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World models for the Psychology of Time

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Introduction: Time is Multifaceted

The psychology of time is extremely complex and diverse. Topics of interest span a wide range; there are studies on biological rhythms, duration experiences, and cultural tempos, to give just a few examples. Major theoretical approaches are also wide-ranging; the more prominent ones are cognitive, biopsychological, developmental, psychoanalytic, and social-psychological approaches, along with a few attempts at eclecticism. Organisms currently being studied in some depth include humans, rats, and pigeons. Different investigations also vary on numerous other dimensions.

How is one to make some sense of this diversity? Does one need to? Even a quick glance at the literature on any particular topic of interest reveals numerous failures to replicate, which are difficult to handle in any sort of normal-science framework. A relatively large number of studies are published every year by investigators who do not explicitly note the ways in which the methods and findings differ from other investigators' methods and findings on the topic. Surely any sensible reviewer should decide not to attempt to make sense of such chaos. However, attempts to synthesize are critical to progress in this field, as in others. It is important not to be overwhelmed by the many dimensions represented in research and theorizing on the psychology of time. Time is, after all, a multifaceted concept.

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In attempting put some order into the chaos, one must adopt a multidimensional perspective on the subject. But as Kaye (1977) so aptly put it in a description of psychology:

> Although it would seem that a multidimensional perspective should dictate families of holistic unities, in my vision of reality things are nested within things, relate as things to things (within limits), defy total absorption, and moreover, exist in several contexts simultaneously. (p. 346).

Perhaps this is why most theorizing on the psychology of time, including some of my own, has tended to be severely limited in scope. It is difficult to find any «families of holistic unities», even within a single topic area within the psychology of time. Attempts to broaden the scope have usually resulted in a simple classification of different types of phenomena, with little attempt to interrelate the different categories in any functional, pragmatic way.

Pepper's «World Hypotheses» and Time

In a classic monograph, Pepper (1942; see also 1973/1982) discussed four «unrestricted» scientific theories that he considered to be relatively adequate. He called them *world hypotheses*, but I prefer the term *world models* (as it was used by De Mey, 1982, for example). Pepper also illustrated the corresponding root metaphors that underlie the world models. In the order in which he discussed them, the world models are formism, mechanism, contextualism, and organicism. (As I note later, this order does not imply any historical, sequential, or hierarchical relationships). There is a recent resurgence of interest in Pepper's work (e.g., Berry, 1984; Efron, 1982), as well as with the larger question of the general role of mental metaphors (e.g., Gentner & Grudin, 1985; Roediger, 1980). A summary of these world models and the corresponding root metaphors follows, with particular emphasis on assumptions concerning the nature of time. For present purposes, Pepper's discussion of the four world models is especially relevant, because he noted how each of the underlying root metaphors treats the subject of time.

Formism

The root metaphor of formism is similarity, or common-sense perception of patterns of relationships between different particular objects. A formist attempts to analyze the universe by classifying objects, which is done by organizing particulars into categories according to their various properties. Theoretical analyses, then, involve models that represent propositions about relationships between particulars classified either in the same category or in different categories. Further, a formist might observe that «every concrete existent object or event is to be located at a date and at a place» (Pepper, 1942, p. 174).

One valuable use of a formistic approach in the psychology of time is the classification of different kinds of time or temporal experiences. For example, it is common to distinguish among the following kinds of experiential categories: simultaneity, successiveness, rhythm, duration, and temporal perspective (cf. Block, 1979; Ornstein, 1969). More generally, though, a distinction is usually made between physical time and psychological time. In a more extensive and useful classification, Fraser (1975, 1978, 1982) discussed five hierarchically nested levels of temporality, which he called *atemporality*, *prototemporality*, *eotemporality*, *biotemporality*, and *nootemporality*. As I note later, though, the world model used in Fraser's theoretical account stems primarily from organicism.

Mechanism

The root metaphor of mechanism is a machine. A mechanistic analysis attempts to explain the universe in terms of relationships or laws that hold among its various parts. The laws are usually expressed in terms of relatively simple cause-and-effect relationships occurring synchronically – that is, in a present-time framework – such as in the operation of a lever. In one version, effects occur among parts localized in an absolute space that is «moving» through time. This was characteristic of the prerelativistic physics of Newton, which Pepper called *discrete mechanism*. With the advent of the general and special relativity theories of Einstein came a different kind of mechanistic analysis, which Pepper called *consolidated mechanism*. In this version, the absolute space and time of Newton were replaced by configurations of elements in a spatiotemporal field. One of the main attractions of mechanistic analyses, in fact, is «a complete and rigid determination of configurations in the spatiotemporal field» (Pepper, 1942, p. 207).

The physical model of discrete mechanism was paralleled in psychology by an analysis of complex mental states into elements that

were assumed to be joined by associations based on temporal and spatial contiguity. This paradigm received its major impetus from the work of psychologists like Wundt and Titchener. Behavioral psychologists also adopted a discrete mechanistic view. When consolidated mechanism became popular in physics, the Gestalt psychologists of the 1920s and 1930s adopted this revised world model.

Contextualism

The root metaphor of contextualism is the historic event, not as some past occurrence, but rather as a «dynamic dramatic active event», which is «intrinsically complex, composed of interconnected activities with continuously changing patterns» (Pepper, 1942, pp. 232-233). There are two clarifications that are important. First, contextualism is concerned with diachronic processes – that is, events unfolding over time. In this view, events are best expressed with an emphasis on verbs, such as making, laughing, solving, and so on. (It is typical of some contemporary contextualists to use terms like *remembering*, as opposed to *memory*, and *thinking*, as opposed to *thought*). Second, the term *context* stems from the past participle of the Latin verb *contexere*, meaning «to interweave». The image of interweaving is particularly appropriate, because it involves complex, interconnected, and continuously changing patterns. Each event, then, contains dynamic, interpenetrating features that change, giving rise to novelty. An event has a certain quality – roughly, its «total character» – and a certain texture – «details and relations which make up that character» (Pepper, 1942, p. 238).

Pepper (1942) noted that contextualism is often called *pragmatism*. An influential early psychologist who adopted this kind of approach was James (1890). Contextualism was rejected or ignored during most of the brief history of psychology, especially by behaviorists. To some extent, the recent interest in contextualism among some experimental psychologists can be traced to Jenkins's (1974) influential article on memory. Psychologists have only recently begun to re-explore the implications of this kind of world model and its philosophical and metaphorical orientation, which may be seen as a kind of *realist interactionism* (Rosnow, 1983). Because time and change are two of the most basic ideas underlying contextualism, I argue later that contextualism is the world model of choice for understanding psychological time.

Organicism

The root metaphor of organicism is the organic process. An organicistic synthesis notes «the steps involved in the organic process, and . . . the principal features in the organic structure ultimately achieved» (Pepper, 1942, p. 281). Pepper preferred not to emphasize the biological connotations of the term *organic*, though. In spite of this, the notions of adaptation, resolution of contradictions or conflicts, and internal drives toward integration are central to organicism. In direct contrast to contextualism, organicism holds that time and change are not real, not factual, but derivative. Just as a tree develops from a seed, each phenomenon ends in a form which is implicit in its earlier forms.

Kaye (1977) noted the relatively recent development of general systems theory, which is very nearly a prototypical organicistic model. The kind of synthesis that general systems theory offers is easily extended to nonliving as well as living systems. Another well-known organicistic view in psychology, one which is quite explicitly biological, is Piaget's theory of development. However, this approach merges an organicistic world model with aspects of a formistic model (Hoffman & Nead, 1983).

Comparisons and Combinations

Pepper (1942) referred to formism and mechanism as analytical theories. He noted that formism is relatively dispersive, whereas mechanism is relatively integrative. Thus, «formism is strong just where mechanism is weak» (p. 146), and there is a tendency for the two to be combined in an eclectic mixture. Pepper also noted that:

> The discrete and consolidated species of mechanism seem to repel one another. Yet unless they keep some contact with each other they tend to be projected quite out of mechanism, the one into dispersive formism and the other into synthetic operational contextualism. (p. 187).

Pepper (1942) referred to contextualism and organicism as synthetic theories, but said that contextualism is dispersive and organicism is integrative. It is particularly relevant here to note that he claimed that organicism «convicts itself of inadequacy» (p. 314). One reason he gave was that «organicism takes time lightly or disparagingly; contextualism takes it seriously» (p. 281). Organicism requires progressive

categories, such as time and change, to give it scope; but according to organicism, these categories do not exist, because «only the absolute is true and in the absolute is no time, nor change» (p. 314).

If there was an issue on which Pepper (1942) was somewhat dogmatic, it was on the feasibility of combining world models. He frequently argued that only confusion can result from mixtures of root metaphors. My own bias is not nearly as strong as Pepper's: I think that combinations need to be explored, although I recognize that any theorist who does so should be aware of possible drawbacks.

De Mey's «Stages»

Without drawing any explicit parallels with the philosophical work of Pepper (1942), De Mey (1982) distinguished four «stages which have been accumulated in thinking about information processing» (p. 4) among modern cognitive scientists. He considered the later stages to be more complex, more refined, and better able to model the cognitive processes involved in such domains as perception, pattern recognition and picture processing, and communication and language processing. In order of increasing sophistication, he called these stages *monadic, structural, contextual,* and *cognitive.* Michon (in press) noted a correspondence between them and Pepper's world models – formism, mechanism, contextualism, and organicism, respectively.

The crux of my disagreement with Michon's (in press) interpretation of Pepper's (1942) world hypotheses, as well as of my disagreement with De Mey's (1982) stages, lies in the relationships between the notion of context and the role of a contextualistic root metaphor in modern cognitive science and in the psychology of time. Michon and De Mey both asserted that modern cognitive science relies on an organicistic root metaphor. Further, Michon detected a hierarchical structure to Pepper's root metaphors, with organicism embedding the lower root metaphors. I think that this is somewhat misleading. As Michon noted, Pepper's original description of the root metaphors did not explicitly or implicitly propose a hierarchical organization. Pepper asserted that:

> It almost seems as if the four hypotheses . . . had a tendency to pull cognitively toward the center, as if the most cognitive adequacy lay somewhere between mechanism and contextualism. This appearance is strengthened by our previous comments to the effect that formism seems to be the weaker of the analytical theories, and organicism the weaker of the synthetic theories . . . We are tempted to surmise that whatever system there is in the world is of the mechanistic type, and whatever dynamic vitality, of the contextualistic sort. (p. 148).

Pepper (1963, 1967) later proposed a new world hypothesis, which he called *selectivism.* It greatly resembles contextualism, but it uses «purposive structure as a whole for a root metaphor» (Pepper, 1967, p. 16). In a subsequent article, though, Pepper (1973/1982) did not mention selectivism, but limited his discussion of scientific metaphors to the four he had identified in 1942. He also reiterated his belief that none of the four is fully adequate.

World Models of Cognitive Science

In order to clarify some important issues, I first provide a brief history of the creation and evolution of metaphors in cognitive science. Then I discuss several recent developments that represent potentially significant changes in world models underlying cognitive science.

A Brief History

As I noted earlier, psychology emerged from philosophy during a period in which physicists still relied on a discrete-mechanistic world model, and cognitively oriented psychologists like Wundt and Titchener adopted that root metaphor. Somewhat later, the Gestalt psychologists used the root metaphor of consolidated mechanism when that became dominant in physics, but most psychology of the first half of the twentieth century was decidedly behavioristic. It is now widely recognized that modern cognitive psychology arose partly as a paradigm shift from the mechanistic approaches to psychology known as behaviorism and, beginning about 1940, neobehaviorsm (Lachman, Lachman,& Butterfield, 1979). Neobehaviorism was seen as unable and unwilling to deal with the complexities of human consciousness, memory, and thought. The main reason was that it was almost entirely based upon a discrete-mechanistic root metaphor, and beginning about the middle of the twentieth century the psychological Zeitgeist was finally shifting away from that world model.

Information-processing models of the 1960s, which dominated cognitive science and are still very influential, reoriented the focus of psychology to the topics of attention and consciousness, memory and

thought. However, the paradigm shift was not as complete as is ordinarily thought, because an essentially mechanistic root metaphor was retained. Instead of using the behavioristic switchboard analogy, humans were viewed initially as a limited-capacity communications channel. Later, the analogy shifted to the kind of information-processing system embodied in the modern digital computer and its associated programs – that is, a general purpose symbol manipulator (Lachman et al., 1979). A mayor innovation was the proposal of control processes, aspects of the overall system which were thought to regulate the processing of information and the resulting activation of internal representations. However, once a person «decided» to engage in specific types of control processes, they were assumed to be implemented in a mechanistic sort of way, much as in a computer program. According to Roediger (1980), even today most models of memory tend to be «spatial analogies with search», in which information is «stored» in «locations», and «retrieval» involves a «search» through those locations. Roediger concluded his survey of memory metaphors in cognitive psychology with this caution: «In 30 years, the computer-based information processing approach that currently reigns may seem as invalid a metaphor to the human mind as the wax-tablet or telephone-switchboard models do today» (p. 244).

In short, most contemporary cognitive science is not characterized to any great extent by the adoption of either a contextualistic or an organicistic root metaphor. The cognitive paradigm is essentially mechanistic, although I agree with Hoffman and Nead (1983) that «the metaphor «The mind is a computer» actually merges the categories of mechanism and formism» (p. 517). Thus, most current cognitive theorizing is not monometaphoric, but can be seen to involve a somewhat tenuous mixture of root metaphors. This is not to deny that increasing numbers of cognitive psychologists are departing from the typical mechanistic-formistic emphasis in order to explore organicistic views, contextualistic views, or a mixture of the two. In some ways Pepper (1942) was perceptive in his claim that «contextualism and organicism are so nearly allied that they may almost be called the same theory» (p. 147).

Some Recent Changes

Modern cognitive science is now changing in several major ways. Several major kinds of shifts in outlook either are contextualistic or

may eventually contribute to a reorientation toward contextualism.

World knowledge. Bartlett's (1932) proposal that remembering involves schemata – continually changing organizations of knowledge and experiences – and his studies of remembering in natural contexts over relatively long time periods foreshadowed a major shift in emphasis. There is now increasing attention to the importance of what is variously called *world knowledge* or *schemata*. To some extent, it is this change that De Mey (1982) emphasized in his analysis of progress in cognitive science, especially progress by theorists on expert systems in the field of artificial intelligence. However, the world model underlying these developments is not necessarily an organicistic one. Instead, the focus on world knowledge can be seen to involve a recognition of a much broader meaning of the term *context*, in which it refers to cognitive structures, or knowledge, supplied by a person as he or she interacts with the environment. This view of context contrasts with the older, more traditional view that context is a property of the external environment, such as in the words of a sentence immediately preceding and following a currently processed part of a sentence.

Distributed memory. The notion that memories are stored in specific traces has tended to predominate in cognitive science. Alternatives have only recently been rediscovered or formulated. One such view of memory which is still in its infancy, but which will very likely gain in popularity, is embodied in distributed-memory models (see, for example, McClelland & Rumelhart, 1985). In these models, mental states are considered to be patterns of activation in a highly interconnected network of simple units. Remembering, then, involves a redintegration of patterns of activation encoded previously. Current versions of distributed-memory models seem to rely too heavily on an overall view which is closest to consolidated mechanism. These kinds of memory models may become of greater heuristic value if the originators explicitly were to adopt a more contextualistic metaphor. Perhaps it may be useful to view the human brain as an incredibly complex, continually changing hologram, in which new events continually reorganize the overall pattern, or contexture. Some distributed-memory models explicitly use a somewhat similar holographic analogy to clarify the specific mathematical assumptions that they make. Just as distributed-memory models seem to come closer to describing the physiological substrate of memory than do localized-trace models, they also seem to be more amenable to a contextualistic view of mind.

Ecological movement. The beginnings of a shift in both scientific metaphors and methods are being expressed by proponents of a new ecological movement in cognitive psychology (see, for example, Bruce, 1985; Neisser, 1976, 1985). This movement emphasizes the functions served by acts of perceiving, remembering, and thinking in complex natural settings, as opposed to relatively simple, well-controlled laboratory settings. As Hoffman and Nead (1983) noted, this development is easily viewed in terms of a contextualistic root metaphor. There is still considerable debate on which methods of research are suggested by an ecological emphasis. Neisser (1985) argued, though, that ecological theories should focus initially on theoretically motivated descriptions of the environment. The puzzle of time presents a crucial challenge for this movement, because time is always revealed in and constructed from changes in the environment, both the environment external to and the environment internal to a person.

World Models of the Experimental Psychology of Time

In the early days of psychology, James (1890) espoused a pragmatic, functionalistic approach to the psychology of time which relied on a decidedly contextualistic world model. Guyau (1902) also proposed a cognitive theory in which multiple factors determined subjective time judgments; his account is surprisingly modern (see Michon & Jackson, 1984). Janet's (1928) discussion of duration as the underpinning of adaptive actions oriented toward irreversible changes was another early example of a non-mechanistic approach.

However, in the early part of the twentieth century, various mechanistic views, such as «internal clock» theories, became influential. These theories, along with specific discoveries such as the existence of biological rhythms, were used to explain phenomena outside their natural boundaries. A clear example of this was Hoagland's (1933) attempt to explain duration experiences in terms of the operation of biochemical reactions.

Since that time, of course, there have been many exceptions to this general trend. Fraisse's (1963) influential book contained a mixture of contextualistic and organicistic root metaphors. Fraisse said, for example, that direct time judgments are «founded immediately on the changes we experience and later on the changes we remember» (p. 234). But he also discussed various organic-like adaptations to change.

Ornstein (1969) also forcefully rejected internal-clock theories of duration experience, but he adopted a mechanistic-formistic metaphor, «storage size» in memory. He argued that internal-clock theories could not parsimoniously account for the results of his studies on the importance of information processing – the «coding» of information during a time period. Further, he provided evidence that the remembered duration of a time period is affected by information supplied after the time period. This work, however, occurred during a period when cognitive psychology was still firmly in the grips of a mechanistic-formistic metaphor – the mind as computer. Even though it contained a few of the characteristics of subsequent contextualistic accounts, Ornstein's (1969) storage-size hypothesis was based on a misldeading model of memory and was therefore doomed because of its inability to handle the more dynamic, contextualistic view of psychological time that is suggested by results of subsequent experiments.

Contextualism and the Psychology of Time

Because contextualism is able to handle effectively the ideas of time and change, it is a world model well suited to the psychology of time. Contextualistic views, however, are not monolithic; they are subject to a range of variation and disagreement, just as other world models are (Georgoudi & Rosnow, 1985; Sternberg, 1984). There are now several distinct, yet somewhat related, contextualistic approaches to the psychology of time. This section discusses the contributions of each, as well as the similarities and differences between them. It is unclear which of these slightly different approaches will prove to be fruitful for understanding psychological time. The best strategy would seem to be to explore all of them, including each in various integrated combinations.

Contextual-Associations Approach

Before reviewing the more purely contextualistic approaches, it is necessary to examine an approach that may appear contextualistic but is really a mixture of mechanism and contextualism. It hardly needs to be restated that classical theories of memory and time, dating back to the tradition established by Ebbinghaus, relied on a discrete-mechanistic root metaphor. In this general approach, memories were assumed to be stored as elemental traces of experiences, with traces associated

by contiguity. Along with the tendency of some cognitive psychologists to admit the importance of contextual associations has come a renewed interest in varieties of contextual elements. Bower (1972), for example, mentioned the following different kinds of such elements: background external stimulation, interoceptive stimulation (such as posture, temperature, nausea, boredom), and the «psychological context» – «what the subject is thinking about», or «the internal monologue» (p. 93). Hewitt (1979) distinguished between stimulus attributes, which he called *intrinsic context*, and background attributed, which he called *extrinsic context.* Although such a distinction may be useful, it is important to remember that context is always an internal, cognitive construction.

Research on different kinds of contextual factors has found that the remembered duration of a relatively long time period lengthens if there are changes in process context (Block & Reed, 1978) or in environmental context (Block, 1982). These kinds of findings lead to the proposal of a contextual-change hypothesis, which says that remembered duration is a cognitive construction involving an assessment of the remembered amount of change in cognitive context during the time period (Block, 1979, 1982; Block & Reed, 1978). In addition to explaining the effects of contextual manipulations, the hypothesis is able to account for the typical finding of a positive time-order effect in duration judgments: The first of two equally long durations is remembered as being longer than the second (see Block, in press). Changes in process context, emotional context, or both probably occur fairly rapidly at the start of a novel experience.

Research on components of event-related brain potentials – aspects of brain-wave changes that may be evoked by certain events – has revealed a possible psychophysiological indication of processes involved in contextual changes. Norman (see Picton, Donchin, Ford, Kahneman, & Norman, 1984) speculated that the P300 component is involved in the need for continual updating of a person's world model, using schemata which contain «information about the environment and about the events that are occurring in the environment» (p. 168). Similarly, Rösler (see Donchin, Heffley, Hillyard, Loveless, Maltzman, Ohman, Rösler, Ruchkin, & Siddle, 1984) proposed that the P300 is involved in what is called *context updating* – roughly, a restructuring of the current «contexting» of events in a person's cognitive network. This notion assumes that the cognitive network is tuned by previously constructed contextual information. When ongoing processing requires

revision of a person's contextually based schemata, the P300 might then reflect this change. The contextual-change hypothesis on remembered duration does not rely on the veracity of this untested notion, of course, but it is strengthened by the kind of neurological evidence obtained by researchers studying components of event-related potentials such as the P300.

Interactive-Factors Approach

Some recent research has showed that different contextual variables interact in affecting the remembered duration of a time period. For example, changes in process context have been found to interact with changes in environmental context (Block, 1982). These and other kinds of contextual changes also play a critical role in jointly determining experienced duration – the experience of time in passing – as in the «watched-pot» phenomenon (Block, George, & Reed, 1980). In addition, duration seems to be assessed in a rather holistic manner, as a result of the combined, interacting influence of different kinds of contextual factors, with the possibility that some factors may be more salient than others (see Block, 1985, in press).

Adapting the kind of contextualistic synthesis characteristic of some of the theorizing of Jenkins (1979, 1981), Block (in press) proposed a tetrahedral model in which four general factors interact to affect temporal experience. Oné factor is characteristics of the experiencer, which include such variables as species, sex, personality, interests, and previous experiences. Another factor is contents of the time period (or sequence of time periods) to which reference is being made. This includes various characteristics of events, such as their number, complexity, modality, and so on. Another factor is activities occurring during a time period (or periods), such as passive nonattending and various types, or levels, of active processing. Another factor is the kind of temporal behavior under consideration, which is assessed in experiments by using different kinds of temporal judgment, or estimation, tasks – simultaneity, rhythm, order, spacing, duration, and so on. An understanding of the complexities and contradictons involved in any kind of temporal experience considered as a whole can occur only if all four of these general kinds of factors are viewed as interacting. The contexture of psychological time, according to this model, is a complex, multifaceted pattern; yet the psychological effects are produced somewhat holistically, as a result of events being in a dynamic flux.

In practice, most experiments on the psychology of time ordinarily manipulate only one or two of these general factors. A somewhat limited, but still useful, understanding may result from considering lower-order interactions of factors.

Eclectic-Dialectical Approach

Recently, several psychologists interested in the study of developmental aspects of remembering and temporality have adopted views that are mostly contextualistic in nature (e.g., Kvale, 1974, 1977; Riegel, 1977a, 1977b). These theorists have labelled their approach *dialectical*. According to Kvale (1977), for example, dialectics uses a number of different scientific methods – it is methodologically eclectic – to explore «development and interaction» by studying «the internal relations between phenomena that exist as aspects of a totality» (p. 165). Much of the metaphoric underpinning of Kvale's dialectical approach seems to be based on an organicistic view emphasizing certain characteristics of living systems. However, in his rejection of a bureaucratic model of memory, with its characteristic emphases on fixed structures and relatively stable elements, Kvale departed from a purely organicistic world model in favor of a more contextualistic one. This is especially true if we consider Kvale's (1974) contextual theory of memory. He asserted that an event is characterized by its meaning, which depends on a temporal context and which may be ambiguous. In addition, he noted that temporal context encompasses the future as well as the past and the present.

Riegel (1977a) argued that dialectical logic is «the mode of thinking that alone can deal appropriately with change, development, and history» (p. 41). Riegel's theory of time is clearly contextual. For example, he said that «dialectical time is like polyphonic music in which various monophonic sequences are *interwoven* [italics added] and in which temporal markings are generated by harmonies and disharmonies of such a composition» (p. 9). His main thesis was that «time always involves at least two interacting event sequences» (p. 3). This implies, at the very least, that time is constructed when a participant or observer of any event sequence interacts with the events occurring in it. In particular, Riegel discussed four different kinds of «planes» or «temporal markings» that result from different kinds of interactions: inner-biological, individual-psychological, cultural-sociological, and outer-physical. This notion is somewhat similar to

that represented in the interactive-factors model I discussed earlier; however, Riegel more explicitly noted the interactions that can occur within any of the four planes.

Cultural-Anthropological Approach

In literature on the psychology of time, it is rare to find a conciliation of two apparently different kinds of emphases – one on temporal conceptions and one on the ecological significance of temporal behavior. The work of Hall (9183), an anthropologist, provided an integrated description of relationships between time and context. Hall observed that a crucial distinction among human cultures concerns whether or not people deal with time and information in a direct, linear manner. He reviewed many different observations relevant to this distinction, and he argued that some cultures tend to be monochronic, low-context cultures, whereas others tend to be polychronic, high-context cultures. Monochronic cultures are those in which people tend to do one thing at a time. This reflects a linear conceptualization of time, along with fairly precise scheduling and social demands of punctuality. Hall referred to these cultures as low-context ones to emphasize that social interactions in them require considerable «contexting» – for example, explicit statements of background information. Other cultures are polychronic in the sense that many different tasks or approaches to a problem are ordinarily interwoven. These cultures tend to be high-context ones, because social networks are extensive enough so that background knowledge does not need to be provided in a routine social interaction. To ask whether the temporal conception and the corresponding contexting are part of the culture or of the people within the culture would be to ask a rather meaningless question. A contextualistic understanding of time requires a synthesis including both the world knowledge, or schemata, supplied by a person – in particular, temporal concepts – and the patterns of environmental interaction characteristic of a given culture – ecological behavior. As Hall put it, time is «a cluster of conecpts, events, and rhythms covering an extermely wide range of phenomena» (p. 13).

The Contextual Nature of Temporal Experience

Consider now some of the basic temporal experiences and concepts of time, with an emphasis on the general contextual underpinnings of

them and the apparent developmental sequence. This brief theoretical review relies mainly on three sources. First, Block (1979) discussed different kinds of temporal experiences from the perspective of a cognitive view emphasizing contextual factors. Second, as I noted above, Riegel (1977a, 1977b) reviewed concepts of time and space from the perspective of a developmental view emphasizing dialectics. Third, the perspective of an information-processing view has provided considerable evidence supporting a continuum ranging from more automatic to more effortful processes (see Hasher & Zacks, 1979).

Development of Temporal Experiences and Concepts

During the earliest stages of human development, there is apparently little or no separation of relatively stable objects in space from relatively transient events in time. The experience of simultaneity is presumably one of the most psychologically primitive ones, even though the physical concept of simultaneity is much more complex. To a large extent, the processes producing an experience of simultaneity of two (or more) interacting event sequences are probably fairly automatic. These processes provide the most critical basis for all subsequent acts of temporal measurement and judgment. In spite of the relative automaticity, judgment of simultaneity is actually rather complex, in the sense that several physiological and cognitive factors, such as arousal level and attentional focus, interact in affecting the underlying processes. Preoperational children tend to make errors in judging velocity and duration which can be traced, in part, to an inability to coordinate the simultaneities of different events.

With the development of remembering and anticipating abilities of the young child comes the notion of an extended psychological present – the «saddle-back, with a certain breadth of its own on which we sit perched, and from which we look in two directions into time» (James, 1890, p. 609). The changes from which we construct the notion of a present are the interweavings of events occurring in different progressions, or movements – activations of different, yet now related, schemata forming the contents of consciousness. The experiencing of rhythm, such as in music or speech, is apparently based on such contextual relationships between events forming part of the psychological present (cf. Jones, 1984).

Presumably because the contextual interweaving of events is relatively automatic, even a fairly young child can usually remember the

relative order or recency of two events that occurred in the same strand, or relatively constrained progression of events. Yet a preoperational child might have great difficulty remembering the temporal order of events that did not occur in a logical, natural order, or of events that occurred as part of different strands. During the concrete- and formal-operational periods of development, remembering temporal-order relationships may require particular encoding strategies as well as relatively effortful reconstructive processes involving relationships between landmark events – easily remembered activities, seasons of the year, and so on (cf. Michon & Jackson, 1984; Underwood, 1977). The child is then able to form «the notion of different event sequences crisscrossing each other but converging upon the momentary state of the reflecting observer» (Riegel, 1977a, p. 8).

The experienced duration of an event must necessarily depend on an ability to remember the onset of the event, an ability which appears very early in human development. However, as other cognitive abilities also develop, many other factors begin to influence experienced duration, such as anticipation. In addition, a concrete operational child is able to realize that he or she might experience a time period that contains many personally important marker events as relatively long compared to the experience of another observer, such as a parent. In much the same way, the older child realizes that the remembered duration of a time period is a personal reconstruction that may be affected by a wide variety of contextual factors.

During the formal operational period of development, an adolescent is able to form relatively abstract, scientific-like conceptions of time. As a result, time may be viewed in a more absolute way, rather than in a way which is entirely relative to the personal experiences of an individual. It is then that a broad temporal perspective might be attained – a broad-scale way of relating to past, present, and future events, which may be remembered, experienced, and anticipated. Of course, the temporal perspective of any adult is not only constructed from relatively automatic, species-wide temporal experiences, but also from relatively effortful, culturally specific temporal conceptions and beliefs.

Adult Beliefs About Time and Temporal Experiences

A reasonably comprehensive survey of adults' beliefs about time and human temporal experiences was designed and conducted recently

by Block, Saggau, and Nickol (1983-84). College students in the United States respondend to a 65-statement questionnaire – the Temporal Inventory on Meaning and Experience (TIME) – concerning physical time, personal time, experienced duration, and remembered duration. The respondents' beliefs about experienced and remembered duration are of particular relevance here. Each of these parts of the TIME contained 13 statements concerning variables that might affect psychological duration. For example, in a part on experienced duration respondents were asked whether a time period that a person is now experiencing seems to pass more quickly if the person is performing a single kind of task versus several kinds of tasks, or if the activity is pleasant versus unpleasant. In a comparable part of the TIME concerning remembered duration, respondents were asked whether the same kinds of variables would make a time period that a person is now remembering seem longer or shorter. A major, general finding in either case is that the respondents agreed that many different kinds of variables affect psychological duration, even though their beliefs were not always in agreement with actual experimental evidence. Respondents tended to report that only a few of the variables mentioned in these sections of the TIME do not affect the experiencing and remembering of duration. Thus, the respondents tended to be «naive contextualists» in the sense that they apparently believe that a wide variety of variables affect the quality of human temporal experiences.

These findings were replicated and extended in subsequent surveys of college students that were conducted in Japan and Malawi (Block, Buggie, & Saggau, 1985). Like students in the United States, respondents in these two different cultures tended to agree that a wide variety of variables affect both experienced duration and remembered duration. Respondents also substantially agreed on the type of effect that is produced by a given variable – whether it lengthens or shortens duration experience. It may tentatively be concluded that people from widely different cultures develop similar beliefs about psychological duration as a result of their personal awareness of contextual effects that occur. Pepper (1973/1982) asserted that «world hypotheses get started like any man's everyday hypothesis framed to solve some puzzling practical problem» (p. 199). The findings of Block, Buggie, and Saggau suggest that many people become naive contextualists as a result of encountering certain common phenomena of psychological time.

This conclusion is also supported, although more indirectly, by the responses to statements concerning physical time. On these, reported beliefs varied considerably from one culture to the next. The relatively substantial cross-cultural differences in beliefs concerning more abstract, scientific-like views on physical time may occur because people do not have any first-hand experiences with the conceptions involved.

Timelessness in Altered States of Consciousness

While experiencing a variety of altered states of consciousness, some people have unusual kinds of experiences that are best described as experiences of *timelessness.* A possible explanation is that people experience the «timelessness of existence» when «atemporal interconnections between events» are synthesized, perhaps automatically by the right cerebral hemisphere (Block, 1979, p. 210). For a variety of reasons, these kinds of experiences are probably not direct experiences of a basic atemporality of the universe. Although some kinds of human temporal experiences may involve more simple levels of temporality, we probably only directly experience the qualities associated with the complex level of temporality that Fraser (1975, 1978, 1982) called the *nootemporal.* This is not to deny that people experience some phenomena resulting from other levels of temporality, such as fluctuations in alertness that are a consequence of biotemporality – specifically, biological rhythms.

Fraser (1981) said that «experiences of timelessness . . . do not constitute very advanced but, rather, primitive states of the mind» (p. 7). (He used the term *primitive* in its psychodynamic sense). A contemporary cognitive interpretation is that such experiences are a result of the temporary termination of ordinary processes that contextualize all events and interpretations of events. In other words, this hypothesis says that we experience timelessness if the momentary environmental and psychological conditions lead us to suspend our beliefs about time and to cease actively constructing a context for our experiences. If this view is supported by future evidence, the experience of timelessness may provide an interesting and valuable limiting case for a contextualistic model of time and mind.

Summary and Conclusions

Time is a multifaceted concept, and work on the psychology

of time is diverse. This review focused primarily on cognitive approaches to an understanding of temporal experiences and conceptions. Pepper's (1942) distinction between four world models – formism, mechanism, contextualism, and organicism – and their underlying root metaphors provides a way to reinterpret the histories and futures of cognitive science and the psychology of time.

Many cognitive theories contain a mixture of world models, especially a combination of mechanistic and formistic metaphors, but some recent theories are more contextualistic. Emphases on world knowledge, distributed-memory models, and ecological psychology reflect this change to some extent. Similarly, with only a few exceptions earlier theorizing on the psychology of time relied mainly on formistic, mechanistic, or organicistic root metaphors; but recent theorizing is becoming more contextualistic.

A contextualistic view may be needed in order to do justice to the complexities of temporal experiences, as revealed in some recent experiments. Adopting this world model requires the specification of complex events in the environment that interact with the momentary dynamics of the mind as a person interweaves a holistic fabric of meaning of the events. Several different kinds of contextualistic approaches are currently being explored, including contextual-associations, interactive-factors, eclectic-dialectical, and cultural-anthropological approaches.

Human awareness of the contextual nature of temporal experiences and conceptions develops gradually. Adults from different cultures report similar beliefs about contextual effects on duration experiences, if not about the nature of physical time. Experiences of timelessness may occur when we suspend these beliefs and cease actively constructing a context for our experiences.

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Abstract

This review focuses primarily on cognitive approaches to understanding experiences and conceptions of time. Pepper's (1942) discussion of world hypotheses, or world models, enables a re-evaluation of the histories and futures of cognitive science and the psychology of time. The root metaphor of contextualism may be useful in synthesizing different views on the psychology of time. Recent research on memory, temporal experiences, and temporal conceptions seems to suggest a contextualistic approach; several such approaches are discussed. Many theories on psychological time have adopted other world models; it may be fruitful to take an alternative view.

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