Minds, Machines, Models, and Metaphors:
A Commentary

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When I was asked to write a comment on this group of papers, I mentioned it to a colleague, and described the papers. He replied, "It sounds interesting, but the trick is not to be too constrained by the papers." In his advice he offered me a guide, a heuristic; but it was a negative one. He did not suggest anything that I could do, should do, or must do; only what I should not do. It was up to me to accept or reject the warning, and if I accepted it, it was up to me to decide what would be an appropriate alternative to being "too constrained by the papers." In turn, I found his advice "interesting," I did accept it, and I spent some time casting about for an alternative which would contrast with being "too constrained by the papers." I entertained several, rejected several, ultimately selected one, and proceeded to act for the sake of that goal. Subsequently, as the project developed, I changed the goal for the sake of which I was acting, not once, but twice.

The point to be made immediately, reflecting a theme present in each of the papers in this series, is that contemporary cognitive psychology has almost nothing to say about the central cognitive processes in the above interchange with my colleague and its consequences in my behavior. Contemporary cognitive psychology has almost nothing to say about my colleague's "interest" in my invitation nor about my "interest" in his advice. It has nothing whatever to say about my accepting or rejecting the heuristic he provided, nor about my generating, selecting, rejecting, and changing goals as the project developed.

The brief episode described above is a perfectly common occurrence in human cognition, so how can it be that contemporary cognitive psychology has so little to say about it? We are more than twenty years into the cognitive revolution, aren't we? The answer to this question is another theme that runs through the papers: there has not been a cognitive revolution; human cognition has not yet been taken seriously as a human function which arises on the base of human powers for agency and for dialectical thinking. And at about this point, I no longer comment on the papers; I begin to respond to them.

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I now see my opportunity and my goal as writing a series of brief essays, stimulated by, but not constrained by, the papers in this series. I see that in pursuing this goal I can benefit immeasurably from the scholarship of the contributors, and I can add perspectives of my own. I begin with some historical/ideological observations.

On Hardware, Models, and Promises

Many of us can easily remember when there was almost no cognitive psychology at all. The most that we could do was to muster an occasional mention of "place learning" or "cognitive maps." We were pretty sure that these would, in due course, receive their proper explanation through some kind of application of association and reinforcement principles. We can also remember when the statistics lab sounded much like a boiler factory as we sat over our Monroes and Marchants, whirring, clicking, and thumping our way through interminable correlation coefficients and analyses of variance. Some of us can even remember how to extract square roots by successive subtraction of odd numbers — absolute magic!

But we were truly delighted and amazed at the first generation of card sorters that could do so quickly and accurately what we did, ourselves, so slowly and inaccurately. Tallies, totals, sorts, re-sorts — and results! And this was only a pale shadow of what was to come, as sensors and wheels and counters gave way to tubes, transistors, and microchips.

The advent of the computer was just in time to save the statisticians and the record keepers of business and industry from drowning in their own numbers, but there were more subtle implications of this salvation. As Weizenbaum (1976) puts it, "Yes, the computer did arrive 'just in time.' But in time for what? In time to save — and save very nearly intact, indeed, entrench and stabilize — social and political structures that otherwise might have been either radically renovated or allowed to totter under the demands that were sure to be made on them. The computer, then, was used to conserve America's social and political institutions" (p. 31). Weizenbaum cites social and political institutions, but with the academy, and the discipline of psychology, deeply embedded in these structures, the potential for stabilizing and entrenching the existing ideology of the discipline was there as well. Weizenbaum recognizes that there was great potential for change because the incorporation of the new technologies required a detailed examination of institutional structures to determine how computers could fit in and be utilized.

But the changes wrought by the advent of the computer were at a technical level, not an ideological level. Weizenbaum puts it strongly: ". . . of the many paths to social innovation opened to man, the most fateful was to make it possible for him to eschew all deliberate thought of substantive change . . . [I]f the triumph of a revolution is to be measured in terms of the profundity of the social revisions it entrained, there has been no computer revolution" (1976, pp.

31-32). The effect, then, was "business as usual," but at a dramatically higher level of technology: greater speed, greater detail, greater efficiency — all ideological desirables.

What of the impact upon psychology, then? Certainly the statistical analysis end of the discipline went on much as usual, and enjoyed remarkable reductions in time and noise. Indeed, that aspect of the enterprise positively flourished, as it became possible to do more and more elaborate manipulations of numbers faster and faster. The importance of this increase in efficiency certainly stabilized and entrenched the statistical way of doing psychology; more and more elaborate experimental designs appeared to generate the numbers which could be handled by these remarkable machines. The search for more and more subtle and elusive universals and regularities moved forward at a fever pitch.

But another, more important, change also resulted. Just when the behavioristic premises which had guided the mainstream of North American psychology for many decades were beginning to be seen as an ' "imposter paradigm" (Haugeland, 1978, p. 225), the computer provided an alternative to the rat, the pigeon, the dog, as the laboratory subject of choice on which to model the human being. Just when the overt manipulation of levers and the travelling through mazes seemed to have run their course as suitable models for human behavior, it became possible to set machines to manipulating symbols and numbers, and to making comparisons and decisions. The natural science warrant for psychology was shored up by reference to communications theory and communications engineering, and the notion of "information" in a technical sense was embraced.

The view of the human brain as a computer merely replaced the generations of other, more primitive, switching models — from a cognitive perspective, the human being came to be seen as an information processing system. We had the hardware, we had the natural science warrant, but psychologists forgot that the notion of "information" as developed by Shannon (cf. Shannon and Weaver, 1949) was absolutely meaningless. Information is merely a measure of channel capacity, admittedly important to communications theory; but "information" bears no significance other than its occupancy of this channel capacity. Nor is there any meaning added by the processing system.

Whether the discrepancies in this metaphor were unnoticed or simply ignored, the optimism stimulated by the adoption of this high-tech model can hardly be overestimated. As early as 1960, Simon predicted "Duplicating the problem-solving and information-handling capabilities of the brain is not far off; it would be surprising if it were not accomplished within the next decade" (cited by Weizenbaum, 1976, footnote, p. 245). And Dreyfus (1979) cites a catalog of promises and predictions for the power of the computer to actually perform important meaningful human cognitive activites. The promises simply have not been fulfilled.

This array of unfulfilled promises is reminiscent of the earlier history of promises made by optimistic spokespersons for psychology in the first half of the century. Behaviorism was to create almost any form of human behavior or

social life we wanted; psychology was to provide the helmsperson for the good society; the advancing experimental techniques were to finally reveal the true nature of the human being. But Danziger (1977) has made it very clear that psychology has characteristically had much more impact on what we *think about humankind* than on what we *know about humankind.* And so it is with the adoption of the computer model. Whereas a generation ago, people were "conditioned" to behave in certain ways, today they are "programmed" to behave in certain ways, and the ideology is stabilized while the terminology changes. It seems more attractive to be modelled after a programmable computer than after a conditionable rat.

Haugeland (1978), discussing cognitive psychology from a philosophical perspective, allows for the genuine important discoveries of computer-modelled cognitive psychology, but he laments the narrowness and limited nature of these, compared to the aspirations and the promises. He is not optimistic. He says:

> Cognitivism is a natural development from Behaviorism. It retains the same commitment to publicly observable and verifiable data, the same rejection of posits and postulates that cannot be treated experimentally, and the same ideal of psychology as a natural science .... But cognitive psychology too can be accused of having an imposter paradigm. (Haugeland, 1978, p. 225)

Optimistic aspirations can continue in spite of the poor results of computer simulation of cognition because there are always new developments in the hardware and the software of the model. It is evident that every day we find computers performing more and more remarkable feats. The replacement for the pigeon and the rat is evolving before our very eyes. But the limitations of the model are not in the details of the evolving hardware and software; they are in the very essence of the model.

On Resistance To Change

With the power of the information-processing model to generate data, and the technological reality and continuous evolution of the information processing machine to back it up, why would any right-minded psychologist with a natural science reductionistic perspective on human functioning want to adopt the kinds of assumptions that Rychlak believes necessary? Rychlak (this issue) says, "Dialectical human cognition allows us to view the human being as an agent of his or her behavior because there *is no* unidirectionality in this mode of thought. Choice, option, the arbitrary whim — any such cognition is possible if we but shift our premises concerning the nature of human cognition." Why would someone aspiring to predict and control behavior and to reduce the determinants of behavior to the simplest elements want to open this can of worms?

Shifting our premises concerning the nature of human cognition means shifting our premises concerning the nature of the human being. That is a

considerable ideological burden to shift. With respect to agency, which underlies the very power to generate dialectical alternatives for thinking, psychology has spent most of the past hundred years either avoiding it or trying to reason it away (Westcott, 1985). Kimble and Perlmuter (1970) have made it perfectly clear: "The obvious goal of what we have called the classical theory of volition, as it has developed over the years, has been to replace the concept of will with a mechanism that could be subjected to experimental tests and conceivably reduced to neurophysiological status" (p. 368).

But volition, agency, and will do not go away. It is almost impossible to talk about meaningful human action without some clear or veiled reference to such concepts. Even the fundamental cognitive notions of *directing* attention or *selecting* information imply agency. But the implication is generally denied as being only metaphorical. For psychologists to admit the genuine assumptions of agency and dialectical capacity is to change the entire view of the human being which has been espoused for a hundred years. In effect, it is to abandon the natural science perspective altogether when dealing with complex and meaningful human behavior. Now that would be a revolution! Not only a new flag, but a new constitution as well. As long as cognitive psychology remains wedded to the high technology computer model, there is no cognitive revolution.

There are pockets of change, however, primarily in critiques of the computer model and in theoretical developments—witness the present papers and the considerable literatures referred to in them. What happens when someone really leaps into the breach, assumes agency as a controlling variable in behavior, and asks subjects to mobilize their volitional capacities to carry out a task? Howard and Conway (1986) have done exactly this, and have found that when people act as volitional agents, they generally achieve that for the sake of which they are acting, whether the aim is *to do* or is *to forbear from doing*. With volition entered as a variable in standard statistical analyses of the results of their studies, Howard and Conway find that volition accounts (in the statistical sense) for vastly more of the variance than does any other contributing variable, and explains (in the theoretical sense) more of the meaningful, purposeful human action it is meant to explain. In spite of resistance to change, the kind of shift Rycklak proposes *can* be made, and appears to be enormously productive.

On Deficiencies

Slife (this issue) has made it perfectly clear that metacognitive functions entail processes of the kinds noted above. Such functions are crucial to any intelligible account of human cognition, but they are explained by reduction to computer metaphors which totally lack these capabilities. In effect, instead of a single homunculus conducting the business of mind, we now have an army of homunculi, with neat divisions of labor. They go under the names of executive or control or monitor functions, but, as Slife develops, each must have its own

back-up of executive or control or monitor functions, and the second rank must
have a third, and so on. Alternatively, the first rank must be accorded the
powers of a human being: precisely what the entire exercise is designed to
avoid.

The capacity for agency and for generating dialectical alternatives is simply
not there in the model, and the information processing system, whether mechan-
ical or human, is left with a capacity for rule-following demonstrative reasoning.
Admittedly, humans do engage in this sort of cognitive activity, but it is only a
small part of their functioning. People almost always operate cognitively on
incomplete evidence and inexplicit guidelines, but when all the relevant parame-
ters are set and the rules are made explicit, computers typically do perform
more quickly and accurately than humans. But to commit to the proposition
that this fragment of human cognition is a suitable model for all of human
cognition is comparable to commiting to the notion that all human learning can
be modelled intelligibly on the conditioned reflex.

On Mixed Metaphors and Coherence

Dreyfus (1979) has pointed tellingly to the mixed and interpenetrated metaphors
employed in the basic works of cognitive psychology. This leads him to characterize
the language in both Miller, Galanter, and Pribram (1960) and in Neisser (1967)
as "incoherent" (p. 179). In these fundamental works Dreyfus does not mean
that the sentences are unreadable. Rather, he means that the terms used imply
the attribution of human characteristics to machines and machine characteristics
to humans, each explaining the other. Biological, mechanical, and human
concepts are mixed without examination or restraint. This is still a serious
problem, indeed, a more serious problem because the current representations
are not "early explorations" of the field, but represent more or less received
wisdom. That is, the incoherence has become institutionalized.

The above can be illustrated by the following passage from the second
edition of a recent text in cognitive psychology (Reynolds and Flagg, 1983). In a
discussion of Neisser's theory of analysis by synthesis, the authors state, "Based
on the results of the initial preattentive analyses a particular signal is selected for
analysis-by-synthesis. The information from the selected signal is combined
into a comprehensive pattern used to determine possible new signals that
would be of relevance. This derived information is then used to warn the
preattentive mechanisms about what signals to expect . . ." (p. 27). Here we have
a monstrous mixing of metaphors, where the human being has machine
characteristics, the "preattentive mechanisms" come to "expect" more signals,
information (presumably in the technical sense) suddenly attains enough meaning
to be "combined into a comprehensive pattern," and so on. The interpenetration
of the peculiarly human with the peculiarly inhuman renders the received
wisdom incoherent.

These are shifty metaphysical sands on which to mount a disciplinary edifice. A great deal of the problem is that cognitive psychology aspires to deal with genuinely human phenomena in a model which is just not equal to the task, for all of its power in handling information in the technical sense. Information, in the technical sense, is *meaningless,* and information in the human sense is *meaningful.* The shift from one to the other makes human cognition as an information processing system based on a computer model a total enigma. This is a central concern that Williams expresses in his paper (this issue). If the computer/information processing model is to be taken seriously, meaning can never be part of human cognition. But almost anything interesting about human cognition inherently involves meaning. Of course, this is a dilemma, resolvable only by commitment: commitment to the mechanistic notion that the world is absurd, human action devoid of purpose, as Williams points out, citing the Dennett arguments, or by commitment to the position that human agency and the dialectical consideration of possibilities is a true human power. As cognitive psychology now stands, officially, the former position is embraced. In this sense it is no different, ideologically, from behaviorism.

On Empirical Possibilities

Most respectable psychological evidence concerning human cognitive functioning has come from limited, contrived, and carefully monitored experimental studies. The restrictive nature of the experiment for elucidating human behavior in its complexity has been explored by many writers over the past twenty years (see especially Gergen, 1982), and a variety of alternatives already exist (see Reason and Rowan, 1981). One of the features that runs through all the alternatives to experimentalism is the recognition that complex human behavior is mediated linguistically, and language is a social product, always in transition and always the result of negotiation. Negotiation is, necessarily, a dialectical process in which alternatives and contradictions are played off against each other until a resolution is reached, at least temporarily. What we accept as truth, what we accept as reality, what we accept as knowing, are all products of negotiation, and coming to any agreement about the nature of the world involves dialectical proceses.

While Rychlak (this issue) rightly points out that we have, for the most part, forgotten this truth which the Greeks knew, the perspective is fundamental to George Kelly's psychology of personal constructs (Kelly, 1955). Kelly's methods of investigation are founded on the capacity of humans to generate alternatives and contrasts and to frame their idiosyncratic worlds with these structures. While much of the research in this tradition has been fairly static description at a point in time, Kelly was especially concerned with the ways in which the dialectical alternatives and contrasts change as people successively construe

and reconstrue their worlds and their relationships. The dialectical perspective was underground for a long while, but it is surely emerging again.

Investigation which is sufficiently open-ended to allow for a great variety of self-generated responses is not easy to do, and there is no pre-established methodology for gathering data or for analyzing them. But self-generated data may yield a richness and representativeness which can be wholly lacking in research designs which severely limit the extent to which a subject shapes the data.

In my own research on the experience of human freedom (Westcott, 1981, 1982), I asked respondents to indicate how free they feel in each of a series of common situations. The respondents indicated a degree of feeling free on a five point scale from "not at all" to "very much." This was a limited kind of response, but respondents were also asked to indicate if, and to what extent, they felt opposite to free in the same situations. They were also asked to characterize by word or phrase this "opposite" feeling. I received over 200 different words or phrases describing feelings opposite to free — dialectical alternatives — and the manner of analyzing them was wholly different from the manner of analyzing the quantitative data deriving from the scale. These dialectical, self-generated alternatives could be analyzed, however, and our analysis demonstrated that the kind of construction placed on the experience of freedom varied with the kind of situation in which freedom was experienced.

And so it is with the construction of the impressions of people. The dialectical model explored by Lamiell and Durbeck (this issue) provides a far richer view of the cognitive activity of persons in common human social situations than is provided by a linear model limited to the use of past inputs. Their data indicate that a dialectical process is not only *more representative* of what people typically do, it *is* what they do. As Kelly pointed out, the dialectic may not always be explicit, that is, the contrast employed may have to be elicited by discreet probes, but the fundamental nature of human understanding is dialectical. The research reported by Lamiell and Durbeck certainly gives strong impetus to empirical work from a perspective which has been more talked about than practiced.

On Reflection

I have been enormously provoked by these papers. They have fully and carefully described the logical, ideological, and empirical difficulties of contemporary cognitive psychology. They have proposed remedies which range from major shifts in the guiding conception of what a human being is, to the development of investigative methodologies which respect the human contribution to human cognition. These papers properly take their place as important contributions to that growing literature which may be seen as the working papers of the real revolution — the revolution in psychology which will encompass

not only the study of cognition, but all other areas of meaningful human action, as well.

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