulting from . . . stimulation are not the data for perception. Stimulation may be a necessary condition for seeing, but it is not sufficient. There has to be stimulus information available to the perceptual system, not just stimulation of the receptors. (p. 55)

Stimulus information is specified in the "light," specifically in what Gibson terms the "ambient optic array" (p. 51).

As opposed to radiant light, which causes illumination, ambient light results from illumination and comes to a particular point of observation from all directions; it "makes available information about reflecting surfaces" (p. 64). This light can be structured because of the structure of the environment.

> Only insofar as ambient light has structure does it specify the environment. I mean by this that the light at the point of observation has to be different in different directions (or there have to be differences in different directions) in order for it to contain any information. The differences are principally differences of intensity . . . ambient light with structure is an ambient optic array. This implies an arrangement of some sort, that is, a pattern, a texture, or a configuration. (p. 51)

The optic array changes because the point of observation changes (i.e., the observer is mobile); however, certain features remain "invariant"; i.e., persist over time. The perspective changes with locomotion, but "one arrangment does not become a wholly different arrangement by a displacement of viewpoint" (p. 73). Both perspective structure and invariant structure specify different kinds of information--the former about locomotion and the latter about the layout.

> Perceiving is a registering of certain definite dimensions of invariance in the stimulus flux together with definite parameters of disturbance. The invariants are invariants of structure, and the disturbances are disturbances of structure. The structure, for vision, is that of the ambient optic array. (p. 249)

The ability to recognize a person's face over a long period of time exemplifies what Gibson means by persistence and change.

In addition to the ambient optic array which specifies information in the environment, Gibson claims the environment "affords" information for perception. "The hypothesis of information in ambient light to specify affordances is the culmination of ecological optics" (p. 143). The concept of affordances supports Gibson's view of the mutuality of an animal and its environment. As Warren (1978) explains,

> Affordances are defined as invariant combinations of properties at the ecological level, taken with reference to the anatomy and action systems of a species or individual and also with reference to its biological and social needs. (p. 11)

Thus, for example, flat surfaces are walk-on-able, climb-on-able, fall-off-able (relative to the animal) (Gibson, p. 128). Certain objects afford grasping; a cave may afford shelter, and so on. What the environment affords one species, it may not afford to another species. Gibson argues, "The basic properties of the environment that make an affordance are specified in the structure of ambient light, and hence the affordance itself is specified in ambient light" (p. 143).

In Gibson's theory, the organism interacts with its environment. The organism's perceptual systems "explore," "hunt," "scan," "detect," "pick-up," and "sweep the visual field." The total organism, not just its eyes, perceives.

> The eye is considered to be an instrument of the mind, or an organ of the brain. But the truth is that each eye is positioned on a trunk that is positioned on legs that maintain the posture of the trunk, head, and eyes

> relative to the surface of support. Vision is a whole perceptual system. (p. 205)

All of the components involved in this visual system are active (p. 218) and are used to explore the environment. Thus, Gibson states, "Perceiving is an achievement of the individual. . . . It is a keeping-in-touch with the world, and experiencing of things rather than a having of experiences" (p. 239). This view of perception corresponds to the naturalistic view of the contextualist. Dewey (1939/1951) states:

> Every experience in its direct occurrence is an interaction of environing conditions and an organism. As such it contains in a fused union somewhat experienced and some processes of experiencing. (p. 544)

Unlike the traditional account of perception which claimed that information is sequentially "registered" and then "processed" or "filtered," in Gibson's theory "the perceptual system simply extracts the invariants from the flowing array; it resonates to the invariant structure or is attuned to it" (p. 249).

As I noted earlier Gibson's theory has been commonly referred to as a theory of direct perception, especially when contrasted to traditional theories of perception. Shaw and Bransford (1977) and Michaels and Carello (1981) have analyzed the philosophical derivation of the term "direct" as it applies to Gibson's theory of perception. For my purposes, it is important to note that although Gibson argues perception is direct, he does not mean "simple." Rather Gibson claims that the perceptual system can directly detect the rich, complex information in the environment and that the psychologist does not have to evoke some type of mentalistic processing (such as deduction or inference) to

account for perception. The information is contained, not inside the perceiver's head, but in the light, in the ambient array. The perceiver picks this up directly; "information does not have to be stored in memory because it is always available" (Gibson, 1979, p. 250). In that Gibson rejects "the assumption that perception is the processing of inputs [sensory or afferent nerve impulses to the brain]," his theory seriously challenges traditional theories of perception. Additionally, as he states, his theory "implies a redefinition of the so-called higher mental processes" (p. 255).

A Contextualist View of Gibson's Theory

Gibson's criticisms of traditional image-cue theories (theories which, I have argued, assume a mechanistic world view) directly parallel those of a contextualist. Indeed, as many of Gibson's followers have noted, Gibson provides "devastating arguments against 'image' conceptions of higher mental processing" (Weimer, 1974, p. 427). Additionally, his naturalistic description of the environment as an ecologically rich source for perceptual information; his concept of a perceptual system which encompasses the organism's total functioning; his recognition of perception as an active, exploratory process; and his identification of the affordances of the environment: these theoretical assertions are similar to contextualistic ones. Like Gibson, a contextualist is a realist in that he also believes that "there is a natural world that exists independently of the organism, but this world is environment only as it enters directly and indirectly into life-functions" (Dewey,

1938, p. 33). Although such similarities as these exist between Gibson's theory and contextualistic categories, Gibson's theory falls short of a contextualist world view on one major count: the very postulates he sets up for a naturalistic account of the environment's role in perception truncate the role of the organism. This is a serious theoretical dilemma as well, since Gibson claims his theory to be interactional.

In the presentation of his theory, Gibson continually stresses the importance of the environment in perception, in part because his goal is to rid psychology of theories in which the perceiver constructs the environment from "insufficient" stimuli; i.e., he wishes to reject all appeals to subjective representation. What emerges from his description, however, is an image of perceiving organisms sanguinely moving about their environment picking up--without much difficulty--the rich information completely specified in the array of ambient light. He states, for example, "Perceiving gets wider and finer and longer and richer and fuller as the observer explores the environment" (p. 255). Michaels and Carello (1981) recognize this kind of criticism of Gibson's theory and respond to it:

> The long-overdue attention that Gibson and his followers have paid to the role of the environment has been misconstrued by some critics to indicate that the animal plays no role in the theory. Some have even gone so far as to say that Gibson's is no more than a "black box" account of perceiving (Krueger, 1980)! Such an interpretation is puzzling in light of the emphasis which ecological psychologists place on mutuality, compatibility, and reciprocity that characterize the animal-environment system. (p. 165)

Gibson, it is true, does stress mutuality, and he does describe the organism as actively searching and exploring. The problem is that asserting that organisms are active is meaningless unless his theory can specify how actions are relevant to perception (cf. Dewey, 1912; Turvey, 1977b). What sets up exploratory or searching behavior if the information is totally contained or available in the light? In order to maintain that perception is always direct (and never mediated by cognition), Gibson can not attribute much activity to the organism; in fact, he can only attribute purely organic behavior (non-cognitive) which fulfills basic biological needs. Even at the biological level, however, actions can be shaped by culture: worms "afford" eat-able-ness in some cultures and not in others.

Gibson avoids any appeal to logical or inferential processes in perception because he seems to think that admitting other than purely organic behavior results in bifurcation of the organism and its environment, a separation both he and the contextualist wish to avoid. The contextualist, however, faces this head on:

> Intellectual operations are foreshadowed in behavior of the biological kind, and the latter prepares the way for the former. But to foreshadow is not to exemplify and to prepare is not to fulfill. Any theory that rests upon a naturalistic postulate must face the problem of the extraordinary differences that mark off the activities and achievements of human beings from those of other biological forms. (Dewey, 1938, p. 43)

In explaining more complex perceptual experiences, the contextualist would argue the organism "funds" (Dewey, 1939/1951, p. 520) them by bringing past experience to bear, a claim I shall elaborate shortly.

Gibson, on the other hand, attributes more and more information to environmental properties. Perceptual systems extract high-order optical invariants (i.e., invariants that are highly complex) which concomitantly "specify higher order affordances" (p. 141), but such a claim still does not address how "extraction" is determined.

Gibson so desires to abolish the bifurcation between organism and environment which characterizes the mechanist tradition that he fails to build in an adequate account of cognition. But the value and importance of his theory are clearly evidenced in a lengthy debate between Fodor and Pylyshyn (1981) who represent what they term the "Establishment" (or information-processing) view of perception and Turvey, Shaw, Reed, and Mace (1981) who follow and extensively develop Gibson's theory along contextualist lines. This debate substantiates the main claim of this dissertation--that contextualism is in the process of becoming a viable alternative to mechanism. In addition, Turvey, et al. develop and extend Gibson's theory in ways that move it closer to a contextualist account of perception.

Fodor and Pylyshyn (1981) argue that the constructs (specifically "invariant" and "pick up") Gibson employs fail to constrain his use of the term "direct" in direct perception. They state:

> Gibson's account of perception is empty unless the notions of 'direct pickup' and of 'invariant' are suitably constrained. For, patently, if any property can count as an invariant, and if any psychological process can count as the pick-up of an invariant, then the identification of perception with the pickup of invariants excludes nothing. (p. 142)

After an analysis of the possible ways Fodor and Pylyshyn think these notions could be constrained so as to avoid trivialization, they conclude that within Gibson's theoretical framework, there is "no satisfactory way."

> It looks as though whatever is perceived is ipso facto the proper object of a perceptual system, and whatever is the proper object of a perceptual system is ipso facto perceived directly; we have, in particular, no independent constraints on the individuation of perceptual systems that will permit us to break into this chain of interdefinition. (p. 152)

They argue that only the information processing account which depends on inferential mediation can suitably constrain Gibson's use of the term "direct" (p. 141). Perception, then, involves representation and matching through some kind of computational processes; this is a claim, of course, that Gibson vociferously denies.

The heart of Fodor and Pylyshyn's arguments about the nature of perception rests on a restricted class of properties and mechanisms called transducers. "Transducers are technically defined as mechanisms which convert information from one physical form to another" (p. 157). Establishment theories contend that what is perceived directly are properties to which given transducers respond (such as the retina for vision) (p. 150). The retina, in visual perception, detects properties of the light, and then properties of the layout are perceived through an inference based on "(usually implicit) knowledge of the correlations that connect them" (p. 165). Properties of the light and properties of the layout are, according to Fodor and Pylyshyn, different states of mind: "Some process must be postulated to account for the transition

from one of these states of mind to the other, and it certainly looks as though the appropriate mechanism is inference" (p. 166). Dewey (1938) identifies this view as representative realism. He states, "According to this view, the direct or given object of cognition is always a mental state, whether 'sensation' or 'idea,' and the existential physical object is known through a mental state taken to be a representation of an external object" (p. 523). In the more recent representative view of perception, as opposed to, say, von Helmholtz's view, the class of properties perceptual organs respond to can be more than sensations--they can be any individual particular, perceptually discriminated.

Fodor and Pylyshyn advocate the indirect theory of perception assumed in information processing accounts of perception, an account which has an intrinsic connection to memory which I shall discuss in the following chapter. In brief, Fodor and Pylyshyn state their main position as follows: "Since the Establishment holds that the psychological mechanism of inference is the transformation of mental representations, it follows that perception is in relevant respects a computational process" (p. 140). As I have noted, the vulnerability of Gibson's theory lies in its exclusion of cognition in organism-environment interactions which leaves it open to the attacks of critics such as Fodor and Pylyshyn who rightly demand a lawful connection between perception and cognition. Contextualist philosophers, as I shall shortly illustrate, face this issue more directly.

Turvey, Shaw, Reed, and Mace's (1981) reply to Fodor and Pylyshyn's criticism of Gibson illustrate that indeed the issues of disagreement exist at a metatheoretical level. Fodor and Pylyshyn state they wish to read Gibson in a conciliatory fashion; and Turvey, et al. make clear that no such reconciliation is likely. They state, for example, "It is not obvious that Fodor and Pylyshyn are addressing the same subject matter as Gibson and the proponents of his ecological approach. To the extent that they are not their arguments against Gibson miss the mark" (p. 238, my italics). This can be contrasted to Fodor and Pylyshyn's conclusion about Gibson's theory: "Missing the point about inference, missing the point about mental representations, and missing the point about intentionality are thus all aspects of missing the same point" (p. 194). The type of perception both speak to differs: "Fodor and Pylyshyn's kind of perception (in percepts) is whatever eventuates in a perceptual judgment of belief. Gibson's kind of perception, in contrast, is that which eventuates in the 'proper' adjustment of oriented (to various levels of the environment) activity" (Turvey, et al., p. 241). Fodor and Pylyshyn's canonical example is Bernard Berenson who "managed to be so good at perceiving (i.e., telling just by looking) that some painting was an authentic Da Vinci" (p. 142). In an effort to better understand perception in the total organism-environment eco-system,Turvey, et al. take their examples from animal behavior.

Both sets of authors agree that the central problem for a theory of perception is an explanation of intentionality, yet both offer

contrasting, even competing, accounts (cf. Fodor & Pylyshyn, pp. 190-195; Turvey, et al., pp. 292-298). Turvey, et al. state the problem of intentionality as follows: "How can an organism . . . take the same propertied thing to afford different acts on different occasions?" (p. 298). Fodor and Pylyshyn state it as "the fact that stimuli enter into the causation of behavior under many different aspects" (p. 190). They argue that "the mind is a mechanism for the manipulation of representations, and how what you see affects what you know is primarily a matter of how you represent what you know and see" (p. 195). On the other hand, the ecological approach allows "natural laws, relating occurrent properties to both animal and environment disposition, to replace cognitive rules, relating concepts and representations" (p. 292).

Key in this generally contextualist-mechanist debate is the role of representation in perception, a debate which carries over into theories of memory. The contextualist wishes to avoid any such mediation in lived experience. Thus, Dewey (1938) argues that the fallacy of representative realism lies in the hypostatization of a representation:

> [Representative realism] views representative power as an inherent property of sensations and ideas as such, treating them as "representations" in and of themselves. Dualism, or bifurcation of mental and physical existence, is a necessary result, presented, however, not as a result but as a given fact. (p. 524)

Turvey, et al. make a similar argument (p. 291); and in the following chapter on memory, I shall illustrate how such a view of perception leads to "the reification of memory" (cf. Kvale, 1976).

Turvey, et al. move closer to contextualism in that their theoretical claims no longer stress "information in the light" (which as Fodor and Pylyshyn argue leads to a simple-minded empiricism; rather they elaborate the natural laws governing organism-environment interactions (see pp. 260-267). Of course, these laws differ significantly from those discussed by Fodor and Pylyshyn. The examples Turvey, et al. use, however, treat only animal behavior which leaves them open to rebuttal from critics such as Fodor and Pylyshyn who would simply reiterate what Dewey pointed to; namely, "the extraordinary differences that mark off the activities and achievements of human beings from those of other biological forms." Although contextualists would agree that examples from animal behavior can serve to illustrate the transactive relationship inherent in organism-environment interactions, they would be quick to point out that naturalistic theories of perception can address cognitive activities without bifurcating the organism from its environment. Indeed, Dewey's Logic: A Theory of Inquiry (1938) develops just such a naturalistic account of cognition in inquiry.

Perhaps the best example a contextualist would offer comes from Dewey's (1928) reply to E.W. Hall. For the contextualist, events have meanings; in his reply to Hall, Dewey distinguishes between "referential" and "immanent" meanings. A sailor in a storm hears a whine, a roar, a crack. If the sailor were inexperienced, then such an event would signify something else; i.e., "he would have to infer--use the noise as a symbol--and do something to find out what it signified" (p. 351). On the other hand, for an experienced sailor the noise will be "a sail

blown out of its bolt ropes." What Dewey means by immanent meaning is that "the consequences of [the sailor's] prior-tested and verified inferences enter directly into the object of perception." This funded, immanent meaning results from prior referential or reflective relations and involves no computational processes or separate mental states. As I shall elaborate in the memory chapter, the past enters into and participates in perception directly, but the organism contributes the meaning as much as the environment. Such insistence on the reciprocal modification of organism and environment leads to the primary distinction between Gibson's theory, as he explains it, and contextualism.

For the contextualist, the environment raises uncertainty--an uncertainty directly evolving from organism-environment interactions. The interaction produces what Dewey terms "disequilibrations." "Indeed, living may be regarded as a continual rhythm of disequilibrations and recoveries of equilibrium. . . . The state of disturbed equilibration constitutes need. The movement towards its restoration is search and exploration" (Dewey, 1938, p. 27). From the imbalance, "indeterminate situations" arise (p. 105). The situation includes the "particular quality of what pervades the given materials," (p. 105), and this quality is not just subjective but belongs as well to the existential situation (p. 106). The indeterminate situation is experienced perceptually; and thus, for Dewey (1912) perception is best defined as "a process of determining the indeterminate" (p. 654) and "a process of choosing" (p. 663). Determining and choosing involve both the perceiver and the situation (context) perceived.

Dewey (1938) argues that the indeterminate situation is "pre-cognitive" (p. 107), and this is somewhat close to Gibson's realism; however, Dewey departs from Gibson in that he argues the products of past resolutions of indeterminate situations enter into and participate in new perceptual experiences.

> I see or note directly that this is a typewriter, that is a book, the other thing is a radiator, etc. This kind of direct "knowledge" I shall call apprehension; it is seizing or grasping, intellectually, without questioning. But it is a product, mediated through certain organic mechanisms of retention and habit, and it presupposes prior experiences and mediated conclusions drawn from them. (p. 143)

In addition, the contextualist is much concerned with cultural and historical determination of perception. Gibson's theory makes a plausible case for perception at the purely organic level of behavior, but the contextualist would argue that such behavior is relatively rare: "To a very large extent the ways in which human beings respond to physical conditions are influenced by their cultural environment" (Dewey, 1938, p. 42). Gibson states directly that he is uncertain about culturally transmitted knowledge (p. 258); for the contextualist, history and culture are woven into the perceptual experience.

In conclusion, the contextualist holds that "the organism is involved in the occurrence of the perception in the same sort of way that hydrogen is involved in the happening--producing--of water" (Dewey, 1911, p. 105). Gibson's theory, as it stands, truncates the role of the organism since from the contextualist view, it has the potential to bring more to the indeterminate situation than what is specified by the

light. For example, Dewey's way of relating past experience to present situations is habit: "Habits enter into the constitution of the situation; they are in and of it, not, so far as it is concerned, something outside of it" (1911, p. 105). Rather than explicating contextualism through Dewey, however, I shall turn to another contemporary theory of perception (Neisser, 1976) which attempts to address the shortcomings of Gibson's theory.

Neisser's Theory of Perception

Gibson's theory of information pickup challenges a significant body of psychological theorizing. Not only do Gibson's assumptions alter, at a metatheoretical level, those more traditional ones which originated with the associationist theories of Berkeley and von Helmholtz, but it also challenges modern theories of perception, like Gregory's (1973) or Bruner's (1957), not derived from the associationist tradition. Moreover, if Gibson's assumptions were accepted, present-day visual information-processing models and theories would, as he asserts, have to be abandoned. This is because many visual information processing models assume the final perceptual experience can be traced back to what is usually termed "sensory input," and that turns out to be, as Neisser (1976) and Turvey (1977a) note, a retinal image or some such correlate which has to be "constructed," "processed," or embellished internally by the perceiver. Gibson's theory claims the reverse: the information is not contained internally in the perceiver but is available externally in the light.

In addition to the extensiveness of his theory's challenge, the tone of Gibson's arguments makes clear, as Fodor and Pylyshyn (1981) put it, that he "does not want to be read in a conciliatory way" (p. 141). Michaels and Carello (1981) directly discount the likelihood of reconciliation between Gibson's theory and, in particular, indirect theories of perception characteristic of traditional information processing approaches. They state:

> The heart of the matter is whether two frameworks--one that approaches perception as a phenomenon in an animal and one that approaches perception as a phenomenon in an animal-environment system--are reconcilable. We believe they are not. Indeed, the gulf between the two camps is so large that often one feels that the other is, at best, oblivious to what the real problems of perception are. Unfortunately, the schism in metaphysics often manifests itself as sanctimonious disdain--in both directions. (p. 165)

Similarly, I have suggested that Gibson has eschewed a mechanistic world view and to some extent replaced it with assumptions that move toward a contextualist world view. To the extent that Gibson's theory follows contextualistic categories, any piecemeal modification of it for the purpose of aligning it with mechanistic categories would be an ill-conceived endeavor, especially given Pepper's (1942/1961) admonition:

> If a world theory partly developed in one set of categories is broken in upon by a foreign set of categories, the structure of corroboration is broken up and we cannot clearly see how the evidence lies. (p. 330)

If, indeed, Gibson's theory does specify an alternative world hypothesis, then his rejection of an eclectic approach would be consistent with Pepper's metaphysical framework.

Several psychologists (Neisser, 1976; Pribram, 1977; Weimer, 1974), however, have argued for reconciliation between constructivist and information pickup theories. Since a review of all these theoretical efforts to provide a conciliatory reading of Gibson is beyond the scope of this chapter, I shall focus on Neisser's. His theory attempts to take Gibson's theory and expand it by assigning a more active role to the organism in perception. Several of the theoretical claims he makes will be reviewed; and, as I shall illustrate, they move in the direction of contextualism rather than mechanism.

In developing his theory, Neisser, like Gibson, rejects traditional image-cue models of perception (pp. 15-16). Neisser also recognizes the value of much of Gibson's theoretical formulations. Specifically, he mentions the following advantages of Gibson's views over traditional ones:

> The organism is not thought of as buffeted about by stimuli, but rather as attuned to properties of its environment that are objectively present, accurately specified, and veridically perceived. The emphasis on the pickup of information over time makes the theory applicable to haptic (touch-relevant) and acoustic information as well as to light, at least in principle. The most important thrust of the theory is to suggest that students of perception should develop new and richer descriptions of the stimulus-information, rather than ever-subtler hypotheses about mental mechanisms. (p. 19)

Those taking a conciliatory approach to Gibson's theory have acknowledged these features as valuable. Neisser, however, in the same vein as Fodor and Pylyshyn, claims Gibson's theory "inadequate, if only because it says so little about the perceiver's contribution to the

perceptual act" (p. 9). A contextualist would share this concern as well.

If perception is part of a truly interactional process between environment and organism, then even at the perceptual level both organism and environment undergo modification. Such reciprocity led Dewey and Bentley (1949) to use the term "transaction" to describe organism-environment interchanges. More specifically, Dewey (1938) states, "Modification of both organic and environmental energies is involved in life-activity. . . . What the organism learns during [the process of inquiry] produces new powers that make new demands upon the environment" (p. 35). For Dewey, as mentioned earlier, organic change can be explained through "habit" (p. 31); however, as Allport (1939/1951, p. 272) notes, because Dewey "neither explicitly defined nor consistently employed" the term habit, psychologists have not, generally, adopted or made use of the concept. The important issue for my purposes is that a contextualist such as Dewey recognizes the need to account for cognitive transformations or modifications of the organism, particularly in indeterminate situations which, the contextualist holds, characterize experience. In this vein, Sarbin (1977, p. 6) identifies Piaget's theories of psychological functioning--specifically his concept of accommodation (i.e., adjustments which "alter the conditions that enter the context of seemingly similar future events")--as illustrative of a contextualist paradigm.

No completely satisfactory psychological account of the organism's role in perception from a specifically contextualist world view

has been advanced. Yet, based on Pepper's description, certain assumptions, which follow from contextualistic categories, can be identified and discussed. Pepper (1942/1961) illustrates the interconnections between the organism and its environment in perception through the example of perceiving a table. Textual continuity exists in the physical organism and in the table; both provide the context for an event. These continuities become fused into one texture in the act of perception.

> The qualities of this texture include what we call color and shape. As these are perceived, they are textural and qualitative emergents. That is, previous to the interlocking of the strands of the continuous textures of table and organism there were no such colors or shapes in existence (at least, not there in the texture of the perception). These are emergent qualitative and integrative novelties arising from a texture of strands partly derived from the so-called physical table and partly from the so-called physical body of me. . . . But the important point to note is that the qualities arise in the integration of the texture and belong neither to me alone nor the table alone, but to the common texture. (pp. 265-266)

So integrative is the ordinary perceptual act that neither the organism nor the table can be isolated out of the event. Always the contextualist points to the indeterminate situation, and its "felt" quality, as pervading life experiences, even perceptually. The resolution of the indeterminate situation--constituted by the organism and the existential conditions--depends on modifications that occur reciprocally; and the modification the organism undergoes occurs cognitively as past resolutions enter directly into new situations and how they are perceived.

Cognition, for Dewey, cannot be treated as a grouping of mental constructs which intervene between the organism and its environment; rather thought, judgment, deliberation, and so forth direct and organize practical activity. In this sense, Dewey's description of higher mental processes is functional. He states, for example: "Ideas are anticipated consequences (forecasts) of what will happen when certain operations are executed under and with respect to observed conditions"; they have a "prospective and anticipatory character" (1938, p. 109). What the perceiver brings to bear on new perceptual experiences, according to Pepper,

> consists of the relation or strands of schemes which satisfy predictions. These schemes, such as maps, diagrams, formulas, functional equations, and symbolic systems, are themselves continuents and are instruments of prediction. These have been developed on the basis of past social experience. (p. 267)

Thus, for the contextualist the organism holds schemes that allow it to anticipate future consequences, and these schemes directly affect perception.

Neisser recognizes the need to account for the organism's role in perception. He adopts Gibson's theoretical formulations of the information available in the light; but rather than arguing that all the information is contained and specified in the light, he argues first, that the perceiver brings into the perceptual experience information that determines what information is ultimately picked up and, second, that the information that is picked up modifies the perceiver's previous information. Perception is an ongoing process, cyclical in nature, as Figure 1 illustrates.

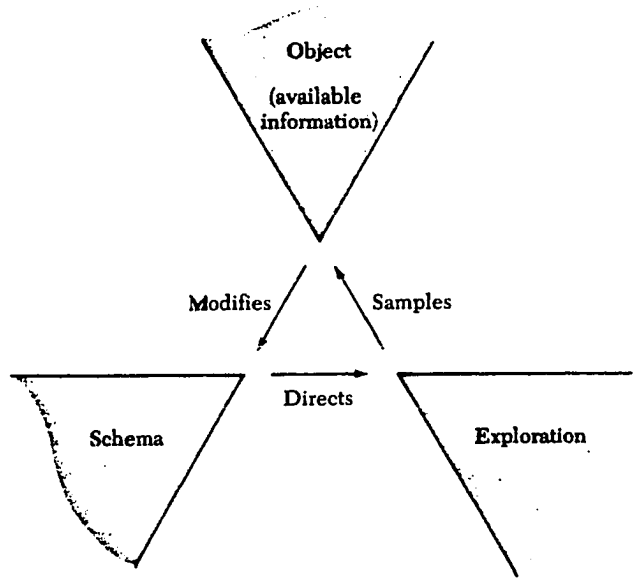

Figure 1. The perceptual cycle. (From Neisser, 1976, p. 21)

The perceiver interacts with the information available in the light through what Neisser terms "anticipatory schemata." "At each moment the perceiver is constructing anticipations of certain kinds of information, that enables him to accept it as it becomes available" (p. 20). The perceiver's anticipatory schemata direct the exploration of the information available to him and are subsequently modified by what is picked up.

Neisser's notion of anticipatory schemata needs further examination, particularly since it has implications for the study of other higher mental processes. Based on Bartlett's (1932, p. 20) use of the term, Neisser defines schema as "that portion of the entire perceptual cycle which is internal to the perceiver, modified by experience, and somehow specific to what is being perceived" (p. 54). Neisser locates

the schema in the nervous system; it is not "stationed" in the perceiver's brain apart from his biological functioning.

> It is some active array of physiological structures and processes: not a center in the brain, but an entire system that includes receptors and afferents and feed-forward units and efferents. It is not likely that this physiological activity is characterized by any single direction of flow or unified temporal sequence. (p. 54)

Schemata do not operate sequentially or unidirectionally; rather, "organisms have many schemata, related to each other in complex ways" (p. 56). A schema is not an individual image (or a finished percept) or a group of images; it is "just one phase of an ongoing activity which relates the perceiver to his environment" (p. 23). Experience shapes and develops schemata. Schemata can not operate apart from the existential contingencies of the situation (the context); thus Neisser stresses that in perception "cognition" and "reality" meet.

Schemata serve as anticipations and connect past experience with the information available to be picked up. The perceiver continues to be aware of the flow of information in the total event, but anticipations guide and direct the search. As Neisser states,

> Perception is directed by expectations but not controlled by them; it involves the pickup of real information. Schemata exert their effects by selecting some kind of information rather than others. . . . The interplay between schema and situation means that neither determines the course of perception alone. (p. 43-44)

Neisser's concept of anticipatory schemata has important implications for establishing contextual effects and for action.

Gibson's theory of direct perception certainly recognizes the importance of the environment, but it tends to homogenize contextual effects. If information is always undifferentially available, how do particular contextual effects become salient in the event? The contextualist assumes interaction is initiated most frequently by a disturbance in the perceptual field, and from that disturbance particular contextual features (i.e., "strands") emerge. These contextual effects become the basis for action.

> When objects or qualities are cognitively apprehended, they are viewed in reference to the exigencies of the perceived field in which they occur. They then become objects of observation, observation being defined precisely as the restrictive-selective determination of a particular object or quality within a total environing field. Usually the total environing field is "understood," or taken for granted, because it is there as the standing condition of any differential activity to be performed. (Dewey, 1938, p. 150)

Neisser's notion of anticipatory schemata, then, stipulates how the perceptual system is directed toward particular contextual features in the event. Within an event, different strands and textures can emerge.

According to Neisser's theory, perceivers "see" information available in the light differently or "see" different information in it because their schemata vary. Differences in what perceivers pick up can be partly attributed to perceptual learning (i.e., their past experiences in detecting the information specified in the layout); but different features of the layout may also emerge given the activities or purposes of the perceivers. For example, if two fully capable perceivers--say, a robber and my secretary--would enter my office and

stand before my desk, each would look at the same information available differently. As both Gibson and a contextualist would maintain, the information is specified in the light; but as Neisser and a contextualist would claim, the perceivers' participate in the constitution of what is "seen." Thus, my secretary would probably not "see" my silver bracelet lying by my billfold, nor would the robber "see" the report. As this example also illustrates, anticipations directly link perception to action. Existential conditions exist in the situation, but different contextual features may emerge given the quality of the situation, and their emergence depends on the experience of the perceiver and the expectations she may have. Neither the existential conditions nor the perceiver come first; no separate mental image stands between the two. For the contextualist the continuous transaction of organism-environment is irreducible.

Conclusion

I have argued that the associationist tradition, as represented in the theories of Berkeley and von Helmholtz, has significantly influenced psychological assumptions and investigations about the nature of perception. In Pepper's metaphysical framework, this tradition in perception constituted a mechanistic world view. There is a paradoxical twist in the application of associationism to psychology: in reducing experience to its particulars in order to gain epistemological certainty, it concomitantly attributes constructive powers to the "mind" (albeit only through associations passively formed). And so, as Yeats describes, "the pragmatical, preposterous pig of a world," (which an

associationist like Berkeley reduced to particular sensations as the most secure, "solid" basic for knowledge) exists only in the "mind" which, paradoxically, can on the instant "but change its theme." Even though radical behaviorists, perhaps understandably skeptical about solving this paradox, tried to eradicate the mind from explanations of behavior, this paradox has remained in psychology and has surfaced again during the last decade in the literature on information processing (see Fodor, 1981, for a current review of behaviorism and cognition). It is perhaps most notable in the indirect theories of perception which underlie information-processing models.

Gibson (1979) has claimed that his theory of direct perception will solve the paradox and make "old puzzles disappear" (p. 304). Categorically rejecting mechanistic assumptions about perception, he attempts to establish a new root metaphor for perception (and psychology as a whole). Although I have focused on recent expressions of a contextualistic root metaphor, I should note that Gibson's and Neisser's theories are foreshadowed, to some extent, by the perceptual transactionists (Adelbert Ames, Hadley Cantril, William H. Ittleson, and others). Dallet (1974) provides an excellent historical analysis of the relation between the transactionists and recent researchers like Gibson.

On many counts, the root metaphor Gibson develops parallels a contextualist one; yet, ultimately, his theory inadequately specifies the perceiver's role, a role which the contextualist claims has its origin in biological activity. Fodor and Pylyshyn's (1981) critical analysis of Gibson's theory points to its shortcoming from a mechanist point

of view. Indirect theories of perception give far-reaching constructive capacities to the perceiver; Gibson's theory of direct perception gives priority to the environment. The contextualist points to the transaction between the two. Neisser's theory of perception as a cycle, in which both the perceiver and the perceived modify and are modified, is an attempt to align Gibson's theory to contextualism; but as I shall argue in my concluding chapter, Neisser's employment of the term schemata raises difficulties. In contrast, Turvey, Shaw, Reed, and Mace (1981) develop Gibson's theory by focusing on natural laws and ecological relationships. This may prove a more fruitful approach in the long run.

My analysis of two recent psychological theories of perception indicates that a mechanistic world view alone will not suffice. As illustrated in my analysis of Johansson's (1973) experiment, mechanistic assumptions become extremely limited in explaining "event" perception. From Pepper's framework, both the theories about and much of the research on event perception represent a move away from multiplicative corroboration as the only legitimate kind of evidence. Event perception researchers and theorists explicitly utilize structural corroboration; this shift to a straightforward hypothetical method may prove to be the most dramatic effect their theoretical and investigative work may have in psychology. My analysis has also made clear that evidence for a contextualist world view is present in recent theoretical and investigative work in perception. In following Pepper's framework, contextualism can neither be proposed as the only legitimate and adequate

world view for the psychological investigation of perception, nor is it without its own theoretical limitations. My argument is that contextualism appears to be as viable as mechanism; and if this proves warranted, the metatheoretical shift occurring in the field of perception will have important implications for understanding other cognitive processes as well. Theoretical accounts of memory are, perhaps, most directly influenced, as I shall illustrate in the next chapter.

Chapter IV

Memory

> We want to know how, by its own vitality, and without carrying complementary material into a mythical unconscious, consciousness can, in course of time, modify the structure of its surroundings; how, at every moment, its former experience is present to it in the form of a horizon which it can reopen--'if it chooses to take that horizon as a theme of knowledge'--in an act of recollection, but which it can equally leave on the fringe of experience, and which then immediately provides the perceived with a present atmosphere and significance. A field which is always at the disposal of consciousness and one which, for that very reason, surrounds and envelops its perception, an atmosphere, a horizon or, if you will, given 'sets' which provide it with a temporal situation, such is the way in which the past is present, making distinct acts of perception and recollection possible.
>
> Merleau-Ponty, Phenomenology of Perception

I have argued that, until recently, a mechanistic world view dominated the field of perception almost exclusively. In addition, the underlying assumptions psychologists have held about perception have greatly influenced what they have claimed about memory. While traditionally, for example, perception and memory have been classified as two separate, mutually exclusive types of activities (Johansson, 1979, p. 97), conceptualizations and descriptions of perceptual activities have both directed and delimited conceptualizations and descriptions of memorial activities. In turn, the assumptions about the nature of perception and memory, and their interrelation, affect assumptions about cognitive processes such as problem solving and concept formation, which rely on complex perceptual and memorial functioning. Mechanism and contextualism present contrasting assumptions not only about perception and memory but also about the relationship between them. In this chapter, I shall illustrate how Pepper's theory of metaphysical systems, and in particular, his description of contextualism may be fruitfully applied to psychological theories of memory.

As in the field of perception, psychologists in the field of memory have been engaged in fairly extensive metatheoretical discussions (Nilsson, 1979). Tulving (1979) identifies the growing interest in metatheoretical issues in recent research literature as one of the most important indices of change within the memory field (p. 25). Certainly, the application of the information-processing approach to the field of memory stimulated a plethora of models and miniature theories, but as Nilsson (1979) notes, the mass of data and numerous theories resulting

from this approach "existed for the most part as independent entities, incapable of being integrated by even the most clever of theorists (p. 6). So many different technical concepts emerged that Underwood (1972) concludes his review of coding theories by stating: "Our models and theories are overloading the subjects' memory" (p. 21). Thus, the recent interest in metatheoretical issues can be attributed, at least in part, to the seeming lack of any consistently employed, cohesive frameworks in the construction of models under the information-processing approach (see Wickelgren, 1981, for an alternative perspective on the status of memory theories).

Many of the metatheoretical discussions concerning memory focus on the role associationism and mechanism have played in conceptualizing memory and its investigation in psychology (e.g., Anderson & Bower, 1973; Wilson, 1980), and several memory researchers (e.g., Bransford, McCarrell, Franks, & Nitsch, 1977; Greeno, James, Da Polito, & Polson, 1978; Jenkins, 1974b; Voss, 1979) have drawn a conclusion about associationism that is strikingly similar to Gibson's: other theoretical, and ultimately, metatheoretical alternatives need to be explored. Jenkins (1974b) states,

> [Associationism] is so pervasive in American psychology that it is almost coextensive with being an experimentalist. . . . But associationism is only one view; it is not a necessary view. (p. 786)

Jenkins also makes clear that the application of associationist models within psychology has supported a mechanistic world view. While recent theoretical discussions in the field of perception have generally not

recognized Pepper's World Hypotheses, it has been more widely referenced in memory literature, primarily since Jenkins employed Pepper's theory of metaphysical systems in his analysis of memory theories.

In arguing that contextualism is being developed as viably in the field of memory as it is in the field of perception, I shall draw on a number of converging theoretical tendencies. Jenkins' article (1974b) will provide the general anchor for my discussion; additionally, Turvey and Shaw (1979) apply the "ecological approach" (taken from the field of perception) to the study of memory. Bransford, McCarrell, Franks, and Nitsch (1977) integrate the Gibsonian view of perception with their contextualist view of memory. Finally, recent research in information processing has forced problems of knowledge representation to surface in the field of memory. As in the field of perception, the resolution of this problem differentiates mechanist and contextualist world views. Winograd (1981), a leading researcher in artificial intelligence, has adopted a contextualist view of understanding language, a view that directly affects the way in which memory can be conceptualized and investigated. So extensive is the general interest in context in memory research that Seigal (1977) has claimed, "The contextualist world view is becoming more and more the dominant one" (p. 197).

My approach in this chapter will generally parallel that of the perception chapter. In the first section, I shall discuss mechanistic conceptualizations of memory and then illustrate how classical associationist assumptions provided the basis for the research tradition which originated with Ebbinghaus (1913); these assumptions continued through

the 1950s in serial and paired associate verbal learning research, although they were modified to fit the stimulus-response paradigm current during this period. With the introduction of the role of organization into memory research in the 1950s and 1960s, one of the classical "laws" of associationism, contiguity, was, on the whole, abandoned, and the information-processing approach began to be applied to the study of memory. As a result of organizational and information-processing points of view, models and miniature theories developed around various conceptualizations of memory "components." My task, in tracing this development, will be to illustrate how mechanism continued to influence psychological treatments of memory under the information-processing approach even though associationist principles continued to be modified (e.g., Anderson & Bower, 1973; Wilson, 1980). Specifically, the nature of the input, the type of processing the input undergoes, the hierarchical, associative networks that represent knowledge in semantic memory, and the relegation of context to a peripheral role will be shown to exemplify mechanistic presuppositions. In the next section, I shall analyze a series of experiments by Bransford and Franks (1971) which call into question mechanistic assumptions about memory and show how the best interpretation of their findings suggest a contextualist viewpoint. In the final section, I shall present a view of memory based on contextualist philosophy and discuss recent theoretical and empirical research in the field of memory that moves toward a contextualist world view.

The Mechanistic View of Memory

In the last chapter, I illustrated how the mechanist account of visual perceptions relies on an empiricist epistemology (i.e., all knowledge can be reduced to perceptual knowledge); the mechanist view of memory assumes empiricism but relies primarily on associationism. In the classical empiricist account of visual perception, an organism's senses are stimulated by particulars from the environment, and the data are registered sequentially on the retina. These elements become bonded together in experience through a psychological process; namely, through the operation of the laws of association. The connections between elements are not rational; in classical empiricism, they are usually limited to those of contiguity, resemblance, and cause and effect. Of all the laws proposed, the law of contiguity remained foremost in accounting for association, particularly in psychology. As Anderson and Bower (1973) state,

> [The focus on contiguity] is witnessed by the number of subprinciples enunciated within British associationism whose only purpose was to augment the principle of contiguity. Specifically, vividness of experience, frequency of experience, duration of experience, and recency of experience were all suggested as determining the strength of a particular association. This set of principles should sound very familiar to experimental psychologists, since they have generated a great many experiments on memory and verbal learning. (p. 23)

Given strength of association determined by such subprinciples, well-formed simple associations build up to form more complex ones. A particular sensory experience and any associations between particulars must be stored somewhere while others are registered and bound together; in the associationist view that somewhere is memory.

Because memory can not be observed directly and its contents and functions can only be inferred, most conceptualizations of memory are fundamentally metaphorical in nature (see Lakoff & Johnson, 1981; Marshall & Fryer, 1978; Roediger, 1980; Watkin, 1978, for discussions of the type of metaphors employed in cognitive psychology and in the field of memory). In the classic associationist accounts, memory, to use John Locke's metaphor as an example, was conceptualized as "the storehouse of our ideas," a "repository." As Locke (1690/1959) states,

> But, our ideas being nothing but actual perceptions in the mind, which cease to be anything when there is no perception of them; this laying up of our ideas in the repository of the memory signifies no more but this,--that the mind has a power in many cases to revive perceptions which it once had, with this additional perception annexed to them, that it has had them before. (p. 194)

Underlying the empiricist view of perception, Gibson has identified the mechanistic metaphor, "The eye is a camera"; in extending this metaphor, memory becomes the container (or, more figuratively, the picture-album) for the snapshots taken by the eye. Both the classical associationist assumptions and the "storage" metaphor have important implications for theories about memory.

For one, perception and memory are conceptualized as two separate processes. In visual perception, discrete entities imprint on the retina; in memory copies of these entities are laid down in traces which later can be searched out. As Johansson (1979) states, "Perceptual 'material' is tied together by memory 'processing'" (p. 97). In a sense, memory becomes the bridge between sensations and experience. What enters memory, as Malcolm (1977) notes, "is thought to stand in a one-

to-one correspondence with . . . past reality, as remembered" (p. 126). He goes on to state:

> It would appear that the persistent philosophical claim that "Memory demands an image" (Russell) is not an insistence on what is literally an image, but rather an insistence on the presence of a "complex structure" which will provide a representation by virtue of having a one-to-one correlation with what is remembered. (p. 127)

From this view, not only are memory and perception separate, but memory also holds a static collection of the objects of past experience; it can not enter into new perceptual experiences in any active sense.

Another implication of the associationist view of memory is its spatiotemporal spread. The law of contiguity states that associations occur together in time and space. Since the particulars of experience never lose their qualities, any association that takes place between them must allow the separateness to be retained. Such a connection, close as it may be in time and space, implies mental space. According to Roediger (1980), "The conception of the mind as a mental space in which memories are stored and then retrieved by a search process has served as a general and powerful explanation of the phenomena of human memory" (p. 238). Based on the law of contiguity (and its subprinciples), stored associations will be strong (e.g., close together) or weak (e.g. far apart). The metaphor of the storehouse is, of course, spatial; moreover, the spread of associations in memory concomitantly explains retrieval of past associations as a "search" through the storehouse. The concept of memory "trace," which can decay or be interfered with by traces previously or newly laid down, is analogous to a path through

associations spread out in time and space. As William James (1890) states, "The habit-worn paths of association are a clear rendering of what authors mean by 'predisposition,' 'vestiges,' 'traces,' etc., left in the brain by past experience" (p. 655).

The passivity of the organism in both perception and memory follows from the above assumptions. As Voss (1977) states, "Associationism tended to maintain that what is learned and remembered is essentially a copy of the environment, and in such learning the individual is a passive recipient of information rather than an active processor (p. 377). The British Empiricists thought that an individual could "deliberately reflect" on prior associations and so discover new ones, but the basic elements of such reflection simply produced new bonding. Memorability results from the recording of impressions and associations, and remembering consists in retrieving them. In classic associationist views, what gets stored in memory has no organizing capacity or construal potential; the organism makes no active contribution to memory. Even more recent approaches to memory have difficulty with the organism's role. For instance, information-processing theorists have generally asserted that the view of the individual as passive has been obviated by the claim that information, in their models, is not "processed." Yet, as many critics have pointed out, "who" processes the information remains unclear; the hypothesis that a homunculus or "inner person" "sees" the retinal image and then processes it leads to an infinite regress because how the "inner person" perceives must be explained (cf. Shaw & Bransford, 1977, pp. 7-10).

Finally, like the act of perceiving, memorial processes in the associationist view strip experience of its context. Perception consists of images, impressions, and/or objects isolated from the situations in which they are embedded, and memory stores them as such an isolated collection of things extracted from experience. This, of course, occurs as the result of reductionism, a key principle in the empiricists' claim about empirical knowledge. The empiricist realizes that the world is not experienced as a series of discrete sensations, and so the world must be reconstituted through associative laws. Although several of the associationist assumptions have been modified historically in psychological theories of memory, this reductionist assumption continues throughout every associative theory of memory. For the mechanist, the association between particulars, whether they be defined as sensations, words, propositions, or properties, involves the reduction of experience and simultaneously a derogation of context (or situation). Conversely, contextualists view the experiential context as essential and irreducible; and while not denying the fact of association, they view it as a single component of the experience.

Such a broad overview of the traditional associationist account of memory leaves out different formulations and more technical developments that occurred within the empiricist philosophical tradition, but the main assumptions which I have outlined will serve to guide my analysis of how mechanism has influenced (and continues to influence) psychological thinking about memory. In the chapter on perception, I began the discussion of the empiricist-associationist tradition in psychology by briefly examining the theory of a key experimental psychologist,

von Helmholtz, whose works have had lasting influence on the psychological investigation of perception. In the field of memory, the assumptions and experiments of Ebbinghaus (1913) had as powerful an impact on the subsequent theory and investigation of memory as von Helmholtz's had in the field of perception.

Within the classical associationist conception, memory contained images or copies of past experience; however, neither these bare particulars nor their association are remembered, only the products of associations. That is, one does not remember a "red" but the "redness" of an apple. Additionally, since memories can not be directly observed, the experimenter had either her own subjective experiences or the verbal reports of others. In order to study memory scientifically, then, the experimental psychologists needed a basic unit to serve as the independent variable in the laboratory setting; moreover, such a basic unit had to be capable of undergoing the processes of association. The basic unit which Ebbinghaus identified and experimented with was the nonsense syllable.

Bartlett (1932) provides one of the most succinct accounts of Ebbinghaus' experimental rationale for using the nonsense syllable in memory experiments.

> [Ebbinghuas] realised that if we use continuous passages of prose or verse as our material to be remembered, we cannot be certain that any two subjects will begin on a level. Such material sets up endless streams of cross-association which may differ significantly from person to person. It is an experiment with handicaps in which the weighting is unknown. Provided the burden of explanation has to be borne by the stimulus, this is obviously a real

> difficulty; for the stimuli have every appearance of varying from one person to another in ways incalculable and uncontrollable. There appears an easy way of overcoming this obstacle. Arrange material so that its significance is the same for everybody, and all that follows can be explained within the limits of the experiment itself. Since the experimental conditions are both known and readily analysable, the explanations can be expressed definitely and with the greatest possible certainty. Now, thought Ebbinghaus, with great ingenuity, if all the material initially signifies nothing, all the material must signify the same for everybody. Moreover, any variable significance that becomes apparent in the course of the experiment must be explained by the course of the experiment. (p. 3)

Germane to Ebbinghaus' methodology was the analytic view of associationism--"the view that attempts to reduce psychological phenomena to as many simple pairs, or sets, of items as possible" (Robinson, 1932, p. 25). In a controlled experiment using language, the stimulus had to be simple, isolatable, and, in Ebbinghaus' thinking, meaningless since a meaningful stimulus would carry with it pre-existing complexes of associations which would contaminate any measurements made during the experiment. The associationist psychologists, at the turn of the nineteenth century, saw their principal task as investigating how simple, elementary entities combine to form more complex ideas. The formation of simple associations was taken to be the basic process from which more complex behaviors could be explained. Discovering how elementary units like nonsense syllables did combine in memory could eventually be generalized to explain how more complex and meaningful materials could be remembered.

By and large, Ebbinghaus' experiments conformed to the associationist tradition which had evolved from the British Empiricists. Because his experiments have been widely cited, I shall briefly describe their main thrust. He repeated aloud a list of nonsense syllables (to the beat of a metronome) and then tried to repeat, from memory, what he had read. His classic "forgetting curve" charts the number of nonsense syllables retained in relation to the number of trials required to relearn the initial material over various time intervals. As Marshall and Fryer (1978) conclude,

> The nature of Ebbinghaus' results: that the number of trials required to learn increases very rapidly as the material increases in length; that the curve of forgetting falls rapidly at first, then more slowly; that overlearning is proportionally related to extent of remembering; and that repetitions separated in time ('spaced') are more effective than when crammed together ('massed') is . . . unexciting. The precise, numerical parameters of these effects are, however, of paramount importance in the construction of finely detailed, fully explicit models. (p. 7)

In the progress of his experiments, Ebbinghaus soon discovered that the seemingly meaningless nonsense syllables he was memorizing could easily elicit numerous associations (which he tried to surpress during the experiment). He notes, for example, that

> the homogeneity of the series of syllables falls considerably short of what might be expected of it. These series exhibit very important and almost incomprehensible variation as to ease or difficulty with which they are learned. It even appears from this point of view as if the differences between sense and nonsense material were not nearly so great as one would be inclined a priori to imagine. (1913, p. 3)

Most researchers who followed Ebbinghaus recognized that nonsense

syllables are not "meaningless" and gave up the attempt to describe the formation of simple associations from scratch, so to speak, and instead attempted to "describe the conditions that modify the strength of [already formed] associations" (Deese, 1965, p. 7).

Ebbinghaus' use of small linguistic items to study association and the quantitative and methodological techniques he employed had considerable impact on the study of memory and association in psychology as a whole. The method he used, called serial reproduction, became the basis for the verbal learning tradition which focused solely on small verbal elements and their association. Specifically, three experimental paradigms emerged. In serial learning, the technique employed by Ebbinghaus, the subject is presented one word at a time from a list and on subsequent presentations tries to anticipate the next word that will be shown (Morris, 1978, p. 27). During the next few decades, however, the paired-associate learning task, an outgrowth of serial learning, came to be the dominant experimental paradigm for testing memory. In this experimental procedure, subjects are presented pairs of items and then required to recall one, usually the second, by being shown the other. In free recall, the third method, the experimenter presents the subject a list of words, one at a time, and then asks subjects to recall the words in any order they choose. The paired-associate learning task, which evolved from Ebbinghaus' experiments, fit congruently with the associationist tradition but also with the behaviorist stimulus-response paradigm that flourished during the 1930 and 1940s.

An important theoretical shift took place when the associationist view of memory was incorporated into the stimulus-response paradigm;

essentially psychologists turned away from the British Empiricists' concern about association between ideas in the mind and focused on associations between stimuli and responses. As Greeno, et al. (1978) note,

> If one considers an association to be a connection between a stimulus and a response, then paired-associate memorizing represents a paradigm case for association theory, in that the process of forming an association can be observed in a relatively simple and pure form. (p. 57)

Robinson's (1932) theoretical analysis of associationism translated associationist principles of contiguity and assimilation into the language of stimulus-response psychology. In order to fit the principle of contiguity into the stimulus-response paradigm, he had to argue against a strict interpretation of contiguously formed associations (i.e., temporal overlap or immediacy). For example, he states,

> But contiguity is after all a continuous variable and the supposition that we get association only with a zero interval between associated processes is not exactly what one would expect . . . it would seem as though we ought to get varying degrees of association with varying degrees of contiguity. (p. 74)

Essentially Robinson emphasizes the secondary factors of association, like frequency, intensity, and duration, as sufficient conditions for learning, rather than contiguity alone. Further, as Deese (1965) explains, "Associations after Robinson are clearly unidirectional. The first element, whether it is conceived of as a percept or a centrally occurring idea, has the property of a stimulus, and the second element has the property of a response" (p. 7).

In the process of aligning associationism with behaviorism, the conception of the stimulus changed. Associations occurred not between elementary ideas (in the mind) but between the observable stimulus as presented by the experimenter and the subject's response. Thus the stimulus could be studied functionally, and verbal learning came to be equated with verbal behavior. Nonetheless, the experimental rationale remained the same:

> The clear parallel between the paired-associate paradigm used to study the experimental association of artificial material, and the stimulus-response pairs studied in word association investigations points to a basic congruence in the assumptions underlying the two methods. That is, in both cases it is assumed that understanding the simple S-R associative habit will be beneficial in understanding more complex cognitive processes. (Cramer, 1968, p. 3)

Although the relation between the stimulus and response came to be viewed functionally, researchers continued to use single words as stimuli in verbal learning experiments because they held an associationist (or objectivist) view of language. Lakoff and Johnson (1980) summarize the building block theory of meaning, which underlies such a view of language, as follows:

> When words and sentences are written down, they can be readily looked upon as objects. This has been the premise of objectivist linguistics from its origins in antiquity to the present: linguistic expressions are objects that have properties in and of themselves and stand in fixed relationships to one another, independently of any person who speaks them or understands them. As objects, they have parts--they are made up of building blocks. (p. 204)

In short, Lakoff and Johnson note, "the meaning of the whole sentence will depend entirely on the meanings of its parts and how they fit together" (p. 202). In the word association tradition, the study of "words," the basic building blocks for meaning, could through associative "chaining," constitute meaning in language (and thought). Thus, the behaviorist influence shifted attention away from the association of mental entities. Even though this particular feature of classical associationism was redefined, such a shift did not alter other associationist principles, such as reductionism.

Ebbinghaus thought he could investigate pure memory experimentally in the laboratory. Under the influence of behaviorism, which emphasized the importance of overt behavior, the study of memory in and of itself (its functions, processes, and structure) attracted little attention. Interestingly, the same year Robinson's (1932) book on associationism was published, Bartlett published a book which criticized associationism and offered an alternative approach to the study of memory. That Bartlett's book, on the whole, did not gain much attention in memory literature until the 1970s exemplifies the stronghold associationism had on the field of memory research. As Watkins (1978) notes, memory span provided a device for measuring associations. Most of the experiments in the verbal learning tradition until the 1950s investigated a variety of task and material variables (see Morris, 1978, for a brief, cogent review). Experimenters tested the effects of similarity between word lists, transfer and practice, distribution of practice, and other variables that affected acquisition (see Hovland, 1951; Kausler, 1974; McGeoch & Irion, 1952, for more extensive accounts of this research).

Interference effects (proactive and retroactive) which explained forgetting were extensively studied.

Although behaviorists like Watson disparaged any reliance on higher mental processes to explain behavior, the verbal learning tradition, to the extent it made theoretical claims about memory, retained a fairly traditional associationist view. The assumption that perception, language, thought, and memory consisted of discrete mental elements all of which correspond to the physical world through empirical connections had strongly influenced psychological thinking (until the advent of classical behaviorism). As Pepper (1942/1961) notes,

> This psychology of discrete mental elements is the neatest and, in that respect, the most intellectually satisfying psychology that has been developed. It almost works, and has been very widely accepted from its first extensive systematization by Locke to its complete development in Titchener. (p. 219)

Although the way in which memory was treated changed under the influence of the stimulus-response paradigm, in the verbal learning tradition memory still remained a repository for stored connections. With the introduction of mediation into the behaviorist paradigm, the conception of memory as storehouse reappeared explicitly (see Cofer & Foley, 1942; Goss, 1961 for theoretical discussions of mediation). The hierarchy of associative chains of behaviors, organized from simple to complex, existed in memory; they could be retrieved and function as mediators in behavior. Maltzman's (1955) extension of Hull's family-habit-hierarchy to problem solving relies on such a view of memory.

The general associationist theory of memory that I have been tracing in psychology can be stated as follows:

> The world presents itself as a diverse series of events; we respond with discrete mental states (ideas) or behaviors (responses) in a series which copies some aspects of the world's series and which can be activated by some portion of that series at some later time. (Jenkins, 1974a, p. 2)

In his article on memory metaphors, Roediger (1980), summarizing the dominant analogies used to describe memory until organizational theories emerged in the 1960s, states,

> The analogies . . . employed some particular object to represent a likeness to memory. The usual assumption was that memories could be conceived as discrete objects distributed across some space (the spatial storage assumption) for which one must then search during recall (the search assumption). (p. 237)

This complements the traditional, and I have argued mechanistic, approach in the field of perception; as Gibson (1979, p. 206) documents, the traditional unit for the investigation of perception was the object (or its parts) which was stored in memory. In the field of memory, experiments in the verbal learning tradition assumed the basic unit for understanding verbal behavior was the word (or its parts). Actively involved in word association research in the 1950s, Jenkins (1974b) outlines the main associationist presuppositions that guided his experimental investigation:

> 1. Units. I believed that words were the fundamental units of language. To me this was natural and obvious.
> 2. Relations. I believed that there was one kind of relation between words, associative linkage. Words became linked

> to each other through use together or use in the same "frames."
> 3. Structures. I believed that mental structures (if there really were any) were assemblies of links, essentially chains of the fundamental units in their fundamental relation. Hierarchies, like Hull's "habit family hierarchies," were simply lists of chains varying in strength, so that one was employed first, then another.
> 4. Complex behaviors. I believed that complex behaviors were built of simple subassemblies and that things got more complicated but not different "in kind." (This belief justified concern with simple units and relations and sanctioned experiments on such units in the faith that they would eventually add up to the complex behaviors of language.)
> 5. Mechanistic explanation. I believed that explanation ultimately rested on a description of the machinery that produced the behavior. I believed that a description of the machinery plus the history of the organism and its present circumstances inevitably predicted its behavior. There are two corollaries of this belief. First, I thought that the action of the machinery must necessarily be automatic. And, second, I could see that most of the interesting behaviors had to be explained by extensive reliance on learning and memory. (p. 786)

Similar accounts of such pre-suppositions can be found in Anderson and Bower (1973) and Greeno, et al. (1978).

As in the field of perception, an associationist view of memory had to account for organization in memory. Certainly, Robinson extended and liberalized British Empiricists' law of contiguity; however, "almost all of the experimental study of association was based upon contiguity in presentation and stimulus-response relations in analysis" (Deese, 1965, p. 29). The law of contiguity implies no rational order or arrangement among mental events; as Deese continues, "these laws, in the simplest application, provide for a rather erratic and haphazard

organization in associative processes. For, at the bottom, associations are determined by the accidental contingencies of experience." Stated alternatively, "One metafeature of associationism denies significant internal structure in the basic unit" (Shimp, 1976, p. 123). In the late 1950s and early sixties a growing number of memory researchers raised issues which challenged the associationist tradition.

Experimental findings (e.g., Bousfield, 1953; Murdock, 1961; Tulving, 1962; 1964), artificial intelligence programs (e.g., Newell & Simon, 1961; 1963), new theoretical frameworks (e.g., Broadbent, 1958; Miller, 1956), and methodological developments (e.g., Brown, 1958; Peterson & Peterson, 1959; Sternberg, 1966) all converged under the information-processing viewpoint. The organizational approach (e.g., Mandler, 1962; 1967), which focused on the concept of memory "structures," incorporated all of these new developments. With the introduction of information processing into the field, a host of new technical concepts flooded the field and research became very specialized. Before turning to the information-processing approach, I shall illustrate some of the problems raised about associationism during this time.

Bousfield's (1953) experiment on category clustering in free recall challenged the view that associations arise contiguously. Using the free recall paradigm, Bousfield presented subjects with a list of words which belonged to different conceptual categories; he presented the words randomly, without regard to class membership. When he asked the subjects to recall the list in any order they chose, he found that, in recall, they reorganized the randomly presented list into groups or

clusters of words that fit the categories. Deese (1965), who reviews Bousfield's experiment as a paradigm case that calls into question the law of contiguity, states,

> The clustering occurs . . . because there was a mediation by a category or concept name or some nonverbal equivalent of a category. (p. 36)

Thus, these findings indicate that the kinds of haphazard arrangement of items one would expect, given contiguous association from past experience, do not occur and that subjects act upon the input and restructure it according to some higher order unit (see Colle, 1972, for a review of the subsequent research on clustering phenomena).

Not long after Bousfield's study, Miller (1956) introduced his theory of "chunking" in short term memory. He argued that short term memory could retain seven plus or minus two items, but the items did not necessarily consist of single units (like letters or numbers). They could consist of larger, more subjective units (like groups of words or numbers) depending on the subject's past experience. Both clustering and chunking defied the law of contiguity (and its subprinciples) because they suggested the importance of the subject's construal capacity and structural properties within the stimulus material.

Tulving's (1962, 1964) experiments on subjective organization in free recall produced results that reinforced these phenomena. Unlike Bousfield, who used a categorized word list, Tulving asked subjects to recall as many words as possible from a list of 16 unrelated words, which he presented one at a time. He then had the subjects study and recall the list again over several trials (a procedure called multitrial free

recall). As would be expected, recall increased with trials. Of more importance, subjects tended to recall words in the same order over successive trials but not in the order in which they were presented. Tulving hypothesized that subjects were using a strategy which he called "subjective organization" in order to enhance their recall. Moreover, as Mandler (1967) and Tulving (1967) later found, use of the strategy of subjective organization served to increase recall. Again, as in Bousfield's study, Tulving's studies found evidence of "unitization" of stimulus material; the subjects altered the material during the course of the experiment. "Tulving's analysis of output protocols convinced psychologists that active processes organized unrelated lists" (Mandler, 1979, p. 312). The patterning of the stimulus material occurred neither as a product of the order in which the items were presented nor as a result of an increase in strength over trials. In another experiment, Underwood, Ham, and Ekstrand (1962) found that subjects could associate a response with only a part of a given stimulus, a part which they selected during the experiment. Based on the finding that the stimulus the experiments presented might not be what operates as the stimulus for the subject, Underwood (1963) distinguished a nominal stimulus (e.g., what the experimenter presents) from the functional stimulus (e.g., what the subject represents the stimulus to be).

Findings such as these could not easily be accommodated by associationism. In the strict associationist view in psychology, contiguity was taken to be a necessary and sufficient condition for learning to occur. Robinson (1932) had argued that the law of contiguity did not seem to be a sufficient condition for learning to occur; studies like

Tulving's raised the question of whether contiguity was even a necessary condition. Indeed, the findings pointed to the role of semantics in establishing relations, rather than close temporal proximity. More seriously, these studies challenged the assumption that the experimenter could isolate some basic, invariant element as a stimulus. In an important analysis of how the stimulus changed as a result of free-recall studies, Shimp (1976) states,

> Several tentative conclusions have been drawn from free-recall data. Most important, a simple response, such as a single word, does not necessarily have the properties of a functional unit simply by virtue of its extreme simplicity and comparative lack of internal structure: a functional unit of behavioral analysis may change during the course of an experiment depending on the nature of the contingencies imposed on a subject's behavior, and some resulting units may be quite complex. (p. 117)

The mechanist world view, which the associationist assumption undergirds, strips away situational context by its reduction of experience (and language) to the particulars which constitute it. Throughout the verbal learning tradition, little attention was paid to the context in which psychological activities occurred. The nature of the task, the kind of instructions, the setting, and even the verbal context provided by the stimulus materials themselves were largely ignored. In the field of perception, the Gestalt psychologists criticized the associationist account of perception because their experience indicated that a specific stimulus could have different effects in different contexts. The free-recall experiments of the 1960s implicitly raised a similar criticism in that the properties of the stimulus changed based on the arrangement of stimulus material and/or the subject's past experience.

The experimental tradition Ebbinghaus initiated assumed that through isolation and control "meaningfulness" could be limited to the stimulus. Somewhat ironically, Bartlett (1932) anticipated the problem raised by these experiments.

> To make the explanation of the variety of recall responses depend mainly upon variations of stimuli and of their order, frequency and mode of presentation, is to ignore dangerously those equally important conditions of response which belong to the subjective attitude and to predetermined reaction tendencies. (p. 4)

Not until the early 1970s did memory researchers systematically explore the question of contextual effects in recognition (e.g., Thomson, 1972; Tulving, 1972; Watkins & Tulving, 1975).

With growing experimental evidence of the role of organization in memory, and particularly in recall, most references to the law of contiguity and its subprinciples disappeared from memory research. More recent advocates of associationism (Anderson & Bower, 1973; Wickelgren, 1981; Wilson, 1980) are quick to separate their associationism from the classical formulations of it. Not all researchers abandoned contiguity; for example, the more traditional associationist position could explain categorical clustering as associative clustering, but Cofer's (1965) study demonstrated that associative clustering and categorical clustering were independent kinds of organization. Although the information-processing approach and the organizational approach raised questions about associationism, their proponents tended to conceive of these approaches as atheoretical. No one makes this claim as clearly as Mandler (1979):

> As a belief, as a point of view organizational approaches are not testable in any conventional sense of the term. The organization of mental contents is assumed to be axiomatic--it guides the kind of theoretical endeavor its adherents propound; it does not itself lead to any testable or falsifiable consequences. Thus any kind of observation about human memory is grist for the organization theorists' mill. Even the remaining strongholds of association theorists, pairwise and serial "associations," are viewed as nothing but challenges. (p. 306)

Whether or not such an analysis holds, the organizational approach, as it merged with and adopted information-processing views, did not overthrow the traditional mechanist conceptualization of memory, nor did it produce a new metatheory.

As I shall argue throughout the remainder of the chapter, the information-processing approach to memory generally supported mechanist pre-suppositions and assumptions, particularly about semantic memory. Estes (1979) states,

> Contemporary theoretical treatments of long-term, semantic memory, like those of short-term memory, have been strongly influenced by the information-processing approach; but for the most part they have not departed as sharply from traditional conceptions of associations. (p. 51)

The information-processing approach introduced formalism into conceptualizations of memory and its functioning. Processing models were programmed on digital computers which operate with information represented in terms of "bits" or discrete elements. These elements relate to each other according to formal rules. Although information-processing research has increasingly employed more flexible and contextually sensitive data types, in all programs experience and

knowledge are reduced to basic, isolated components or facts connected through logical operations. But the mechanism is perhaps most evident in the man-machine analogy.

The man-machine analogy underlies most information-processing approaches designed to simulate how knowledge in memory operates. Briefly stated, "Mental processes resemble . . . the kinds of processes found in computer programs: arbitrary symbol associations, treelike storage schemes, conditional transfers, and the like" (Minsky, 1969, p. 429). The analogy pervades much research in cognitive psychology and memory. Although somewhat simplified, the extension of the analogy is described best in introductory textbooks. Loftus and Loftus (1976) state, for example:

> Both computers and people are information-processing systems. . . . Both computers and humans take in information from the environment. Computers do this using card readers, tape drives, etc., whereas humans do it using their sense organs. Inside a computer, the information from the environment is manipulated, recoded, and combined with other information already there. This is done via activation of electronic registers. Inside a person, information is manipulated, recoded, and combined with other information already there. This is done via activation of memory. Finally, a computer outputs information to the environment via output devices, such as teletypes and line printers. Likewise, humans output information to the environment via such output devices as mouths and hands. (pp. 5-6)

Many psychologists employing information-processing concepts claim the man-machine analogy is "used purely as an heuristic device" and "does not imply any particular ethical or philosophical position" (Herriot, 1974, p. 3). One of the main tenets of this dissertation

is that analogies such as this do not arise in a metatheoretical vacuum. Pepper's theory of metaphysical systems, Kuhn's (1962) theory of scientific paradigms, and more recently Lakoff and Johnson's (1980) theory of metaphor and thought assert that conceptual tools, such as metaphors or analogies, provide frameworks that place constraints on the development of theory and, ultimately, metatheory. Certainly, the use of the computer as an analogical tool does not a priori imply a particular metatheory; rather, in the case of the computer analogy, the literalness with which the analogy is applied and the extent of its application to cognition determine its metatheoretical import. As several critics (Dreyfus, 1979; Shaw & Bransford, 1977) have documented, the information-processing approach in cognitive psychology takes "the mind as machine" metaphor quite seriously.

To illustrate how information-processing approaches explain memory, I shall briefly summarize the fairly standard account given by Loftus and Loftus (1976). Accompanying most descriptions of the flow of information through memory are charts (similar to the one illustrated earlier, p. 22). Information, impinging on the senses, goes into what are called sensory stores (iconic or echoic, for example). Through some type of recognition process, usually feature detection, information gets transferred from the sensory stores to a short-term store where, if it is elaboratively rehearsed, it enters long-term store. Once the information reaches long-term memory, it must then be stored in such a way that it can be retrieved. In the information-processing framework, most attention has been given to the contents and structure of long-term,

semantic memory because, as Loftus and Loftus (1976) state, "in order to theorize about a retrieval process, we need to know something about the structure from which we are retrieving" (p. 124).

Although such an approach and the types of pyschological questions it brings with it for theory and research deviate significantly from the word association tradition, most of the assumptions which underlie it have supported a mechanist view. This can be illustrated best by the model's reliance on the sensory store which holds "raw, sensory information, as yet unanalyzed for meaning" (Loftus & Loftus, 1976, p. 21). As noted in the perception chapter, such an assumption implies that perception is indirect; that is, that the information received is somehow insufficient and must be reconstructed (which is equivalent to "processed"). Although Neisser (1976) altered his views of perception, his original book (1967) presents the classic formulation of cognitive psychology from the information-processing point of view. In it, he advocates the indirect perception hypothesis:

> As used here, the term "cognition" refers to all the processes by which the sensory input is transformed, reduced, elaborated, stored, recovered, and used. (p. 4)

Neisser's definition of sensory input, the basis for all cognitive activity in the information-processing view, is not explicitly stated, but it turns out to be some rudimentary perceptual object, for he later discusses motion perception as "successive 'snapshots' taken by the moving eye" (p. 140).

The information-processing approach, then, in most standard accounts relies on the traditional mechanist account of perception. "In

this way perception and memory are separated in accordance with the traditional definitions: The information is obtained in a series of unchangeable percepts and stored and combined by memory acts" (Johansson, 1979, p. 96). The nature of the information that undergoes processing varies from model to model, but most models posit some basic, elemental units as "nodes" in a network with associative connections (or links) between them.

Another illustration of mechanistic assumptions underlying the standard information-processing approach is the account of pattern recognition called feature analysis. Although it can be argued that the feature-analysis tradition in perception and memory conforms to Pepper's formist root metaphor (cf. Verbrugge, 1977), I would argue that, on the whole, information-processing theories attempt to describe spatiotemporal regularities in cognition. Pepper frequently documents (see pp. 174-177, 184-185, 198, 220) how formist and mechanistic categories can collapse into each other. The ties between particulars in formism and the mechanist's structural particulars in time and space are a case in point. Once the information-processing approach, however, strips the situational context to some elemental unit (usually attributes or features), then some kind of mechanism (or program) must operate on it in order to reconstitute the integrated nature of patterns in recognition. Such a view of how information enters memory has implications for how it is stored and retrieved. The usual assumption is that some basic unit is mapped into semantic memory.

Whether semantic features or networks best represent semantic memory has been recently debated (e.g., Collins & Loftus, 1975; Rips,

Shoben, & Smith, 1973; Smith, Shoben, & Rips, 1974). Wilson (1972) and Hollan (1975) have argued that these forms of representation do not essentially contradict each other (see Wilson, 1980, pp. 145-153, for a more extensive discussion of these issues). A majority of the models proposed represent semantic memory in the form of an elaborate network of interconnected "nodes" (see Frijda, 1972, for a review of this development). Depending on the model, the information that undergoes processing has various characterizations: "chunks, features, associations, semantic markers, phrase structures, lists, discrimination nets, and propositions" (Anderson & Bower, 1973, p. 136). Quillian (1969) and Collins and Quillian (1969) introduced the network analogy to account for knowledge about word meanings.

Unlike earlier formulations of association which stressed contiguity, Collins and Quillian's model stressed relations or connections between words that are stored. Quillian (1968) states the rationale for his program:

> In selecting a task to perform with a model memory, one thinks first of the ability to understand unfamiliar sentences. It seems reasonable to suppose that people must necessarily understand new sentences by retrieving stored information about the meaning of isolated words and phrases, and then combining and perhaps altering these retrieved word meanings to build up the meanings of sentences. Accordingly, one should be able to take a model of stored semantic knowledge, and formulate rules of combination that would describe how sentence meanings get built up from stored word meanings. (p. 236)

In the representational network, the conceptual items are hierarchically organized into logically nested subordinate-superordinate relations

between words. The participation in the relationship determines the association, not contiguity. Other network models have been proposed by Anderson and Bower (1973); Hayes-Roth (1977); Kintsch (1972, 1974); and Rumelhart, Lindsay, and Norman (1972).

The emphasis on logical relations and semantic factors resulted, in part, from the impact of Chomsky's linguistic theory, which pointed to grammatical relations not apparent in surface structure, and psychological studies such as Sach's (1967), whose findings indicated that syntactic structure had little impact on long-term retention while meaning did. Since Anderson and Bower's (1973) Human Associative Memory (HAM) has been so influential in research literature, I shall use it not only for illustration but also for comparison purposes as well. HAM is "conceived to be a network of associative relations among abstract semantic concepts--an interrelated set of 'meaningful propositions'" (p. 36). Anderson and Bower claim their theory to be "neo-associationist."

> Unlike past associative theories, we will not focus on associations among single items such as letters, nonsense syllables, or words. Rather, we will introduce propositions about the world as the fundamental unit. A proposition is a configuration of elements which (a) is structured according to rules of formation, and (b) has a truth value. . . . We will suppose that all information enters memory in propositional packets. On this view, it is not even possible to have simple word-to-word associations. Words can become interassociated only as their corresponding concepts participate in propositions that are encoded into memory. However, propositions will not be treated here as unitary objects or Gestalt wholes in memory having novel, emergent properties. Rather, propositions will be conceived as structured bundles of

> associations between elementary ideas or concepts. (p. 3)

Although the unit of analysis has been altered, associationist presuppositions abound. First HAM reduces all information to propositional packets which are "structural bundles of associations between elementary ideas or concepts." Each unit retains its distinctiveness so that it can be "activated" or "primed," and the linkage between units is context-independent. As Anderson and Bower state, "Our theory provides a quite 'mechanistic' interpretation of sentence learning" (p. 332); indeed, it corresponds almost exactly to Lakoff and Johnson's (1980) description of the objectivist view of language. Most of the probed recall experiments which Anderson and Bower present involved the presentation of simple sentences (propositions) isolated from any context (much like experimenters isolated individual words in word studies). Other network models, notably Hayes-Roth's (1977) and Kintsch's (1974), depart from Anderson and Bower's model in that they argue against the independent associate links (in HAM) and for higher-order units, more compatible with the notion of gestalts, which change in the learning process and under the influence of any given structure imposed upon them (see Goetz, Anderson, & Schallert, 1981, for recent experiments that challenge HAM's independent associative links). These models are more sensitive to context.

Many of the associative network models have been forced to face the issue of context because of the work of Tulving (1972) and his associates (e.g., Tulving & Thomson, 1973; Watkins & Tulving, 1975; Wiseman & Tulving, 1975). They have demonstrated that semantic

contextual variations during learning dramatically influence retention and retrieval. Tulving's (1972) encoding specificity principle "emphasizes the importance of encoding events at the time of input as the primary determinate of the storage format and retrievability of information in the episodic memory system" (p. 392). Tulving's theory of episodic memory assumes that all the events surrounding the acquisition of a word become represented in memory. The associationist can, in face of this evidence, try to control contextual variables or further isolate the stimulus from contextual effects so that it can enter a "node" in semantic memory independently, but the complexity of contextual effects ultimately raises a serious problem for networks; to state it simply, once they are admitted, they "jam" the system.

> If the number of senses a word has depends on the number of possible contexts of the word, the number of nodes for a single word in the system may become unmanageably large. (Watkins & Tulving, 1975, p. 28)

Associationist theories of memory always tend to provide ad hoc accounts of context. Bower (1972), for example, describes all the possible contextual features in an experiment as "contextual drift," which simply operate to enhance recall. Thus, the more situational attributes the subject encodes, the more cues will be available for retrieval, and this increases the probability for successful recall of the item (cf. Bransford, McCarrell, Franks, & Nitsch, 1977, for a contextualist analysis of how HAM handles context through "tagging"). Another example of Anderson and Bower's derogation of context is their explanation of episodic memory; this explanation can be inferred from their account of

learning single words (in word association studies). Since such information is not in propositional form it must be converted into some kind of proposition such as "In the list, I was presented with X" or "I thought of word X, then thought of word Y." They go on to state:

> These [propositions] encode autobiographic events--what Tulving (1972) has called "episodic" memories. If such propositions are learned, then presentation of appropriate cues would cause retrieval of the propositional memory structures. (p. 418)

When faced with nonpropositional data elements in experiments--which the total stituational context would certainly consist of as well--HAM adds propositions to match them. Anderson and Bower admit that "HAM does not provide any magical truths about encoding strategies" (p. 419). Nevertheless, the overall context can not be reduced to just another set of propositions; even for their theory to be consistent, the proposition about the stimulus material which enters memory has to be seen "through" the total context of the materials and experimental situation.

I have argued that, in general, the information-processing approach to memory is mechanistic, even though classical associationist assumptions have been modified. To the extent that the network models of memory claim to be comprehensive accounts of the structure of knowledge, they tend to embody a mechanistic world view. Thus, the model of Kintsch (1974), who limits his analysis of the construction of meaning in memory to a written text, is less mechanistic than Anderson and Bower's (1973), which posits the proposition as the basic unit of all information. The problems with context have been so powerful that recently artificial-intelligence programs which use "frames,"

"scripts," and "schemata" to represent stereotypical situations have been advanced (e.g., Bobrow & Norman, 1975; Minsky, 1975; Shank & Abelson, 1977). These programs move toward a contextualistic world view; however, as I shall illustrate later, Dreyfus (1979) and Winograd (1981) have noted the limitations of such programs for capturing all aspects of situational contexts.

Essentially, the spatial metaphor for memory as a storehouse for associations has dominated conceptions of memory in most psychological theories. Roediger (1980) concludes that

> there are currently very explicit associative theories that embody, as do the organizational theories, the spatial storage and search assumptions (e.g., Anderson & Bower, 1972, 1973). Typically, these theories assume that memory can be represented, much as in the subway-map model, as a great network of nodes that represent word concepts and are linked by associative paths . . . the organization, hierarchical, and associative theories are all similar in containing the spatial storage and search metaphors, despite the fact that none of them makes an explicit comparison between memory and particular objects. (p. 237)

Although the nature of basic elements has shifted, association between them prevails. Instead of being simply connected, they are linked associatively through relations. In their review of the metaphors which have dominated the field of cognitive psychology, Lakoff and Johnson (1981) conclude that "the mind is a machine" and "the memory is a container" metaphors need alternatives if cognitive science is to grow. To such an alternative I now turn.

Memory for Events

I shall introduce a contextualist view of memory by analyzing a series of experiments by Bransford and Franks (1971). The findings of their now-classic experiments challenge many of the associationist assumptions which supported traditional investigation of memory through the use of individual word items. Jenkins (1974b) supports his contextualist view of memory, in part, through an analysis of Bransford and Frank's study under a section entitled "Event Recognition." A number of other experiments following in the wake of Bransford and Franks' experiments have corroborated their findings (see Bransford & Franks, 1973; Bransford, McCarrell, Franks, & Nitsch, 1977, for reviews of this research). In many respects, this experiment and its results parallel Johansson's (1973) experiment on event perception and raise similar problems for associationism. Although Branford and Franks (1971) do not discuss their experimental findings within the metatheoretical framework employed by Pepper, the conceptualization, purpose, design, and results of their series of experiments are significantly different from associationist presuppositions about what is remembered.

To carry out their study, Bransford and Franks constructed four complex sentences which could be broken down into four simple, declarative sentences. For example:

COMPLEX: The ants in the kitchen ate the sweet jelly which was on the table.

SIMPLE: The ants were in the kitchen.
The jelly was on the table.
The jelly was sweet.
The ants ate the jelly.

These simple sentences (which they termed one-component ideas) were then recombined to form sentences which contained two of the component ideas (e.g., The ants in the kitchen ate the jelly) or three of the component ideas (e.g., The ants ate the sweet jelly which was on the table). A complete set of sentences for each complex sentence (or FOUR component idea) contained one FOUR, three THREES, four TWOS, and four ONES. The acquisition list contained twenty-four sentences, six from each of the four different idea sets (i.e., two ONES, two TWOS, and two THREES from each idea set). The subjects were never presented the FOUR component sentence. The sentences were randomly arranged with the constraint that no two sentences from the same idea set occurred consecutively on the list (p. 336).

During acquisition, the experimenters read the twenty-four sentences; following acquisition, they presented the subjects with the recognition set of sentences which contained new sentences in addition to the ones they had heard. The new sentences (which included ONES, TWOS, THREES, and FOURS) were taken from the four idea sets originally constructed but not included on the acquisition list. The subjects were instructed to decide whether or not they had heard the sentence during acquisition. For each sentence, they were to assign a confidence rating to their judgment. In a second experiment, Bransford and Franks repeated the first experiment but added "noncase" sentences, sentences which were syntactically similar to those in the original acquisition set but which "contained combinations of relations which were not consonant with any of the ideas presumably acquired during acquisition" (p. 342).

The results of their experiments indicated that subjects "recognized" many new sentences with great confidence even though they were never actually presented during the acquisition task. As Bransford and Franks state,

> Many NEW sentences received higher recognition ratings than OLD sentences Ss had actually heard before. . . . If Ss remembered those sentences heard during acquisition, OLD sentences should have received higher confidence ratings than all NEW sentences. Data clearly indicated, however, that OLD sentences did not receive the highest ratings on the recognition list. (p. 340)

The recognition and rating depended on the complexity of the sentences. Subjects rated with confidence (+4 and +5 on a scale of 5) the complex sentence (FOUR component idea) when in fact they had not been presented it during acquisition. Additionally, Bransford and Franks point to the ordinal relationship between FOURS, THREES, TWOS, ONES, and NONCASES. The THREES and TWOS received positive mean ratings (+2 or better); the ONES slightly negative ratings; the NONCASES low ratings (averaging about -4).

These findings suggest that memory is not just a function of individual items presented during acquisition. The subjects "acquired something more general or abstract than simply a list of those sentences experienced during acquisition" (p. 348). Certainly, the subjects relied on the information presented since they readily recognized and confidently rejected noncase sentences; nonetheless, some type of integration of the individual items into wholistic semantic ideas occurred. As Bransford and Franks state, "The subjects were most confident of having

heard those sentences expressing all the semantic information characteristic of the complete ideas acquired during acquisition" (p. 348). Bransford and Franks describe the integrative phenomena their experiment reveals as "the abstraction of linguistic ideas"; it has also been variously termed "abstract schemata construction" or, more prosaically, "memory for gist."

Bransford and Franks' study departs from the associationist research tradition on memory for language. They note that many previous studies treated memory for linguistic items, such as words or sentences, and state their purpose as follows:

> The primary concern of the present paper is not with memory for individual sentences or individual words; rather it is for wholistic, semantic ideas. . . . [Wholistic ideas] may result from the integration of information expressed by many different sentences experienced successively and often non-consecutively in time. (p. 332)

Like Johansson's (1973) study of motion perception, Bransford and Franks' study does not presuppose that memory can be reduced to a static collection of elements totally contained within the stimuli; rather the stimuli (moving dots in Johansson's experiment and sentences in Bransford and Franks') consist of relational sets which interact and alter the characteristics of individual stimulus components (a dot or a simple sentence). Since Bransford and Franks found that subjects thought they recognized both complex sentences (which they had never seen) as well as novel sentences which were consonant with the abstracted ideas, they claim, much like Johansson, that subjects actively integrated the information contained in individual sentences presented to them.

Contrary to associationists' claims--namely, that visual perception and remembering depend on the reconstitution of experience from particulars which accumulate over time--Johansson's and Bransford and Franks' findings indicate the total perceptual or memorial event determines what is perceived and remembered and not the particulars first registered and then stored consecutively through time.

Both studies strongly suggest that visual perception and memory are not a function of the consecutiveness of individual items presented over time. Associationism holds that products of visual perception (usually a static retinal image or icon) and memory retain their individiual identities; thus each complex whole can be reduced to its parts. During recognition, subjects reconstitute perceptions and memories from these elemental parts which spread out consecutively over time. The speed of the subjects' recognition in Johansson's experiment suggests that subjects were not reconstituting individual identities (dots); and, as Bransford and Franks note, "The information encompassed by NOVEL THREES and FOURS could only have been acquired by integrating information across various acquisition sentences experienced nonconsecutively in time" (p. 348, emphasis added). Most associative network models would predict that: 1) subjects would remember those sentences actually presented and 2) that the simple sentences would gain the highest confidence ratings since those simple building blocks should be stored and activated first during recognition. In opposition to this prediction, the total list of sentences presented to subjects in Bransford and Franks' experiments formed a context during acquisition that affected the individual items during recognition. As Jenkins

(1974b) notes, "The phenomena we find in recognition depend on the quality of event that the subject constructs from the experimental material during the acquisition phase of the experiment" (p. 790).

In challenging the associationist assumption that what is remembered is the accretion of individual items stored consecutively over time, Bransford and Franks' experiments concomitantly challenge the objectivist view of language assumed in past memory research. Given their findings, a sentence (or set of sentences) is not just a linguistic object whose entire meaning depends on parts and how they fit together. Associationism assumes meanings lie in words or propositions which become interconnected in a network of relations. The information Bransford and Franks' subjects constructed was more than what was directly represented in the acquisition sentences. The NOVEL sentences contained combinations of relations the subjects had not experienced. Clearly, the subjects were not passively encoding information but integrating and assimilating the information in ways that produced a degree of semantic precision considerable enough to allow them to recognize and reject NONCASE sentences.

Finally, Bransford and Franks' findings cannot be easily accommodated by most associatively constructed storage theories. Although different network models posit various kinds of elemental units (input) and different types of linkages, the individual input entities, however defined, must remain impervious to the integrative or abstraction phenomena identified by Bransford and Franks or else one loses access to any control element which functions as a gate in a network of

associations (cf. Estes, 1972). How an item enters memory (or how its trace is laid down) is not as important as activation and organization of the network itself. Additionally, the concept of activation usually assumes a spatiotemporal spread of nodes. In Bransford and Franks' study, the linguistic strings interacted in such a way that their individual identities were transformed, yet the meaning remained. What entered memory was not what was recognized, and what was recognized can not be easily accounted for by linear, hierarchical processing.

The Bransford and Franks study is a paradigm case of an experiment that more readily lends itself to a contextualist rather than associationist interpretation of remembering. Jenkins (1974b) offers the following contextualist account of the experiment:

> The subjects have used the various strands repeatedly available in the texture of the experiment to construct four events that are completely described by the four long, complex sentences. The quality of each of the events is indeed the total meaning of the complex sentence. Once the fusion of the strands into events has occurred (particularly since the strands are heard over and over again in various combinations), the subject cannot perform an analysis to recover the exact pattern of input that furnished support for the construction that he made. (p. 190)

The contextualist category of fusion (cf. Chapter 2, p. 55) states that different strands and textures in the event merge together without regard to consecutiveness in time and space. The strands and textures so tightly fuse that they cannot be individually extracted from the total context. What is remembered is not the individual linguistic items but

the quality of the subjects' interaction with the stimulus material. "Remembering is a function of the total set of experiences to which an input belongs" (Bransford, McCarrell, Franks, & Nitsch, 1977, p. 455).

Although I have argued that Bransford and Franks' findings corroborate a contextualist view of memory, I should note briefly that some attempts have been made to reinterpret their findings from an associationist perspective. Anderson and Bower (1973), for example, provide an admittedly post hoc explanation of the results (even though HAM is built from propositions similar to the sentences used by Bransford and Franks). They argue that each sentence (which Bransford and Franks presented the subjects) has an accompanying context tag, something of the order "In context C, I studied that the ants ate the jelly" (p. 348). Because the sets of sentences contain material which overlaps, each sentence has several context tags. Thus a kind of interference effect explains why the subjects cannot discriminate NEW from OLD sentences. The problems with this explanation (as they admit) lies in the complexity of interrelations between propositions since the subjects must "compute" the relations:

> The [subject] must examine all the contextual linkages of all the propositions in the target sentence, determine if there are any intersections, check whether these intersecting contexts lead to all the target propositions, and finally make sure that no nontarget propositions are connected to any candidate contexts. (p. 350)

The concepts of interferences or confusion typify most associationist explanations of the results obtained by Bransford and Franks (cf. Walker

& Meyer, 1980). Nevertheless, as Bransford, McCarrell, Franks, and Nitsch (1977) reply to such an explanation, the fact remains that "the subjects are not confused about the global information derived from the total set of acquisition experiences. They know the overall events that were communicated" (p. 456).

Not all associationist theories account for the phenomena of linguistic abstraction like HAM does. Hayes-Roth's (1977) knowledge assembly theory, for example, explains this phenomenon through the theoretical constructs of higher order assemblies and unitization (and thus her account is not post hoc). Stated in terms of her theoretical constructs, cogits, "the smallest information structure perceptually or cognitively delineated," assemble in configurations which can be strengthened to the point of unitization; "the configuration then acts as a discrete, all-or-none activatable memory representation" (p. 261). Through fractionation of cogit representation within the assemblies and units, integrated facts retain their individual identity.

> The representation [of complete knowledge structures] presumably changes from a collection of parts to a unitary, integrated representation of all the parts. Therefore, recall and recognition of parts of studied materials should occur primarily for materials that do not have unitized representations. Recall and recognition of materials that do have unitized representations should be all-or-none. (p. 264)

Although Hayes-Roth (1977) does not discuss Bransford and Franks' experiments, unitization of the information might appear to account for the fact that subjects in their experiment rated the complex sentence with

a high degree of confidence rather than the individual sentences; the configurations formed by the sentences would be activated all at once. The fact that words were repeated across sentences in different combinations would cause interference in verifying individual sentences (Walker & Meyer, 1980, p. 428).

Hayes-Roth's knowledge-assembly theory addresses several contextualist concerns; however, from a contextualist view, the shortcoming of Hayes-Roth's theory in accounting for the abstraction of linguistic ideas lies in the mechanistic account of perception (cf. Chapter 3, p. 74) and the concept of the "cogit" which functions as a discrete memory representation. The perceived "stimulus" and represented memory "cogit" enter the subject's knowledge structure context free. An associationist account of perception would have to hold that subjects in the Bransford and Franks study first extracted and kept isolated basic perceptual units which become stored in memory as cogits. These units "interact" only after they enter the subject's knowledge structure. The contextualist argues that the interaction is pervasive throughout the acquisition process. Such factors as the nature of the experimental task and the activities of the subject (e.g., problem solving, inference, and effort to comprehend) determine what is remembered in an experiment because these all combine to constitute the quality of the event. Bransford and Franks' findings point to a dynamic interaction, even transaction, between the subject and the experimental task and materials which Hayes-Roth's theory can not easily address given its strict associationist account of acquisition.

Several experiments which have explored and extended Bransford and Franks' findings suggest that what is remembered is not entities or isolated word items but events (e.g., Barclay, 1973; Bransford, Barclay, & Franks, 1972; Bransford & Johnson, 1972, 1973; Bransford & McCarrell, 1974; Johnson, Doll, Bransford, & Lapinski, 1974). Such a view of memory calls for a metatheoretical shift. The constructive nature of memory which these experiments point to indicates that memory is not "some kind of object--a storehouse for holding information--or a process" (Nilsson, 1979). Neither can memory be studied in isolation from what the subject does during acquisition. Memory cannot be severed from perception; it functions within the total cognitive system. As Craik (1979) notes, researchers such as Bransford and Franks view remembering as a skilled activity "rather than the matching of the products of perception against postulated memory traces from perceptual experiences" (p. 96). The investigation of memory for events implies that context plays a crucial role. It can not be derogated to a variable which can be manipulated. The event and its quality determine what the possibilities are for analyses (Jenkins, 1974b, p. 794).

Toward a Contextualist View of Memory

In this chapter I have outlined the development of associationist assumptions about memory and analyzed an experiment (Bransford & Franks, 1971) the results of which differed significantly from the associationist view of memory. I argued that, much like Johansson's (1973) experiment in the field of perception, Bransford and Franks' experiment

in the field of memory suggested a set of presuppositions and assumptions different from those current in psychology at that time. I identified such a shift in thinking about memory as, ultimately, a metatheoretical one. Similar to Jenkins' (1974b), my claim is that the shift is from a mechanist to a contextualist world view. In the section on associationism and memory, I noted areas where mechanism seemed limited in explaining some memory phenomena and suggested that another world view, namely, contextualism, might be fruitfully explored as an alternative. In this section I shall review several trends in recent psychological literature on memory that further indicate contextualist assumptions are being viably employed.

My discussion of a contextualist view of memory will be based on Jenkins' (1974b) article and Bransford, McCarrell, Franks, and Nitsch's (1977) "Toward Unexplaining Memory." My approach will be to link several major contextualist philosophical assumptions about memory to recent thinking and research in memory literature and thus somewhat expand the groundwork laid by Jenkins and Bransford, et al. It is important to note that every world hypothesis accounts for context in some way; therefore, my task will be to identify those assumptions in the field of memory that tend to corroborate contextualism. Specifically, I shall discuss how several memory theorists have recognized the need to study memory functionally, as a part of the organism's interactions with its environment. Based on an example from Dewey, I shall then describe current contextualist metaphors for memory and briefly identify some of the research used as evidence for such

conceptualizations. Finally, I shall discuss how researchers in the field of artificial intelligence have employed more and more contextually sensitive memory structures such as schemata, frames, scripts, and descriptions. Through analyzing the recent arguments of Dreyfus (1979) and Winograd (1981), I shall illustrate the contextualist view regarding such representations of knowledge in memory. To be sure, not all theoretical shifts in the field of memory lead to contextualism; nonetheless, the convergence of a number of trends indicates that, at this time, contextualism is undoubtedly mechanism's strongest contender.

In the contextualist world view, the study of any cognitive activity, including memory, must originate with "experience" which involves dynamic interchange between the organism and its environment. Experience "is not itself merely physical nor merely mental, no matter how much one factor or the other predominates" (Dewey, 1934, p. 246). In perceptual activity, the organism makes direct contact with the environment; the existential situation is immediately "felt," "had," or "given." In Gibson's terminology, the environment affords information which the organism directly "picks up." In this sense the environment contributes to experience. As with other types of cognitive activity, the study of memory concerns the organism's contribution to experience. Given such contributions, the contextualist is quick to point out that meanings lie neither <u>in</u> the organism nor <u>in</u> the environment: "That to which both mind and matter belong is the complex of events which constitute nature" (Dewey, 1925/1929, p. 75). In the lived event, the organism and environment contribute meaning, but "both inner

and outer factors are so incorporated that each [loses] its special character" (Dewey, 1934, p. 246). As I have illustrated through Bransford and Franks' (1971) experiment, for the contextualist the quality of an event determines what is retained from experience, not the particulars because the latter are affected by the transaction. As Dewey (1934) writes:

> Whenever anything is undergone in consequence of a doing, the self is modified. The modification extends beyond acquisition of greater facility and skill. Attitudes and interests are built up which embody in themselves some deposit of meaning of things done and undergone. These funded and retained meanings become a part of the self. (p. 264)

Thus, memory, as a part of the organism's cognitive system, functions in an environmental context, a situation, which is always, to some degree, dynamic and novel.

Several lines of thinking in current psychological theories about memory suggest these broader contextualist assumptions. Those cognitive psychologists, strongly influenced by Gibson's theory of perception, state the general case most strongly:

> One of the major goals of biological and psychological theory must be to account not just for particular forms of response, isolated in the laboratory, but for the overall unified adaptation of the organism to its environment. (Johnston & Turvey, 1980, p. 165)

Specifically, in regard to the study of memory, Turvey and Shaw (1979) write, "First and foremost, memory--like perception--rather than being merely an organismic process, should be a property of an ecosystem"

(p. 218). Other examples of this tendency abound. For instance, in his introduction to Perspectives on Memory Research, Nilsson (1979) concludes, "The term memory refers to one aspect of adequate cognitive functioning in a given situation" (p. 8). In a recent volume on organization and structure in memory, Puff (1979) identifies the emergence of an "adaptive perspective," which involves "the consideration of evolutionary, adaptive, ontogenetic or developmental, and cultural factors in understanding the nature and function of organization in human memory" (p. 10). Voss (1979) makes the case that memory theory will, in the future, incorporate the organism's broader biological-cultural context; Lachman and Lachman (1979) analyze the contemporary study of permanent memory from an evolutionary perspective. At a more applied level, Kintsch's (1974; 1979) research program on reading comprehension, based on global, gist-producing macro-processes, exemplifies a functional treatment of memory from an interactionist perspective. But the historical forerunner to a biological-cultural perspective in the field of memory is Bartlett (1932), whose theory of remembering is pervasively cited in much current memory literature. It would be well, then, to summarize his main contentions.

Bartlett's treatment of memory is explicitly biological and functional (p. 198); he carried out his experiments in naturalistic settings and with "the type of material [e.g., stories] that we have to deal with in daily life" (p. 204). In general, his presuppositions and assumptions about memory corroborate a contextualist world view. Kvale (1977) makes extensive connections between Barlett's theory and

a contextualist/dialectic world view. For example, he writes:

> To Bartlett, remembering . . . developed to meet the demands of the life world. Remembering serves a biological function in a ceaseless struggle to master and enjoy a world full of variety and rapid change. (p. 181)

Since the early 1970s, several of his theoretical constructs, primarily the notion of schemata, have influenced research in the field of memory. Cofer (1973), for example, provides an excellent account of how Bransford and Franks' (1971) findings conform to Bartlett's theory. Spiro (1975, 1977) defends Bartlett's conception of assimilative schemata against studies such as Gomulicki's (1956) and Zangwill's (1972) which failed to replicate Bartlett's findings. Bobrow and Norman's (1975) context-dependent descriptions and Schank's (1981) system of plans, goals, themes, and scripts for use in "understanding" systems exemplify how recent memory researchers have been influenced by Bartlett's comprehensive, and generally contextualist, approach to remembering. All of these theoretical trends in the literature indicate a growing concern with the interactive nature of the organism and its cognitive functioning in an environmental situation.

The reciprocally determinative relationship between the self and the world underlies contextualist assumptions about cognitive functioning, and such a transactional view ultimately derogates any static, formal representation of the external world "in" the organism. Bartlett (1932) concludes, "Remembering is not the re-excitation of innumerable fixed, lifeless and fragmentary traces" (p. 213).

Similarly, Nilsson (1979) argues, "We have to abandon the idea that memory is some kind of object--a storehouse forholding information--or a process" (p. 7). This has particular significance for earlier associationist conceptualizations of semantic memory; as Bransford, McCarrell, Franks, and Nitsch (1977) note, "Static conceptualizations of semantic memory fail to orient one toward the flexibility of understood relationships as a function of the context or setting in which events occur" (p. 461). I have shown that the mechanist tradition in the psychological study of memory has conceptualized memory as the storehouse for objects (or their traces) in some, usually compartmentalized, hierarchical, structured network. The contextualist conceptualization of memory significantly differs from this metaphor. I shall introduce it by summarizing an example from John Dewey's Experience and Nature (1925/1929). His analysis of watching a play illustrates how experience "depends upon the operative presence of a continuum of meanings" (p. 306).

As viewers of a play, if we are to understand each presented phase of the play, then we must have grasped the meaning of the previous parts of the play. Yet this meaning carries into the present phase without our deliberately remembering the past parts, for to remember the past actions or events would cut us off from the present action. That is, in the act of recollection, our attention would be divided so that we could "not be aware of what is now said and done" (p. 306). The meaning from the past "suffuses, interpenetrates, colors what is now and here uppermost." Somewhat ironically, Dewey

even states that words such as "context and background, fringe, etc." suggest "something too external to meet the facts of the case." As viewers, then, our present understanding of a particular phase of the play cannot be based on recollection.

> The purport of past affairs is present in the momentary cross-sectional idea in a way which is more intimate, direct and pervasive than by way of recall. (p. 306)

Not only do the present actions fulfill "the meanings constituted by past events," but they also anticipate future actions because the present actions progress indeterminately. He concludes that

> it is this double relationship of continuation, promotion, carrying forward, and of arrest, deviation, need of supplementation, which defines that focalization of meanings which is consciousness, awareness, perception. Every case of consciousness is dramatic; drama is an enhancement of the conditions of consciousness. (p. 306)

Awareness and perception involve "a continuum of meaning in process of formation" (p. 308); meanings do not result from discrete acts of recollection.

The example of watching a play instantiates the contextualist root metaphor--"the event alive in its present" or "the dynamic active event" (Pepper, 1942/1961, p. 232). Contextualist conceptualizations of memory attempt to avoid any bifurcation between the organism and the environment; past experiences "fund" experience or contribute to it. Dewey (1925/1929) describes mind as "contextual and persistent . . . structural, substantial; a constant background and foreground" (p. 303). The meanings from past experience, through a process similar

to that of sedimentation, build up a whole system, a deposit of meanings. As Merleau-Ponty (1962) states, "We find, as a basic layer of experience, a whole already pregnant with an irreducible meaning" (pp. 20-21). According to Kestenbaum (1977) the funded and retained meanings to which Dewey frequently refers can be best described as a "field of habitual meanings" (p. 42). The organism's field of meanings enters into lived experience.

In "lived" experience, such as the watching of a play, the contextualist claims that recognition precedes recollection; the past is "in" the present situation. For example, Merleau-Ponty (1962), in arguing against the empiricist separation of perception and memory, states, "To perceive is not to experience a host of impressions accompanied by memories capable of clinching them. . . . To remember is not to bring into the focus of consciousness a self-subsistent picture of the past" (p. 22). The problem with this view, he writes, is as follows:

> Before any contribution by memory, what is seen must at the present moment so organize itself as to present a picture to me in which I can recognize my former experiences. Thus the appeal to memory presupposes what it is supposed to explain: the patterning of data, the imposition of meaning on a chaos of sense data. (p. 19)

Perception "carries its meaning within itself" (p. 21), and thus Merleau-Ponty describes the real problem of memory and perception in the quotation which introduces this chapter. What Merleau-Ponty terms a "field," "atmosphere," "horizon," or "given 'sets,'" Dewey terms

"field of habitual meanings." Very similar to these conceptualizations is Bartlett's schema which "refers to an active organization of past reactions, or of past experiences" (p. 201), operating as a unitary mass. For the contextualist, then, "the past operates as an organised mass rather than as a group of elements each of which retains its specified character" (Bartlett, p. 197).

The contextualist conceptualization of memory stresses the organism's activity in an event and the reconstructive nature of remembering. Such emphasis results from contextualism's fundamental presuppositions of novelty and change. As Pepper (1961/1942) describes it: "A texture, through its strands, is constantly involved in its context, and the two together are so complex and so constantly changing that the nature of a total texture could hardly be expected ever to be duplicated" (p. 257). Thus, any element or particular stripped from its context is, in the long run, a distortion. Dewey (1925/1929) states that

> recognition is not cognition. It is what the word implicitly conveys; re-cognition; not in the sense that an act of cognizing is repeated, but in the sense that there is a reminder of the meaning in which a former experience terminated, and which may be used as an acceptable tool in further activities. (p. 328)

Remembering involves reconstruction rather than reproduction. Bartlett perhaps best illustrates the reconstructive nature of remembering from a contextualist viewpoint in the following analogy:

> In a world of constantly changing environment, literal recall is extraordinarily unimportant. It is with remembering as it is with the stroke in a skilled game. We may fancy that we are repeating a series of movements learned a long time before from a textbook or from a teacher. But motion study shows that in fact we build up the stroke afresh on a basis of the immediately preceding balance of postures and the momentary needs of the game. Every time we make it, it has its own characteristics. (p. 204)

The contextualist emphasizes the reconstructive nature of memory because in the alive, dynamic event, the individual actively participates by bringing to bear deposits of meaning from past experience.

Several memory researchers and theorists have been articulating new metaphors for memory that approximate, evermore closely, contextualism. Very generally, Wechsler (1963) anticipates the current move away from conceptualizing memory as a storehouse. He states:

> In short, for the experiencing individual, memories do not exist before they are revived or recalled. Memories are not like filed letters stored in cabinets or unhung paintings in the basement of a museum. Rather, they are like melodies realized by striking the keys on a piano. Ideas are not more stored in the brain than melodies in the keys of a piano. (p. 151)

More apropos to a contextualist view, however, Bransford, McCarrell, Franks, and Nitsch (1977) propose that "a major role of past experience is to provide 'boundary constraints' that set the stage for articulating the uniqueness, as well as sameness of information" (p. 434). Their stage setting metaphor, which they compare to Gibson's (1966)

conception of attunement to invariant information, emphasizes activity and novelty. Their research findings on linguistic comprehension suggest to them that

> the role of past experience is not simply to provide a repertoire of stored meanings (or senses) that can be retrieved and novelly recombined in terms of syntactic rule structures and selection restrictions. Instead the role of past experience is to provide the organism with abstract tools that can be used to articulate novel significances that a speaker or writer intends. (p. 436)

In contextualist terms, the abstract tools comprise the qualitative residue of past experience. Similar to Bransford, et al. (1977), Turvey and Shaw (1979) state that "experience is <u>preparatory</u> to perceiving . . . experience attunes or sensitizes perceptual systems to the information that specifies affordances" (p. 217). In their ecological formulation, memory knowledge "persists by analogical extension (generalization) from earlier to later situations" (p. 219). A final example of a reconceptualization of memory that moves toward a contextualist view is Voss' (1979). He advocates a problem solving approach to memory and stresses "that what is stored is a by-product of problem-solving activity" which becomes "assimilated with information already stored that is related to the general problem-solving activity" (p. 393).

Such broad metatheoretical reconceptualizations of memory can be applied to already existing theories in cognitive psychology which have implications for the role of memory. Lachman and Lachman (1979) have already provided an excellent analysis of the compatibility of

Rosch's research (1973, 1975, 1978) with an evolutionist, ecological, and I would claim, contextualist, perspective. Rosch's work on the prototype structure of natural-language semantic categories suggests that family resemblance rather than specific features define categories (Rosch & Mervis, 1975). In the contextualist view (cf. Chapter 2, p. 56), similarity in experience is not based on intrinsic or permanent properties of natural objects but on convergent references which emerge in the contextually bound situation. Thus, like Rosch's definition, categories from a contextualist view are culturally sensitive and flexible. Rosch argues that categories vary in their relatedness to a prototypical instance, and thus her theory can account for novelty. Such a view of categories or concepts significantly differs from the sharply bound categories employed in information-processing models of semantic memory where category membership is treated as all-or-none. Nelson's (1974, 1977) explanation of the formation of concepts in children illustrates contextualist assumptions and complements Rosch's definition of natural-language concepts.

In her account of initial concept formation, Nelson (1974) stresses the role of context and dynamic relationships in the child's experience with the world.

> Whole elements (which may or may not have individual identity) take on definitions as concepts in terms of the synthesis of their functional or dynamic relations. (p. 276)

As an example, she uses the child's formation of the concept, ball. The ball is part of an event which includes textures: the child, other

people, places, actions, and the effects of actions. These textures constantly fluctuate; the ball remains constant but only in relation to its context. Eventually, the child synthesizes the varied relationships which contain the ball, and this becomes the core of his concept (p. 277). Nelson describes the process of abstraction as follows:

> Initially, all of the relational information that is salient to the child may be retained, including information about possible actors and locations. Later, this specific information may be replaced with more general and abstract specifications (e.g., human location suitable for play), while only the specific defining functions of each particular concept (e.g., rolls, bounces) are retained in the core. (p. 278)

Analysis into attributes is a secondary process that occurs when the child needs to find a ball among other objects. Nelson's definition of the concept as "a dynamic set of functions and relationships" is a contextualist definition. Nelson (1977) briefly mentions that Bransford, Nitsch, and Franks' (1977) analysis of memory (and knowing) is relevant to her theory (p. 235). The meaning of a concept "derives from its context" (p. 234); conceptual development "is from context derived to context free" (p. 235). Such a view supports the process-oriented approach to meaning and memory advocated by Bransford, Nitsch, and Franks (1977).

Contextualist reformulations of the concept of memory, and as well as more general contextualist cognitive theories such as Rosch's and Nelson's have influenced the study of memory empirically. Through my analysis of the mechanist approach to memory, I indicated how context

effects continued to modify what could be counted as the functional stimulus unit (e.g., Shimp, 1976). Using linguistic materials, Bransford and Franks (1971) found that the information the subjects constructed was more than what was directly represented in the acquisition sentences. The emphasis on the global, contextual aspects of the experimental situation has resulted in the use of more ecologically valid stimulus materials such as connected discourse and text comprehension (Bransford, 1979; Craik, 1979; Gibbs, 1979; Neisser, 1976). So influential has the contextualist view of memory become that social psychologists have successfully applied it to the study of social cognition (e.g., Tsujimoto, 1978; Woll, Fraps, Weeks, Pendergrass, & Vanderplas, 1980). The increasing focus on memory for events has not only shifted the nature of stimulus materials but has also come to include a broader range of phenomena such as memory for goal-directed action (Lichtenstein & Brewer, 1980); memory for operations and activities (Kolers, 1973); and efforts toward comprehension that facilitate recall (Auble & Franks, 1978; Auble, Franks, & Soraci, 1979). The emphasis on contextual effects has led some researchers away from explaining memorability through strength of trace and to employ concepts such as meaningfulness, distinctiveness, and elaboration. Based on their research on encoding, Craik and Jacoby (1979) write, for example:

> In our view, distinctiveness is unlike strength, primarily because distinctiveness is necessarily a relational, rather than an absolute, concept. That is, the distinctiveness of an object or event is always relative to a particular context. (p. 153)

Although the tenets of contextualism have influenced empirical research in memory, its greatest impact on the conceptualization of memory can be seen in the field of artificial intelligence.

During the last several years, researchers in artificial intelligence (AI) have developed more "holistic" information-processing models which have increasingly attempted to represent the background knowledge of everyday situations and ordinary language. More context-sensitive data structures such as scripts, goals, and plans (Schank & Abelson, 1977; Schank, 1981) frames and K-lines (Minsky, 1975, 1981); and schemata (Bobrow & Norman, 1975; Rumelhart & Ortony, 1977) have replaced atomist, reductionist views of knowledge representations in memory. Winograd (1976) characterizes this shift as follows:

> The AI programs of the late sixties and early seventies are much too literal. They deal with meaning as if it were a structure to be built up of the bricks and mortar provided by the words, rather than a design to be created based on the sketches and hints actually present in the input. This gives them a "brittle" character, able to deal with tightly specified areas of meaning in an artificially formal conversation. They are correspondingly weak in dealing with natural utterances, full of bits and fragments, continual (unnoticed) metaphor, and reference to much less easily formalizable areas of knowledge. (p. 17)

Several of these research programs employ the term "schemata" for the organizational units of memory. According to Rumelhart and Ortony (1977),

> Schemata are data structures for representing generic concepts stored in memory. They exist for generalized concepts underlying objects, situations, events, sequences of events, actions, and sequences of actions. Schemata are not atomic. A schema contains, as part of its specification, the network of

> interrelations that is believed to generally hold among the constituents of the concept in question. Schemata, in some sense, represent stereotypes of these concepts. (p, 101)

The move toward more flexible, interactive data structures in information-processing models results, in part, from a general recognition of the importance of the role of context in explaining memory phenomena. Bobrow and Winograd (1977), for example, state:

> The results of human reasoning are context dependent, the structure of memory includes not only the long-term storage organization (what do I know?) but also a current context (what is in focus at the moment?). We believe that this is an important feature of human thought, not an inconvenient limitation. (p. 32)

I have indicated that associationist approaches to memory derogate context. Clearly these researchers have constructed programs which attempt to address context directly, not in a derivative, post hoc fashion.

Such conceptualizations of the representation of knowledge in memory differ significantly from the earlier associationist sequential, serial processing mechanisms which represented knowledge in hierarchical networks. With the emphasis on schemata, for example, any reference to the discrete particulars of perceptual experience has vanished. Bobrow and Norman (1975) suggest that schemata are event driven. They explain, "By this, we mean that all input data invoke processing" (p. 142). In earlier, more associationist models, processing was primarily data driven; i.e., dependent on feature analysis of sensory data which then passed upward to higher level units. Newer processing strategies

include top-down, conceptually driven analysis which is "guided by the contextual information" (Norman, 1979, p. 135). Schemata guide the interaction so that any notion of "stages of processing disappears" (p. 138).

Another illustration of the way in which recent work in artificial intelligence has departed from the associationist approach to memory can be seen in Schank's (1981) description of the types of memories people have, namely, "event memory," "generalized event memory," "situation memory," and "intentional memory" (pp. 121-123). Situational memory, for instance, "provides the overall context for a situation" (p. 122). Schank's concept of a script "does not actually exist in memory in one precompiled chunk"; rather scripts are constructed from higher-level general memory structures as they are needed (p. 124). Essentially, scripts, like Minsky's frames, contain stereotypical social activities: "We define a script as a predetermined causal chain of conceptualizations that describe the normal sequence of things in a familiar situation. Thus, there is a restaurant script, a birthday-party script, a football script, a classroom script, and so on" (Schank, 1975, p. 131). From the perspective of Ebbinghaus' memory research with nonsense syllables which he thought signified nothing, it would appear that the study of memory in more holistic information-processing models has shifted from mechanism to contextualism. Dreyfus (1979) and Winograd (1981), however, suggest that this is not the case.

In his introduction to the revised edition of The Limits of Artificial Intelligence, Dreyfus criticizes recent holistic information-

processing approaches from a contextualist viewpoint.

> In the end the very idea of a holistic information processing model in which the relevance of the facts depends on the context may involve a contradiction. To recognize any context one must have already selected from the indefinite number of possibly discriminable features the possibly relevant ones, but such a selection can be made only after the context has already been recognized as similar to an already analyzed one. The holist thus faces a vicious circle: relevance presupposes similarity and similarity presupposes relevance. (p. 54-55)

This is similar to the argument made by Merleau-Ponty (1962) which I cited earlier: "the appeal to memory presupposes what it is supposed to explain" (p. 19). The contextually sensitive information-processing models operate on the assumption that what is represented in memory can be formalized in a structured description which can then be acted upon by rules. This introduces a bifurcation between the organism and its environment the contextualist wishes to avoid. As Dreyfus writes, "The only way to avoid this loop is to be always-already-in-a-situation without representing it so that the problem of the priority of context and features does not arise" (p. 55).

The appeal to broader and broader contexts (in a "nested" hierarchy such as that suggested by Norman, 1979) which can be activated from the top down does not solve the problem. Dreyfus notes that

> the programmer must either claim that some features are intrinsically relevant and have a fixed meaning regardless of context--a possibility already excluded in the original appeal to context--or the programmer will be faced with an infinite regress of contexts. (p. 221)

That is, a machine must be able to recognize a first context in order to "single out its relevant features, or there will be a temporal regress of contexts extending infinitely into the past and the machine will not be able to begin the recognition process" (pp.223-224). From a contextualist view, the holistic processing approach offers preanalyzed situational contexts and thus cannot adequately simulate how memory functions in real world situations characterized by novelty and change.

The contextualist does not deny the fact that rules, stereotypical behavior, and formalized symbolic representations can play a role in remembering. Nor does the contextualist deny that remembering can function by searching out isolated bits or facts based on formalized procedures. But the contextualist disparages such formalisms in explaining human behavior and memory. Sometimes memorial processes follow logical rules and procedures, and sometimes memory can be searched as if through an associative network; but always the contextualist points to aspects of the pragmatic context which resists formal descriptions. Wittgenstein, for example, identifies the infinite regress involved in applying rules to human behavior (cf. Dreyfus, p. 203); and he also despairs of being able to formalize concepts in terms of a list of traits and argues, much like Rosch, for recognition based on family resemblance. Dewey (1922) distinguishes "routine" habit from "intelligent" habit; routine habit does involve mechanization, but intelligent habit "grows more varied, more adaptive by practice and use" (p. 72). The contextualist, then, always points to the improbability of ever completely formalizing knowledge in structures.

The contextualist also claims that memory does not bifurcate the organism from the lived situation. While more sensitive to context, the recent information-processing structures, when activated, become disembodied from the organism. Bobrow and Norman's (1975) model is a case in point.

> We view the cognitive processing structure as one that consists of a multilayered assemblage of experts. Each expert is a process that knows how to handle the data and suggestions provided it. (p. 145)

Kvale (1977) observes that such processing models imply a bureaucratic metaphor for processing; frequently the homunculus residing in memory is characterized as an organizational expert, who shuffles schemata, ships requests to higher processes and so on. Minsky (1981) writes,

> One could say little about "mental states" if one imagined the Mind to be a single, unitary thing. Instead, we shall envision the mind (or brain) as composed of many partially autonomous "agents"--as a "Society" of smaller minds. . . . To give this idea substance, we must propose some structure for that Mental Society. In fact, we'll suppose that it works much like any human administrative organization. (p. 88)

In many ways, such conceptualizations of how memory functions in experience recall the debate between Fodor and Pylyshyn (1981) and Turvey, Shaw, Reed, and Mace (1981). The ecological realists' theory of perception denies the kind of epistemic mediation assumed by information-processing theories. As Shaw and Bransford (1977) contend:

> The ecological approach, unlike information-processing theories, denies also that nature, in any sense, communicates messages to us written in a kind of

> sensory shorthand which, to be comprehended, must be translated by a phalanx of cognitive homumculi into a more readable longhand for perusal by whom no one can say. (p. 10)

In lived experience, memory does not project its structures through processing "onto" a situation; rather memory is situated in the live, dramatic event.

Winograd (1981) has recently revised many of his earlier information-processing views, and his conclusions about the representation of knowledge in cognition are strikingly similar to Dreyfus' and the ecological realists'. After a lucid description of how Maturana (1977) and Gadamer (1976) influenced his thinking on language understanding, Winograd addresses the question of whether human knowledge can be represented in formal structures. As he notes, "One of the most challenging of Maturana's view is his dogmatic insistence that cognition is not based on the manipulation of mental models or representations of the world" (p. 248). Particularly significant to Winograd is Maturana's argument that formal representations involve an error of reification which takes the following form:

> 1. A scientist observes some recurrent pattern of interactions of an organism.
> 2. He or she devises some formal representation (for example a set of generative rules or a "schema") that characterizes the regularities.
> 3. The organism is assumed to "have" the representation, in order to be able to exhibit the regularities.
> 4. (Depending on the particular subfield) The scientist looks for experiments that will demonstrate

> the presence of the representation, or designs a computer program using it to see whether the behavior can be generated by the program. (pp. 248-249)

As Winograd explains, "The error is in the reification of the representation at step 3" (p. 248). The reification results from a third person point of view, an observer who sees the representation from outside the situation. The contextualist always begins with first person experience as it is lived, felt, and revealed; given this orientation, contextualist philosophers such as Merleau-Ponty and Wittengenstein claim ordinary experience does not have to be represented at all.

That Winograd's assumptions are contextualist is evident on several counts. Namely, he argues that his current work moves toward understanding language from the domain of human action and interaction: "In this domain the relevant regularities are in the network of actions and interactions within a human society" (p. 251). His growing concern with speech acts involves the social context in which they occur and the cultural and historical background implied by that context. He acknowledges, "We can never make the background fully explicit" (p. 255). Although Winograd does not discuss memory directly, his arguments have implications for those who conceptualize cognitive information-processing structures as containing regularities across situations. The problem of reification concerns memory theory since most theorists have assumed that formal representations which they construct exist in the rememberer. Formally described and imposed

memory structures, the contextualist warns, extract the organism from its situation.

It is not clear from Winograd's article how closely his views correspond to other contextualist-oriented psychologists whom I have cited, but his stance on the representation of knowledge in understanding language clearly parallels the claims ecological realists have made in the fields of perception and memory. His concerns clarify the implications for holding a contextualist view of memory. More holistic information-processing models have attempted to address contextualist concerns, but these do not instantiate contextualism. As Shaw and Bransford (1977) explain, "The knowing-agent is not some final stage in the epistemic process, some caboose at the end of a train of ideas, not even a missing link in a cause-and-effect chain; rather the knowing-agent is the totalité of the process itself" (p. 10).

Thus the power of a contextualist root metaphor lies in its insistence on the dynamic vitality of live experience. The contextualist argues that perception and memory function adaptively in the midst of and in response to the total situational context of events which always contain some degree of novelty and change. Past experience "funds" present experience, and acts of recollection involve reconstructions based on the qualities of past events. Such a set of contextualist categories has emerged in recent psychological literature on memory; they offer an entirely different interpretation of memory from that of mechanism.

Conclusion

My analysis of the psychological treatment and investigation of perception and memory illustrates two systematic applications of Stephen Pepper's theory of metatheoretical systems. Such an approach requires recognition of underlying assumptions that have guided and continue to guide psychological theory and research. Historically, mainstream American psychology has grounded itself in a mechanist world view; in part because, as Bartlett (1932) and Joynson (1970) have argued, psychologists have "stood in awe of the stimulus"; i.e., some basic unit that could be isolated in the laboratory (cf. Shimp, 1976). In its more tolerant phases, mechanist psychology has simply claimed that it aims to explain the reconstitutive nature of psychological experience; that is, to isolate the particulars of experience and study causal relations among them. In its more dogmatic phases, it asserts that all experience reduces to particulars and that meaningful psychological phenomena can only be explained by appeals to laws which combine the particulars into wholes. Such a view seemingly circumvents any appeal to cognition, a view Pepper finds indefensible.

Within Pepper's framework, the tolerant, undogmatic mechanist cannot be refuted. No one states the appeal (and possible limitation)

of mechanism so eloquently, perhaps, as Merleau-Ponty (1962). He writes:

> The physicist's atoms will always appear more real then the historical and qualitative face of the world, the physico-chemical processes more real than the organic forms, the psychological atoms of empiricism more real than perceived phenomena, the intellectual atoms represented by the 'significations' of the Vienna Circle more real than consciousness, as long as the attempt is made to build up the shape of the world (life, perception, mind) instead of recognizing, as the source which stares us in the face and as the ultimate court of appeal in our knowledge of these things, our experience of them. (p. 23)

Although I have emphasized the shortcomings of associationism and mechanism in order to argue that another metatheoretical alternative can viably account for psychological phenomena, the apparent precision which results from mechanistically framed investigations makes it a particularly strong analytic view. As Pepper states it:

> The world appears literally as a cosmos where facts occur in a determinate order, and where, if enough were known, they could be predicted, or at least described, as being necessarily just what they are to the minutest detail. (p. 143)

My contention throughout this dissertation has been that psychology has sometimes blindly adhered to this world view even when the evidence of experiment suggests other interpretations. From Pepper's perspective, the epistemological chaos that characterizes current psychological investigations (cf. Chapter 1) can be attributed, in part, to the tendency of psychologists to overestimate the adequacy of mechanism as a world view.

The attention given to various metatheoretical and philosophical issues, particularly in cognitive psychology, has resulted in a critical examination of the limits of mechanism. As a result, those psychologists adhering to mechanism have more explicitly, and forcefully, laid their metatheoretical cards on the table. Wickelgren (1981), for example, responds to criticisms that the field of memory has not produced a substantive body of knowledge by asserting:

> The number of different types of links is an important and as yet unsettled theoretical issue, but the issue concerns the specific type of associative memory we have, not whether or not human memory is characterized by specific node encodings and direct access retrieval, which are widely accepted as the critical defining properties of an associative memory and should be so considered in all of cognitive psychology. Cognitive psychology should recognize that a major theoretical problem has been largely solved, namely, the definition of the concept of associative memory, and that a great truth has been established regarding how the mind works, namely, that it is associative. (p. 27)

Based on Pepper's framework, I have suggested that psychology might not be best served by "one great truth alone." That the mind works associatively is one view; it is not the only legitimate view. The debate between Fodor and Pylyshyn (1981) and Turvey, Shaw, Reed, and Mace (1981) instantiates the existence of two discordant sets of assumptions about the nature of cognition.

In my Introduction, I showed how the neobehaviorist paradigm which dominated the study of psychology in America has been so challenged that many psychologists no longer find its assumptions defensible.

Although the reintroduction of cognition into psychology challenged the nonmediational tenets of radical behaviorism, cognitive theories and models have not necessarily preempted the mechanist assumptions which have dominated psychological investigation historically, as Wickelgren's claim vividly illustrates. Cognitive psychologists such as Bransford, McCarrell, Franks, and Nitsch (1977); Gibson (1979); Neisser (1976, 1982); and Turvey and Shaw (1977) have advanced theories of perception and memory that differ significantly from both the neobehaviorist and the information-processing traditions. When viewed from a metatheoretical perspective such as Pepper's, the alternatives they suggest indicate a shift away from associationist and reductionist assumptions implicit in a majority of behavioral and cognitive theories of behavior. Such a distinction and its implications can be exemplified by Johnston and Turvey's (1980) ecological approach to a theory of learning.

Johnston and Turvey (1980) state explicitly that their intent is to outline a competing metatheory to mainstream psychological theories of learning which emphasize "analysis of the mechanism of learning" (p. 199). They write:

> Most of the important issues in current psychology of learning presuppose an associationist account of learning (see Jenkins, 1979). The ecological approach does not involve associationism and so issues such as the role of reinforcement, the nature of Pavlovian-operant interactions, and stimulus-response specificity simply do not arise. (p. 199)

Briefly, their ecological theory stresses "the relationships between

animals and their (natural) environments" so that the minimal unit for the ecological study of learning is the ecosystem, not the animal (p. 197). Citing Dewey and Bentley's (1949) transactional style of inquiry, they claim, "Learning goes on in ecosystems, not in animals" (p. 155). Based on a model developed by Sommerhoff (1950, 1969), they argue that learning is medium term (as opposed to long- or short-term) adaptation.

> Animals become attuned, in the course of evolution, to particular aspects of environmental structure that support learning. They evolve the particular attunements (i.e., learning abilities) that they do because such adaptations are pragmatically successful in the environment in which the population has evolved. (p. 183)

Extrapolated from the ecological approach to perception and memory, the theory of learning these authors espouse moves toward contextualism.

The identification and development of such metatheoretical alternatives within psychology have raised a growing number of thorny theoretical questions which contemporary cognitive psychology may not be able to dismiss easily. The nature of information available to and for perception, the effects of past experience on present experience, the types of laws governing the relationship between the organism and its environment, the ontological status of mental representation, and the role of inference and rules in intelligent behavior: all these, implicated throughout my discussions of perception and memory, represent some of the problematic issues faced by cognitive psychologists. Whether in the area of perception, memory, or learning, as Johnston

and Turvey's theory suggests, mechanist and contextualist world views address these problematic issues from very different perspectives.

I have limited my examination of competing metatheoretical systems to the fields of perception and memory; and as a part of my conclusion, I shall press this analysis to cover psychological investigations of a cognitive function that stipulates the interrelatedness of perception and memory: problem solving. Another reason for investigating problem solving in relation to metatheoretical assumptions is that both behavioral and information-processing approaches have been developed in this area; in many ways, information-processing approaches have both modified and superceded behavioral ones. Finally, as understood by the contextualist, problem solving is the most general characterization of cognitive activity. It is an extremely complex activity which seemingly defies any "complete" or final analysis; and by definition problem situations contain some degree of novelty and change, a basic contextualist assumption. John Dewey's (1938) theory of problem solving still stands as the classic contextualist one.

Computer-simulated and artificial-intelligence models and theories have dominated the study of problem solving during the last decade. In many respects, this approach, compared to stricter associationist and behaviorist accounts, shares some important contextualist assumptions about problem solving. In order to clarify my discussion of computer-simulated approaches to problem solving, I shall follow Searle (1981) in distinguishing between "strong" and "weak" (or cautious) claims about computer-simulation research.

> According to weak AI [artificial intelligence] the principal value of the computer in the study of the mind is that it gives us a very powerful tool. For example, it enables us to formulate and test hypotheses in a more rigorous and precise fashion. But according to strong AI, the computer is not merely a tool in the study of the mind; rather, the appropriately programmed computer really is a mind, in the sense that computers given the right programs can be literally said to understand and have other cognitive states. (p. 352)

The contextualist has no problem with weak AI; but with the strong AI position the contextualist takes serious issue, as I shall show in my discussion.

Thus an examination of theories and models of problem solving will allow me to tie together the various issues that have been discussed throughout this dissertation and suggest the broader implications of adhering to contextualist and mechanist world views. Through such a broader application of contextualism, I can then better assess the more salient weaknesses of contextualism as a world view for cognitive psychology. In other words, I shall maintain that although contextualism has become a viable alternative to mechanism, it can not be embraced as the only legitimate world view. Finally, I shall suggest some implications of what Pepper calls "postrational eclecticism" for cognitive psychology.

Problem Solving

De Groot (1966) recounts an experience that he and Reuben Fine, a chess grandmaster, had while walking together in Amsterdam.

> We came by the well-known chess cafe at Leidseplein. Through the window, we saw, first, two chess players sitting at the nearest table, and then the position on the board between them. Said Fine (and this was after an "exposition" of hardly two seconds): "Hm, they are good players." (p. 48)

De Groot then asks, "What did he actually see, and what did he infer? Is it possible that he immediately saw an acceptable 'master-level-likely' position? Or was this an inference? I only raise the question" (p. 49). In his problem-solving experiments on chess playing, he found that the visual memory capacity of chess masters is not superior to lesser players; however, if chess masters are exposed for five seconds to a complicated middle-game position, they can reproduce it with few, and often no, errors. A lesser player can not do this (p. 34). The immediate recognition of a complicated middle-game position and the ability to reproduce it raises the issue of the effects of past experience on present experience from the point of view of problem solving, and in his article de Groot anticipates what has become a central theoretical concern in the fields of perception and memory.

Recognizing that perceptual and memorial processes have largely been ignored in the problem-solving research literature, de Groot explains that his attitude toward them "has become one of deep respect. These phenomena are highly complex, often ambiguous and very difficult to pin down in terms of a code, a model, or a program" (p. 50). He suggests that the chess master's experience and knowledge enter into

perception: "To a rather large extent, abstraction is replaced by perception, but we do not know much about how this works, nor where the borderline lies" (pp. 33-34). His findings are strikingly similar to Johansson's (1973) on the perception of moving dots, and his explanation parallels Bransford and Franks' (1971) on the abstraction of linguistic ideas. Throughout this section, I shall use de Groot's observations and findings as a paradigm case to illustrate mechanist and contextualist views of problem solving. Before turning to the treatment of problem solving through computer simulation, I shall briefly describe associationist and behaviorist accounts.

Strict associationist accounts of problem solving (see Mednick, 1962, for one of the few) reduce problem situations to particular stimulus elements which build up associatively and recombine to form new associations. Behaviorist accounts, similarly reductionistic, explained the combinations and recombinations of habit sequences in usually hierarchical, chained structures (Maltzman, 1955). Kendler and Kendler (1962), for instance, state the behaviorist framework for the investigation of problem solving as follows:

> A more analytical approach can be taken to the selection of an experimental situation to investigate problem solving. If problem solving is compounded of elementary behavioral processes, then it may be more strategic to devise some simple problems in which the relationships of fundamental psychological mechanisms to problem solving are highlighted. That is, tasks should be devised . . . to isolate and magnify the basic mechanisms that operate in such complex tasks. (p. 224)

They report a series of experiments on conceptual problem solving tasks, the results of which support postulating a mediational mechanism within a behavioral chain (p. 257) (cf. Kendler, 1969; Kendler, Kendler, & Sanders, 1967, for subsequent research on the role of mediation in problem solving). With the introduction of computer simulation into the field of problem solving, however, researchers began identifying difficulties with both associationist and behaviorist accounts of the role of cognition in problem solving. In particular, the reduction of problems to elementary units or processes and the limited scope of problems investigated posed formidable constraints in explaining more ecologically valid problem tasks.

The most serious difficulty is how to constrain the multiplicative nature of chains of associations which need to be searched in order to solve a problem. Even the verbal mediation theory of problem solving (Goss, 1967; Kendler, 1969; Kendler & Kendler, 1975) reduce problem-solving behavior to a search through trains of works and images. Dreyfus (1979) explains this problem as one of exponential growth:

> Alternative paths multiply so rapidly that we can not even run through all the branching possibilities far enough to form a reliable judgment as to whether a given branch is sufficiently promising to merit further exploration. (p. 101)

De Groot (1966) recognizes this problem as well. After a statistical analysis of a master game position, he concludes that

> the superior achievement of masters in perceptual experiments can not be explained by a supposed general knowledge of chess possibilities and probabilities. Their superior

> performance in perception experiments is not based on the availability of (first-order) "probability tables" in the backs of their minds. (p. 39)

Another related difficulty was that the laboratory study of problem solving involved fairly simple problem tasks which consisted of isolated stimuli such as different sized and colored "cups" (Kendler & Kendler, 1962) or word items. Unlike the behaviorists, according to Green (1966), "The information processors prefer complex, or as they say, 'rich' experimental situations so that the complex structure of man's behavior can be displayed" (pp. 5-6).

Several important developments in the field of cognitive psychology influenced the information-processing approach to problem solving. Bruner, Goodnow, and Austin's (1956) theory of concept formation challenged the noncognitive characterization of stimulus-response (S-R) psychology. Their work paralleled, in many respects, the organizational theorists' in the field of memory. Associationist explanations of concept formation stress the association of elements or features which constitute a given concept; in S-R accounts the defining features, taken together in a stimulus, come to evoke a conceptual response. In contrast, Bruner et al. emphasize the role of cognition in problem solving and learning. Specifically, they investigated the types of strategies subjects used in forming concepts and the role of hypothesis testing in problem solving generally. Commenting on his early work in concept formation, Bruner (1966) writes, "I was enormously impressed at the logic-like or 'rational' quality of adult

human conceptualizing. . . . One could discern systematic strategies in behavior that had the quality and creases of well practiced rule-governed routines" (p. 2). Bruner's (1973) theory of cognitive processes is, of course, fundamentally a theory of perception: "A theory of perception needs a mechanism capable of cognition" (p. 8). He is concerned with internal models or "generic coding systems" (i.e., systems of categories) by which individuals "go beyond the information given."

Bruner et al. (1956) not only introduced coding or categorization into the description and prediction of behavior but also stressed the regulative nature of cognition generally. In subsequent literature on concept formation, researchers continued to define and isolate features of a particular concept and then study the logical relationships among them; this research generally assumed a hypothesis testing framework. Formalism thus enters into cognitive psychology with the assumption that problem solving can be described as essentially rational behavior, governed by logical rules. Bourne (1970), for example, conceives of conceptual problem solving as a simple logic system, the calculus of propositions, and concludes his study by stating that "behavior is better represented as a hierarchical, rule-following system than as a linear, cause-effect mechanism" (p. 556); and Scandura (1970) provides support for "adopting the rule as the basic unit of behavioral analysis" (p. 523). It is important to note that the study of rules in linguistics and the social sciences generally has had a complicated history (cf. Collett, 1977), and they have an important

function in contextualist philosophy. However, in the psychological literature on concept formation, researchers have tended to focus on simple systems such as set theory or the calculus of propositions (Bourne, Dominowski, & Loftus, 1979). These context-free rules formally determine the relationship of the various features of a concept--features which are registered and then compared to a memory representation which stores the defining features (see Rips, Shoben, & Smith, 1973, for a corresponding theory of memory).

The analytic approach to concept formation described above contrasts the synthetic approach of Rosch (1975; Rosch & Mervis, 1975) and Nelson (1974) which I presented in the Memory chapter as evidence of contextualism in broader theories of cognition. These theories attribute a core meaning to a concept; they do not reduce concepts to particular features or attributes which then are reconstituted in memory through the application of formal rules. As Dreyfus states, man, as an object, "can be treated as an information-processing device and the laws can be understood on the Kantian model, as reasons, which are rules in the mind applied by the mind to the input" (p. 179); but such a view, he further argues, decontexualizes experience. Thus, the early work in concept formation (as an instance of problem-solving behavior) challenged the neobehaviorist paradigm and paved the way for information-processing models of problem solving.

Of all the approaches to problem solving, the research in artificial intelligence and computer simulation, particularly the work of Newell and Simon (1972), has been the most influential during the last

twenty years (Anderson, 1980; Simon, 1979). In many respects, it has moved toward contextualism in its conceptualization and investigation of problem solving. For example, researchers have generally investigated more life-like problems such as the study of games like chess. Much emphasis is placed on the activity of the problem solver; the analysis of verbal protocols (Newell & Simon, 1972; Ericsson & Simon, 1980) is an essential methodological tool for verifying theory. Moreover, computer-simulated problem-solving research has focused attention on the context of the problem. Early in the research, terms such as "task environment," "problem space," and "heuristics" came to characterize problem-solving activity.

According to Newell and Simon (1972), the environment of a problem is structured by a task; the task environment "refers to an environment coupled with a goal, problem, or task. . . ." (p. 55) In simulation, the objectively defined task (from the point of view of the experimenter) constitutes the task environment. The problem solver represents the task environment internally and selects a problem space (p. 88). A number of the features of the problem space are claimed to be functionally equivalent to the characteristics of the program. Simon and Newell (1971) state:

> Though the problem space and program are not task-invariant, they constitute the adaptive interface between the invariant features of the processor and the shape of the environment, and can be understood by considering the functional requirements that such an interface must satisfy. (p. 150)

Once the problem space has been constructed, the problem solver

employs rules of thumb or shortcuts called heuristics. Heuristic processes extract information represented in the problem space and reduce the size of the space by "examining small, promising regions of the entire space and simply ignoring the rest" (p. 151). One heuristic search system, means-ends analysis, "finds differences between current and desired situation" (p. 152) so that in trying various possibilities, the beginning and the end become closer until the problem is solved.

Newell and Simon's approach to problem solving focuses on a wide range of task variables which influence problem-solving behavior, particularly in the construction of the problem space. Simon and Newell (1971) emphasize, for example, "how radical . . . the differences among alternative problem spaces can be for representing the same problem" (p. 154). The same response (i.e., the solution to the problem) occurs even when the experimenter varies the structure of the environment or the problem solver employs different types of strategies (Simon, 1975). Such an emphasis on the context of the problem deviates from an associationist view which reduces problem situations to particular stimulus elements which build up and recombine through the strength of individual associations. In information-processing approaches, the problem-solver's response is not linked to an effective stimulus, but rather to different sets of elements called symbols which are internally encoded. In representing objects as symbols (which have relations), computer simulation programs do not define and isolate the stimulus unit; rather they emphasize the

internal representation of symbols and their manipulation. "The theory posits a set of processes or mechanisms that produce the behavior of the thinking human. Thus, the theory is reductionistic" (Newell & Simon, 1972, p. 9).

Even though the problem-solving simulations demonstrate increased activity of the problem solver (e.g., heuristics) and the relevance of context (e.g., task environment), information processing introduced into the study of problem solving an "essential formalism to describe and explain its phenomena" (Simon & Newell, 1971, p. 148). For example, in delimiting how they treat problem solving, Newell and Simon (1972) state that they will "mainly be concerned with . . . systems of symbols" and the actions they examine "are mainly manipulations of symbol structures" (p. 72). The problem space consists of a "set of elements" or symbol structures and "a set of operators" or information processes which are small and finite (p. 811). Allport (1979) succinctly describes the basic characteristics of the general class of computational mechanisms called production systems:

> A Production System (PS) comprises two main components: a set of rules, or "productions," and a data base. In the basic PS, each rule consists of an ordered pair of symbolic structures: a procedure or action that can be applied to the data base and a condition for applying it (written, condition→action). The data base can be any collection of symbolic information. In systems designed to model psychological processing, the data base is taken to represent the system's knowledge about the current state of the world, or "working memory," whereas the rules constitute its long-term knowledge. (p. 68)

In order to simulate an information-processing system on a computer, the programmer defines a formal language and then specifies an "interpreter"; and, as Newell and Simon (1972) state, "At some level the interpreter must just be a mechanism that accomplishes directly the actions described" (p. 37, emphasis added). In representing the processes of problem solving, the programmer assumes that the processes "must be the product of a rule-governed sequence of discrete operations" (Dreyfus, p. 172).

Problem-solving simulations such as Newell and Simon's assume that human memory is associative and that what is stored are symbols of corresponding stimulus patterns or "chunks" (see Newell & Simon, 1972, pp. 792-795). I discussed such tenets of information-processing models of memory in the previous chapter. In explaining de Groot's findings that chess masters can reconstruct chess positions after a five-second exposure, computer-simulated problem-solving programs accumulate (at least theoretically) chunks of symbols in long-term memory (Chase & Simon, 1973). Simon and Gilmartin (1973) estimate that masters store in memory some 50,000 different chess patterns. Expert problem solving, then, involves the accumulation of chunks of symbols internally represented and an increasing and varied number of mechanisms which connect them. However, even given accumulation of information into chunks, the problem situation must always be reduced to context-free features upon which procedural rules can operate (Dreyfus, p. 30). Moreover, the programmer predetermines and prestructures which features function in the situation. Assumptions such as these

lead contextualists to be highly critical of the use of simulation as more than a tool.

Generally, the information-processing approach to problem solving implies a fundamental, albeit rule-obeying, mechanism. Contextualist assumptions about problem solving differ significantly from those of the computer model--particularly when researchers make "strong" AI claims about simulation as explanation. For one, the contextualist approaches the problem situation as a whole. The features or facts of a given problematic situation are infinite; problem-solving activity is embedded in its pragmatic context. In the computer model, elements of features are extracted from the situation (by the programmer), and then meaning is given back or reconstituted through the application of rules. But this abstracts the problem-solving activity from its context. In response to the claim that behavioral regularity need be rule governed, Dreyfus states, "Our activity is simply as rule governed as is necessary for the task at hand--the task itself, of course, being no more precise than the rules" (p. 271).

The contextualist always points to the change and novelty which pervade lived, problematic situations and which defy rational, abstract, universal regularities. The learning of rules is itself context dependent (see Dominowski & Wetherick, 1976, for findings which support this). The point of most contention between the computer model and the contextualist, however, lies in the computer model's separate "mental" level of the mind where problem solving occurs. For example, in his review of Wittgenstein's posthumously published Remarks on the

Philosophy of Psychology, Hacking (1982) notes that Wittgenstein "would have been quite hostile" to cognitive psychology's study of "how mental representations are connected with cognitive functions in the brain" (p. 43). The contextualist disavows any hypostatized "separate" mental life intervening between the problem solver and the problematic situation. Any representation of a problem is functionally related to the total context of inquiry.

Within the field of cognitive psychology, Newell and Simon's (1972) model of problem solving has come to be so influential that other alternatives rarely surface in the literature. Certain assumptions in earlier Gestalt views of problem solving parallel contextualist concerns. Asher (1963; Jacobsen & Asher, 1963), for example, discusses problem solving as a process of disruption, and Sheerer (1963) accounts for how the phenomenon of fixation (i.e., the inability to see novel solutions) is overcome through "insight" of perceptual recentering. The contextualist approach to problem solving, however, can be best illustrated by reviewing Pepper's general account and Dewey's (1938) stages of the problem-solving process. For the contextualist, all cognitive activity that ends in knowledge is embedded in the problematic situation and efforts toward its resolution.

Pepper's explanation of contextualism characterizes the given event as containing textures which consist of strands.

> Smooth-running strands constitute the contextualist interpretation of what we generally mean by order. Blocking is accordingly a fact of disorder, and it inevitably involves some degree of novelty. (p. 255)

Strands have references which point backward and forward in time. A problem arises when a linear reference is blocked and the end (or satisfaction) of an action is prevented. An instrumental action is initiated as "a result of some obstacle that intervenes between the beginning of the action and its end or satisfaction" (p. 260) and neutralizes the blocking. This activity "enters right into the texture of a terminal activity" and is not separated from it.

> At the early stages of an instrumental act, when the obstacle is vividly felt, the instrumental activities are qualitatively taken as rather separate events, but as they become integrated with the terminal texture they fuse into the quality of one total texture. (p. 263)

For example, when learning to read an x-ray, a radiologist would be involved with analyzing various textures and strands (i.e., the various shadows of structures of different densities of film) and would rely on inference and representation in detecting abnormalities. The highly trained radiologist, however, directly (i.e., noninferentially) sees a tumor on an x-ray of a lung; and this "funded" experience, the contextualist argues, has a quality all of its own.

In a somewhat similar fashion, Dewey's (1938) account of problem solving begins by the recognition of an indeterminate situation and its unique quality which "not only evokes the particular inquiry engaged in but . . . exercises control over its special procedures" (p. 105). The doubt or indeterminancy exists in the <u>situation</u> and not in the person alone. Indeterminate situations are precognitive, but once they are taken as the subject for inquiry, they become instituted and the

determination of a problem-solution follows.

> The way in which the problem is conceived decides what specific suggestions are entertained and which are dismissed; what data are selected and which rejected; it is the criterion for relevancy and irrelevancy of hypotheses and conceptual structure. (p. 108)

The constituents relevant to the solution of a problem then guide the development of suggestions or ideas which lead to an eventual resolution. Both perception and conception functionally correlate "in such a manner that the former locates and describes the problem while the latter represents a possible method of solution" (p. 111). Suggestions and ideas take on symbolic meanings, and thus reasoning enters into problem-solving activity.

Broadly speaking, reasoning allows the problem solver to anticipate the consequences of carrying out a given hypothesis. The facts of the situation which enter into reasoning are by no means autonomous or discrete elements imposed on the problem solver from without; they develop out of and operate within the total problematic context.

> Some observed facts point to an idea that stands for a possible solution. This idea evokes more observations. Some of the newly observed facts link up with those previously observed and are such as to rule out other observed things with respect to their evidential function. The new order of facts suggests a modified idea (or hypothesis) which occasions new observations whose result again determines a new order of facts, and so on until the existing order is both unified and complete. (p. 113)

Throughout the problem-solving process, ideas or hypotheses are continually tested; the problem solver does not just collect facts and apply rules since the existential situation continues to be modified through the problem-solving process. The dramatic problematic situation can not be known completely by reason alone; nor can the conclusions of the past inquiries satisfy the demands of new problem situations.

A contextualist approach to problem solving is holistic and synthetic. De Groot's observations and experiments are readily accounted for by the assumptions of contextualism. The master chess player immediately and noninferentially apprehends the level of chess being played by a brief glance at a position on the board because past experience enters into directly and funds present experience. "There is a total situation 'had,' having its direct meaning-content" (Dewey, 1928, p. 351). From a problem-solving situation, the "conclusions" of past chess games "become means, material and procedural," in further experience with chess:

> There are conceptual objects, and objects of perceptual experience, which have been so instituted and confirmed in the course of different inquiries, that it would be a waste of time and energy in further inquiries to make them objects of investigation before proceeding to take and use them. (Dewey, 1938, p. 140)

What master chess players understand or immediately apprehend "presupposes prior experience and mediated conclusions drawn from them" (p. 143). Thus, the products of past problem-solving experiences with chess allow them to <u>see</u> differently from a lesser player. And in a

real chess game, the master player uses this funded background as a framework which sets the stage for choosing between various moves. The contextualist does not deny that during a game the chess player may follow rule-like operations or evoke certain representations in order to consider various alternatives; but problem-solving behavior can not be abstractly characterized by these procedures alone because the very rules and representations will themselves depend on the situational context.

Bransford, Nitsch, and Franks (1977) present a similar interpretation of de Groot's experiments, although they discuss them in terms of "growth" rather than problem solving per se. They characterize growth as changes in frameworks or "as a 'remodeling' of a structure as a whole," an assertion they find "congruent with Gibson's (1966) claim that learning involves the education of attention"; they further state:

> From the present perspective, past experience provides an increasingly precise and differentiated framework that sets the stage for perceiving, understanding and acting. Such a framework permits experts to be optimally selective and efficient because it permits them to rule out or inhibit all kinds of ultimately unfruitful possibilities (e.g., see Bransford & Franks, 1976). (p. 48)

In their analysis, however, they claim that "becoming an expert . . . seems to involve a process of <u>decontextualization</u>. Knowing becomes less and less context bound" (p. 49). A contextualist such as Dewey might reply that while growth certainly involves going beyond initial

situational contexts, it never involves moving beyond context as such. From the perspective of the novice chess player, the master may seem to have decontextualized problem situations; but from the perspective of the master chess player in competition with another master, the context is thick and rich with significance and meaning. Thus, rather than decontextualization, a contextualist might point to this phenomenon as recontexualization.

A contextualist world view for cognitive psychology asserts itself most forcefully in the area of problem solving. A problematic situation institutes a transaction between the organism and the environment, and the existential contingencies and the perceptual and conceptual activities of the organism coalesce in a tightly woven experience which has a unified quality impervious to any "final" formal analysis; yet this experience avails itself for analysis--as the situation so demands. The contextualist agrees that behavior can be regulated, that rules do sometimes apply, that the environment can be represented; but as total explanations, each of these is degenerative of lived experience because our situatedness-in-the-world is first and foremost, constitutive. Granted, the strict empiricist, as Merleau-Ponty admits, will always appear more real, more definite; the rationalist more cogent, more structured. The contextualist offers no such grounds for certainty. But to adapt a metaphor from Hacking's (1982) review of Wittgenstein, the contextualist's little guerilla army of unlike examples, of contextual nuances may begin to tell against the big guns. And in the sense that its concerns have moved problem-

solving research toward issues of context, however yet narrowly defined, it has already begun to tell.

The Limits of Contextualism as a World View for Cognitive Psychology

Contextualism is strongest when it is describing the present event, the practical activities of the organism in the natural environment, and the cumulative impact of culture and history in experience. At all costs, the contextualist rejects "setting up a hard and fast wall between the experiencing subject and that nature which is experienced" (Dewey, 1925/1929, p. 24). Even given its strengths as a refined world hypothesis, within Pepper's theory of metatheoretical systems, contextualists can not claim to have formulated a completely adequate world view. I shall examine one of its general inadequacies and then illustrate some of the difficulties that must be overcome if it is to become a more broadly accepted alternative to mechanism in the field of cognitive psychology.

Although contextualism interprets the richness and dynamic quality of the present given event and its structure, it falls silent about larger patterns of structure between events. Pepper states:

> It is very definite about the present event and the premonitions it gives of neighboring events, but less and less definite about the wider structure of the world. It is willing to make more or less speculative wagers about the wider structure of the world. But if anyone pushes a contextualist hard, he retires into his given event and the direct verification he makes from it. (p. 276)

Contextualism generally roots all cognitive activity in practical, ongoing oranism-environment interchanges in which the organism modifies the environment and is, in turn, modified. Thus, as a world view, it is hard pressed to account for complex intellectual structures which operate independently of modification of the external world. Mathematical physics and astronomy are cases in which cognition involves reflective abstraction. Scheffler (1973) states the problem in terms of general scientific thinking:

> Scientific theories do not, generally, grow out of practical activities; they are embedded in complex intellectual structures linked only indirectly, and as wholes, to contexts of evidence and experiment. Their assessment is intimately dependent upon these intellectual structures, and involves, aside from practical efficacy, theoretical considerations bearing their relative simplicity, naturalness, comprehensiveness, elegance, and connectibility with associated structures. (p. 79)

Evidence of complex conceptual and intellectual structures involved in higher level problem solving (whether those structures be logical, mathematical, or linguistic) can not be handled easily by the contextualist's insistence on the specious present and direct verification (see Piaget, 1970, for a review of various theories of structuralism in relation to his own).

From a formist's world view, experiences involving reflective abstraction are different in kind from those involving perceptual or emotional immediacy. The problem of finding a mate, for example, suggests an altogether different process than discovering a

mathematical truth; the former situation feels context bound, but the latter transcends context in that solving a Euclidean geometry problem seems no different an experience no matter who solves it or what the end in view (see Weimer, 1977, p. 297, for a similar criticism of contextualism). For the contextualist, solving a problem and arriving at the hypothesis which solves it "gives no insight into the qualities of nature. [Contextualism] insists that a symbolic statement or a map or a model is no more than a tool for the control of nature" (Pepper, pp. 274-275). Thus, as Pepper notes, contextualism is faced with a dilemma between accepting the limited scope offered by the analysis of the present event and the self-contradiction involved in acquiring scope; i.e., both affirming and denying the structure of nature (p. 20). Like the mechanist who, when faced with internal theoretical contradictions, points to the particulars which constitute experience, the contextualist, when similarly confronted, points to nature as changing and full of novelty.

In Rorty's (1979) introductory discussion of Wittgenstein, Heidegger, and Dewey and their attempts to formulate new contexts for thought, he describes their work as "therapeutic rather than constructive, edifying rather than systematic, designed to make the reader question his own motives for philosophizing rather than to supply him with a new philosophical program" (pp. 5-6). As he emphasizes, these philosophers broke radically with centuries-old philosophical traditions, traditions which permeate psychology as well. The contextualist does not offer psychology a "pre-made" systematic program;

in many respects its seeming ambiguity and looseness results from its comparison to more commonly accepted views against which it has developed. Its constructive efforts are relatively new. Rorty's characterization is useful as background for understanding how contextualism is currently being integrated into psychology. To illustrate the difficulty of this integration into the discipline, I shall compare two of the attempts to introduce explicitly contextualist views into cognitive psychology--Neisser's (1976) and Turvey, Shaw, Reed, and Mace's (1981).

Although I argued that Neisser attempts to take into account issues about cognition that a contextualist would raise and even though some of his almost phenomenological descriptions of experience are clearly intended to capture the complexity of context in cognition, several of his theoretical concepts, particularly his notion of schema, are, as Kaufman (1980) has claimed, notoriously vague. Neisser claims, for example, that schemata are like formats (but more "open" and "flexible" than formats), plans, frames, and genotypes (rather than phenotypes) (pp. 55-59).

> Such metaphorical descriptions do not, of course, satisfy the rigor that we must require of a scientific concept--especially not when the concept is one of such centrality as assigned to the schema in Neisser's theory. As far as can be told from Neisser's exposition, it seems to us that Neisser presents us with a totally unconstrained cognitive omnibus system capable of "solving" any kind of problem. Far from being a scientific theory of any sort, the schema-model is just a way of talking about the phenomena it purports to explain. (Kaufman, 1980, p. 95)

Bartlett (1932), one of the first to introduce the concept of schema into psychology, had reservations about employing such a term. Neisser claims similar discomfort with the meaning of the word, although like Bartlett, he adopts it for lack of a better alternative but then attempts to integrate it into several different, and I have argued, incompatible theories. In some respects, Neisser's theory, which he constructs eclectically (p. 24), illustrates Pepper's warning against such theoretical amalgamation. Neisser's term loses precision because he mixes categories from different world views; schemata both "pick up" information (in Gibson's sense) and function as cognitive mechanisms (in the information-processing sense).

Originally indicative of a contextualist perspective, the notion of schema has now also been incorporated into information-processing models of cognition (Rumelhart & Ortony, 1977). Its meaning in contemporary research is so unconstrained that its use seems to simply signify a reaction against the tenets of associationism. Rumelhart and Ortony, for example, state, "Schemata attempt to represent knowledge in the kind of flexible way which reflects human tolerance of vagueness, imprecision, and quasi-inconsistencies" (p. 111). But of course schemata do not attempt to represent knowledge, researchers do; and so it turns out that schemata are really central mechanisms and that there are various kinds of them such as "a rather abstract problem solving [one]" (p. 113). Bartlett was not as much concerned about the representation of knowledge as with how experience so organizes itself that the past enters into the present. Rumelhart and Ortony

indicate that their use of the term derives from Kant more than Bartlett, but these varying adaptions of the term have thus far proven theoretically vague.

The development of contextualism in psychology has been thwarted by such fuzzy, loosely defined concepts (see Scriven, 1977, for a criticism of the term "tuning"). This is a real disadvantage, especially when the alternatives are, for example, neatly packaged, often elaborately developed network models which seemingly offer more organized, straightforward explanations of cognitive behavior. Of course, mechanists will always claim that contextualist concepts are unconstrained based on their notion of what it means to be constrained; but there is still a sense in which contextualist terminology has been loose and unrefined. In a discipline which has historically been defensive about its status as a science, any such vagueness, internal to its own views, provides ground for facile dismissal. Contextualist philosophers, on the other hand, have commonly taken great care in discussing the role of science in human experience and, in fact, viewed their philosophy as laying the foundation for scientific inquiry.

The inability of psychologists to offer more plausible and refined contextualist accounts of cognition in behavior may account for the direction that Turvey and his colleagues have taken in their development of Gibson's ecological theory of perception. In their discussion of an ecological learning theory (1980) and in their response to Fodor and Pylyshyn (1981), the ecological realists have exemplified their assumption through the study of animal behavior; only scant

mention is made of human behavior. They concentrate much of their analysis on the conception of ecological laws; "roughly, laws that inform the relation of things perceived to actions performed" (Turvey et al., 1981, p. 271). Because of the historical preemptiveness of mechanism in psychology, their approach may prove to be the most effective for establishing the scientific viability of contextualism as a world view. Although contextualist philosophers never shied away from exemplifying their assumptions through human behavior, perhaps they did not envision the powerful union of mechanism and a kind of formism in the information-processing model of cognition. And it is this merger that the ecological realists rigorously tackle. At present, their theory offers the most cogent, viable form of contextualist thinking in psychology.

Thus, contextualism, like mechanism, has its own limitations and cannot solve all the problems to which cognitive psychology has fallen heir. Both mechanism and contextualism are equally adequate, but ultimately limited world views. The extension of Pepper's analyses leads to the recognition of metatheoretical diversity, and it is to the implications of such diversity in cognitive psychology that I shall now turn.

Postrational Eclectism for Cognitive Psychology

Every relatively adequate world view attempts to be completely comprehensive and all-inclusive, and its strength derives from its structural corroboration and refined cognitive evidence. The proponent

of a given world view, actually engaged in investigation, aims toward establishing greater cognitive reliability of interpretations of separate facts and fields of facts (p. 109). The commitment to the possibility of a totally legitimate given world view advances its adequacy and strength. In Kuhn's (1962) terms, a scientist takes up a paradigm as if it were the only legitimate and potentially adequate framework for knowledge.

In cognitive psychology, for example, researchers pose their empirical and theoretical questions based on their metatheoretical assumptions. Wickelgren (1981) stakes out as the issue for investigation, the critical defining properties of an associative memory and Jenkins (1974) the physical and psychological context of memory for events; Hayes-Roth and Thorndyke (1979) present evidence for a word-based theory of memory and Bransford and Franks (1971) a theory of memory for holistic, semantic ideas. At a more theoretical level, Fodor and Pylyshyn (1981) state the logical and scientific evidence for a theory of indirect perception based on inference from properties; and Gibson (1979) and Turvey, Shaw, Reed, and Mace (1981) present competing logical and scientific evidence for a theory of direct perception based on the apprehension of meaning. Each of these not only advances a particular world view, but also sets up the nature of his or her empirical and hypothetical evidence against some other. The identification of the complexity of the issues at stake in such debates is one of the central advantages in applying Pepper's framework to psychology; it should be clear that these areas of disagreement will unlikely be

resolved by empirical evidence alone since what "counts" as evidence for one world view may well be rejected by another; or, as I have illustrated with Bransford and Franks' and de Groot's studies, interpretation of the "facts" may vary significantly.

Given the contrasting theoretical orientations in the literature, the appeal of an eclectic approach in cognitive psychology is seductive, particularly since, as Pepper states:

> Mechanism gives a basis and a substance to contextualist analyses, and contextualism gives a life and a reality to mechanistic syntheses. Each is threatened with inadequacy just where the other seems to be strong. (p. 147)

A combined mechanist and contextualist view, formed by selecting their strongest and best analyses, might appear to eliminate the inadequacies both contain when viewed singly. But as Pepper staunchly maintains, the disadvantages of such a combination far outweigh any insights that may be gained. We have seen, in several attempts to synthesize tenets of, for example, information-processing theories and contextualist or ecological theories, that the resulting hybrid theory glosses over difficulties or produces new confusions. When categories from two different world hypotheses are merged, the newly proposed eclectic theory has by definition no root metaphor (p. 112). Since cognition has its roots in common sense experience and progressively refines and expands evidence through structural corroboration, breaking into the set of categories within a given world view weakens either its precision or scope. "The dangers of eclecticism arise from its

interference with the processes of structural corroboration" (Pepper, p. 341). If such seemingly creative theorizing ultimately results in serious conceptual difficulties, what approach, then, remains for the psychologist engaged in practical, ongoing research--both theoretical and empirical?

To deal with this dilemma, Pepper proposes a postrational eclecticism which "is simply the recognition of the equal or nearly equal adequacy of a number of world theories and a recommendation that we do not fall into the dogmatism of neglecting any one of them" (p. 342). In the short run, psychologists must investigate as if ultimate truth about the world will be discovered; but in the long run, they must be able to stand back and take a more tolerant view of diverse sources of knowledge. Thus, Pepper's theory culminates in the suggestion that only an undogmatic view can be defended, particularly since dogmatic claims do not themselves increase the cognitive value of a theory. In earlier chapters I claimed that psychology has often succumbed to holding dogmatic views about what sorts of evidence count as knowledge; and Pepper's analysis warns us not to mistake the evidence for a particular theoretical orientation as the only possible legitimate evidence. He advocates, then, tolerance in the metatheoretical arena.

Within psychology, contextualists and mechanists have--in their finest and most constructive endeavors--engaged in a dialectical process in which the evidence for one challenges the other to more carefully and thoroughly refine its own line of corroboration. At their

worst, they have become dogmatic by denying the very possibility of other interpretations of psychological experiences and thus obviated the chance of accepting new evidence which might stimulate further theoretical growth. Certainly the recent surfacing of contextualism into cognitive psychology has changed basic perspectives--some psychologists have abandoned a mechanistic framework altogether and embraced contextualism as the most fruitful for their research; others have carved out theoretical rebuttals to the contextualist challenge. But the most dramatic influence of the emergence of diverse metatheoretical perspectives has been the increasing recognition that psychology can no longer claim to be a field divested of metaphysical assumptions.

Conclusion

In summary, it would be well to briefly outline the main line of arguments I have followed throughout this disseration. The reintroduction of cognition into psychology over the last twenty years has dealt a serious blow to the neobehaviorist paradigm which had dominated psychological investigations since the early 1900s. Within psychology generally, a state of seemingly diverse conceptual frameworks and research models emerged, and nowhere so prolifically as in the field of cognitive psychology. An examination of two different areas in cognitive studies--perception and memory--illustrated, however, that the conceptual diversity points to more far-reaching and fundamental assumptions about human nature and the nature of the world. In order

to unify and arbitrate among these various theories and approaches, I employed Stephen Pepper's World Hypotheses as a metaphysical framework. Based on an examination of theoretical developments and key experimental findings in these areas, I claimed that contextualism has become a viable contender to mechanism, the world view long dominant in psychology generally. Guided by Pepper's principle of postrational eclecticism, I continued to stress throughout that contextualism and mechanism both offer adequate metatheoretical views. A recognition of the importance of metaphysics and an attitude of tolerance toward competing world views provide a healthy climate in which psychology can sharpen the kinds of questions it poses in its development of theories, hypotheses, and models of human behavior.

REFERENCES

Allport, D. A. Conscious and unconscious cognition: A computational metaphor for the mechanism of attention and integration. In L. Nilsson (Ed.), Perspectives on memory research: Essays in honor of Uppsala University's 500th Anniversary. Hillsdale, N.J.: Lawrence Erlbaum, 1979.

Allport, G. W. Dewey's individual and social psychology. In Schilpp (Ed.), The philosophy of John Dewey. New York: Tudor, 1951. (Originally published in 1939.)

Anderson, J. R. Cognitive psychology and its implications. San Francisco: W. H. Freeman, 1980.

Anderson, J. R., & Bower, G. H. Recognition and retrieval processes in free recall. Psychological Review, 1972, 79, 97-123.

Anderson, J. R., & Bower, G. H. Human associative memory. Washington, D.C.: Winston, 1973.

Asher, J. J. Towards a neo-field theory of problem solving. Journal of General Psychology, 1963, 68, 3-8.

Auble, P. M., & Franks, J. J. The effects of effort toward comprehension on recall. Memory and Cognition, 1978, 6, 20-25.

Auble, P. M., Franks, J. J., & Soraci, S. A. Effort toward comprehension: Elaboration or "aha!"? Memory and Cognition, 1979, 7, 331-350.

Bakan, D. On method: Toward a reconstruction of psychological investigation. San Francisco: Jossey-Bass, 1967.

Bandura, A. Principles of behavior modification. New York: Holt, Rinehart & Winston, 1969.

Bandura, A. Social learning theory. Englewood Cliffs, N.J.: Prentice-Hall, 1977.

Barclay, J. R. The role of comprehension in remembering sentences. Cognitive Psychology, 1973, 4, 229-254.

Bartlett, F. C. Remembering. Cambridge, England: Cambridge University Press, 1932.

Berkeley, G. A treatise concerning the principles of human knowledge. In M. W. Calkins (Ed.), Berkeley: Essay, principles, dialogues. New York: Charles Scribner's Sons, 1929. (Originally published, 1710.)

Bobrow, D. G., & Norman, D. A. Some principles of memory schemata. In D. G. Bobrow & A. Collins (Eds.), Representation and understanding: Studies in cognitive science. New York: Academic Press, 1975.

Bobrow, D. G., & Winograd, T. An overview of KRL, a knowledge representation language. Cognitive Science, 1977, 1, 3-46.

Bolles, R. C. Learning, motivation, and cognition. In W. K. Estes (Ed.), Handbook of learning and cognitive processes (Vol. 1). Hillsdale, N.J.: Lawrence Erlbaum, 1975.

Bourne, L. E., Jr. Knowing and using concepts. Psychological Review, 1970, 77, 546-556.

Bourne, L. E., Jr., Dominowski, R. L., & Loftus, E. F. Cognitive processes. Englewood Cliffs, N.J.: Prentice-Hall, 1979.

Bousfield, W. A. The occurrence of clustering and the recall of randomly arranged associates. Journal of General Psychology, 1953, 49, 229-240.

Bower, G. H. Stimulus-sampling theory of encoding variability. In A. W. Melton & E. Martin (Eds.), Coding processes in human memory. Washington, D.C.: Winston, 1972.

Bransford, J. D. Human cognition: Learning, understanding, and remembering. Belmont, Calif.: Wadsworth, 1979.

Bransford, J. D., Barclay, J. R., & Franks, J. J. Sentence memory: A constructive versus interpretive approach. Cognitive Psychology, 1972, 3, 193-208.

Bransford, J. D., & Franks, J. J. The abstraction of linguistic ideas. Cognitive Psychology, 1971, 2, 331-350.

Bransford, J. D., & Franks, J. J. The abstraction of linguistic ideas: A review. Cognition, 1972, 1, 211-249.

Bransford, J. D., & Franks, J. J. Toward a framework for understanding learning. In G. Bower (Ed.), Psychology of learning and motivation (Vol. 10). New York: Academic Press, 1976.

Bransford, J. D., & Johnson, M. K. Contextual prerequisites for understanding: Some investigations of comprehension and recall. Journal of Verbal Learning and Verbal Behavior, 1972, 11, 717-726.

Bransford, J. D., & Johnson, M. K. Consideration of some problems of comprehension. In W. Chase (Ed.), Visual information processing. New York: Academic Press, 1973.

Bransford, J. D., & McCarrell, N. S. A sketch of a cognitive approach to comprehension. In W. Weimer & D. Palermo (Eds.), Cognition and the symbolic processes. Hillsdale, N.J.: Lawrence Erlbaum, 1974.

Bransford, J. D., McCarrell, N. S., Franks, J. J., & Nitsch, K. E. Toward unexplaining memory. In R. E. Shaw & J. D. Bransford (Eds.), Perceiving, acting, and knowing: Toward an ecological psychology. Hillsdale, N.J.: Lawrence Erlbaum, 1977.

Bransford, J. D., Nitsch, K. E., & Franks, J. J. Schooling and the facilitation of knowing. In R. C. Anderson, R. J., Spiro & W. E. Montague (Eds.), Schooling and the acquisition of knowledge. Hillsdale, N.J.: Lawrence Erlbaum, 1977.

Brewer, W. F. There is no convincing evidence for operant or classical conditioning in adult humans. In W. B. Weimer & D. S. Palermo (Eds.), Cognition and the symbolic processes. Hillsdale, N.J.: Lawrence Erlbaum, 1974.

Broadbent, D. E. Perception and communication. London: Pergamon Press, 1958.

Broadbent, D. E. Behaviour. London: Eyre & Spottiswoode, 1961.

Bronfenbrenner, U. Toward an experimental ecology of human development. American Psychologist, 1977, 32, 513-531.

Brown, J. Some tests of the decay theory of immediate memory. Quarterly Journal of Experimental Psychology, 1958, 10, 12-21.

Bruner, J. S. On perceptual readiness. Psychological Review, 1957, 64, 123-152.

Bruner, J. S. Toward a theory of instruction. Cambridge, Mass.: Harvard University Press, 1966.

Bruner, J. S. Beyond the information given: Studies in the psychology of knowing. New York: Norton, 1973.

Bruner, J. S., Goodnow, J. J., & Austin, G. A. A study of thinking. New York: John Wiley, 1956.

Burt, E. A. The status of World Hypotheses. Philosophical Review, 1943, 52, 590-601.

Buss, A. R. A dialectical psychology. New York: John Wiley, 1979.

Chase, W. G., & Simon, H. A. The mind's eye in chess. In W. G. Chase (Ed.), Visual information processing. New York: Academic Press, 1973.

Cofer, C. N. On some factors in the organizational characteristics of free recall. American Psychologist, 1965, 20, 261-272.

Cofer, C. N. Constructive process in memory. American Scientist, 1973, 61, 537-543.

Cofer, C. N., & Foley, J. P., Jr. Mediated generalization and the interpretation of verbal behavior. I. Prolegomena. Psychological Review, 1942, 49, 513-540.

Colle, H. A. The reification of clustering. Journal of Verbal Learning and Verbal Behavior, 1972, 11, 624-633.

Collett, P. (Ed.). Social rules and social behaviour. Totowa, N.J.: Rowman & Littlefield, 1977.

Collins, A. M., & Loftus, E. F. A spreading activation theory of semantic processing. Psychological Review, 1975, 82, 407-428.

Collins, A. M., & Quillian, M. R. Retrieval time from semantic memory. Journal of Verbal Learning and Verbal Behavior, 1969, 8, 240-247.

Cook, T. D., & Campbell, D. T. Quasi-experimentation: Design and analysis issues for field settings. Chicago: Rand McNally College, 1979.

Craik, F. I. Human memory. Annual Review of Psychology, 1979, 30, 63-102.

Craik, F. I., & Jacoby, L. L. Elaboration and distinctiveness in episodic memory. In L. Nilsson (Ed.), Perspectives on memory research: Essays in honor of Uppsala University's 500th Anniversary. Hillsdale, N.J.: Lawrence Erlbaum, 1979.

Cramer, P. Word association. New York: Academic Press, 1968.

Dallet, K. Transactional and probabilistic functionalism. In E. C. Carterette & M. P. Friedman (Eds.), Handbook of perception (Vol. 1). New York: Academic Press, 1974.

Deese, J. The structure of associations in language and thought. Baltimore, Md.: Johns Hopkins Press, 1965.

de Groot, A. D. Perception and memory versus thought: Some old ideas and recent findings. In B. Kleinmuntz (Ed.), Problem solving: Research, method, and theory. New York: John Wiley, 1966.

De Nike, L. D. The temporal relationship between awareness and performance in verbal conditioning. Journal of Experimental Psychology, 1964, 68, 521-529.

Dewey, J. The reflex arc concept in psychology. Psychological Review, 1896, 3, 357-370.

Dewey, J. Epistemological realism: The alleged ubiquity of the knowledge relation. The Journal of Philosophy, 1911, 8, 99-107.

Dewey, J. Perception and organic action. Journal of Philosophy, 1912, 9, 645-668.

Dewey, J. Human nature and conduct. New York: Henry Holt, 1922.

Dewey, J. Meaning and existence. The Journal of Philosophy, 1928, 25, 345-353.

Dewey, J. Experience and nature. Chicago: Open Court, 1929. (Originally published, 1925.)

Dewey, J. Art as experience. New York: Minton, Balch & Company, 1934.

Dewey, J. Logic: The theory of inquiry. New York: Henry Holt, 1938.

Dewey, J. Experience, knowledge, and value. In P. A. Schilpp (Ed.), The philosophy of John Dewey. New York: Tudor, 1951. (Originally published in 1939.)

Dewey, J., & Bentley, A. F. Knowing and the known. Boston: Beacon Press, 1949.

Dominowski, R. L., & Wetherick, N. E. Inference processes in conceptual rule learning. Journal of Experimental Psychology: Human Memory and Learning, 1976, 2, 1-10.

Dreyfus, H. L. What computers can't do: The limits of artificial intelligence (Rev. ed.). New York: Harper & Row, 1979.

Dulany, D. E. The place of hypotheses and intentions: An analysis of verbal control in verbal conditioning. In C. W. Eriksen (Ed.), Behavior and awareness: A symposium of research and interpretation. Durham, N.C.: Duke University Press, 1962.

Earhard, B. Associationism (and the nativist-empiricist axis). In E. C. Carterette & M. P. Friedman (Eds.), Handbook of perception (Vol. 1). New York: Academic Press, 1974.

Ebbinghaus, H. Memory. A contribution to experimental psychology (H. A. Ruger & C. E. Bussenius, trans.). New York: Teachers College Press, Columbia University, 1913. (Originally published, 1885.)

Ericsson, K. A., & Simon, H. A. Verbal reports as data. Psychological Review, 1980, 87, 215-252.

Estes, W. K. An associative basis for coding and organization in memory. In A. W. Melton & E. Martin (Eds.), Coding processes in memory. New York: Winston, 1972.

Estes, W. K. On the description and explanatory functions of theories of memory. In L. Nilsson (Ed.), Perspectives on memory research: Essays in Honor of Uppsala University's 500th Anniversary. Hillsdale, N.J.: Lawrence Erlbaum, 1979.

Evans, R. I. B. F. Skinner: The man and his ideas. New York: Dutton, 1968.

Finkleman, D. Science and psychology. American Journal of Psychology, 1978, 91, 179-199.

Fodor, J. A. The mind-body problem. Scientific American, 1981, 244(1), 114-123.

Fodor, J. A., & Pylyshyn, Z. W. How direct is visual perception? Some reflections on Gibson's "Ecological Approach." Cognition, 1981, 9, 139-196.

Frijda, N. H. Simulation of human long-term memory. Psychological Bulletin, 1972, 77, 1-31.

Gadamer, H. Philosophical hermeneutics. (D. E. Linge, trans.). Berkeley: University of California Press, 1976.

Garner, W. R. Uncertainty and structure as psychological concepts. New York: John Wiley, 1962.

Gergen, K. J. Social psychology as history. Journal of Personality and Social Psychology, 1973, 26, 309-320.

Gibbs, J. C. The meaning of ecologically oriented inquiry in contemporary psychology. American Psychologist, 1979, 34, 127-140.

Gibson, J. J. The senses considered as perceptual systems. Boston: Houghton Mifflin, 1966.

Gibson, J. J. The theory of affordances. In R. E. Shaw & J. D. Bransford (Eds.), Perceiving, acting, and knowing: Toward an Ecological Psychology. Hillsdale, N.J.: Lawrence Erlbaum, 1977.

Gibson, J. J. The ecological approach to visual perception. Boston: Houghton Mifflin, 1979.

Goetz, E. T., Anderson, R. C., & Schallert, D. L. The representation of sentences in memory. Journal of Verbal Learning and Verbal Behavior, 1981, 20, 369-385.

Gomulicki, B. R. Recall as an abstractive process. Acta Psychologia, 1956, 12, 77-94.

Goss, A. E. Early behaviorism and verbal mediating responses. American Psychologist, 1961, 16, 285-298.

Goss, A. E. Verbal mediation responses and concept formation. In C. P. Duncan (Ed.), Thinking: Current experimental studies. New York: McGraw-Hill, 1967.

Green, B. F. Introduction: Current trends in problem solving. In B. Kleinmuntz (Ed.), Problem solving: Research, method and theory. New York: John Wiley, 1966.

Greeno, J. G., James, C. T., Da Polito, F. J., & Polson, P. G. Associative learning: A cognitive analysis. Englewood Cliffs, N.J.: Prentice-Hall, 1978.

Gregory, R. L. Eye and brain: The psychology of seeing (2nd ed.). New York: McGraw-Hill, 1973.

Gregory, R. L. Choosing a paradigm for perception. In E. C. Carterette & M. P. Friedman (Eds.), Handbook of perception (Vol. 1). New York: Academic Press, 1974.

Guthrie, E. R. The psychology of learning. New York: Harper, 1952.

Haber, R. N. Information processing. In E. C. Carterette & M. P. Friedman (Eds.), Handbook of perception (Vol. 1). New York: Academic Press, 1974.

Hacking, I. Wittgenstein the psychologist. The New York Review of Books, 1982, 24(5), 42-44.

Hayes-Roth, B. Evolution of cognitive structure and processes. Psychological Review, 1977, 84, 260-278.

Hayes-Roth, B., & Thorndyke, P. W. Integration of knowledge from text. Journal of Verbal Learning and Verbal Behavior, 1979, 18, 91-108.

Hebb, D. O. Organization of behavior. New York: John Wiley, 1949.

Hempel, C. G. Problems and changes in the empiricist criterion of meaning. Revue Internationale de Philosophie, 1951, 4, 41-63.

Hempel, C. G. A logical appraisal of operationism. Scientific Monthly, 1954, 1, 251-320.

Hempel, C. G. Philosophy of natural science. Englewood Cliffs, N.J.: Prentice-Hall, 1966.

Herbst, P. G. Behavioral worlds. London: Tavistock, 1970.

Herriot, P. Attributes of memory. London: Methuen, 1974.

Hilgard, E. R. Consciousness in contemporary psychology. Annual Review of Psychology, 1980, 31, 1-26.

Hochberg, J. E. Organization and the gestalt tradition. In E. C. Carterette & M. P. Friedman (Eds.), Handbook of perception (Vol. 1). New York: Academic Press, 1974.

Hochberg, J. E. Perception (2nd ed.). Englewood Cliffs, N.J.: Prentice-Hall, 1978.

Hollan, J. D. Features and semantic memory: Set theoretic or network model. Psychological Review, 1975, 82, 154-155.

Horgan, T. Reduction and the mind-body problem. In M. H. Marx & F. E. Goodson (Eds.), Theories in contemporary psychology (2nd ed.). New York: Macmillan, 1976.

Hovland, C. I. Human learning and retention. In S. S. Stevens (Ed.), Handbook of experimental psychology. New York: John Wiley, 1951.

Hull, C. L. Principles of behavior. New York: Appleton-Century-Crofts, 1943.

Humphrey, G. Thinking: An introduction to its experimental psychology. New York: John Wiley, 1963.

Jacobsen, T. L., & Asher, J. J. Validity of the concept constancy measure of creative problem solving. Journal of General Psychology, 1963, 68, 9-19.

James, W. The principles of psychology (Vol. 1). New York: Henry Holt, 1890.

Jenkins, H. M. Animal learning and behavior theory. In E. Hearst (Ed.), The first century of experimental psychology. Hillsdale, N.J.: Lawrence Erlbaum, 1979.

Jenkins, J. J. Can we have a meaningful theory of memory? In R. L. Solso (Ed.), Theories in cognitive psychology: The Loyola Symposium. Hillsdale, N.J.: Lawrence Erlbaum, 1974. (a)

Jenkins, J. J. Remember that old theory of memory? Well forget it! American Psychologist, 1974, 29, 785-795. (b)

Johansson, G. On theories for visual space perception. Scandanavian Journal of Psychology, 1970, 11, 67-79.

Johansson, G. Visual perception of biological motion and a model for its analysis. Perception & Psychophysics, 1973, 14, 201-211.

Johansson, G. Spatio-temporal differentiation and integration in visual motion perception. Psychological Research, 1976, 38, 379-393.

Johansson, G. Memory functions in visual event perception. In L. Nilsson (Ed.), Perspectives on memory research: Essays in honor of Uppsala University's 500th Anniversary. Hillsdale, N.J.: Lawrence Erlbaum, 1979.

Johansson, G., von Hofsten, C., & Jansson, G. Event perception. Annual Review of Psychology, 1980, 31, 27-63.

Johnson, M. K., Doll, T. J., Bransford, J. D., & Lapinski, R. Context effects in sentence memory. Journal of Experimental Psychology, 1974, 103, 358-360.

Johnston, T., & Turvey, M. T. A sketch of an ecological metatheory for theories of learning. In G. Bower (Ed.), The psychology of learning and motivation. New York: Academic Press, 1980.

Joynson, R. B. Breakdown of modern psychology. Bulletin of the British Psychological Society, 1970, 23, 261-269.

Kantor, J. R. Behaviorism in the history of psychology. The Psychological Record, 1968, 18, 151-166.

Kaplan, A. The conduct of inquiry. San Francisco: Chandler, 1964.

Kaufmann, G. Imagery, language, and cognition: Toward a theory of symbolic activity in human problem-solving. Oslo, Norway: Universitetsforlaget, 1980.

Kausler, D. H. Psychology of verbal learning and memory. New York: Academic Press, 1974.

Kendler, H. H., & Kendler, T. S. Vertical and horizontal processes in problem solving. Psychological Review, 1962, 69, 1-16.

Kendler, H. H., & Kendler, T. S. Mediation and conceptual behavior. In K. W. Spence & J. T. Spence (Eds.), Psychology of learning and motivation (Vol. 2). New York: Academic Press, 1968.

Kendler, H. H., & Kendler, T. S. From discrimination learning to cognitive development: A neo-behavioristic odyssey. In W. K. Estes (Ed.), Handbook of learning and cognitive processes (Vol. 1). Hillsdale, N.J.: Lawrence Erlbaum, 1975.

Kendler, H. H., Kendler, T. S., & Sanders, J. Reversal and partial reversal shifts with verbal material. Journal of Verbal Learning and Verbal Behavior, 1967, 6, 117-127.

Kendler, H. H., & Spence, J. T. Tenets of neobehaviorism. In M. H. Marx & F. E. Goodson (Eds.), Theories in contemporary psychology (2nd ed.). New York: Macmillan, 1976.

Kendler, T. S. Development of mediating responses in children. In J. P. DeCecco (Ed.), The psychology of language, thought and instruction. London: Holt, Rinehart & Winston, 1969.

Kestenbaum, V. The phenomenological sense of John Dewey: Habit and meaning. Atlantic Highlands, N.J.: Humanities Press, 1977.

Kintsch, W. Notes on the structure of semantic memory. In E. Tulving & W. Donaldson (Eds.), Organization of memory. New York: Academic Press, 1972.

Kintsch, W. The representation of meaning in memory. Hillsdale, N.J.: Lawrence Erlbaum, 1974.

Kintsch, W. On modeling comprehension. Educational Psychologist, 1979, 14, 3-14.

Koch, S. Reflections on the state of psychology. Social Research, 1971, 38, 669-709.

Koffka, K. Some problems of space perception. In C. Murchison (Ed.), Psychologies of 1930. Worchester, Mass.: Clark University Press, 1930.

Kohler, W. Some tasks of gestalt psychology. In C. Murchison (Ed.), Psychologies of 1930. Worchester, Mass.: Clark University Press, 1930.

Kolers, P. A. Remembering operations. Memory and Cognition, 1973, 1, 347-355.

Kuhn, D. Mechanisms of cognitive and social development: One psychology or two? Human Development, 1978, 21, 92-118.

Kuhn, T. S. The structure of scientific revolutions (2nd ed.). Chicago: University of Chicago Press, 1970. (Originally published, 1962.)

Kvale, S. Dialectics and research on remembering. In N. Datan & H. W. Reese (Eds.), Life-span developmental psychology: Dialectical perspectives on experimental research. New York: Academic Press, 1977.

Lachman, J. L., & Lachman, R. Theories of memory organization and human evolution. In C. R. Puff (Ed.), Memory, organization, and structure. New York: Academic Press, 1979.

Lakatos, I., & Musgrave, A. (Eds.). Criticism and the growth of knowledge. Cambridge, Mass.: Cambridge University Press, 1970.

Lakoff, G., & Johnson, M. Metaphors we live by. Chicago: University of Chicago Press, 1980.

Lakoff, G., & Johnson, M. The metaphorical structure of the human conceptual system. In D. A. Norman (Ed.), Perspectives on cognitive science. Hillsdale, N.J.: Lawrence Erlbaum, 1981.

Lazarus, A. A. Has behavior therapy outlived its usefulness? American Psychologist, 1977, 32, 550-554.

Lazarus, A. A. A matter of emphasis. American Psychologist, 1979, 34, 100.

Lichtenstein, E. H., & Brewer, W. F. Memory for goal-directed events. Cognitive Psychology, 1980, 12, 412-445.

Locke, J. An essay concerning human understanding (Vol. 1). (Collated and annotated, A. C. Fraser). New York: Dover, 1959. (Originally published, 1690.)

Loftus, G. R., & Loftus, E. F. Human memory: The processing of information. Hillsdale, N.J.: Lawrence Erlbaum, 1976.

Mace, W. M. Ecologically stimulating cognitive psychology: Gibsonian perspectives. In W. B. Weimer & D. S. Palermo (Eds.), Cognition and the symbolic processes. Hillsdale, N.J.: Lawrence Erlbaum, 1974.

Mace, W. M. James J. Gibson's strategy for perceiving: Ask not what's inside your head, but what your head's inside of. In R. E. Shaw & J. D. Bransford (Eds.), Perceiving, acting, and knowing: Toward an ecological psychology. Hillsdale, N.J.: Lawrence Erlbaum, 1977.

Mahoney, M. J. Cognition and behavior modification. Cambridge, Mass.: Ballinger, 1974.

Malcolm, N. Memory and mind. Ithaca: Cornell University Press, 1977.

Maltzman, I. Thinking: From a behaviorist point of view. Psychological Review, 1955, 62, 275-286.

Mandler, G. From association to structure. Psychological Review, 1962, 69, 415-427.

Mandler, G. Organization and memory. In K. W. Spence & J. T. Spence (Eds.), The psychology of learning and motivation: Advances in research and theory. New York: Academic Press, 1967.

Mandler, G. Organization, memory, and mental structures. In C. R. Puff (Ed.), Memory, organization, and structure. New York: Academic Press, 1979.

Marshall, J. C., & Fryer, D. M. Speak memory!: An introduction to some historic studies of remembering and forgetting. In M. M. Gruneberg & P. Morris (Eds.), Aspects of memory. London: Methuen, 1978.

Maturana, H. R. Biology of language. In R. W. Rieber (Ed.), The neuropsychology of language. New York: Plenum Press, 1977.

McGeoch, J. A., & Irion, A. L. The psychology of human learning. New York: Longmans, 1952.

Mednick, S. A. The associative basis of the creative process. Psychological Review, 1962, 69, 220-232.

Meehl, P. E. Clinical vs. statistical prediction. Minneapolis: University of Minnesota Press, 1954.

Merleau-Ponty, M. Phenomenology of perception. (C. Smith, trans.). London: Routledge & Kegan Paul, 1962.

Michaels, C. F., & Carello, C. Direct perception. Englewood Cliffs, N.J.: Prentice-Hall, 1981.

Miller, G. A. The magical number seven, plus or minus two: Some limits on our capacity to process information. Psychological Review, 1956, 63, 81-96.

Minsky, M. Matter, mind, and models. In M. Minsky (Ed.), Semantic information processing. Cambridge, Mass.: M.I.T. Press, 1969.

Minsky, M. A framework for representing knowledge. In P. Winston (Ed.), The psychology of computer vision. New York: McGraw-Hill, 1975.

Minsky, M. K-lines: A theory of memory. In D. A. Norman (Ed.), Perspectives on cognitive science. Hillsdale, N.J.: Lawrence Erlbaum, 1981.

Mishler, E. G. Meaning in context: Is there any other kind? Harvard Educational Review, 1979, 49, 1-19.

Morris, P. Task and material variables. In M. M. Gruneberg & P. Morris (Eds.), Aspects of memory. London: Methuen, 1978.

Murdock, B. B., Jr. The retention of individual items. Journal of Experimental Psychology, 1961, 62, 618-625.

Nafe, J. P. Structural psychology. In C. Murchison (Ed.), Psychologies of 1930. Worchester, Mass.: Clark University Press, 1930.

Neel, A. Theories of psychology: A handbook. New York: Schenkman, 1977.

Neisser, U. Cognitive psychology. New York: Appleton-Century-Crofts, 1967.

Neisser, U. Cognition and reality: Principles and implications of cognitive psychology. San Francisco: W. H. Freeman, 1976.

Neisser, U. Memory: What are the important questions? In U. Neisser (Ed.), Memory observed: Remembering in natural contexts. San Francisco: W. H. Freeman, 1982.

Nelson, K. Concept, word, and sentence: Interrelations in acquisition and development. Psychological Review, 1974, 81, 267-285.

Nelson, K. Cognitive development and the acquisition of concepts. In R. C. Anderson, R. J. Spiro & W. E. Montague (Eds.), Schooling and the acquisition of knowledge. Hillsdale, N.J.: Lawrence Erlbaum, 1977.

Newell, A. You can't play 20 questions with nature and win: Projective comments on the papers of this symposium. In W. G. Chase (Ed.), Visual information processing. New York: Academic Press, 1973.

Newell, A., & Simon, H. A. The simulation of human thought. In W. Dennis (Ed.), Current trends in psychological theory. Pittsburg: University of Pittsburg Press, 1961.

Newell, A., & Simon, H. A. GPS, A program that simulates human thought. In E. A. Feigenbaum & J. Feldman (Eds.), Computers and thought. New York: McGraw-Hill, 1963.

Newell, A., & Simon, H. A. Human problem solving. Englewood Cliffs, N.J.: Prentice-Hall, 1972.

Nilsson, L. Functions of memory. In L. Nilsson (Ed.), Perspectives on memory research: Essays in honor of Uppsala University's 500th Anniversary. Hillsdale, N.J.: Lawrence Erlbaum, 1979.

Nilsson, L. (Ed.). Perspectives on memory research: Essays in honor of Uppsala University's 500th Anniversary. Hillsdale, N.J.: Lawrence Erlbaum, 1979.

Noble, C. E. Induction, deduction, abduction. In M. H. Marx & F. E. Goodson (Eds.), Theories in contemporary psychology. New York: Macmillan, 1976.

Norman, D. A. Perception, memory, and mental processes. In L. Nilsson (Ed.), Perspectives on memory research: Essays in honor of Uppsala University's 500th Anniversary. Hillsdale, N.J.: Lawrence Erlbaum, 1979.

Osgood, C. E. Method and theory in experimental psychology. New York: Oxford University Press, 1953.

Owen, D. H. The psychophysics of prior experience. In P. K. Machamer & R. G. Turnbull (Eds.), Studies in perception. Columbus: Ohio State University Press, 1978.

Page, M. M. Demand characteristics and the verbal operant conditioning experiment. Journal of Personality and Social Psychology, 1972, 23, 304-308.

Pastore, N. Helmholtz on the projection or transfer of sensation. In P. K. Machamer & R. G. Turnbull (Eds.), Studies in perception. Columbus: Ohio State University Press, 1978.

Pepper, S. C. The root metaphor theory of metaphysics. The Journal of Philosophy, 1935, 32, 365-374.

Pepper, S. C. The basis of criticism in the arts. Cambridge, Mass.: Harvard University Press, 1956.

Pepper, S. C. World hypotheses: A study in evidence. Berkeley: University of California Press, 1961. (Originally published, 1942.)

Pepper, S. C. Concept and quality: A world hypothesis. La Salle, Illinois: Open Court, 1966.

Peterson, L. R., & Peterson, M. J. Short-term retention of individual verbal items. Journal of Experimental Psychology, 1959, 58, 193-198.

Piaget, J. Structuralism. (C. Maschler, trans.) New York: Harper & Row, 1970.

Polanyi, M. Personal knowledge. New York: Harper & Row, 1958.

Polanyi, M. Logic and psychology. American Psychologist, 1968, 23, 27-43.

Pomerantz, J. R., Sager, L. C., & Stoever, R. J. Perception of wholes and of their component parts: Some configural superiority effects. Journal of Experimental Psychology: Human Perception and Performance, 1977, 3, 422-435.

Popper, K. R. Conjectures and refutations: The growth of scientific knowledge. New York: Harper & Row, 1963.

Pribram, K. H. Some comments on the nature of the perceived universe. In R. E. Shaw & J. D. Bransford (Eds.), Perceiving, acting and knowing: Toward an ecological psychology. Hillsdale, N.J.: Lawrence Erlbaum, 1977.

Puff, R. C. Memory organization research and theory: The state of the art. In R. C. Puff (Ed.), Memory, organization, and structure. New York: Academic Press, 1979.

Quillian, M. R. Semantic memory. In M. Minsky (Ed.), Semantic information processing. Cambridge, Mass.: M.I.T. Press, 1968.

Quillian, M. R. The teachable language comprehender. Communications of the Association for Computing Machinery, 1969, 12, 459-475.

Reese, H. W., & Overton, W. F. Models of development and theories of development. In L. R. Goulet & P. B. Baltes (Eds.), Life-span developmental psychology: Research and theory. New York: Academic Press, 1970.

Riegel, K. F. Foundations of dialectical psychology. New York: Academic Press, 1979.

Rips, L. J., Shoben, E. J., & Smith, E. E. Semantic distance and verification of semantic relations. Journal of Verbal Learning and Verbal Behavior, 1973, 12, 1-20.

Robinson, E. S. Association theory today: An essay in systematic psychology. New York: Century, 1932.

Rock, I. An introduction to perception. New York: Macmillan, 1975.

Rock, I. In defense of unconscious inference. In W. Epstein (Ed.), Stability and constancy in visual perception. New York: John Wiley, 1977.

Roediger, H. L. Memory metaphors in cognitive psychology. Memory and Cognition, 1980, 8, 231-246.

Rorty, R. Philosophy and the mirror of nature. Princeton, N.J.: Princeton University Press, 1979.

Rosch, E. H. On the internal structure of perceptual and semantic categories. In T. E. Moore (Ed.), Cognitive development and the acquisition of language. New York: Academic Press, 1973.

Rosch, E. H. Cognitive representations of semantic categories. Journal of Experimental Psychology: General, 1975, 104, 192-233.

Rosch, E. H. Principles of categorization. In E. H. Rosch & B. B. Lloyd (Eds.), Cognition and categorization. Hillsdale, N.J.: Lawrence Erlbaum, 1978.

Rosch, E. H., & Mervis, C. B. Family resemblances: Studies in the internal structure of categories. Cognitive Psychology, 1975, 7, 573-605.

Royce, J. R. Cognition and knowledge: Psychological epistemology. In E. C. Carterette & M. P. Friedman (Eds.), Handbook of perception (Vol. 1). New York: Academic Press, 1974.

Rumelhart, D. E., Lindsay, P. H., & Norman, D. A. A process model for long-term memory. In E. Tulving & W. Donaldson (Eds.), Organization of memory. New York: Academic Press, 1972.

Rumelhart, D. E., & Ortony, A. The representation of knowledge in memory. In R. C. Anderson, R. J. Spiro & W. E. Montague (Eds.), Schooling and the acquisition of knowledge. Hillsdale, N.J.: Lawrence Erlbaum, 1977.

Rychlak, J. F. The psychology of rigorous humanism. New York: John Wiley, 1977.

Sachs, J. Recognition memory for syntactic and semantic aspects of connected discourse. Perception and Psychophysics, 1967, 2, 437-442.

Sampson, E. Scientific paradigms and social values: Wanted--a scientific revolution. Journal of Personality and Social Psychology, 1978, 36, 1332-1343.

Sanford, N. Will psychologists study human problems? American Psychologist, 1965, 20, 192-202.

Sarbin, T. R. Contextualism: A world view for modern psychology. In J. K. Cole (Ed.), Nebraska Symposium on Motivation (Vol. 24). Lincoln: University of Nebraska Press, 1977.

Scandura, J. M. Role of rules in behavior: Toward an operational definition of what (rule) is learned. Psychological Review, 1970, 77, 516-533.

Schank, R. C. Using knowledge to understand. In R. Schank & B. Nash-Weber (Eds.), Theoretical issues in natural language processing (Proceedings of a conference). Cambridge, Mass., June 10-13, 1975.

Schank, R. C. Language and memory: In D. A. Norman (Ed.), Perspectives on cognitive science. Hillsdale, N.J.: Lawrence Erlbaum, 1981.

Schank, R. C., & Abelson, R. P. Scripts, plans, goals, and understanding. Hillsdale, N.J.: Lawrence Erlbaum, 1977.

Scheffler, I. Reflections on educational relevance. In R. S. Peters (Ed.), The philosophy of education. New York: Oxford University Press, 1973.

Scott, W. A., Osgood, D. W., & Peterson, C. Cognitive structure: Theory and measurement of individual differences. Washington, D.C.: V. H. Winston, 1979.

Scriven, M. Comments on Chapter 2 by Bransford, Nitsch, and Franks. In R. C. Anderson, R. J. Spiro & W. E. Montague (Eds.), Schooling and the acquisition of knowledge. Hillsdale, N.J.: Lawrence Erlbaum, 1977.

Searle, J. R. Minds, brains, and programs. In D. Hofstadter & D. C. Dennett (Eds.), The mind's I: Fantasies and reflections on self and soul. New York: Basic Books, 1981.

Segal, E., & Lachman, R. Complex behavior or higher mental process. American Psychologist, 1972, 27, 46-55.

Shapere, D. The paradigm concept. Science, 1971, 172, 706-709.

Shaw, R. E., & Bransford, J. D. Introduction: Psychological approaches to the problem of knowledge. In R. E. Shaw & J. D. Bransford (Eds.), Perceiving, acting and knowing: Toward an ecological psychology. Hillsdale, N.J.: Lawrence Erlbaum, 1977.

Shaw, R. E., & Bransford, J. D. (Eds.). Perceiving, acting and knowing: Toward an ecological psychology. Hillsdale, N.J.: Lawrence Erlbaum, 1977.

Shaw, R. E., & Pittenger, J. Perceiving the face of change in changing faces: Implications for a theory of object perception. In R. E. Shaw & J. D. Bransford (Eds.), Perceiving, acting and knowing: Toward an ecological psychology. Hillsdale, N.J.: Lawrence Erlbaum, 1977.

Sheerer, M. Problem solving. Scientific American, 1963, 208(4), 118-128.

Shimp, C. P. Organization in memory and behavior. Journal of the Experimental Analysis of Behavior, 1976, 26, 113-130.

Siegel, A. W. "Remembering" is alive and well (and even thriving) in empiricism. In N. Datan & H. W. Reese (Eds.), Life-span developmental psychology: Dialectical perspectives on experimental research. New York: Academic Press, 1977.

Simon, H. A. The functional equivalence of problem solving skills. Cognitive Psychology, 1975, 7, 268-288.

Simon, H. A. Information processing models of cognition. Annual Review of Psychology, 1979, 30, 363-396.

Simon, H. A., & Gilmartin, K. A simulation of memory for chess positions. Cognitive Psychology, 1973, 5, 29-46.

Simon, H. A., & Newell, A. Human problem solving: The state of the theory in 1970. American Psychologist, 1971, 26, 145-159.

Skinner, B. F. The behavior of organisms. New York: Appleton-Century-Crofts, 1938.

Skinner, B. F. Are theories of learning necessary? Psychological Review, 1950, 57, 193-216.

Skinner, B. F. A case history in scientific method. American Psychologist, 1956, 11, 221-233.

Skinner, B. F. Contingencies of reinforcement. New York: Appleton-Century-Crofts, 1969.

Skinner, B. F. Beyond freedom and dignity. New York: Knopf, 1971.

Smith, E. E., Shoben, E. J., & Rips, L. J. Structure and process in semantic memory. Psychological Review, 1974, 81, 214-241.

Sommerhoff, G. Analytical biology. London: Oxford University Press, 1950.

Sommerhoff, G. The abstract characteristics of living systems. In F. E. Emery (Ed.), Systems thinking. Baltimore, Md.: Penguin, 1969.

Spence, K. W. The empirical basis and theoretical structure of psychology. Philosophy of Science, 1957, 24, 97-108.

Spielberger, C. D., Berger, A., & Howard, K. Conditioning of verbal behavior as a function of awareness, need for social approval, and motivation to receive reinforcement. Journal of Abnormal and Social Psychology, 1963, 67, 241-246.

Spielberger, C. D., & De Nike, L. D. Descriptive behaviorism versus cognitive theory in verbal operant conditioning. Psychological Review, 1966, 73, 306-326.

Spiro, R. J. Inferential reconstruction in memory for connected discourse. (Tech. Rep. No. 2). Urbana Ill.: University of Illinois, Laboratory for Cognitive Studies in Education, October 1975.

Spiro, R. J. Remembering information from text: The "state of schema" approach. In R. C. Anderson, R. J. Spiro & W. E. Montague (Eds.), Schooling and the acquisition of knowledge. Hillsdale, N.J.: Lawrence Erlbaum, 1977.

Sternberg, S. High-speed scanning in human memory. Science, 1966, 153, 652-654.

Stevens, S. S. Psychology and the science of science. Psychological Bulletin, 1939, 36, 221-263.

Swartz, R. J. Perceiving, sensing, and knowing. Garden City, N.Y.: Anchor Books, 1956.

Thomson, D. M. Context effects in recognition memory. Journal of Verbal Learning and Verbal Behavior, 1972, 11, 497-511.

Tolman, E. C. Purposive behavior in animals and men. New York: Appleton-Century-Crofts, 1932.

Tolman, E. C. The determiners of behavior at a choice point. Psychological Review, 1938, 45, 1-41.

Tsujimoto, R. N. Memory bias toward normative and novel trait prototypes. Journal of Personality and Social Psychology, 1978, 36, 1391-1401.

Tulving, E. Subjective organization in free recall of "unrelated" words. Psychological Review, 1962, 69, 344-354.

Tulving, E. Intratrial and intertrial retention: Notes toward a theory of free recall verbal learning. Psychological Review, 1964, 71, 219-237.

Tulving, E. The effects of presentation and recall of material in free-recall learning. Journal of Verbal Learning and Verbal Behavior, 1967, 6, 175-184.

Tulving, E. Episodic and semantic memory. In E. Tulving & W. Donaldson (Eds.), Organization of memory. New York: Academic Press, 1972.

Tulving, E. Memory research: What kind of progress. In L. Nilsson (Ed.), Perspectives on memory research: Essays in honor of Uppsala University's 500th Anniversary. Hillsdale, N.J.: Lawrence Erlbaum, 1979.

Tulving, E., & Thomson, D. M. Encoding specificity and retrieval processes in episodic memory. Psychological Review, 1973, 80, 352-373.

Turvey, M. T. Contrasting orientations to the theory of visual information processing. Psychological Review, 1977, 84, 67-88. (a)

Turvey, M. T. Preliminaries to a theory of action with reference to vision. In R. E. Shaw & J. D. Bransford (Eds.), Perceiving, acting, and knowing: Toward an ecological psychology. Hillsdale, N.J.: Lawrence Erlbaum, 1977. (b)

Turvey, M. T., & Shaw, R. The primacy of perceiving: An ecological reformulation of perception for understanding memory. In L. Nilsson (Ed.), Perspectives on memory research: Essays in honor of Uppsala University's 500th Anniversary. Hillsdale, N.J.: Lawrence Erlbaum, 1979.

Turvey, M. T., Shaw, R. E., Reed, E. S., & Mace, W. M. Ecological laws of perceiving and acting: In reply to Fodor and Pylyshyn (1981). Cognition, 1981, 9, 237-304.

Tyler, L. E. More stately mansions--Psychology extends its boundaries. Annual Review of Psychology, 1981, 32, 1-20.

Underwood, B. J. Stimulus selection in verbal learning. In C. N. Cofer & B. S. Musgrave (Eds.), Verbal behavior and learning: Problems and processes. New York: McGraw-Hill, 1963.

Underwood, B. J. Are we overloading memory? In A. W. Melton & E. Martin (Eds.), Coding processes in human memory. Washington, D.C.: Winston, 1972.

Underwood, B. J., Ham, M., & Ekstrand, B. Cue selection in paired-associate learning. Journal of Experimental Psychology, 1962, 64, 405-409.

Verbrugge, R. R. Resemblances in language and perception. In R. E. Shaw & J. D. Bransford (Eds.), Perceiving, acting, and knowing: Toward an ecological psychology. Hillsdale, N.J.: Lawrence Erlbaum, 1977.

Voss, J. F. Organization, structure, and memory: Three perspectives. C. R. Puff (Ed.), Memory, organization, and structure. New York: Academic Press, 1979.

Walker, C. H., & Meyer, B. J. Integrating information from text: An evaluation of current theories. Review of Educational Research, 1980, 50, 421-437.

Warren, R. The ecological nature of perceptual systems. In E. C. Carterette & M. P. Friedman (Eds.), Handbook of perception (Vol. 10). New York: Academic Press, 1978.

Watkins, M. J. Theoretical issues. In M. M. Gruneberg & P. Morris (Eds.), Aspects of memory. London: Methuen, 1978.

Watkins, M. J., & Tulving, E. Episodic memory: When recognition fails. Journal of Experimental Psychology: General, 1975, 104, 5-29.

Watson, J. B. Psychology as the behaviorist views it. Psychological Review, 1913, 20, 158-177.

Watson, J. B. Behaviorism. New York: Norton, 1924.

Wechsler, D. B. Engrams, memory storage, and mnemonic coding. American Psychologist, 1963, 18, 149-153.

Weimer, W. B. Overview of a cognitive conspiracy: Reflections on the volume. In W. B. Weimer & D. S. Palermo (Eds.), Cognition and the symbolic processes. Hillsdale, N.J.: Lawrence Erlbaum, 1974.

Weimer, W. B. A conceptual framework for cognitive psychology: Motor theories of the mind. In R. E. Shaw & J. D. Bransford (Eds.), Perceiving, acting, and knowing: Toward an ecological psychology. Hillsdale, N.J.: Lawrence Erlbaum, 1977.

Weimer, W. B., & Palermo, D. S. (Eds.). Cognition and the symbolic processes. Hillsdale, N.J.: Lawrence Erlbaum, 1974.

Wertheimer, M. The problem of perceptual structure. In E. C. Carterette & M. P. Friedman (Eds.), Handbook of perception (Vol. 1), New York: Academic Press, 1974.

Wertheimer, M. Humanistic psychology and the humane but tough-minded psychologist. American Psychologist, 1978, 33, 739-745.

Westland, G. Current crises of psychology. London: Heinemann, 1978.

Wickelgren, W. A. Human learning and memory. Annual Review of Psychology, 1981, 32, 21-52.

Wilson, K. V. Memory organization and question answering. In J. R. Royce & W. W. Rozeboom (Eds.), The psychology of knowing. New York: Gordon and Breach, 1972.

Wilson, K. V. From associations to structure: The course of cognition. New York: North-Holland, 1980.

Winograd, T. Artificial intelligence and language comprehension. In Artificial intelligence and language comprehension. Washington, D.C.: National Institute of Education, 1976.

Winograd, T. What does it mean to understand language? In D. A. Norman (Ed.), Perspectives on cognitive science. Hillsdale, N.J.: Lawrence Erlbaum, 1981.

Wiseman, S., & Tulving, E. A test of confusion theory of encoding specificity. Journal of Verbal Learning and Verbal Behavior, 1975, 14, 343-351.

Woll, S. B., Fraps, C. L., Weeks, D. G., Pendergrass, J., & Vanderplas, M. A. Role of sentence context in the encoding of trait descriptors. Journal of Personality and Social Psychology, 1980, 39, 59-68.

Zangwill, O. L. Remembering revisited. Quarterly Journal of Experimental Psychology, 1972, 24, 123-138.

Zimbardo, P. G. The human choice: Individuation, reason, and order versus deindividuation, impulse, and chaos. In W. J. Arnold & D. Levine (Eds.), Nebraska Symposium on Motivation (Vol. 17). Lincoln: University of Nebraska Press, 1969.