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Mechanist and Organicist Parallels between Theories of Memory and Science

Robert F. Belli

University of New Hampshire

Pepper's (1942) world views of mechanism and organicism are useful toward drawing parallels between theories of memory and science. Associationist theories of memory and logical empiricist theories of science both consider thinking and knowing to be mechanistically built-up from simpler phenomena. The mechanist theories all incorporate certain categories of mechanism: parts, rules, and complex activity. In constrast, Bartlett's (1932) schema theory of memory and Kuhn's (1970) paradigm theory of science both employ an organicist approach by emphasizing that thinking and knowing cannot be veridically reduced to simple parts. The organicist theories consider cognition as an adaptive process involving such categories as organic whole, oppositions, and integrations. The influence of world views not only permeates the conflicting traditions within psychology and philosophy, but with regard to theories of memory and science, provides conflicting conceptions on the nature of cognition.

In recent years, Stephen Pepper's philosophy of knowledge has had significant impact upon many disciplines. Pepper (1942) discusses how cognitive orientations, or "world views," help to organize observations (i.e., data) to provide coherent understandings of the world. According to Pepper, each world view consists of a basic metaphor and a set of categories that are used to define the structure of the world. As conceived, world views are used in the acquisition of all knowledge, including scientific and philosophical knowledge.[1]

There has been recognition that rival psychological theories often reflect contrasting world views (Hoffman and Nead, 1983; Overton, 1984). Cognitive psychological theories that adopt contrasting world views offer opposing

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[1]Pepper (1942) discusses four world views: formism, mechanism, contextualism, and organicism. This paper focuses upon mechanism and organicism.

perspectives on the nature of cognition itself. *Mechanist* theories, applying the basic metaphor that thinking is like a mechanical process, are concerned with the composition of thought. *Organicist* theories, that apply the basic metaphor that thinking is like an organic process, focus on the adaptive development of thought. Mechanist and organicist theories thus differ respectively on whether *statics* or *dynamics* fundamentally describe the nature of cognition (see Pepper, 1942).

In theories of cognition, the categories of mechanism are used to describe the composition of thought as consisting of (1) *independent parts* (particulars) that are "located" in specified "places," (2) *laws* or *rules* that relate the parts together, and (3) a mode of *complex activity* that results from parts interacting according to the laws or rules. In contrast, the categories of organicism describe the structure of thinking in its developing. Thinking is seen to consist in (1) an *organic whole* ("organism") with an adaptive drive, (2) *oppositions* that appear to impede progress, and (3) *integrations* that resolve the oppositions, resulting in a further developed organic whole that becomes confronted by newer, higher level, oppositions (see Hoffman and Nead, 1983; Pepper, 1942).

In the psychology of memory, mechanist perspectives such as associationism, and organicist perspectives such as Bartlett's (1932) schema theory, reflect their contrasting world views in their differences concerning the processes involved in remembering. The associationists held that memory is a fairly passive and mechanistic combination of fundamental parts; for Bartlett, memory is an active, adaptive process, involving the search for meaning. The contrast, then, centers on the mechanist assumption that static elements are fundamental, versus the organicist assumption that adaptive change is primary (see Pepper, 1942).

Just as psychological theories often reflect world views, contrasting theories in philosophy may also reflect world view differences. In the philosophy of science, logical empiricism and Kuhn's (1970) paradigm theory can be seen as a contrast between the world views of mechanism and organicism, respectively. Whereas logical empiricism considers valid scientific theories as passively built-up from the logical (rule-bound) combinations of elemental facts, Kuhn considers scientific communities as actively developing holistic paradigms in their adaptive search for knowledge.

The existence of mechanist-organicist contrasts between theories of memory and science leads to an understanding that there exist similarities between the theories that share the same world view. Theories of memory that share a world view with theories of science create an affinity of perspective on the nature of cognition, relating psychological processes with epistemological issues. In this paper, world view categories outline the similarities between theories of memory and science. Mechanist parallels between associationist theories of memory and logical empiricist theories of science will be examined, as well as organicist parallels between Bartlett's (1932) schema theory of

Table 1

Mechanist Theories of Memory and Science

World View Categories	*Associationist Theory of Memory*	*Logical Empiricist Theory of Science*
Parts	Chunks	Basic Statements
Laws or Rules	Associations	Logical Relations
Complex Activity	Memory and Behavior	Valid Theory/Knowledge
Hierarchies	Associative Chains	Scientific Calculus
Cumulative Change	Accumulate Traces	Accumulate Knowledge

memory and Kuhn's (1970) paradigm theory of science.

Associationism and logical empiricism, marked by the view that fundamental to cognition is the existence of basic parts, were both dependent on the notion that accurate cognitive "copies" of the environment served as these parts. For the associationists, the ability to acquire and "store" copies of the environment formed the basis of how people were able to remember past experiences. For the logical empiricists, the ability to acquire copies of the environment during observation was likewise important, as it was believed that accurate observations formed the basis of knowledge. Using a mechanist world view, associationists construe human memory, and logical empiricists construe valid theories, as consisting of the lawful or rule governed composition of these copies of experience. The associationists depicted the complexity of memory and behavior as consisting of chunks combined via the laws of association; the logical empiricists viewed valid knowledge as built-up from basic statements of observation related by the rules of logic (see Table 1).

In constrast, the organicist theories emphasize the fundamental importance of change and development that occurs with thinking and remembering (Bartlett, 1932), and with the search for knowledge by scientific communities (Kuhn, 1970). Bartlett and Kuhn both consider development as consisting of active and adaptive interpretations or constructions of the environs. Applying the categories of organicism, such constructions can be seen as the integrations that result from confrontations with oppositions. Bartlett's term, "schema," representative of an organic whole, develops when confronted by new experiences; Kuhn's "paradigms" are seen to change by solving or integrating puzzles and anomalies (see Table 2).

It is not surprising that parallels between associationism and logical empiricism exist, as they share an historical link with the mechanist tradition of British empiricism. However, no such historical link exists between the organicist schema and paradigm theories. Bartlett and Kuhn independently developed their theories as reactions against the mechanist perspectives that had dominated their respective fields. Parallels exist between the concepts

Table 2

Organicist Theories of Memory and Science

World View Categories	*Schema Theory of Memory*	*Paradigm Theory of Science*
Organic Whole	Schema	Paradigm
Adaptive Drive	Acquire Meaning	Acquire Knowledge
Oppositions	Experiences	Puzzles/Anomalies
Integrations	Construct Past/Present	Construct Environs
Assimilation	Constructive Memory	Normal Science
Accommodation	Reconstructive Memory	Crisis Science

of "schema" and "paradigm" because they share the world view of organicism. That Bartlett and Kuhn independently proposed theories that share the same fundamental organicist categories attests to the value of Pepper's (1942) insights regarding the role of world views in directing perspectives on the human condition.

MECHANIST VIEWS ON MEMORY AND SCIENCE

Mechanist theories (see Pepper, 1942) are marked by the view that the world can be reduced to fundamental parts. Although these parts are related by laws or rules that determine their combination into complexes, they have an existence independent of one another. Mechanist approaches are primarily analytic as they involve a drive toward the discovery of elements. That is, knowledge is accomplished by the analysis of complexes into fundamental elements and rules, whereby synthesized complexes are lawful derivatives of basic parts.

Mechanist approaches are exemplified in the psychology of memory by associationism, and in the philosophy of science by logical empiricism. Both associationism and logical empiricism have served as traditional perspectives for their respective fields. In more recent years, the mechanist assumptions of these two traditions have been seriously questioned. A review of the histories and ideas of associationism and logical empiricism reveals their allegience to the mechanist world view.

Associationism

Aristotle is usually credited as the first to formally offer an associationistic theory of memory. Aristotle held that there are three principles of association that are often applied during remembering: similarity, contrast, and contiguity (Boring, 1950). According to Aristotle (ca. 350 BC/1972), "starting in our thoughts from the present or from something else, [recalled is] something

similar, or opposite, or neighboring" (p. 54). The principles of association as provided by Aristotle were intended as an explanation for the non-random succession of ideas during remembering. The British empiricists expanded the principles of association beyond memory to include wider aspects of thinking and knowing (Schacter, 1982).

Hume's empiricism, an associationistic account of thinking (psychology) and knowing (epistemology), served as an intellectual predecessor to both psychological associationism (Boring, 1950) and logical empiricism (Brown, 1977; Smith, 1986). Hume's (1777/1975) psychological views depicted human thought as something formed through the association of ideas, i.e., through the construction of complex ideas from the association of simpler ideas. Also, Hume asserted that these simpler ideas are reflections or copies of even more basic parts of experience, which he called impressions. According to Hume, "when we analyze our thoughts or ideas, however compounded or sublime, we always find that they resolve themselves into . . . simple ideas . . . [and] that every idea which we examine is copied from a similar impression" (1777/1975, p. 19).

With regard to epistemology, Hume (1777/1975) recognized that associations of simple ideas into complex ideas, and complex ideas into more complex ideas, led to the possibility of forming a supposed idea that lacked meaning and truth. Hume asserted that when:

> . . . any suspicion [exists] that a philosophical term is employed without any meaning or idea . . ., we need enquire, *from what impression is that supposed idea derived?* And if it be impossible to assign any, this will serve to confirm our suspicion. (p. 23, emphasis in original)

Thus, for Hume, impressions exist as the fundamental parts from which all knowledge is built.

Hume's psychological views influenced the thinking of the British associationists during the 19th century (Boring, 1950). According to the British associationists, contiguity was the primary principle of association that led to the combination of elements of experience into more complex ideas, and that such combinations were conditional upon the frequency of their repetition. Ebbinghaus (1885/1964) provided experimental evidence in support of the importance of contiguity and repetition in memory. Ebbinghaus created nonsense syllables—consonant-vowel-consonant (CVC) combinations—to serve as the material for some of his experiments. In one of Ebbinghaus's experiments, the more frequently repeated lists of contiguously presented CVCs were more thoroughly and easily recalled. Ebbinghaus's experimental approach directed American research on memory well into the 20th century, which remained largely associationistic in its orientation.

Hume's arguments about epistemology influenced later thinking in the

philosophy of science. Just as Hume argued that sense impressions constitute the basic elements of all forms of knowledge, Mach (1905/1976) was to insist that knowledge in *science* is reducible to observational data, termed as sensations. These sensations were thought to be neither mental nor physical, but to exist as neutral elements in nature (see also Smith, 1986). Thought creates abstract compounds of these neutral elements according to the practical interest of the thinker. For Mach, scientific knowledge is the result of economized thinking made possible by the practical discovery of the existence of stability and lawfulness in nature.

Logical Empiricism

The logical empiricists accepted the empiricist themes of Hume and Mach that knowledge must be based on sense experience. However, they opposed their predecessors' views that knowledge is built-up from an association of ideas or the compounding of elements in thought (Smith, 1986). Rather, for the logical empiricists, knowledge was believed to be achieved through the appropriate use of logical rules to correctly combine the elements of experience.

The ideas of Russell and Wittgenstein were influential in the logical empiricist attempt to unify formal logic with experience. Wittgenstein (1921/1974) suggested that "facts," not "impressions," are the basic parts of experience which form the foundation of true propositions. "The world is a totality of facts" (p. 5). A fact, for Wittgenstein, was also referred to as a "state of affairs" (p. 5). Wittgenstein felt that the truthfulness of propositions depended on the existence of facts: "An elementary proposition asserts the existence of a state of affairs. . . . If an elementary proposition is true, the state of affairs exists: if an elementary proposition is false, the state of affairs does not exist" (pp. 30–31). Wittgenstein borrowed Russell's logicist position that relations also exist among propositions so that complex "propositions are deducible from . . . . fundamental logical principles" (Russell, 1903/1938, p. xv). Therefore, Wittgenstein (1921/1974) was able to asert that the truth-value of complex propositions—concerned with the existence of complex states of affairs—depends on the truth values of the simple propositions from which the complex propositions are built. For Wittgenstein, logical relations exist only as syntactic or linguistic rules that have no content. Thus, they are independent of experience and are not psychological in nature.

Logical empiricism propagated a philosophy of science based on two assumptions: (1) that elementary propositions, to be true, must be empirically or factually verified, and (2) that complex propositions, to be true, must be composed of true elementary propositions combined through the proper use of logical relations (Brown, 1977; Kraft, 1950/1953). Although logical relations replaced principles of association as the appropriate combinatorial rules of

the fundamental parts of knowledge, logical empiricism continued to reflect a mechanist world view.[2]

Categorical Parallels between Associationism and Logical Empiricism

Mechanist theories, applying the basic metaphor that "the world is like a machine," employ categories that define the structure of the composition of the world. The composition of any machine consists of independent *parts* with *laws or rules* that relate the parts together and determine a mode of *complex activity* that is reducible to the parts. As an example of a machine, an automobile consists of independent parts such as nuts, bolts, belts, pistons, gears, etc. In order for the automobile to work, however, these parts must be related by mechanical, chemical, and physical laws. Thus, the ability of the automobile to transport passengers is reducible to its parts, and their repair or replacement.

The complexity involved in an automobile's ability to fulfill its function in transportation requires that parts be aggregated into *hierarchical structures*. Some parts compose the engine that powers the automobile, other parts compose the wheels that permit relatively frictionless movement. There are also intermediary aggregates: transmission, axles, exhaust pipes, etc. Finally, any changes that might accrue in an automobile's transport abilities results in the addition or subtraction of parts. As an example, placing additional parts on the carburator can result in quicker acceleration. With any mechanism, the addition or subtraction of parts results in *cumulative change*.

Although associationist and logical empiricist theories involve different domains of interest—memory and scientific knowledge, respectively—they employ the same mechanist categories (see Table 1). The following discussion will clarify each theory's adherence to the categories of mechanism. Later in the paper, it will be shown that criticisms of associationism and logical

[2]It must be noted that Pepper (1942) considered logical empiricism in its purest form as not adopting any world view. For Pepper, the goal of logical empiricism was to refine fact and logic to the extent that they became independent of any cognitive orientation. Thus, both fact and logic were to be observables, "so clear and distinct and simple that disagreement about them . . . can scarcely arise" (p. 52). However, Pepper recognized that, as practiced, logical empiricism could not avoid tacitly adopting world views. The reliance upon logical propositions, for example, is a characteristic of the world view known as *formism*, which applies the basic metaphor of similarity (see also Hoffman and Nead, 1983). Further, in my analysis, logical empiricism is shown to exhibit the mechanist characteristics of using laws (in the form of logical relations or rules) to connect fundamental and independently existing particulars (in the form of facts). As logical empiricism contains both formistic and mechanistic aspects, it is best considered as a formist-mechanist eclecticism rather than as a pure mechanist theory. Pepper noted the tendency for formism and mechanism to merge. For a fuller discussion of eclecticisms, the reader is encouraged to consult Pepper (1942) and Hoffman and Nead (1983).

empiricism have centered on attacking the assumptions provided by the mechanist categories.

Parts

In any mechanist account, there is a reliance on independent parts or elements which are taken to be the fundamentals of existence, knowledge, or whatever reality is under investigation. Ebbinghaus devised CVCs to serve as such parts in human memory, other investigators used digits (Hebb, 1961), 3-consonant trigrams (Peterson and Peterson, 1959), single words, and word triads (Murdock, 1961). As many different types of materials have been considered as parts, Miller's (1956) concept of "chunk"—a grouping of elements (e.g., a word is a chunk composed of many letters)—has served as the unit of measurement in more recent associationist studies (Melton, 1963). According to Jenkins (1963, 1974), many associationists believed that their studies would reveal words or sentences as the basic parts of memory and language.

Correlatively, the logical empiricists believed in the existence of basic parts of experience that serve as the building blocks of knowledge. Following Wittgenstein's assertion that "facts" are such fundamental parts, the logical empiricists later considered basic statements of fact to serve as the basic elements. " 'Protocol statements' . . . are those statements which express the *facts* with absolute simplicity, without any moulding, alteration or addition, in whose elaboration every science consists, and which precede all knowing" (Schlick, 1934/1959, pp. 209–210, emphasis in original). Thus, the basis of knowing was sought by attempts to describe the basic facts of experience in terms of an observation language composed of basic sentences and an experiential vocabulary. The desired observation language was to be uncontaminated by hypotheses, assumptions, or presuppositions; it would be a pure language independent of theory (Feigl, 1970). Two possibilities for the observation language were considered: one as a language of subjective sense data or sensations; the other as a language of intersubjective observation of physical objects (Feigl, 1970; Hempel, 1970). In any event, knowledge in science was construed as being reducible to basic statements in an observation language, and these statements served as fundamental parts for logical empiricism.

Laws or Rules

Associative laws served as the basis of relating fundamental parts for theories of memory, combining basic experiences that become "traces stored" in memory. Furthermore, associative bonds of elemental ideations were said to be strengthened with more frequent exposure, resulting in experiences that are "more or less deeply engraved in some mental substratum" (Ebbinghaus,

1885/1964, p. 53). Hebb (1961) believed the physiological basis of memory traces resided in synaptic routes being strengthened with the repetition of contiguous experiences. The view that traces exist as an enduring product of the combination of basic parts of experience is so fundamental to associative theories of memory that I will refer to such theories as "static trace theories."

The logical empiricists relied upon logical relations to serve as principles of order (Kraft, 1950/1953) combining atomic empirical propositions (the basic statements of an observation language) into compound propositions. The meaningfulness of the compound propositions was logically determined by the content of the atomic statements.

> The truth-value of compound propositions depends exclusively on the truth-values of the simple propositions which are their components. . . . Consequently, what alone matters is the truth-value of the simple, atomic propositions from which the truth-values of the compound propositions are derivable by pure logic. (Kraft, 1950/1953, p. 115)

Further, since empirical or observation statements were necessarily independent from theory (see above), theoretical concepts could only gain meaning by a correspondence with empirical propositions, governed by the appropriate application of logical "correspondence rules" (Feigl, 1970).

Complex Activity

For static trace theories, the complexity of memory and behavior was felt to be reducible to fundamental parts and laws. Associationist theories of memory depicted complex behaviors as ordered and hierarchical structures, built-up from traces existing as chains of fundamental elements. According to Jenkins (1974), some associationists construed hierarchical structures as "simply lists of chains varying in strength, so that one was employed first, then another" (p. 786). For example, in remembering a list, such as the alphabet, or in performing habitual behavior, such as walking, there is an ordered sequence to be followed. That is, the higher order behaviors are structures built from lower order behaviors. As examples, reciting the alphabet consists of combinations of smaller structures such as pronouncing the letter "C" after having elicited a "B"; walking involves smaller structures such as placing heel of left foot down, raising right foot up, placing whole of left foot down, and so on. Moreover, in learning the associations that combine elements into traces or structures, many associationists believed that a cumulative progression in performance occurs dependent on the frequency of exposure to similar corresponding experiences (Ebbinghaus, 1885/1964; Hebb, 1961; see Jenkins, 1974).

Similarly, the logical empiricists felt that the complexity of theoretical concepts and terms that constitute knowledge were reducible to more fundamental

propositions. It was widely held that valid theoretical concepts must be reduced to experience to the extent that empirical verification became possible (Carnap, 1928/1967; Feigl, 1970; Hempel, 1970; Kraft, 1950/1953; Nagel, 1961). "All meanings must ultimately be reducible to the given, . . . all conceptual meanings can be constituted on the basis of experienced data alone" (Kraft, 1950/1953, p. 84).

Since knowledge was believed to consist of theoretical concepts as well as fundamental propositions based on observation, hierarchical structures were seen to exist in science. Carnap (1928/1967) claimed that higher order theoretical concepts hover above more basic empirical concepts, which in turn are built-up from the basic elements of experience: a view reiterated by Feigl (1970), Hempel (1970), and Nagel (1961). Although the "calculus" of the relations of higher order theoretical concepts was construed as a purely logical structure independent of any empirical basis (Nagel, 1961), for the truth-value of theoretical concepts to be ascertained, connecting links must be maintained with experience, "solidifying" the structure upon a foundation built upon the "soil" of observation (Hempel, 1970).

Finally, for the logical empiricists, any changes in scientific understandings were viewed simply as a "process of cumulative growth of knowledge" based on facts (Brown, 1977, p. 60). Newly observed facts were seen as simply combined into theories through the appropriate application of logical rules.

Reactions Against the Mechanist Categories

By employing the mechanist categories, associationism and logical empiricism focused on the composition of memory and scientific knowledge. Accordingly, change is dealt with as a derivative of the ordinary rule governed activities that determine memory or scientific knowledge. The associationists saw memory as reproducing past experiences via the activation of static traces; the logical empiricists viewed scientific theories to result from the accretion of facts.

The mechanist emphasis on statics does not deal effectively with observations concerning the fundamental importance of change. Scholars have noted that memory is often not reproductive (Bartlett, 1932; Jenkins, 1974; Neisser, 1967), and that scientific theories, which change over time, influence what is considered to be factual evidence (Kuhn, 1970). Such scholars, faced by these contradictions to the mechanist world view, have adopted other world views more compatible to the understanding of the dynamics of nature. *Organicism* offers the perspective of adaptive development. Another of Pepper's (1942) world views, *contextualism*, also emphasizes that change is of primary importance.

Contextualist approaches have received considerable attention with respect

to the psychology of memory (Hoffman and Nead, 1983). As an example, an influential contextualist theory of memory has recently been introduced by Jenkins (1974). For Jenkins, remembering is a purposeful activity that occurs within the changing "physical and psychological context in which [an] event was experienced" (p. 793). Since events, contexts, and the purposes of the rememberer continuously change, there is no ultimate way to understand the remembering process. Thus, just as the rememberer is actively pursuing an understanding of events, Jenkins instructs the researchers of memory that they also must "pick the right kinds of events for [their] purposes" (p. 794). And for Jenkins, the purpose of studying memory is to be able to relate "laboratory problems to the ecologically valid problems of everyday life" (p. 749).

Organicist theorists have likewise understood the need for an ecologically valid approach, i.e., an approach sensitive to dynamics. Bartlett (1932) and Kuhn (1970) both thought that the mechanist approaches, by their focus on statics, resulted in an ecologically invalid posture toward studying memory and science, respectively.

Bartlett (1932) was critical of Ebbinghaus's use of CVCs. Bartlett felt that experiments that use CVCs create "an atmosphere of artificiality for . . . . memory experiments, making them rather a study of the establishment and maintenance of repetition habits" in the form of isolated and simplified reactions (p. 4). Further, Bartlett reacted against the associationist view "that when we know how the isolated response is conditioned we can legitimately conclude that it is determined in the same manner when it is built with others into more complex forms of reaction" (p. 4). Bartlett decided against the use of CVCs. "I [Bartlett] have discarded nonsense syllable material, though not without prolonged trial. I have employed as nearly as possible the sort of material most closely resembling that commonly dealt with in real life" (p. 12).

Bartlett (1932) also reacted against the notion offered by static trace theories that memory consists of the activation of permanently stored memories. "The first notion to get rid of is that memory is primarily or literally reduplicative, or reproductive. In a world of constantly changing environment, literal recall is extraordinarily unimportant" (p. 204). Bartlett, of course, recognized that remembering involves the use of a "raw material" (see also Neisser, 1967). However, Bartlett clearly rejected the notion that such material existed as static parts or traces, for the raw material itself was seen as changing:

> . . . though we may still talk of traces, there is no reason in the world for regarding these as . . . stored up somewhere, and then re-excited at some much later moment. The traces that our evidence allows us to speak . . . live with our interests and with them they change. (Bartlett, pp. 211–212)

Instead of the term traces, Bartlett encouraged discussion "of our living, vital, constantly changing images" (p. 212).

Similarly, Kuhn (1970) reacted against the logical empiricist claim that "facts," as data, serve as an unchanging raw material from which knowledge is built:

> Is sensory experience fixed and neutral? Are theories simply man-made interpretations of given data? The epistemological viewpoint that . . . dictates [this position] no longer functions effectively, and the attempts to make it do so . . . now seem to me hopeless. (p. 126)

Kuhn observed that the traditional model of cumulative scientific change implied that:

> . . . one by one, in a process often compared to the addition of bricks to a building, scientists have added another fact, concept, law, or theory to the body of information supplied in the contemporary science text. But that is not the way a science develops. (p. 140)

For Kuhn, a science develops through the resolution of crises that alter what are considered the facts and laws of nature.

Theorists who have challenged the traditional mechanist world view share a similar concern regarding the importance of dynamic phenomena in nature. The world views of contextualism and organicism have provided for these theorists fresh perspectives on how to view the cognitive processes that are involved with memory and scientific development.

CONTEXTUALIST AND ORGANICIST VIEWS ON MEMORY AND SCIENCE

Pepper (1942) considers contextualism to have been born with the pragmatism of Peirce and James. James (1890/1918) rejected the associationist view that experiences are built-up from simple sensations, and instead proposed the existence of a unitary consciousness that selected meaningful experiences from the complexity of a changing world. Although James is often considered as one of the founders of American psychology, contextualist approaches had not gained wide acceptance until recently. Notable exceptions reflecting contextualist themes have been Gestalt psychology (Henle, 1985), Tolman's purposive behaviorism (Pepper, 1934), and Brunswik's probabilistic functionalism (Tolman and Brunswik, 1966). All of the above approaches consider the fundamental level of study to be molar, complex, dynamic phenomena with the organism as an agent interacting with the environment (and not merely responding to the environment).

Organicist perspectives are exemplified by theories of dialectical historical

and social development, originating with Hegel (Hoffman and Nead, 1983; Overton, 1984; Pepper, 1942). In psychology, organicist approaches have been represented by developmental perspectives that focus largely on the growth of individuals, such as Piaget's approach at studying the cognitive development of children as involving adaptive processes. More recently, life-span developmental approaches, such as the dialectical psychologies of Riegel (1979) and Buss (1979), have sought to understand the interrelationships among changing individuals within changing societies. For both Riegel and Buss, the individual-society dialectic, in which there appears apparent conflicts between individuals and the societies to which they belong, provides opportunities for new developments arising through integration of the conflicts[3].

Both contextualist and organicist theories (see Pepper, 1942) consider change and complexity to be the most fundamental characteristics of the world. Opposed to the mechanist's reliance on static observation and logical analysis, both contextualists and organicists emphasize an active and flexible interpretation of a changing world. Further, both world views deny the ability to adequately reduce events or changes to any independently existing, static parts.

Since contextualism and organicism display many of the same themes, there can be considerable confusion on distinguishing whether a theory is best represented as contextualist or organicist (see also Overton, 1984)[4]. This problem largely centers on the tendency of these two world views to merge (Pepper, 1942).

A Comparison of Contextualism with Organicism

So closely related are the world views of contextualism and organicism that Pepper (1942) notes "that they may almost be called the same theory, [contextualism] with a dispersive, [organicism] with an integrative plan" (p. 147). Ideally, differences do exist between these world views with respect to their categorization of change. Whereas the dispersive plan of contextualism deemphasizes the search for any ultimate categories of change, the integrative

[3]Researchers who have worked from a developmental perspective have offered organicist views on the cognitive processes involved during remembering (for a more detailed review, see diSibio, 1982; Reese, 1976). As an example, Piaget and Inhelder (1973) have argued that children remember past tasks based on their current level of cognitive development. That is, as children advance developmentally, their memory of their performance on past cognitive tasks likewise changes to correspond to advances in operational level. Reese (1976) describes Piaget's organicist view of memory as rejecting "the concept of a permanent [static] memory trace" (p. 297), thus rejecting a fundamental category of mechanism.

[4]In an earlier version of the present paper (Belli, 1984), I had described Bartlett's (1932) schema theory and Kuhn's (1970) paradigm theory as contextualist. In this paper, I now discuss the organicist parallels between the theories of Bartlett and Kuhn.

plan of organicism requires an analysis of the categories of change. For the contextualists, there are only two categories that define the structure of the world, and albeit, rather abstractly: there are (1) *events*, and (2) *changes* (Hoffman and Nead, 1983). On the other hand, organicist theories, viewing the world as being like an "organic process," employ categories that define the structure of organic change and development: there exist (1) *organic wholes* (organisms) with adaptive drives, which in their development are confronted by (2) *oppositions* that may appear to impede progress, but actually do resolve into (3) *integrations* resulting in advanced organic wholes. Whereas contextualism emphasizes the uniqueness of events in a continual state of flux, organicism deciphers change as consisting of the regularities displayed by models of organic growth.

As practiced, however, contextualist theories often introduce conceptions of change that include some organicist aspects of regularity. As examples, Jenkin's (1974) contextualist theory of memory, and Bransford's (1979) thesis on human cognition (cited by Hoffman and Nead, 1983, as contextualist), both emphasize the contextually consistent position that remembering often occurs in contexts that undergo non-ordered fluxuations. Nevertheless, both also describe remembering as including constructive and reconstructive processes. Construction and reconstruction can be metaphors of mechanism if these terms imply "building" from a foundation of static parts (e.g., Hume's associationism), or metaphors of organicism if these terms represent processes of integrating oppositions by organic wholes that themselves change (see Bartlett, 1932; Neisser, 1967; Spiro, 1976, 1980). They clearly cannot represent the metaphors of a pure contextualism. Since both Jenkins (1974) and Bransford (1979) appreciate the fundamental nature of change, the regularity depicted by notions of constructive processes implies that a bit of organicism has invaded their contextualism.

As for the organicist theories, they often include contextualist conceptions that some changes are unstructured. Pepper (1942) noted that pure organicist theories postulate a final integration or end-state to which all changes eventually resolve (e.g., Hegel's absolute idea). Bartlett (1932) had no conception of finality, despite the emphasis he placed on organic process, and actually had an appreciation for the uniqueness of any situation that involved remembering. Likewise, although Kuhn (1970) emphasizes the adaptive and orderly processes that occur during scientific development, he denies that one day all scientific knowledge will be merged into one, and actually insists that each discipline is unique in terms of the questions that are asked of nature, and the answers that are accepted. Thus, the denial of finality found in the theories of both Bartlett and Kuhn implies that there exists some unstructured changes, and that contextualist themes have invaded their organicism.

Whether the theories that have developed out of reactions against

mechanism are contextualist, organicist, or contextualist-organicist eclecticisms, they truly represent a movement of a similar nature. In illustrating the organicist aspects of the theories of Bartlett and Kuhn, I do not deny that these theories also contain contextualist themes, nor do I deny the relevance of other theories known to be contextualist.

Bartlett (1932) and Kuhn (1970) presented organicist views regarding the adaptive processes involved in memory and scientific development. Although developing their theories independently, Bartlett's schema theory and Kuhn's paradigm theory were to describe the same organicist structure of change as occuring within memory and science.

Categorical Parallels between Schema and Paradigm Theories

Any living organism, such as an oak tree, undergoes an organic process. As an acorn lying on the soil, the yet to be "oak tree" exists as an *organic whole* possessing an *adaptive drive*. The acorn is faced with *oppositions*, these are aspects of the environment that the acorn uses to fulfill its adaptive drive, such as water and nutrients. At first, the oppositions have yet to become a part of the acorn. However, the acorn does eventually *integrate* these oppositions by *assimilating* the water and nutrients into itself, and by *accommodating* or changing itself. With time, a newly developed organic whole emerges—a seedling. The seedling then faces newer oppositions, such as light, which it assimilates into a food source, and also may accommodate by developing its branch structure for greater light utilization. The organic process continues until an even more developed organic whole, an adult tree, comes into existence.

Note that with an organic process there exists a progressive development with emergent higher levels of organized organic wholes that are not reducible to previous stages of development. For example, a seedling is qualitatively different from an acorn, and cannot be construed simply as the addition of an acorn with its oppositions. Instead of a strictly additive process, integration results in a jump in level of development. Further, since there are drastic changes in organic wholes as they develop, there are no static parts into which organic wholes can be analyzed. Any "parts" that may seem to constitute an organic whole exist interdependently, and moreover, continuously undergo development themselves.

In describing remembering and the acquisition of scientific knowledge, Bartlett (1932) and Kuhn (1970) employ the organicist categories. These categories will be used to illustrate parallels between Bartlett's schema theory of memory and Kuhn's paradigm theory of science (see Table 2).

Organic Whole

The respective concepts of schema for Bartlett and paradigm for Kuhn each serve as the "organic wholes" for their theories. Schemata and paradigms were introduced to signify complex patterns that are unitary and nonreducible in their composition, and noncumulative in their development. As organicists, both theorists felt that the terms were descriptive of the actual ongoing processes peculiar to memory or science, which included active and adaptive participation on the part of individuals or scientists.

A schema, for Bartlett (1932), "refers to an active organisation of past reactions, or of past experiences, which must always be . . . operating in any well-adapted organic response" (p. 201). The word schema represents:

> . . . the organised mass results [that] are actively *doing* something all the time; are, so to speak, carried along with us, complete, though developing, from moment to moment. . . . It would probably be best to speak of [an] active, developing pattern. . . . I think probably the term 'organised setting' approximates most closely and clearly to the notion required. I shall, however, continue to use the term 'schema.' (Bartlett, p. 201, emphasis in original)

For Kuhn (1970), "a paradigm is an accepted model or pattern" (p. 23) that as a "universally recognized scientific achievement [provides] model problems and solutions to a community of practitioners" (p. viii). Further, a paradigm is a "fundamental unit . . . of scientific development, a unit that cannot be fully reduced to logically atomic components which might function in its stead" (p. 11). A paradigm serves as an organized setting or context for the scientist, it permits the active scientist to deal with reality according to guidelines.

Just as organic wholes have adaptive drives, the concepts of schema and paradigm also serve respectively as representations of the active and adaptive participation of individuals upon stimuli, and scientists upon data. Both Bartlett and Kuhn recognized that individuals or scientists are not passive recipients of stimuli or data, but rather that individuals adaptively remember with an "effort after meaning" (Bartlett, 1932, p. 227), and that scientists adaptively search for scientific truth. For Bartlett, a schema, an organized mass of past experience, is "not merely something that works the organism, but something with which the organism can work" (p. 208). Kuhn recognized that paradigms, developed through an active effort by scientists to understand the world, influence the data, just as data influence theories. Paradigms aid scientists in delineating the data to be accepted into their scientific theories.

As part of its adaptive drive, a schema or paradigm aids in the selection and interpretation of the information one acquires from the environment. Bartlett and Kuhn recognized that persons with different past experiences perceive the environment differently. Bartlett (1932) noted:

> . . . the old and familiar illustration of the landscape artist, the naturalist, and the geologist who walk in the country together. The one is said to notice and recall beauty of scenery, the other details of the flora and fauna, and the third the formation of soil and rock. (p. 4)

Kuhn (1970) provided a similar example: "Looking at the bubble-chamber photograph, the student sees confused and broken lines, the physicist a record of familiar subnuclear events" (p. 111). Schemata and paradigms serve to restrict and focus perception in "a world of constantly changing environment" (Bartlett, 1932, p. 204).

> What a man sees depends both upon what he looks at and also upon what his previous visual-conceptual experience has taught him to see. In the absence of such training there can only be, in William James' phrase, "a bloomin' buzzin' confusion." (Kuhn, 1970, p. 113)

Since schemata and paradigms lead to differences in the perception of reality, schemata are unique to individuals, and paradigms are unique to scientific disciplines. Bartlett criticized Ebbinghaus's apparent goal of ascertaining a pure memory devoid of personal differences. Bartlett recognized "memory . . . to have a characteristically *personal* flavour" (p. 213, emphasis in original). Similarly, Kuhn criticized the logical empiricist views concerning the unity of science. Scientific development is occasioned by many different paradigms, many different specialties, "and even men who, being in the same or closely related fields, begin by studying many of the same books and achievements may acquire the rather different paradigms in the course of professional specialization" (p. 49).

Oppositions and Integrations

There are two forms of oppositions that are common to both schema theory (Bartlett, 1932) and paradigm theory (Kuhn, 1970). One form leads to assimilative integration, the other leads to accommodative integration. Bartlett construed any currently occurring, ongoing experiences to serve as oppositions that become assimilated by schemata during constructive remembering. That is, perceiving is an aspect of remembering, as it involves the adaptive activation of schemata[5]. Kuhn conceived of puzzles as the ordinary oppositions that become assimilated by paradigms during "normal science." With both theories, there are also oppositions that require qualitative or emergent changes in schemata or paradigms themselves. Bartlett understood that some experiences may require an accommodation of schemata to new, "contradictory" experiences (Spiro, 1980). Kuhn depicted anomalies as being contradictory to paradigms, re-

[5]For the contextualists as well, perceiving and remembering are considered as inseparable processes (Jenkins, 1974).

quiring an accommodative change in the paradigms themselves.

Assimilative processes. Bartlett's (1932) term "constructive" remembering depicted a process whereby acquired experiences are assimilated to integrate into stable schemata. As an example of constructive memory, habits exist because organisms, using stable schemata, construct the environment and their own movements in essentially the same way during the present as in the past. In this respect, constructive remembering is similar to static trace theory accounts of sequential, ordered behavior. Although Bartlett recognizes the equivalence, he takes issue with the existence of traces: a habit "may look like the continual re-excitement of well-established traces; but it is not. It is simply the maintenance of a few 'schemata', each of which has its natural and essential time order" (p. 205). On the one hand, an individual may need to break a habit, in which case the schema will essentially change, as will be seen during reconstructive remembering. On the other hand, habits are maintained because the organism finds such habits adaptive, and a theorist who focuses on the passive looking character of habits cannot realize the potentiality of active, consciously-directed behavior. Rote-memory and habitual behavior are:

> . . . nothing but the repetition of a series of reactions in the order in which they originally occurred. . . . [However,] an organism which possesses so many avenues of sensory response as man's, and which lives in intimate social relationship with numberless other organisms of the same kind, must find some way in which it can break up this chronological order and rove more or less at will in any order over the events which have built up its present momentary 'schemata'. (p. 203)

Bartlett also considered constructive remembering to apply to instances whereby an "effort after meaning" during acquisition will result in differences among various persons in their assimilation of the same information. The critical factor is the activation of an appropriate schema. Individuals, when not otherwise directed, will activate a personal schema during acquisition; however, people can be directed to activate a schema held in common with others. Bartlett (1932) and Gomulicki (1956) have shown differences in retrieval of stories due to the schemata that the rememberers, without direction, have activated. Other psychologists (Bransford, Barclay, and Franks, 1972; Bransford and Johnson, 1972; Carmichael, Hogan, and Walter, 1932) have shown that people can be directed to activate different schemata during the acquisition of the same material resulting in different responses during retrieval in predicted directions.

Just as one can view constructive remembering as the assimilation of stimuli into stable schemata, Kuhn (1970) characterizes normal science as the assimilation of scientific puzzles into stable paradigms. Just as habit formation can be seen as a cumulative progression, Kuhn sees "normal science" as a puzzle-

solving activity that is "a highly cumulative enterprise" (p. 52). Thus, normal science, in this respect, is equivalent to the logical empiricist model of the accumulation of facts and knowledge. However, as we have seen, the logical empiricist view does not appreciate the interaction of theory with data, nor of the paradigm with nature. Normal science is "an attempt to force nature into the preformed and relatively inflexible box that the paradigm supplies" (p. 24). Thus, the paradigm itself creates the puzzles that are oftentimes solved by designing and constructing "apparatus able to solve the problem" (p. 27).

Accommodative processes. Bartlett considered memory schemata to be continuously undergoing development. Reconstructive remembering best describes this accommodative process. Bartlett recognized that reconstructive memory occurs when newly acquired experiences interact with an established schema, resulting in an alteration of the schema. In current usage, memory reconstruction refers to instances whereby information introduced at an acquisition phase will interact with different and at times contradictory information during retention, leading to responses during retrieval that reflect the information interaction (Loftus, 1975; Loftus, Miller, and Burns, 1978; Loftus and Palmer, 1974; Pezdek, 1977; Spiro, 1976, 1980). Reconstructive remembering is a noncumulative process that will often lead to inaccuracy during retrieval.

Despite the potential for inaccuracy, Bartlett (1932) emphasized the adaptive nature of reconstructive remembering. Using the analogy that memory is akin to the performance of a tennis stroke, Bartlett asserts:

> When I make the stroke I do not, as a matter of fact, produce something absolutely new, and I never merely repeat something old. . . . I may think that I reproduce exactly a series of text-book movements, but demonstrably I do not; just as, under other circumstances, I may say and think that I reproduce exactly some isolated event which I want to remember, and again demonstrably I do not. (p. 202)

Just as the tennis player wants to accommodate to new information presented by new situations in a game setting in order to deal more effective tennis strokes, reconstructive remembering allows one to reconstrue the past in order to effectively deal with current situations.

Similar to reconstructive remembering, in which schemata accommodate to new information (Bartlett, 1932; Spiro, 1980), Kuhn (1970) views crisis science as a process whereby a scientific paradigm accommodates during the solving of anomalies. The terms Kuhn uses to describe this process are instructive:

> The transition from a paradigm in crisis to a new one from which a new tradition of normal science can emerge is far from a cumulative process, one achieved by an articulation or extension of the old paradigm. Rather it is a reconstruction of the field from new fundamentals, a reconstruction that changes some of the field's most elementary

> theoretical generalizations as well as many of its paradigm methods and applications. (pp. 84–85)

Kuhn asserts that after the paradigm shift, there is an actual change in perception by which "the data that scientists collect [also become] different" (p. 121). This shift, however, is not often recognized after the resolution of the crisis, and science is again viewed as being a cumulative progression.

IMPLICATIONS OF WORLD VIEW PARALLELS

The parallels illustrated between the psychology of memory and the philosophy of science demonstrate that theories which adopt the same underlying cognitive orientation, or world view, use the same categories to structure the nature of thought and knowledge. By examining world views, particularly those implicit within disciplines that themselves deal with the nature of thought or knowledge, one can gain insights into the different ways cognitive processes are viewed.

Mechanism and Stability

Static trace theories and logical empiricism both share an origin in British empiricism. Hume (1777/1975), concerned with the nature of scientific knowledge and human thought, stated that putative stabilities in nature (i.e., causes and effects) are nothing but stabilities in human thought (i.e., the principles of association). Following Hume, both static trace theorists and logical empiricists focused upon the stability in human thought and observation.

With static trace theories, stability in human thought is the result of reduplicative or reproductive memory: retrieval consists of arousing memories that have remained since storage, these memories being encoded copies of original experiences. Similarly, for the logical empiricists, stability in scientific knowledge results from the ability of scientists to mirror nature during observation, and then to logically coalesce the collected data. Thus, both trace theories and logical empiricism were founded upon the notion that human thought and knowledge fundamentally exist as passive reflections of nature.

Organicism and Development

In contrast, the organicist perspectives of Bartlett (1932) and Kuhn (1970) reject the notion that thought and knowledge arise from static reflections of the world. In the adaptive drive for understanding, individuals and scientists construct nature actively. These constructions are not built from static parts, but are integrations derived from prior integrations, and constantly undergo development. Thought and knowledge are not marked by stability,

but rather by ongoing change.

Opposed to the mechanist premise that human knowledge and thought reflect the stability of nature, an organicist perspective highlights the degree to which stability is read *into* nature in the adaptive process of cognition. That is, nature is not necessarily stable (although at times it may be), but people often tend to interpret and construct nature as being stable. Focusing upon interpretation results in an emphasis upon the cognitive orientations of persons with regard to their thinking and behavior (i.e., upon schemata), and upon the cognitive orientations of scientists with regard to scientific knowledge (i.e., upon paradigms).

Within the organicist camp, an affinity between the concepts of schema and paradigm results because both terms represent cognitive orientations. Further, as mentioned earlier, world views also represent cognitive orientations. Pepper (1973) recognized a similarity between his notion of world view and Kuhn's notion of paradigm, and Kuhn has acknowledged this similarity also (Efron, 1980). Although the concept of paradigm is generally restricted to discussions concerning scientific knowledge, world views enter discussion concerning all forms of knowledge, including scientific knowledge (Hoffman and Nead, 1983; Overton, 1984; Patterson, 1982). Overton (1984) considers the concepts of paradigm and world view to both represent underlying cognitive orientations (conceptual systems) involved in the competition among theories and research traditions in the field of psychology as well as other sciences. More generally, the terms schema, paradigm, and world view, coexist due to their different referents: schemata represent the cognition of individuals; paradigms represent the orientations of scientific communities; world views represent the cognitive orientations of grand philosophical perspectives that encompass all knowledge seeking activity. Despite the different referents, paradigms and world views can be seen as schemata held in common by a community of practitioners or scholars[6].

In particular, one can think of the schemata of individual scientists as reflections of, and contributors to, paradigms maintained by scientific communities. As the schemata of a certain community of scientists develop due to accommodations to anomalous experiences, there will result a paradigm clash with

[6]In this paper, Bartlett's (1932) schema theory of memory and Kuhn's (1970) paradigm theory of science are treated as representatives of organicism. Noting the similarity of the concepts of schema, paradigm, and world view, one becomes tempted to consider Pepper's (1942) basic metaphor theory of knowledge as itself organicist. Pepper (1942) mentioned in passing that his theory could be understood as representing a world view, although he offered no suggestion of what this world view is. However, of the world views, Pepper seems to have preferred contextualism (see Pepper, 1934, 1966). As Pepper's basic metaphor theory, Kuhn's paradigm theory, and Bartlett's schema theory all focus on the complexity of cognitive orientations as fundamental to human understanding of experience, I feel that if Pepper's theory itself is best considered as contextual, there still remains a substantial affinity of his theory with the organicist paradigm and schema theories.

the "traditional" group. As a paradigm stabilizes, so will the schemata of the participating scientists. An example of a paradigm clash has been alluded to in this paper. Bartlett and his followers, confronted with results that could not be explained by associationist accounts of memory, accommodated to these anomalous findings by devising a new paradigm of human memory, known as schema theory. The emergence of a new paradigm consisted in the changed thinking (or using Bartlett's terminology, the changed schemata) of Bartlett and his followers about the nature of thought. It can also be said, using Kuhn's terminology, that Bartlett's paradigm regarding the nature of thought had changed. Thus, the schemata of individual scientists, with regard to their scientific knowledge, could also be referred to as their personal "paradigms."

Similar comments can be made regarding the relationship between schemata and world views. As world views differ, so do the schemata of those individuals who subscribe to them. One can view the differences in perspective between logical empiricism and Kuhn's paradigm theory not only as a world view clash, but also as reflecting the different schemata activated by these thinkers with regard to the nature of scientific knowledge. Pointing out that students may have differing orientations in their quest for knowledge, Geddis (1982) has argued that effective teachers are aware of the personal "world views" of their students. Such personal world views exist as the schemata students activate during the acquisition of knowledge.

An organicist perspective highlights the degree to which cognitive processes are involved during the knowledge acquisition of the scientist, scholar, student, and ordinary individual. To understand how knowledge is acquired in any activity—scholastic, scientific, or otherwise—one must recognize, as did Pepper (1942), that the acquisition of knowledge is tied to human cognitive processing. Thinking and scientific knowing are not distinct; they must be considered as derivations of the same, developing, adaptive drive to acquire meaning within our world.

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