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Can Cognitive Psychology Account for Metacognitive Functions of Mind?

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Metacognitive functions are those mental abilities that are considered beyond or "meta" to conventional conceptions of cognitive abilities. As defined here, metacognition would include consciousness functions, such as self-awareness and knowing about knowing, and executive functions, such as self-regulation and control processes. These functions are crucial to the cognitive movement in psychology because they provide the means by which cognition can be a source of influence apart from the passive storage and retrieval of environmental influences. Current explanations of metacognitive functions are examined and found to be inadequate. It is contended that these explanations all assume a *demonstrative* form of human reasoning that is insufficient, in principle, to account for metacognitive functions. Alternate assumptions that emphasize *dialectical* reasoning are proferred as a possible means of accounting for metacognitive phenomena.

Metacognition and related issues such as control theory and self-regulation have been relatively "hot" topics in psychology of late. Part of the reason for their recent importance is that metacognition is the culmination of the "cognitive movement." This movement began as a reaction to those psychologists who considered the environment the sole controller of the person. Cognitive approaches postulated that at least some of this control resided in the person's mental apparatus. The issue of how these "control" processes operate is the issue of metacognition, a topic now being considered by psychologists working in areas from artificial intelligence to cognitive development.

The present paper contends that this culmination of the cognitive movement will ultimately be its invalidation. Just as the adequacy of an idea can be tested by extending its implications to their logical conclusions, so the cognitive movement can be tested by its extension to its metacognitive conclusions. Mainstream cognitive models will be shown to fail this test. Their basically mechanistic theorizing (see Rychlak, 1977; Williams, 1985) is insufficient to explain how a mind can have control and awareness of itself. Their assumptions of human reasoning will be revealed to be at the root of this insufficiency. Mainstream theories rely exclusively on demonstrative forms of logic that cannot, in principle, account for metacognitively initiated changes in cognitive

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processes. As an alternative, assumptions that emphasize dialectical logic will be offered as a possible means of conceptualizing metacognitive functions.

Metacognitive Functions

The first order of business is to clarify what functions of the mind are considered to be metacognitive. The definition employed in this paper is broader than most uses of the term metacognition, but quite consistent with the literature on "meta" conceptions (cf. Brown, 1978; Cavanaugh and Perlmutter, 1982). It refers to characteristics of human thinking that are "meta" or "beyond" cognition. The quotation marks indicate, of course, that these characteristics are not considered external to the brain or mentation in general. Cognitive psychologists required metacognitive concepts because they sensed a need for mental functions "outside" of those activities usually associated with cognition.

These functions typically fall into two categories: consciousness and executive. Consciousness functions are those mental activites that permit us to be aware of some of our thoughts, memories, and cognitive activities. These functions include self-awareness, self-monitoring, and knowledge about knowledge, variously termed metaknowledge or metamemory (Matlin, 1983). The term "consciousness," of course, is used in other senses than this. Consciousness of one's environment is perhaps the other main category of meaning. This meaning, however, is probably best viewed as a cognitive rather than a metacognitive function because it involves traditional cognitive processes such as attention and short-term memory (e.g., Klatzky, 1984). Metacognitive phenomena are thought to influence these processes, but the focus of the present paper is on *self*-consciousness, viz., the awareness of those cognitive factors that process environmental information rather than the cognitive factors themselves.

Executive functions are those mental activities that allow us to voluntarily alter and direct our cognitions. They include functions like self-regulation, problem-solving, and "control processes." Control processes are the "command" or "central" systems of cognitive models such as information processing (e.g., Atkinson and Shiffrin, 1968; Shiffrin and Schneider, 1977). These systems are responsible for deciding which items are to be rehearsed in short-term memory and stored in long-term memory. Control and self-regulation theories also center on executive processes (as defined here). These theories use cybernetic principles to explain how self-regulating systems, such as human cognition, control their own functioning (e.g., Carver and Scheier, 1981, 1982; Kanfer, 1977; Rehm, 1977). Both approaches illustrate how executive processes are viewed as being "beyond" the flow of environmental input and cognitive functioning in order to control processing.

Consciousness and executive functions are also important to the cognitive movement. Not only do these functions monitor and control cognitive operations, but they also provide the means by which cognition can be an influence apart

from the influences of the environment. The cognitive movement began as a rallying point for those who felt that the human mind made its own original contribution to behavior. Clearly, the mind "processes" information from the environment, but the manner in which it does this processing (e.g., how it is organized, stored, endowed with meaning) is the *mind's* contribution, as controlled by metacognition. If, however, these mental contributions are themselves determined by previous environmental inputs, then such contributions would not be *uniquely* mental. Mind would merely be the preserver of previous environmental factors that impact present environmental stimuli. As defined here, metacognitive functions would not exist, and the unique contributions of mind which are the root of the cognitive movement would not be possible.

Empirical Investigations

Empirical tests do seem to indicate the existence and importance of metacognitive functions. However, space limitations do not permit a thorough review of the burgeoning experimental literature on such phenomena. Several recent cognitive texts include whole sections or chapters on the topic (e.g., Gross, 1985; Matlin, 1983). Part of the original impetus for researching metacognition stemmed from attempts to understand "production deficiencies" in learning. One example is the "tip-of-the-tongue" phenomenon (Brown and McNeill, 1966) wherein a person may know that they know an answer (metaknowledge), but is unable to recall it. In this case, the deficiency is considered cognitive because there are no cognitive retrieval pathways to access the answer, yet there is a metacognitive awareness that the answer is known. The breakdown is in the knowledge system (lack of retrieval pathways) rather than the knowledge-about-knowledge system.

In many learning disabled children, however, the opposite is true (Brown and Palinscar, 1982). These children often possess the same cognitive knowledge and abilities as regular children, but lack the metacognitive awareness to know that they have the knowledge and abilities (Reid and Hresko, 1981). That is, the deficiency is not in the cognitive *acquisition* of the skill (or the requisite retrieval associations), but in the metacognitive *production* of the skill. The necessary skills may be a part of one's repertoire, but these skills may not be identified or directed appropriately in the particular situation.

Slife, Weiss, and Bell (1985) matched learning disabled and regular students in their knowledge, aptitude, and ability for mathematics. Their methodology even permitted these students to be matched on their performance on the same set of math problems. However, when both sets of students were asked to identify those problems they solved correctly and those they solved incorrectly (i.e., knowing what they knew and knowing what they did not know), the performance of learning disabled students was dramatically poorer. Similarly, minor depressives have rarely shown significant cognitive deficits when compared

to a matched set of normals. They have, however, shown deficits in their ability to control and direct cognition effectively in problem solving tasks (Slife, Marcoux, and Vlahos, 1986).

These studies also evidence another property of metacognitive factors: independence from cognitive factors. Although cognition and metacognition interact extensively, metacognitive skills cannot be reduced to cognitive skills. Not only do the two sets of skills have separate characteristics and domains, but they also vary independently of one another (Gross, 1985; Slife et al., 1985). As demonstrated in the studies above, it is not unusual to observe high cognitive skill with low metacognitive skill and vice versa. Such studies help to establish the construct validity of metacognition (Slife, Weiss, and Bell, 1984), and are fairly representative of dozens of other studies that indicate the existence and significance of metacognitive factors in human mental functioning. Furthermore, the existence of these factors is supported by our experience of ourselves, e.g., knowing our thoughts, directing our attitudes. Indeed, no experience of ourselves would be possible without metacognition in this sense.

Cognitive Explanations

Given the existence and importance of metacognition for cognitive models, how have such processes been explained? Consciousness functions have typically been associated with two related conceptions: short-term memory and focal attention. As mentioned above, these factors are often posited in theories involving consciousness of the environment. However, they are also employed in theories that attempt to conceptualize how cognitive processing is itself monitored and managed (Klatzky, 1984). Short-term memory is viewed as the site where all mental "work" is performed (e.g., Baddeley, 1981). Not only is environmental input processed, but the processing itself is thought to be consciously scrutinized in this phase of information processing. However, this fact alone explains very little.

For this reason, conscious scrutiny or "work" is often further defined as demand for attentional capacity. In some models, focus of attention is considered to be synonymous with short-term memory (see Klatzky [1984] for a review). However, explanations of *why* attention is allocated to certain memory items over others is very unclear in this literature. Most theorists do not consider this at all, concerning themselves with describing rather than explaining the role of attention of memory (Carver and Scheier, 1982; Klatzky, 1984; Shallice, 1978). The pertinent issue here, of course, is how attentional processes themselves operate. Certainly, the properties of memory items contribute to the particular focus of attention, but if this is the sole factor of attention, then consciousness itself is not influenced by uniquely mental phenomena.

The issue of unique mental contributions to factors such as attention and "working" memory is probably best understood in the context of executive

functions. These functions are commonly analogized to executive programs in a computer, and explained by cybernetic principles. Simon (1979), for example, discusses "production systems" and "central processors" in this manner. Such systems are comprised of conditional, if-then, programming statements that require particular conditions to be met before certain actions are taken. In this sense, metacognition is an executive system that is programmed to monitor and direct other systems, such as attentional focus and short-term memory. The connection between systems is provided by a cybernetic feedback loop. This is thought to permit cognitive factors to be monitored (i.e., in consciousness) and executive directions to be given depending on the information fed back. The relation between cognition and metacognition, then, is analogous to two "on-line" computers that are programmed with different objectives but nevertheless tied together via feedback operations.

As intriguing as this explanation of metacognition is, it seems to beg the question. The metaphor used to describe metacognition appears to be the same as that used to describe cognition. If cognition requires a monitor and controller to fully understand its functioning, then so does metacognition. How does the "production system" get programmed? What controls and monitors this program? Some theorists have proposed "meta-metacognition" (e.g., Kitchener, 1983), but what is to prevent a logical extension to processors ad infinitum?

This style of theorizing is really a variant of the homunculus explanation where the problematic properties of a system are shunted off to the next level of explanation. Newell (1980) has acknowledged the presence of such theorizing and called for the "banishment of the homunculus" in cognitive science. If-then programming statements affect the direction the computer takes, but to say that they "control" the computer is misleading. They are merely relaying the directions and control statements of outside agents. Obviously, if these outside agents are environmental factors, executive programs of this sort do not account for unique mental contributions to behavior. They merely provide the means by which previous environmental inputs affect present mental events.

Feedback principles appear to be generally inadequate to explain how metacognition could monitor and control cognition. A mechanism that is feeding back output as new input does not *know* that it *is* feeding back (Rychlak and Slife, 1984). One can, of course, connect another feedback loop to monitor the first, but then the second loop is left unmonitored and cannot know that it is feeding back. It is highly debatable whether the first loop can "know" that it is feeding back, even with the existence of the second loop. However, the important point is that the nature of the new system (the interaction of two feedback loops) cannot be known to the system itself, because the monitoring loop is itself unmonitorable.

This characteristic of feedback is consistently overlooked by many cognitive scientists. In a recent book on cybernetics, Kenney (1983) describes the thermostat, his "classic example of feedback," as "monitor[ing] its own performance and

[*being*] self-corrective" (p. 67). Yet, this is clearly not the case. The thermostat monitors and corrects the room temperature, and not its own performance of monitoring and correcting the room's temperature. It does not monitor the accuracy of its temperature gauge, nor does it have any way of knowing if the temperature variations are a result of room conditions or its own corrections.

The typical counter to this point is that a system of feedback loops can be so integrated and complicated that eventually the system is indeed monitoring and directing itself. The epitome of this is the computer, and the issues being considered here are also important to those in the field of artificial intelligence (Dreyfus, 1979; Hofstadter, 1981). The computer, of course, is a maze of integrated and complicated feedback loop operations. As Weizenbaum (1976) has noted, however, the very notion of such integrated operations presumes that the master program is already in place. That is, these operations occur only after a sequence of processing has been decided upon; they cannot affect the initial decisive act of selecting the master program from among alternatives. In this sense, so-called control processes cannot be said to voluntarily control cognition because they are controlled by a master program that cannot select itself.

Perhaps the most elaborate and sophisticated of the control theories is that described by Carver and Scheier (1982). They build upon the work of Kanfer (1977) and Powers (1973) in attempting to employ cybernetic principles to explain self-regulating systems such as cognition. Carver and Scheier begin by noting that the basic unit of cybernetic control, the negative feedback loop, has two "influences" that originate *outside* the loop: the "reference value" and the "disturbance" (p. 112). The latter influence is the collective outside forces that impinge on the system. In the case of cognition this would almost always be environmental forces. Consider their example of a feedback loop—a driver steering a car. The condition of the moving car with respect to the road is sensed as feedback and responded to through turns of the wheel. Their example of a "disturbance" is air turbulence that buffets the car and thus causes compensatory steering actions. They note, however, that the "essence" of a disturbance's influence is that it affects the present state separately from the system's own action. Disturbances do not alter or control the "central" function of the feedback system.

The *central* function is to create and maintain a specific desired condition, viz., whatever condition constitutes its "reference value." The reference value then is the goal or master program of the feedback loop. In the case of the driver, the goal is to follow the road. In the case of the thermostat, its master program is its temperature setting. The feedback system's purpose is to maintain or actualize the goal set for it; it cannot do otherwise. Disturbances do not affect this goal; they are merely the conditions to which the system adjusts (e.g., a rise in room temperature in the case of the thermostat). The reference value, therefore, is clearly the controller of this "basic unit of control."

To their credit, Carver and Scheier (1982) attempt to answer the "tricky question . . . of where [the reference value] comes from" (p. 113). This is

obviously important to any theorist attempting to explain how systems control themselves, because the control apparently resides in how the reference value is selected. (Note that this is perfectly analogous to the issue raised above regarding the selection of the master program.) Carver and Scheier first point out that many feedback systems function within heirarchically organized sets of feedback loops (see also Powers, 1973). At each level of the hierarchy, the results of the behavior are monitored and compared with the reference values provided from the level above. In other words, each superordinate level acts by specifying reference values for the next subordinate level. In the car steering example, the driver has the goal of returning class notes to a person across town. This goal leads to a particular route he must follow, which leads in turn to following the route in the manner described above.

The importance of hierarchically arranged feedback loops is difficult to deny, but it merely puts off the answer to the original question: Where does the ultimate reference value that controls this complex process originate? How was the goal to return the notes (or whatever is the ultimate goal) selected? At this point, Carver and Scheier state that these questions take "us from a general discussion of control theory . . . to a more specific discussion of how such ideas may be applied to the domain of personality and social psychology" (p. 117). They subsequently suggest that these ultimate reference values are "based partly on the situation's observable elements and partly on the person's previously organized knowledge . . . [which itself is] . . . a function of prior associations between behavior and categories of settings" (pp. 117-118).

What can be concluded from our summary of this elaborate theory of control? First, it is a mystery to the present author how accounting for the reference value that controls the hierarchy of feedback loops is somehow outside of the domain of control theory. This type of cybernetic theorizing seems to point quite clearly to control being external to the cybernetic process. Carver and Scheier admit at the outset that the reference value is outside the feedback loop, as described above. This is tantamount to saying that cybernetic mechanisms cannot, in principle, account for the factors that control self-regulating systems. Second, those factors that Carver and Scheier feel determine the reference value are ultimately environmental inputs of one sort or another. These theorists may have had in mind some unexplained self-generated factor that controls which behaviors and settings are associated, but this would seem unlikely given that their theory was intended to explain such controls in the first place. It is far more likely that this "control theory" is another case of cognitive psychology's ultimate and consistent reliance on environmental input as the controller of cognitive processes.

In sum, then, none of these approaches to control and monitoring has actually described the means by which the mind has some original impact on its own functioning. These approaches could be construed as describing the hard-wired mental structures that influence the processing of information. Such structures are, in a sense, original in their impact. However, they do not

account for cognitive or behavioral *change*. That is, the variance of attitudes, learning, and behavioral patterns of any type would ultimately be the result of environmental change, because hard-wired structures do not change (except possibly through maturational factors) and certainly no voluntary control by the cognizer is possible.

Perhaps, of course, the environment *is* responsible for all cognitive operations, i.e., there are no metacognitive functions. However, empirical evidence (described above) does support the existence of such phenomena, and metacognitive factors do appear to be separate from information acquisition activities. In other words, the evidence suggests the existence of mental functions that are not determined by environmental inputs (see also Rychlak, 1977, 1981; Slife, Miura, Thompson, Shapiro, and Gallagher, 1984). Of course, it is rare when evidence convinces all theorists on such fundamental matters. However, an important question would remain, regardless of whether or not this evidence were convincing: Is it possible to *conceive* of uniquely mental or metacognitive influences on behavior?

Demonstrative and Dialectical Reasoning

The present author answers this question in the affirmative, and a conception that offers promise in this regard will be outlined below. In order to do this, however, problems with current cognitive and metacognitive theorizing require conceptualization. Common to all of these problems is the type of human reasoning assumed by theorists, and thus the type of processing and encoding permitted to occur. Virtually all mainstream models of human cognition rely on what is sometimes termed *demonstrative reasoning* (Rychlak, 1977; Tageson, 1982; Williams and Lilly, 1985). This form of reasoning is typically labeled "logical" because Aristotle's "law of contradiction" is enforced: X cannot be "A" and "not-A" in the same space and time; and similarly, "bachelors" cannot be "married males" in the usual sense of these terms. In other words, one must be consistent with one's premises (logical). If Socrates is a man and all men are mortal, then Socrates *has* to be mortal, in a very deterministic sense. The computer is the epitome of this type of reasoning because it cannot "reason" outside of or contrary to its "premises" or master program. It can simulate contrariness or error, but it can only do so by being consistent with its higher-order programming.

Demonstrative reasoning, then, "begins" only *after* premises or programs have been selected. There is always something logically (if not chronologically) precedent to this reasoning, i.e., the more basic premise or the higher-order program. It follows, therefore, that such reasoning cannot explain the selection of these programs or premises. Logic can never tell us which premise to reason from; logic tells us how to reason once a premise has been selected. The mind from this perspective must be rigidly consistent with its logical precedents,

whether they be the biological imperatives of the sociobiologists, the stimuli of the behaviorist, or the executive systems of the cognitive psychologist. Demonstrative reasoning can only describe how persons think and reason once mental premises or, as Carver and Scheier (1982) termed them, "functionally superordinate reference values" (p. 117), are in position. It cannot help us to understand how humans select and arrive at these values themselves. Consequently, reliance on demonstrative assumptions in cognitive psychology will never permit us to conceptualize uniquely cognitive or metacognitive influences that contribute to behavior. To accomplish this, *dialectical reasoning* must be added to the account.

Dialectical reasoning is the mind's ability to reason oppositionally, or, in our case, alternatively. This is the reasoning that occurs "before" demonstrative logic, when alternative premises are being considered. Philosophers from Plato (1888) to Kant (1952) to Adler (1927) have relied upon this form of reasoning to generate alternatives, sometimes in direct opposition to the particular meanings under consideration.[1] When applied to human consciousness (cf Kant, 1952; Rychlak, 1977), the dialectic is the recognition that meanings are often bipolar. That is, some meanings are apprehended as having "poles" of implications that are the opposite from the unipolar implications which are "logically" consistent.

For a dialectical reasoner, what is mentally encoded is not only what the information is, but also what the information is not. To process the meaning of "beauty," for example, one must be able to understand the boundaries of this meaning and thus gain a rudimentary understanding of "ugliness." In this sense, "A" and "not A" coexist in time and space, and indeed define or outline one another. The stereotypic "preacher's kid" not only understands how he or she is "supposed" to behave, but also how he or she is not supposed to behave. Mechanisms follow instructions as they are given, but dialectical reasoners must decide whether to follow the instructions as they are given or as they are alternatively implied by the information.

Metacognition, Dialectical Reasoning, and Teleology

The construct of metacognition is similar in many ways to dialectical reasoning. Metacognitive abilities imply that there are mental activities that go beyond the usual flow of information. The mind not only processes information cognitively, it "sees" the information from the vantage point of a metacognitive observer "outside" the flow. To be an "observer outside the flow" is to know the boundaries of the information and thereby understand what the information is and is not. Metacognition could be construed, then, as conceptualizing information by virtue of its dialectical contrast.

[1] This is separate from the Hegelian tradition which dominated dialectical theory in the late eighteenth and early nineteenth centuries. Hegel referred to the dialectic as a dynamic unfolding of successive clashes between historical movements that ultimately coalesced into a "synthesis" (Rychlak, 1977).

Similarly, metacognitive functions permit humans to abstract from events and know that they are knowing. Metacognition is an acknowledgement of the mind's ability to reflect on itself, and even reflect on its reflecting (self-consciousness). As demonstrated above, cybernetic mechanisms cannot, in principle, monitor the mechanisms doing the monitoring. The dialectical process of knowing-about-knowing, on the other hand, occurs not through higher order monitoring, but contrasting implications. Knowing implies that we could be knowing otherwise. Indeed, it is not until a dialectic contrast is apparent that consciousness is born (or conceptualized). Having this contrast, i.e., knowing that one could be knowing otherwise, allows the mind to conceptualize (or reflect upon) knowing or metaknowing capacities at any "level" of mentation. It also allows the mind to have some understanding of alternatives to our knowledge (or metaknowledge).

The dialectic then provides another missing element in conceptions of metacognitive functions: a means of generating alternatives that is not determined by environmental input. It is true, of course, that these alternatives are in some sense *derived* from experiences with the environment. However, these derivations are mentally "reasoned to" and not "input" per se. They are also not pre-programmed (by definition). Persons can reason to any number of conceivable (by them) "opposites." Thus, the dialectical opposite of "down" may be "up," "happy," or "high." As such, these derivations are uniquely mental in origin and not *determined* by particular associations from the environment.

The fact that options are available also permits the mind to act on particular choices of its own selection. That is, not only are the options originated metacognitively, but the choice among options can also be a uniquely mental phenomenon. In this sense, reference values can be selected from among dialectically generated meanings. Goals can be determined by choosing from among naturally available alternatives. These goals and values are not imposed from "outside" as in cybernetics, but are inherent in the reasoning process.

Bipolar meanings are not, however, sufficient to account for this metacognitive process of choosing from among alternatives and thus controlling cognitive activities. The dialectic certainly makes this process possible through its natural logic of alternative meanings, but the dialectic does not provide for a means of acting on a particular alternative. A purely dialectical mind would be constantly reasoning from pole to pole, alternative to alternative, in a never-ending derivation and speculation. None of the speculations or derivations would be acted upon, only further derived and speculated upon.

Dialectical reasoning has been accompanied historically (see Rychlak, 1977) by another assumption of human nature that seems necessary to allow particular meanings to be acted upon. That assumption is sometimes labeled teleology because "telos" implies an "end." Teleology is the assumption that humans can act "for the sake of" particular ends or goals. An array of goals or values may be available, but a person can also affirm and consistently act for the sake of one such value, at least until another value or goal is itself affirmed. The role of

demonstrative logic is essential here, of course. Once a goal is selected and as long as that goal is maintained, a telic approach would hold that behavior and cognitions must be (demonstratively) consistent with that goal. Dialectical meanings would be abandoned at this point and demonstrative reasoning adopted to logically and consistently extend the chosen goal to behavior and cognition. The person would remain aware of dialectical alternatives but could continually choose the particular goal they are currently acting upon.

Rapprochement?

The theorizing of many cognitive and metacognitive scientists might seem compatible at this point. With a reference value "specified" (through dialectically generated alternatives and a telic affirmation of a particular goal), Carver and Scheier's (1982) hierarchically organized feedback loops might be a means of extending this value to behavioral levels. With conditional "programming statements" determined, Simon's (1979) production system could be a method for carrying out particular goals. Similarly, the origination and operation of the "control processes" of information processing models of memory would be explained. The processes underlying the rehearsal of a certain item in short-term memory or the retrieval of a particular experience in long-term memory would be better understood.

Unfortunately, problems with this compatibility begin to be noticed when this apparent rapprochement between dialectical/telic (hereafter telic) theorizing and traditional cognitive theorizing is examined more closely. Dreyfus (1979) addresses one of these problems in this manner: "Once the *a priori* thesis that all behavior must follow [demonstrative] instructions is thus weakened, we might as well claim that skilled behavior need not be based on unconsciously followed instructions at *any* level . . ." (p. 287). In other words, most cognitive conceptions depict behaviors and cognitions as being relatively automatic. Once the ultimate reference value or programming has been selected, the hierarchy or production system performs its desired task inexorably and without interruption (cf., Carver and Scheier, 1981, 1982; Kimble and Perlmutter, 1970). In telic theorizing, however, no pattern is automatic *in the same sense.* Goals must be continually affirmed on almost a moment by moment basis to be actualized, because dialectical alternatives are apparent to the cognizer at all times. For this reason, many long-term goals are temporarily suspended or never realized. Hence, the driver returning the notes, in the example above, may stop off for a soda before resuming action on his goal, or decide that the day is too nice to be driving across town. The driver in all cases is demonstratively consistent with his goals, but the goals themselves are dynamic.

This is not to say that so-called habits or patterns of behaviors have to occur with full awareness. Indeed, most goals require very sophisticated patterns of behavior that full awareness might actually impede (e.g., walking, driving a car).

Clearly, elements of behavioral patterns can be related together as a whole and acted upon. However, what are related together are not environmental inputs or sets of program statements or feedback loops, but *patterns of goals* that must be continually affirmed.

Despite these possible incompatibilities, a rapprochement is worth considering. Cognitive theories have been an important heuristic, and there are many seemingly automatic aspects to human mentation. Perhaps the relation between metacognition and cognition is analogous to the relation between the programmer and the computer. The notion of metacognition and its separation from cognition is what makes this rapprochement potentially possible, because it allows both conceptions to occupy different domains of mental functioning.

Conclusion

The present paper began by asking whether the so-called "cognitive movement" has succeeded in its original goal of framing a mental apparatus that made its own contribution to behavior. If the theories and models reviewed here are any indication of the general literature, it seems clear that the cognitive movement has so far failed. What currently passes for "cognitive" and "metacognitive" factors are mental structures that have little to do with behavioral or mental change, but function essentially as preservers of past environmental inputs. Cognitive psychology has merely succeeded in elongating the causal chain of traditional behaviorism. One of the original founding assumptions of this school was that change began with the environment. As demonstrated here, cognitive approaches have not altered this assumption. They have only routed this change through the mental apparatus and perhaps altered it depending on a person's "hard-wired" neurological structure and experience with previous environmental changes. The potential for a rapprochement between theories that do and do not permit self-generated influences remains a possibility. However, in view of the current state of cognitive theorizing, the clear answer to the query that titles this paper, "Can Cognitive Psychology Account for Metacognitive Functions of Mind," is "no."

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