Information and Time

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Abstract

The conceptual roots of the modern notion of information are traced. One of the most prominent of these roots stems from an unlikely source--Western views of time. This root is perhaps the main reason for the wide appeal and explanatory power of our current conception of information, particularly in cognitive psychology and artificial intelligence. Unfortunately, however, this appeal and power have led many theorists and researchers to overlook problems with this conception. Psychology's dominant assumption of time not only underlies these problems but also prevents their solution. An alternative assumption of time--hermeneutic temporality--is thus described. This alternative is shown to avoid the more problematic aspects of the dominant view and offer a more promising basis for conceptualizing information.

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"Today information is the most valuable commodity in business. Any business." This is the text of a full page advertisement in an American periodical (Roszak, 1986, p. 8). It exemplifies the value currently placed on information in business and industry, if not our Western culture generally. The key to power is no longer "who you know" but the quality and quantity of the information you have. This is because we supposedly live in what popular commentators, Alvin Toffler (1980) and John Naisbitt (1982), have termed the Information Age. Indeed, information has become so important to our society that Theodore Roszak (1986) believes it has attained a cult-like status. In his book, The Cult of Information, he remarks:

> People who have no clear idea what they mean by information or why they should want so much of it are nonetheless prepared to believe that we live in an Information Age, which makes every computer around us what the relics of the True Cross were in the Age of Faith: emblems of salvation. (p. x)

Interestingly, Roszak claims that most psychologists "worship" at the same altar as that of businessmen--the altar of information.[1] Certainly psychologists rely on information in much the same way as any professional. However, as Roszak also notes, many psychologists view their main subject matter--the human being--as an information processing system. As two prominent cognitivists, Alan Newell and Herbert Simon, observed long ago, the "programmed computer and human problem solver are both species belonging to the genus 'Information Processing System'" (Newell & Simon, 1972, p. 870). Although many cognitive psychologists have questioned the strict information processing model in their account of cognitive activities

(e.g., McClelland, Rumelhart, Hinton, 1988; Smolensky, 1988), there is no indication that alternative models have lessened their emphasis on information. As the author of a popular cognitive text acknowledges, "Cognitive psychology is [still] concerned with how information is represented or stored in memory" (Ashcraft, 1989, p. 64; cf. Solso, 1991, pp. 4-6).

This assumption may be the crux of our society's need for information. If our minds process, represent, and store information, then we are all vitally dependent upon it. Information is our very life blood as cognitive beings:

> Like it or not, we are information dependent. It is a commodity as vital as the air we breathe, as any of our metabolic energy requirements. For better or worse, we're all inescapably embedded in a universe of flows, not only of matter or energy but also of whatever it is we call information. (Young, 1987, p. 1)

The question arises, however: What is this "flow" of information? An understanding of this flow would seem crucial to an understanding of human cognition and behavior, not to mention an understanding of how humans survive and thrive in an information economy. Surprisingly, little has been written about this central concept. Although the term "information" pervades our scholarly and popular literature, few examinations of the concept and its implications have been undertaken.

This, then, is the purpose of the present article. It begins by tracing the conceptual roots of the modern notion of information, particularly as it applies to the cognitive sciences. One of the most prominent of these roots stems from an unlikely source--Western views of time. This root is perhaps the main reason for the wide appeal and explanatory power of our current

conception of information, particularly in cognitive psychology and artificial intelligence. Unfortunately, however, this appeal and power have led many theorists and researchers to overlook problems with this conception. Psychology's dominant assumption of time not only underlies these problems but also prevents their solution. An alternative assumption of time--hermeneutic temporality--is thus described. This alternative is shown to avoid the more problematic aspects of the dominant view and offer a more promising basis for conceptualizing information.

The Modern Concept of Information

The formal study of information probably began with Claude Shannon's ground-breaking paper, "A Mathematical Theory of Communication" (Shannon, 1962). Shannon's work is widely recognized as having revolutionized the way in which scientists and technicians use the term information (Dreyfus, 1979, p. 165; Roszak, 1986, p. 11; Rychlak, 1991, pp. 5-6; Young, 1987, p. 5). Before Shannon's paper, the term denoted some type of knowledge or fact. Most lay persons would have presumed that information occurred in the understanding of a speaker or listener. Working out of the Bell Labs, however, Shannon was more interested in what occurred in the telephone wire between parties of the conversation. He endowed the word information with a special technical definition. Information came to connote a quantitative measure of communication exchanges, particularly regarding the coding of messages into electronic pulses.

The increasing use of computers greatly facilitated the popularity of this conception. As Weizenbaum (1976) explains, computers operate on a "train of pulses," a series of on/off switches (of electrical current) that allow transformation into the "bits" of computer language (pp. 76-77). Although

programmers rarely operate at this level, this flow of pulses nevertheless underlies all the higher-order functions that now pass for programming. Indeed, this flow of "determinate, independent elements" is now considered our most fundamental conception of information and "an assumption [that] lies at the basis of thinking in [artificial intelligence]" (Dreyfus, 1979, p. 206-207). Of course, many such elements are required to transmit information across a wire or space, but each element is considered to have its own independent piece of the message. This the reason information is thought to occur in a stream or flow. Each pulse is transmitted separately from the others in this stream, and each pulse is received separately, one-at-a-time, as it registers its own portion of the data.

This conception of information became so popular that it rapidly replaced commonly held notions, e.g., information as fact (cf. Dreyfus, 1979, p. 165; Roszak, 1986, p. 12; Young, 1987, pp. 4-6). Shannon was confronted with the understandable confusion that resulted from his restricted use of the word and its more conventional meaning:

> I think perhaps the word 'information' is causing more trouble. . .than it is worth, except that it is difficult to find another word that is anywhere near right. It should be kept solidly in mind that [information] is only a measure of the difficulty in transmitting the sequences produced by some information source" (as cited in Weaver, 1949, p. 12)

Because Shannon emphasized the transmission as it occurs between the speaker and listener, the meaning of the transmission is irrelevant. Indeed, his own use of the term information can include gibberish (Dreyfus, 1979, pp. 165-167; Roszak, 1986, pp. 11-16; Rychlak, 1991, p. 5). Anything

that can be coded for transmission--regardless of its semantic content--is information from his perspective (Shannon, 1962, p. 3). Shannon's colleague, Warren Weaver (1962), probably put it most succinctly in this passage:

> The word information, in [Shannon's] theory, is used in a special sense that must not be confused with its ordinary usage. In particular, information must not be confused with meaning.
>
> In fact, two messages, one of which is heavily loaded with meaning and the other of which is pure nonsense, can be exactly equivalent, from the present viewpoint, as regards information. It is this, undoubtedly, that Shannon means when he says that "the semantic aspects of communication are irrelevant to the engineering aspects." (p. 99)

Historically, however, Shannon and Weaver's distinctions have been blurred. Not only has Shannon's conception of information overcome the more traditional notion of information, but the difference between his conception of information and the meaning of messages has also been lost. Information has come to be a stream of data pieces, and these data pieces are themselves thought to contain meaning and knowledge. The meaning of a transmitted message is now widely considered to be "in" the information flow. Many now assume that receiving and decoding this flow are all that is necessary to gain the meaning of the message as transmitted. As Van Gulick (1990) notes, information processing systems are "often spoken of as 'extracting information'" from the flow of data pieces (p. 109).[2]

Information in Cognitive Psychology

Many psychologists believe that the human mind performs a similar extraction function. Shannon's conception of information has dovetailed

nicely with the empiricism of many cognitive models (Dreyfus, 1979, p. 211; cf. Ellis & Hunt, 1989, p. 12; Rychlak, 1988, pp. 210-217, 1991, pp. 28-31; Slife, 1993, pp. 110-124). That is, meaning--or "message," as it is often referred to--is thought to be inherent in the stimuli or input that is transmitted from the environment to the mind (e.g., Ellis & Hunt, 1989, p. 14; Van Gulick, 1990, p. 108). This, of course, accounts for all the cognitive terms indicating that the mind is "registering," "storing," and "retrieving" information. What is it that is being registered, stored, and retrieved if it is not the message as coded in the information pieces? This is not to preclude the possibility of previously stored information being combined with incoming information to form new meanings (e.g., "conceptually driven processing," Ashcraft, 1989, p. 73). It is merely to note the often implicit assumption that the information currently being input is itself considered to contain a message or a meaning.

This assumption is also not exclusive to information processing models of human cognition. Any cognitive model that considers data from the environment to be transmitted to the mind across time and space makes a similar assumption. In this sense, information is distributed across some span of time and space. This means that pieces of the information occur at separate points of time and space, and the mind must process or store each piece as it is received. These pieces do not have to be conceptualized as "pulses" or "bits" in the strict sense of these terms. These pieces can be holistic, multiply channeled, or "parallel distributed" portions of the information as they are transmitted and occur in continuous (or discontinuous) streams across time (e.g., Dennett, 1991, pp. 253-263; McClelland, Rumelhart, Hinton, 1988). Such pieces also do not require

separate stages of memory, as many information processing models assume (and some models of cognition have disputed). All that is required is that information be received in pieces across time.

Of course, the meaning of a particular message cannot be discerned from any combination of informational pieces. Few cognitive scientists believe that the elements of information can simply be "added up" to produce the meaning. The elements themselves have an organization that is crucial to the understanding of the overall meaning of the input. Nonetheless, this would seem to be a problem: How does the receiver discern the organization of a set of data pieces that have been received independently of one another? Meaning is a particular relationship between two or more referents, and the independence of these data pieces as separate carriers of information would seem to obviate information about their original relationship or organization. In other words, their dependence--before transmission--cannot be reconstructed upon reception when the parts are independent by their very nature.

This problem is perhaps more easily recognized in other information processing systems such as computers. As artificial intelligence researcher, Anthony Oettinger (1979), puts it, "the burden of artificial intelligence is indeed its apparent need to proceed--in futility--from the atom to the whole" (p. xiii). Oettinger's point is that artificial intelligence devices must proceed from atoms of information to holistic meanings. They cannot truly have an "artificial intelligence" without being able to understand holistic meanings, yet the information to which they have access is received in independent pieces. Even in pattern recognition, artificial intelligence devices typically pick up separate aspects of the pattern as they scan. The first aspect (or

piece) is stored before the next aspect of the pattern has been received or processed (Dreyfus, 1979, p. 241). In this sense, the computer has no access to the pattern as a simultaneous organization of its data. Information about the original data arrangement is required to truly understand the pattern or meaning.

Artificial intelligence researchers have responded to this problem by claiming that holistic qualities can be formalized in such a way that they are sent along with the other pieces of information (Dreyfus, 1979; pp. 130-162). Algorithms and operations for relating the pieces as a whole are thought to be coded into the informational flow. This means, however, that these "holistic" pieces have the same properties as the previous pieces, occurring in separate time and space regions along the information flow. We now need information about the organization of these pieces. That is, holistic pieces must also be translated into discrete elements of information (to be part of the flow), and this necessitates additional information about their arrangement. We now require meta-holistic pieces to indicate how the holistic pieces themselves are arranged. Without these meta-holistic pieces, the holistic pieces which, in turn, indicate the organization (and meaning) of the original pieces would be nonsensical. Unfortunately, this regress never ends. The meta-holistic pieces--themselves part of the flow of pieces--require meta-meta pieces that, in turn, require meta-meta-meta pieces, and so on.

The point is that the relations among parts can never be represented with independent parts. The core of the problem is that form and content cannot be realistically separated (see Smythe, 1992 for a complementary analysis). Even if the "content" of a message can be coded into independent pieces, the original "form" of the content--as a simultaneous structure--cannot

be coded into a sequential entity such as a "stream" or a "flow" (Slife, 1993, pp. 20, 27, 132-135). Oral and written communications may seem to occur sequentially, but in actuality the receiver of communications experiences nested meanings--relationships among the words heard or seen--rather than individual words, each with its own portion of the message. That is, a large portion of each word's meaning stems from its simultaneous relationship to the other words (McClelland, Rumelhart, Hinton, 1988; Saussure, 1966). To read a sequence of words without this relationship--i.e., to read the words as independent parts--would be to read meaningless gibberish. All that would be available at the end of this type of informational stream is the cumulative record of independent elements--as each element is received in time--and not the qualities of the elements derived from their relationship to one another in the original structure.

Time and Information

If this is true, why has this conception of information so dominated psychology, particularly in those areas related to human cognition (e.g., cognitive therapy, memory research, artificial intelligence)? Surely the holistic quality of messages and patterns is crucial to the function of cognition. If this "flow" approach to information is independent of such pivotal qualities as meaning--as Shannon and Weaver first contended--why have so many cognitive researchers continued to embrace it? Dreyfus (1979) feels that this "myth"--as he terms it--was fostered by the success of classical physics (p. 213). Physicists, such as Galileo and Newton, felt they could study the motions of the universe in terms of independent objects moving in linear arrays across time. Why, then, the cognitive scientist or artificial intelligence researcher seems to ask, can't information be studied in the same

way as any physical system--as separate objective elements flowing in motion across time. If this approach worked for physics, why wouldn't this work for the study of information systems?

This is where the issue of time most visibly reveals its fundamental, yet subtle, role in conceptions of information. Because motion requires change across time, any understanding of motion--whether it be the motion of physical objects or the motion of informational pieces--necessarily involves assumptions about time. In both cases, classical physics and contemporary conceptions of information, time is assumed to be linear in nature (Slife, 1993, pp. 13-29, 132-135). That is, time is assumed to flow smoothly and inexorably, as a line, independently of our consciousness. Newton (1990) perhaps said it best when he articulated his assumption of absolute time: "Absolute, true and mathematical time, of itself, and from its own nature, flows equably without relation to anything external" (p. 8).

This assumption of time may be a familiar, perhaps even a commonsensical, notion. Newton is recognized as one of the primary progenitors of our culture's conception of time (Burtt, 1954, pp. 230, 239-255; McGrath & Kelly, 1986, pp. 26, 30; Rychlak, 1988, p. 48, 275-276; Slife, 1993, pp. 17-21). Time is often viewed as an absolute entity--in the sense of being independent of our consciousness--and flowing "out there" as a linear stream. Time is also considered to consist of a set of discrete moments or instants. As Lovejoy (1961) puts it: "Time as ordinarily conceived is sundered into separate moments which are perpetually passing away" (p. 75). The reason for this is the line metaphor. Just as the Euclidian line consists of discrete and separable points, linear time is thought to consist of discrete and separable instants. Events, from this perspective, are in time and take on

time's properties. Thus, event processes "flow" in linear streams and can be broken into discrete events.

One set of these events is the flow of information itself. In fact, this is where information gets it "flowing" property. Similar to any other process (from this linear perspective), information must be viewed as a set of events--or "pulses"--occurring in the linear sequence of time. Most cognitive models assume this implicitly. Pieces of information are considered to traverse the distance between the information source and the information receptor (e.g., the mind) continuously. This accounts for the popularity of this notion of information. Information is thought to be like any other physical process; it must occur along the line of time. Indeed, many scientists would question whether information could be understood any other way, and this may the most telling evidence of linear time's influence upon this conception of information. Linear time is axiomatic, and thus information has to be part of this linear stream.

In this sense, then, the problem of meaning and information is really a problem inherent in linear time. As Slife demonstrates in a recent book entitled, Time and Psychological Explanation, linear time is itself ultimately reductionistic (Slife, 1993, p. 20). Because most scientific processes are thought to be distributed along the line of time, these processes can literally never exist as a whole at any moment in time. That is, if a process begins at Time 1, proceeds through Time 2, and ultimately culminates at Time 3, only a reduced portion of this process can be studied at any point in this sequence. Recording devices, such as a scientist's memory, permit each piece of the process to be "photographed" and juxtaposed with the next moment's piece

until all the process is viewed at the same time. However, no direct access to the process-as-a-whole is ever possible:

> This makes interpretation of each part's relation to the whole problematic, because each part crosses our window of the present independently of the whole. Any properties of the part that may be derived from its relationship to the process-as-a-whole are not available. Without these properties, an understanding of the process-as-a-whole is itself problematic. All that is available at the end of the process is the cumulative record of independent parts, as each part is encountered in time, and not information about how these parts are related as a whole. (Slife, 1993, p. 20)

As applied to the flow of information, we can never understand the meaning of each data piece (its relation to the whole) as we encounter it in time. Without the meaning of each piece, we cannot know the meaning of the whole. We have the same problem we had before: trying to figure out the qualities of parts and wholes from independent pieces of information given to us in a linear sequence. It cannot be done. The axiomatic status of this time assumption, however, makes it appear that this is the only way in which the bits and pieces of reality can be understood. Unfortunately, this understanding obviates the meaning of the bits and pieces. One of the classical ways of dealing with this loss of meaning in science is to deny that the natural sciences deal with meaning. Natural science--as many view it--can only deal with the world as "objective" things, divorced of meaning (cf. Williams, 1990).

Psychologists, however, cannot take a similar refuge. Meaning is central to the issue of information and cannot be defined away. Few

psychologists, I believe, would dispute that humans somehow, some way, convey meanings to one another. Consequently, any conception of information that defines away meaning is itself untenable. We could, of course, attempt to formulate a new conception of information that includes the factors integral to meaning. Smythe (1992), for example, reviews many of the mainstream cognitive approaches for incorporating meaning, but continues to find them wanting for similar reductionistic reasons. The problem is that time itself is viewed in a manner that precludes meaning. As long as reality is construed in this linear manner, no satisfactory conception of information is possible. The reductionistic qualities of linear time--distributing all processes into discrete parts along itself--will prevent any meaningful definition of information. Our first step, then, is the formulation of a nonlinear conception of time.

An Alternate Conception of Time

The philosophy of Martin Heidegger (1962) is particularly helpful in this regard. Heidegger completely rejected the linear notion of time for essentially the same reason as discussed here--meaning for him was radically holistic (cf. Polkinghorne, 1990). That is, any element of meaning, such as a data piece, can never be understood independently of its holistic context. The organization of the data, as its elements occur together (simultaneously), is crucial to the understanding of each element's meaning and qualities. The whole endows each part with meaning and quality. As we shall see, other aspects of this holistic context are important to Heidegger, but there is--even at this juncture--a provocative aspect to Heidegger's conception of holistic context that requires our attention: holistic context includes both time and space.

From a linear perspective, time is not regarded as a factor of holistic context. Because linear time is a one-dimensional entity (a line), no changes in quality are permitted. Time proceeds "equably," as Newton put it, without disruption or alteration in its rate or properties. Time is thus the same at any point in its flowing; time's lack of variance prevents it from being a variable. From a Heideggerian perspective, however, lived time and space can both vary in their qualities. This is because time and space each have three dimensions, even when speaking only of the "now." Just as all three dimensions of any spatial situation co-occur in the now, so all three dimensions of time--past, present, and future--co-occur in the now for Heidegger. The past as memory and givenness, and the future as anticipation and possibility, exist in and provide a vital simultaneous context for the present. Indeed, according to Heidegger, no one dimension of time can truly be a meaningful dimension without the context provided by the other two dimensions. The lived present, for example, cannot be understood in any meaningful sense without the contemporaneity of the past and future.

The linear view, of course, considers the temporal dimensions to occur in a linear sequence, with the past, present, and future forever separated in time. Each dimension is encountered in its turn, but no dimension can be the simultaneous context for any other dimension. This is true no matter how small the interval (or separation) between temporal dimensions. Although time is a line, the present is still considered a point on the line separating the past and future. As Lovejoy (1961) puts it, "the present seems, at most, a bare knife-edge of existence separating [the past and future]" (p. 75). Temporal dimensions are thus sequential. Past events may cause present events, but the past cannot be present without violating the basic conception

of time. Historically, this has been a major reason for the postulation of universal laws--laws that transcend time. Such laws are needed to cut across the separate time dimensions and provide knowledge that is applicable to more than one point in time. Data or ideas that are only applicable to one timepoint are usually not considered knowledge at all.

From Heidegger's perspective, however, universals accomplish knowledge at the expense of the truly contextual present. Instead of incorporating the unique and context-filled present, universals strip moments of their individual uniquenesses and relate together only their similarities (their universalities). This is akin to a psychologist relating together the similarities of qualitatively different stages of child development. These similarities may form an interesting universal conception of stages, but this conception would not be very useful for understanding a child in a particular stage of development. This conception lacks the unique qualities of the specific stage by the very process of universalizing. Virtually any law, according to Heidegger, has a similar problem. After the various moments of time are related in a lawful manner, an impoverished and inapplicable aggregate of moments is all that is left. This aggregate cannot be applied, because it has nothing to do with the unique context of any particular moment, only the contextless aggregate of moments.

This is a constant dilemma for the linear theorist. Either knowledge is pertinent only to a specific point in time and thus useless for any other point in time, or knowledge is universalized so that it generalizes to other timepoints and loses its applicability to specific contextual moments. As Heidegger notes, however, this dilemma is a consequence of our view of time.

The recognition that time's three dimensions are simultaneous, rather than successive, permits any particular moment to be itself a temporal whole. Knowledge of the present, in this sense, is not just knowledge of one point on a one-dimensional line. It is an integrated knowledge of all three temporal dimensions. A nonlinear type of universality is preserved, because a full understanding of the now implies some understanding of the past (memories) and future (possibilities) as well. A conversation among friends, for example, cannot be understood in terms of the linear present only. The meaning of the friends' past relationship as well as the import of their anticipated future together are crucial to the "nowness" of the conversation.

Information and Temporality

What implication does this view of time have for our notion of information? First, the condition of "togetherness" or simultaneity is crucial to meaning. Wholes simply are not wholes without their parts being together at the same time. No part, and certainly no sequence of parts, can ever have any meaning apart from the whole. Holistic (and simultaneous) relationships must be recognized first in order to endow the part with its partness, its meaning. As Heidegger (1962) puts it, "the totality of involvements which is constitutive. . . is 'earlier' that any single item" (p. 116). Recent notions of information reverse this order, assuming that a message begins with parts--or isolated "things"--when it is received. The hope is that this aggregate of independent and discrete elements will be organized into a whole that is similar to the whole of which they were originally part. This is the only conception of information or meaning possible. Linear time precludes any direct access to the whole, because its parts must be distributed across the line of time.

Heidegger's conception, on the other hand, makes the whole of any meaning or organization accessible from the first. Information is not spread across a line of time. Information is the meaning of the lived "now" with all its interrelatedness. For Heidegger, "things constantly step back into the referential totality, or, more properly stated, in the immediacy of everyday occupation they never even first step out of it. . .Things recede into relations" (Heidegger, 1985, p. 187). Everyday things give rise to and define one another in a field theory of meaning. Samuel Todes (1963, 1966) describes in detail this field-structure of experience that is prior to the facts and implicitly determines their relevance and significance. Smythe (1992) argues that even the interpretation of information cannot be understood as a separate stage of the cognitive process. Interpretation requires "an implicit understanding of meanings that are already available preinterpretively" (p. 358). For Smythe, Todes, and Heidegger, people experience the world as fields within fields. Aspects of wholes are not experienced as isolated facts but as nested meanings within a simultaneous series of contexts. This network of meanings in its totality is what Heidegger calls "world."

Crucial to world is not only physical totality but also temporal totality. The lived dimensions of space are an important aspect of world, but the lived dimensions of time are also vital to this network of meaning relations. No meaning, in this sense, is a meaning of the present only (i.e., a data piece); all meanings of the "now" necessarily involve meanings of the past and future. In contrast to conventional conceptions of time, the past, for example, is not dead and gone, nor is this supposedly immutable entity stored for later retrieval. The past is a constant and dynamic presence <u>in</u> the present. Meanings of the past are changeable meanings rather than stored pieces of

information or aggregates of various past experiences. They are, first and foremost, dynamic meanings, in flux with respect to both our simultaneous spatial and simultaneous temporal contexts. Without this present past and present future, no meaning and no interrelatedness are possible.

Heidegger's temporality is surprisingly well supported by recent empirical findings. Many constructivists, for example, hold that memories are reconstructed rather than retrieved (Ashcraft, 1989, pp. 306-320). That is, the past as originally experienced is not stored but is constantly being reconstructed in light of present situations and future objectives.[3] In this sense, it is as correct to hold that the present "causes" the meanings of the past (which are themselves in the present) as it is to say that the past causes the meanings of the present.[4] Related findings on mood congruence can also be interpreted (or reconstructed) in this manner. These findings indicate that conditions of the present, such as mood, affect not only the particular memories that are "retrieved" but also how those memories are viewed (Slife, Miura, Thompson, Shapiro, & Gallagher, 1984). A "childhood trauma," for instance, can be seen in retrospect (and in happier times) as a good lesson learned. The point is that the past in cognition is not a fixed and "dead" entity as linear theorists have depicted it. The past is alive in the experiential present and constantly intermingled with the other two temporal dimensions.

Cognitive theorists seem to be aware of the need for the past as a context for the present. Unfortunately, the only option at their disposal for bringing the past into the present, given their linear view of time, is causal law. Causal law, however, destroys temporality (Slife, 1994). That is, the contextual importance (and thus meaning) of all temporal dimensions is lost

under causal law. The present is lost because it is at the mercy of the immediately preceding event. As a mere "effect" of this causal event, the present cannot make its own contribution to meaning. This would seem to place the past in charge of the present, and mainstream cognitivists do depend on the past almost exclusively for their explanation of the present. However, the past is also lost in this deterministic framework. The past as a totality--as a simultaneous whole--is not involved in determining the present in linear causality. What is involved in this determinism is the most recent, ending event of the past and not the past as a whole. Of course, the future cannot contribute anything of its own to the present, by definition. The future is forever doomed to follow the present and is always constrained by the preceding time dimensions in any case.

The upshot is that causal law cannot bring temporal context to events of the present. The present remains fundamentally contextless. Similar to the informational piece, the present is a discrete event, independent from other present moments that have now passed away. The fundamental difficulty with this framework is that humans do not seem to experience the world in this manner. Even if a person experiences a sequence of events (e.g., words on a page or sights on a trip), these events are not experienced as atoms of reality. Each event has a physical and temporal context from which it cannot be extricated. Everyday actions for us are alive with all their interrelated meanings. We do not experience present moments only, divorced from related past memories and future anticipations. We experience wholes and meanings, full-blown and alive with possibility.

Nor can the mind itself be divorced from these wholes. The mind and its environment are currently portrayed as residing in separate time and

space regions (cf. Slife, 1993, pp. 218-219, 240-243). The environment must traverse the space and time distance between the regions to reach the mind with its information. This type of cognitive model results in a linear view of information. The flow of information is needed as a bridge between these separate time-space regions, with the pieces of this information distributed across this bridge. This leads, in turn, to mind-environment "interactions" in which the mind and the environment "communicate" with one another through a series of transmissions and receptions.

The radical contextuality and holism of Heidegger challenge this cognitive model. Mind and world are themselves parts of a single (and synchronous) structure in his view. No informational flow is necessary because the two parts communicate with each other by virtue of their relation as parts of a superordinate gestalt. Similarly, no entities correspond to the lexical terms of "mind" and "environment," because these are not separable entities in the conventional sense. This is part of the reason that Heidegger refers to this superordinate gestalt as Dasein. As in any whole-part relationship, the alteration of a part (e.g., the "environment") can change--synchronously--the meaning of any whole (Dasein) and thus any part within that whole (e.g., "mind") without ever having "touched" that part in any way. No transmission across time and space is necessary.

"Mind" and "body" have a similar holistic relationship.[5] Currently, many cognitivists assume that information is received by the senses (in pieces) and then transmitted (across time) to the mind. Sensation and perception, in this sense, serve as part of the bridge needed to allow communication between the information transmitter (environment) and information receiver (mind).[6] Heidegger (1971), however, abandons this

linear notion of sensation: "In opposition to the subjectivistic misinterpretation that perception is directed in the first instance only to something subjective, that is, to sensations, it was necessary to show that perception is directed toward the extant [thing] itself" (p. 71). In other words, we are in direct contact with the things themselves, not with subjective sensory impressions. Once this "prejudice of sensation," as Merleau-Ponty terms it, has been set aside, what is given immediately is not the sensory impression--with the external world making its way (across linear time) into the organism--"but the meaning, the structure, the spontaneous arrangement of parts" (Merleau-Ponty, 1962, p. 58).

Heidegger makes clear that when we look at something--a tree in bloom, for example--we are not merely receiving sensations (stimuli, input, pieces) from which we must then represent the tree.[7] What we are seeing is the tree as it is--as a whole in the meadow--not the tree as transmitted across the meadow, received by our senses, and then represented in our mind:

> Does the tree stand "in our consciousness," or does it stand in the meadow? Does the meadow lie in the soul, as experience, or is it spread out there on the earth?. . . It will not do to admit. . .that, naturally, we are standing face to face with a tree in bloom, only to affirm the very next moment as equally obvious that this view, naturally, typifies only the naive, because pre-scientific, comprehension of things. . . . In truth, we are today rather inclined to favor a supposedly superior physical and physiological knowledge, and to drop the blooming tree. . . . The thing that matters first and foremost, and finally, is not to drop the tree in bloom, but for once let it

stand where it stands. Why do we say "finally"? Because to this day, thought has never let the tree stand where it stands. (1968, pp. 41-44)

Conclusion

To allow the tree to "stand where it stands"--as a part in relation to ourselves and the meadow--is to have direct access to the tree. The tree stands some distance from us, but the tree is also part of the same superordinate whole of which we are part: the world. To be part of the lived world, mind and body must be what Merleau-Ponty calls a "synergistic system." Mind is not a brain in a bottle, with the body as so many neuronal wires into the bottle. Mind itself must be embodied. Grasping a ball (or viewing a tree in bloom) is not an action of my hand (or my eyes), it is an action of me. As an embodied being, I am "outside" with other embodied beings. I am not "inside" as a being in a bag of skin but "outside" as a being-in-the-world. Indeed, the inside/outside distinction is itself false from Heidegger's point of view.

This distinction is necessary only because of traditional subject/object dualism. Descartes' original dualism between subject and object carried with it the assumption of res extensa. That is, the body is basically a passive bit of extension that serves as a conduit to the external world. Traveling through this conduit is, of course, the function of information and the reason for its ubiquity in our society. As long as the subject is "in here" inside the boundary of the skin and the object is "out there" beyond this boundary, something like the linear force of information is required. Mind and environment, in this sense, are in separate worlds (inner and outer), and communication between these worlds must occur in smaller elements across the time and space separating them. With the postmodern challenge of such

Cartesian dualism, however, the conventional mechanistic conception of information is challenged as well.

This challenge does not mean that the mechanistic conception of information is wrong. Indeed, this conception will likely have continued importance in all types of engineering applications, as Shannon originally intended. On the other hand, if the foregoing temporal analysis of information has any credence, the importance of this mechanistic conception will be limited for understanding embodied and situated human action--Dasein. This may seem to contradict the so-called advances of artificial intelligence. However, these advances have been more technological and involved more sterile and mechanistic tasks. As Dreyfus (1979; 1986) has demonstrated, the closer artificial intelligence has come to the situated and embodied realm of human action, the more limited these advances are.

If I am situated and embodied--as part of the same region of time and space--I have direct contact with the tree. The first bloom I see on the tree has a direct and immediate impact on me, because both the bloom and I are parts of the same world, parts of the same whole. As with any whole, a change in a part (the tree) can have a simultaneous impact on the gestalt of the whole (world) and thus the qualities of the other parts (my perception of the tree). Only the assumption of linear time--with its sequencing of past, present, and future--can make this simultaneous change appear to occur in a linear sequence. Heidegger's conception of temporality does not require that the tree, the body, and the mind be distributed along the line of time, with our only access to the tree being its final sensory impression. Heidegger's integration of the three dimensions of time allows the integration of these

three factors of the world and permits the tree to stand where its stands--as part of that world.

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Footnotes

[1]The "information explosion" is also cited as one of the top ten most important influences in psychology since World War II (as cited in Hogan & Sexton, 1992).

[2]This conception found dramatic support from an unexpected quarter. When microbiologists Watson and Crick announced that they had broken the "genetic code," the word code seemed to link this discovery to information theorists. In this sense, the DNA molecule was seen as a set of chemically encoded data bits. The information or meaning of the molecule was "in" these bits and could be discerned by deciphering their coded messages. In this passage, biologist Stephen Rose (1970) identifies cybernetics as the "theoretical tool" for unlocking the chemistry of life,

> the study of information transfer: the converting of information from one form to another--the human voice into radio waves and back into sound once more. . . To [the cyberneticist], protein synthesis is just such another case. The mechanism for ensuring the exact replication of a protein chain by a new cell is that of transferring the information about the protein structure from the parent to the daughter cell. (p. 162).

[3]This is a priori constructivism as opposed to empiricistic constructivism (cf. Slife, 1993, pp. 124-128).

[4]The use of "cause" here may seem problematic. From a linear perspective, causal processes are considered to be distributed across linear time, and thus causes are thought to have to precede effects. As others have shown, however, this notion of antecedence is not a formal property of causality (Bunge, 1959, p. 63; cf. 1963, p. 189). Cause and effect work just fine as simultaneous events.

[5]Language conventions force the continued use of the term "mind" here, though I do not assume that this is a separate entity--in a separate time/space region--from either the "environment" or the "body."

[6]Mind and body are thus in separate time/space regions, resulting in the many mind/body problems of psychology (Fuller, 1990, pp. 66-71).

[7]Dennett (1991) seems to have a similar concern when he criticizes the "Cartesian Theatre" of many cognitive models (p. 253). His remedy to this concern, however, is quite different from one offered here (pp. 253-263).