Behavior and Philosophy, *32*, 179-195 (2004).

FROM DARWIN TO WATSON (*AND* COGNITIVISM) AND BACK AGAIN: THE PRINCIPLE OF ANIMAL–ENVIRONMENT MUTUALITY

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ABSTRACT: Modern cognitive psychology presents itself as the revolutionary alternative to behaviorism, yet there are blatant continuities between modern cognitivism and the mechanistic kind of behaviorism that cognitivists have in mind, such as their commitment to methodological behaviorism, the stimulus–response schema, and the hypothetico-deductive method. Both mechanistic behaviorism and cognitive behaviorism remain trapped within the dualisms created by the traditional ontology of physical science—dualisms that, one way or another, exclude *us* from the "physical world." Darwinian theory, however, put us back into nature. The Darwinian emphasis upon the mutuality of animal and environment was further developed by, among others, James, Dewey, and Mead. Although their functionalist approach to psychology was overtaken by Watson's behaviorism, the principle of animal–environment dualism continued to figure (though somewhat inconsistently) within the work of Skinner and Gibson. For the clearest insights into the mutuality of organism and environment we need to set the clock back quite a few years and return to the work of Darwin and the early functionalist psychologists.
Key words: Darwin, ecological psychology, mutualism, behaviorism, cognitivism

> I distinguish between the movements of the waters and the shift of the bed itself; though there is not a sharp distinction of the one from the other. (Wittgenstein, 1969, §§97)

> Traditional theories have separated life from nature, mind from organic life, and thereby created mysteries. . .Those who talk most of the organism, physiologists and psychologists, are often just those who display least sense of the intimate, delicate and subtle interdependence of all organic structures and processes with one another. . . .To see the organism *in* nature. . .is the answer to the problems which haunt philosophy. And when thus seen they will be seen to be *in,* not as marbles are in a box but as events are in history, in a moving, growing never finished process. (Dewey, 1958, pp. 278, 295)

Behaviorism continues to figure centrally within the history and demonology of modern psychology. As Gustav Bergmann once said about John B. Watson,

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although psychologists no longer bother to refute behaviorism, they still invoke its name "to scare little children in the existentialist dark" (Bergmann, 1962, p. 674).

Placing behaviorism within the history of psychology, however, is far from easy. As Arthur Lovejoy (1936) warned us long ago, doctrines designated by names ending in "ism" usually turn out to be untidy coalitions of distinct and even conflicting doctrines, and this is true of behaviorism. Recent historical scholarship on behaviorism does not suggest the existence of a simple historical entity. Even the works of individual behaviorists seem riven with contradictions, and it does not help to appeal to the term "behavior" as the definitive subject matter of psychology, let alone behaviorism. The meaning of the term "behavior" has always been wide open: from the molar to the muscle-twitch, from the structural to the functional, from the purposive to the mechanical.

I want to question the place given to behaviorism within the histories of the so-called cognitive revolution. Cognitivism is very much a continuation of the kind of mechanistic behaviorism it claims to have undermined. I shall argue that *that* kind of behaviorism supplanted an earlier, more radical psychology that, although having little use for the term "behavior," placed a central emphasis on the mutual coordination of animal and environment, and this emphasis was perpetuated, though inconsistently, in the work of Skinner and Gibson. I regard this early Darwinian-inspired psychology as the true revolution, and this article will therefore be an attempt to set the clock back in psychology some hundred years or so.

Behaviorism and the "Cognitive Revolution"

In 1968, in their summary of a conference on "verbal behavior and general behavior theory," Horton and Dixon concluded that "contemporary psychologists, whether they call themselves S-R theorists, associationists, or functionalists, overwhelmingly subscribe to the behavioristic paradigm. In other words, they adopt the technical language commonly associated with general S-R theory and, in essence, methodological behaviorism." They went on to take note of the theoretical tensions highlighted by several of the contributors to the conference had highlighted: "To us, it appears that a revolution is certainly in the making" (Horton & Dixon, 1968, pp. 578, 580).

From the outset, cognitivism has presented itself as the revolutionary antithesis of behaviorism. Certainly, several of the early pioneers did mean serious business, and a number of them have in recent years come to express regrets about just how tame the revolution has proved to be (e.g., Bruner, 1990; Garner, 1999; Martin, Nelson, & Tobach, 1995; Neisser, 1997).[1] As Garner recently complained,

[1] "For three decades now information processing psychologists have offered us a 'cognitive psychology' that reduces the phenomena of human mental life to differences in reaction time, or to different patterns of erroneous judgments. When this 'achievement' is compared to the desiderata of the early cognitive theorists. . .the discrepancy is enormous and unsettling. The call for a cognitive theory came from scientists who wanted to understand human thinking, planning, and deciding as they function in the real world, solving problems that arise as people try to make their way through

"cognitive psychology lost out to the received view, with its operational and reductionistic method. . .The old won out over the new!" (1999, p. 21). However, a good number of the early pioneers were clear from the outset that they saw themselves as extending rather than undermining the behaviorist framework.[2] There was also a good deal of "hype," with the supposed revolutionaries enthusiastically invoking Thomas Kuhn's muddled notion of scientific revolutions in their cause (Bruner, 1983, p. 85; see also Goodwin, 1999, p. 407): "Every one toted around their little copy of Kuhn" (James Jenkins, cited in Baars, 1986, p. 249).

Until the last ten years or so it was regarded as heresy to suggest that the "new" cognitive psychology was not as revolutionary as it claimed to be and hardly distinguishable from the kind of behaviorism it was supposed to have undermined, yet the continuities are obvious (Costall & Still, 1991; Knapp, 1986; Leahey, 1992). First of all, there is the commitment to stimulus–response theory. Thus, although cognitive psychologists continue to insist that their task is to explain what "goes on" between the stimulus and response, they fail to notice that they do not thereby reject stimulus–response psychology but remain trapped within its limitations. It is not as though the earlier behaviorists did not engage in theorizing about what mediates between stimuli and responses and even, as in the case of Hull, in cybernetic terms not far removed from those of modern cognitive psychological theory. Thus, as Reed has put it, cognitivism is "little more than the 'flip side' of behaviorism, trying to establish 'mental processes' as anything that is left over after one tries to stuff all psychological phenomena into the S-R box" (Reed, 1997, p. 267).[3]

Cognitive psychology has also remained committed to a very old-fashioned notion of scientific method. As Neisser has noted, "Ironically, the 'hypothetico-

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the world, dealing with each other and with all the various aspects of daily life. The input-output framework that has so dominated experimentation and theorizing about cognition has simply stymied almost all research that might have explored the intricacies of the phenomena of human thought and judgment in everyday life." (Reed, 1997, p. 266)

[2] All along, Herbert Simon has regarded himself as working within the framework of behaviorism: "Cognitive (information processing) psychology is the natural continuation of both behaviorism and Gestalt psychology. Alan Newell and I said that in the first paper we published on our own work in a psychological journal—in the *Psychological Review*, 1958. I still believe it." (Letter to Michael Landau, 8 November, 1993.) Recall Miller, Galanter, and Pribram's coy description of themselves as "subjective behaviorists": "Our emphasis was upon processes lying immediately behind action, but not with action itself. On the other hand, we did not consider ourselves introspective psychologists, at least not in the sense Wilhelm Wundt defined the term, yet we were willing to pay attention to what people told us about their ideas and their Plans. How does one characterize a position that seems to be such a mixture of elements usually considered incompatible? Deep in the middle of this dilemma it suddenly occurred to us that we were subjective behaviorists" (Miller, Galanter, & Pribram, 1960, p. 211).

[3] According to Donald Hebb in his presidential address to the American Psychological Society, the new cognitivism was tied essentially to the stimulus–response framework: "the whole meaning of the term 'cognitive' depends on [the stimulus–response idea], though cognitive psychologists seem unaware of the fact. The term is not a good one, but it does have meaning as a reference to features of behavior that do not fit the S-R formula; and no other meaning at all as far as one can discover." (1960, p. 737)

deductive method' that was so strongly advocated by Hullian behaviorists half a century ago has become the stock-in-trade of their cognitivist successors" (Neisser, 1997, p. 248). Like the earlier research in "learning theory," highly contrived experiments are set up to test the arcane predictions from the latest theory.

Most fundamentally, there has been the same commitment to methodological behaviorism. As Bernard Baars, in his book celebrating the cognitive revolution, had to acknowledge, "All modern psychologists restrict their *evidence* to observable behavior, attempt to specify stimuli and responses with the greatest possible precision, are skeptical of theories that resist empirical testing, and refuse to consider unsupported subjective reports as scientific evidence. *In these ways, we are all behaviorists*" (Baars, 1986, pp. viii-ix; emphasis added).

So how do the new and the old behaviorism differ? One of the most salient differences lies in the shift from associationist to rule-based, representationalist theory.[4] Indeed, in the light of the achievements of neoconnectionist modeling in the late 1980s, there was a good deal of talk about "counter-revolution" (e.g., Greeno, 1987).

Perhaps the most important difference concerns what cognitivist psychology claims to be *about*, namely cognitive structures and processes rather than what people *do:*

> To take behavior as the focus of attention for psychology is as big an error as to take tracks in cloud chambers as the main object of study in particle physics. Such tracks are interesting *only as clues* to the existence of certain particles and to their properties. (Macnamara, 1999, p. 241; emphasis added)

In this view, what people do is only of interest insofar as it is a manifestation of underlying cognitive processes, and hence provides us with evidence of those processes. It seems to me that this shift has justified not only the revival of the hypothetico-deductive method but also the retreat from the real world and the restriction of what people do in our experiments to simple, arbitrary movements such as pushing buttons. In many respects, however, much of the traditional research generated by "learning theory" was equally artificial.

In fact, there is a more fundamental difference that renders the cognitivist project deeply problematic. The textbooks present us with reassuring analogies between the nature of cognitive research and interpreting cloud-chamber tracks or diffraction patterns, or inferring the structure of computer programs from their input and output. However, the general line within cognitivist psychology has been that we need to postulate an explanatory of the "cognitive" precisely because there is *no* systematic relation between what people do and what lies behind it. Behavior

[4] As Edwards has noted, both associationism and information processing psychology are equally at home with stimulus–response theory: "In some respects, cognitive psychology is not as distant from stimulus–response (S-R) behaviorism as its proponents made out. While it replaces non-mentalism with mentalism, it retains the mechanistic notion of mind as an input-output conversion device, where the path between input and output is traced as information flow rather than S-R connections" (Edwards, 1997, p. 28).

and cognition are logical disjunct. What people *do* can *mean anything*. If this is really true, then there is absolutely no basis for inference and no legitimate analogy with, for example, cloud chamber research! In short, the cognitive revolution has not just been tame but terminally bewildered. If we want a real revolution to counteract the kind of behaviorism both deplored and practiced by cognitive psychologists, then we need to look to what was happening within biology and psychology *before* behaviorism: the rise of Darwinian theory.

Behaviorism and the Darwinian Revolution

The Separation of Life From Nature

If the textbooks are to be believed, Descartes set up, almost single-handedly, a whole range of dualisms that continue to trouble the human sciences: the physical vs. mental, body vs. mind, animal vs. human, self vs. other, mechanical vs. rational, passive vs. active, natural vs. normative—to mention just a few. Certainly, Descartes had been impressed by the scope of the new scheme of physical science and its remarkable extension to the distant heavens, on the one hand, and to the intimacy of our own bodies on the other. (He had been particularly struck by William Harvey's account of the circulatory system.) As Descartes saw it, the new physics was nothing less than a comprehensive science of nature. Consequently, anything failing to figure within that science *must exist beyond the realm of the natural* (Wilson, 1980, pp. 41-42).

But, of course, Descartes was not acting alone. Galileo and Kepler, among many others, also seem to have engaged in a similar "ontological fix" to save the universal claims for the new physics (Burtt, 1967; Whitehead, 1926; Young, 1966; cf. Chapman, 1966): the new science explains *everything—and everything it fails to explain is not really real*.[5]

Within this scheme, psychology's own subject—the "*subject*"—became radically subjectivized as that which *eludes* science. As Alexandre Koyré put it:

> [Modern science] broke down the barriers that separated the heavens and the earth. . .[But] it did this by substituting for our world of quality and sense perception, the world in which we live, and love, and die, another world—the world of quantity, of reified geometry, a world in which, though there is a place for everything, there is no place for man. (1965, p. 24)

This is not just a matter of rather distant history. One can still find physicists who insist that their task is "to build a world which is foreign to consciousness and in which consciousness is obliterated" (G. Bergman, cited in Rosen, 2000, p. 82), but we need to think through the implications of this exclusion of *us*. First, it is not clear how there could ever be *any* kind of science because, after all, scientists are

[5] For example, Galileo's treatment of the "secondary qualities" (Burtt, 1967) and the strict bounds that Kepler put upon his mechanistic account of vision, based on the analogy of eye and camera (Straker, 1976).

people, and science is a human enterprise. If scientists, at least, do not belong to the natural order of things, how is science getting *done*?

The dualistic scheme of traditional science also "set up" psychology to be a rather strange kind of enterprise, the science of the "unscientific"—the science of that which *eludes* science. When physical science had promoted its methodology (of atomism, mechanism, and quantification) to an exclusive ontology, psychology (so conceived) was a pretty obvious mistake just waiting to happen—an essentially derivative science modeled on physics, yet having as its subject the very realm that physics rendered utterly obscure.

Discussions of the history and philosophy of science continue to remain fixated upon classical physics, and when psychologists themselves worry about the status of their own science, it is, again, classical physics they usually take as their standard. Yet physics itself has been subject to fundamental change over the last century (most notably, relativity theory and quantum theory), and in a way that has questioned the exclusion of *us*, if not as a possible object of scientific inquiry, at least—*qua* scientists—as the practitioners of science itself. In both of these fields observer and observed are no longer regarded as separate but as complementary.

However, well before these changes in physical theory there had already been a radical development within biology that changed the nature of science and found a more secure place for people within the natural order of things.

Bringing Things to Life

Charles Darwin's evolutionary theory broke nearly all the rules, yet it came to be accepted as part of natural science. It was nonmathematical, predominantly nonmechanistic (Costall, 1991), and it invoked history and contingency (Gould, 1989; Landau, 1991). It also reconciled what had previously been regarded as two diametrically opposed ideas: *adaptation* and *evolution*.

By the early nineteenth century evolutionary theory had come to be associated with atheism, materialism, and, indeed, political terror. To counter evolutionism, natural historians (typically clergymen who had time on their hands) presented "evidences of the existence and attributes of the Deity collected from the appearances of nature," to quote the subtitle of William Paley's *Natural Theology* (1819). Many of their texts sought to name and shame the materialists and their connection with political revolution.

The natural theologians deployed two distinct arguments, both based on the evidence of *design* in nature. First, they pointed to the exquisite *adaptations* of plants and animals to their circumstances (and, conversely, of the circumstances to the organism)[6] as compelling evidence of divine design. The very fact of adaptation, they insisted, ruled out the possibility of evolutionary change because surely any transformation of a species and/or the world could only lead to a

[6] This conception of adaptation as reciprocal is explicit in Patrick Matthew's early selectionist account of adaptation, in which he notes "most wonderful variation of circumstance parallel to the nature of every species, as if circumstance and species had grown up together" (Matthew, 1831/1973, p. 39).

disruption of their coordination, hence "degeneration" rather than improvement (Whewell, 1846, p. 104; see also Richards, 1987, pp. 63-64, on Georges Cuvier).

The second argument from design (primarily associated with idealist biology) concerned homology or *unity of type*, such as the similarity of skeletal plan across different species, even when their body parts were adapted to quite different purposes (Bowler, 1977).

Darwin's remarkable achievement was to reconcile the concepts of transformation and these two different senses of design. He explained adaptation in terms of transformation (and, conversely, transformation in terms of adaptation[7]) and, for good measure, he managed to explain unity of type in terms of commonality of descent. Yet this was not just a question of the one-sided assimilation of design into the preexisting schema of mechanistic science. When Darwin introduced the concept of adaptation into the discourse of natural science, he also undermined the dualism of subject and object at the heart of both Cartesian mechanistic science and Cartesian mentalistic psychology.

So much has happened since Darwin (not least the hijacking of Darwinism by traditional mechanistic science) that it easy to forget the profound impact his work initially had upon psychology precisely because Darwin had *not* been trained as a psychologist. As his protégé, George Romanes, suggested:

> Mr. Darwin was not only not himself a psychologist, but had little aptitude for, and perhaps less sympathy with, the technique of psychological method. The whole constitution of his mind was opposed to the subtlety of the distinctions and the mysticism of the conceptions which this technique so frequently involves; and therefore *he was accustomed to regard the problems of mind in the same broad and general light that he regarded all the other problems of nature.* (Romanes, 1882, pp. 65-66; emphasis added)

In addition to Darwin's treatment of mind as inherent to the natural order of things (Allen, 1983; Richards, 1987; Schweber, 1985; Smith, 1978), there was his specific emphasis upon the fact of adaptation—the *co*-ordination—of organism and environment. Here is John Dewey discussing the impact of biological thinking on the "new psychology" as early as 1884, just two years after Darwin's death:

> We see that man is somewhat more than a neatly dovetailed psychical machine who may be taken as an isolated individual, laid on the dissecting table of analysis and duly anatomized. . . .To biology is due the conception of organism. In psychology this conception has led to the recognition of mental life as an organic unitary process developing according to the laws of all life, and not a theatre for the exhibition of independent faculties, or a *rendezvous* in which isolated sensations and ideas may gather, hold external converse, and then forever part. Along with this recognition of the solidarity of mental life has come that of the relation in which it stands to other lives organized in society.

[7] This latter aspect of Darwin's theory was taken up shortly after Darwin's death by James Mark Baldwin and Conwy Lloyd Morgan (see Costall, 1993). For an excellent biography of Darwin that places him squarely in social and political context, see Desmond & Moore (1991).

> *The idea of environment is a necessity to the idea of organism, and with the conception of environment comes the impossibility of considering psychical life as an individual, isolated thing developing in a vacuum*. (Dewey, 1884, pp. 278, 285; emphasis added)

A very similar stress upon the need to take the animal–environment relation as the focus of study also occurs in the work of William James and George Herbert Mead:

> Since organism and environment determine one another and are mutually dependent for their existence, it follows that the life-process, to be adequately understood, must be considered in terms of their interrelations. (Mead, 1934, p. 130)

> The great fault of the older rational psychology was to set up the soul as an absolute spiritual being with certain faculties of its own by which the several activities of remembering, imagination, reasoning, willing, etc., were explained, almost without reference to the peculiarities of the world with which these activities deal. But the richer insight of modern days perceives that our inner faculties are adapted in advance to the features of the world in which we dwell, adapted, I mean, so as to secure our safety and prosperity in its midst. . . .*Mind and world in short have been evolved together, and in consequence are something of a mutual fit*. (James, 1892, p. 3-4; emphasis added)

Of course, many aspects of Darwin's work have been appropriated (and misappropriated) by psychologists within differential psychology, eugenics and sociobiology, and developmental and comparative psychology. It is therefore important to remember that Darwin himself conducted psychological research. He was not entirely the "old buffer" portrayed in the textbooks, relying exclusively on anecdotal reports.

An important, but neglected, example of Darwin's psychological research concerned the action of earthworms and was published in his final book *The Formation of Vegetable Mould, Through the Action of Worms With Observations on Their Habits* (Darwin, 1881). This seemingly minor, even quaint, topic meant a lot to Darwin. He conducted his studies of earthworms over many years, and he was convinced that worms were among the most important species in the history of the earth in terms of their widespread and radical impact upon the landscape (Ghilarov, 1983).

Darwin's studies of earthworms relate to his wider project in several ways. First, over the course of many years he carefully recorded the rate at which earthworms' castings came to cover objects on the surface of the ground. Although the process is very slow, it was evident that earthworms must have a profound impact, eventually burying very large structures indeed. This, Darwin argued, was a demonstration of the more general point that very gradual change can nevertheless lead to profound—even radical—change of the kind he proposed selection could itself eventually achieve.

Second, he regarded the activity of the earthworms as essentially adaptive and sought to determine, in relation to the ambient conditions, the biological significance of their drawing leaves into their burrows—was it to maintain the humidity or the temperature of their burrows?

Third, he carefully tested the earthworms by presenting them with unfamiliar and awkward leaves (including artificial leaves cut out of paper) to see how they coped (after all, it is far from an easy task to drag a large leaf into such a narrow opening), yet the worms proved to be impressively flexible and astute, heading for the optimum part of the leaf. They were, Darwin insisted, far from the mechanical automatons of Cartesian psychology:

> They act in nearly the same manner as would a man, who had to close a cylindrical tube with different kinds of leaves, petioles, triangles of paper, &c. For they commonly seize such objects by their pointed ends. But with thin objects a certain number are drawn in by their broader ends. They do not act in the same unvarying manner in all cases, as do most of the lower animals; for instance, they do not drag in leaves by their foot-stalks, unless the basal part of the blade is as narrow as the apex, or narrower than it. (Darwin, 1881, p. 313; see also Reed, 1982)

Finally, and most importantly, Darwin's example of earthworms and their "world" invites us to think differently about the relation between animal and environment, for even within so-called ecological approaches to psychology it is easy to slip into a kind of environmental determinism and reify the environment as an "independent variable" external to the animal in question. Animal and environment are interdependent, however, and this is not just a question of logic or definition but of history, "a moving, growing never finished process" (Dewey, 1958, p. 295). Earthworms, through their collective activity, have both transformed and sustained their circumstances. Earthworms and the vegetable mould surrounding them have co-evolved. Vegetable mould simply did not exist before the evolution of earthworms. Their relation is *mutual:*

> In his *Earthworms* [Darwin's] attention was drawn to that aspect of ecology which at that time and still many years later was neglected by ecologists. Ecology, according to its very definition, studies interaction and interrelationships of organisms and their environments. Up to a short time ago, ecologists only studied dependence of organisms on their environment. Darwin in his *Earthworms* has shown brilliantly the other side of the medal—the influence of organisms on their environment, i.e. the dependence of the milieu, of the environment, on their activity. (Ghilarov, 1983, pp. 3-4)

After Darwin

So what happened to this early mutualist psychology? Well, for a while it seems to have thrived. Far from the image of early psychology as devoted exclusively to introspection, there was certainly a lively interest in what people actually do. As Woodworth (1943, 49-50) has stressed, a psychology of "conduct"

was well established long before Watson's declaration of the behaviorist revolution, but this early psychology became eclipsed for a number of reasons. At the beginning of the twentieth century Darwinism seemed deeply discredited, not the least following the rediscovery of Mendel's work and its emphasis on discrete rather than continuous variations. Darwinism also gave way to what one might call Huxleyism, the displacement of *in vivo* natural history by the *in vitro* examination of isolated "preparations" (living or dead) favored by experimental physiologists. Furthermore, psychology's own agenda turned more to technological control rather than self-understanding (Danziger, 1979).

Linked to all this was the rise of Watsonian behaviorism. Watson's version of behaviorism was essentially a return to Cartesian assumptions. The first of these was the supposed logical disjunction between body and mind, and Watson's methodological focus upon "behavior" as that which is *observable*. Second, there was, within Watson's eclectic mix—of Russian reflexology, school textbook physiology and hand-waving about practical implications—the return of the conception of the body as a passive mechanism, or, in other words, stimulus–response psychology (cf. Dewey, 1896).

Not least, there was the radical transformation of the term "behavior" itself. By the time of the "behaviorist revolution," the word "behavior" had largely lost its original moral meaning: how one conducted oneself in public. This original meaning is retained in the term "misbehavior" and the command "behave yourself!" Behavior, in this original sense, was publicly observable and regular in the sense of respecting societal norms; however, when the term was extended, as a metaphor, to physical processes (e.g., chemical reactions) and later to animals, its moral significance and reference to a wider "situation" was lost, and merely the sense of observability and regularity remained (see Ardener, 1973; Costall, 1998).

Skinner, Gibson, and the Principle of Animal–Environment Mutuality

Despite the protests of the functionalist psychologists against Watson's misrepresentation of their position (see Roback, 1964, pp. 248-250)[8] and their searching, if remarkably polite, objections to Watson's own approach (e.g., Dewey 1914/1977),[9] this early mutualist perspective was largely eclipsed by his "dualistic" behaviorism. Yet the Darwinian emphasis upon the mutual coordination of animal and environment did not entirely disappear from behaviorism. It is evident, for example, in Skinner's definition of behavior, which, although initially placing the emphasis on *observability*, finally stresses the "commerce" between animal and environment:

[8] According to Watson, the functional psychology along with Gestaltism were "illegitimate children of introspective psychology. Functional psychology, which one rarely hears of now, owed its vogue to considerable patter about the physiologically adaptive functions of the mind. The mind with them is a kind of adjusting 'guardian angel.'" (Watson, 1930, p. 1)

> Behavior is what an organism is *doing*—or more accurately what it is observed by another organism to be doing. But to say that a given sample of activity falls within the field of behavior simply because it normally comes under observation would misrepresent the significance of this property. It is more to the point to say that *behavior is that part of the functioning of an organism which is engaged in acting upon or having commerce with the outside world*. (Skinner, 1938, p. 6; emphasis added)

In addition, Skinner's theoretical terms such as *operant* and *reinforcer* embody relational thinking because they are defined reciprocally and functionally. Perhaps Skinner's clearest statement of the "internal" relation between animals and their environments occurs in his accounts of his own scientific activity. The so-called Skinner boxes were designed, in effect, to "reflect" the animals they were to contain:

> A laboratory for the study of behavior contains many devices for controlling the environment and for recording and analyzing the behavior of organisms. With the help of these devices and their associated techniques, we change the behavior of an organism in various ways, with considerable precision. But note that *the apparatus was designed by the organism we study*, for it was the organism which led us to choose a particular manipulandum, particular categories of stimulation, particular modes of reinforcement, and so on, and to record particular aspects of its behavior. (Skinner, 1961, p. 543; emphasis added)[9]

James Gibson, a contemporary of Skinner, put a special emphasis on the mutuality of animal and environment. As he put it, "The words animal and environment make an inseparable pair" (Gibson, 1979, p. 8).

Two of Gibson's concepts are more specific manifestations of this principle. The first is the concept of "affordances":

> The *affordances* of the environment are what it *offers* the animal, what it *provides* or *furnishes*, either for good or ill. The verb to afford is found in the dictionary, but the noun affordance is not. . .I mean by it something that refers to both the environment and the animal in a way that no existing term does. It implies the complementarity of the animal and the environment. (Gibson, 1979, p. 127)

Affordances are actual properties of the environment even though they are animal-dependent. Apples and, for that matter, grass afford eating—they constitute food—but *in relation to* certain kinds of organism.[10] If, for example, ungulates and

[9] William Timberlake has noted Skinner's remarkable "feel" for what would be suitable for the animal in question. Designing a suitable apparatus is by no means trivial. Timberlake (this issue) describes his own considerable difficulties in designing a lever that would afford "pressing" for a rat, but not, for example, sitting on, biting, or placing the head under.

[10] There are striking, though unacknowledged, similarities between Gibson's concept of affordances and Tolman's discussion of "behavior-supports": "Behavior cannot go off in vacuo. It requires a complementary 'supporting' or 'holding-up'. . .A rat cannot 'run down an alley' without an actual

certain insects did not exist, grass would not "be" food. The concept of affordances, as Gibson left it, has many limitations (see Costall, 1995), yet with this simple concept Gibson challenged the long-standing assumption within Western thought that "reality" *excludes* us.

A second concept of Gibson's, "visual kinesthesis," concerns our "awareness of being in the world" (Gibson, 1979, p. 239). It relates to Gibson's classic work on "optic flow" and "the awareness of movement or stasis, of starting and stopping, of approaching or retreating, of going in one direction or another, and of the imminence of an encounter" (Gibson, 1979, p. 236). Then there is the "visible horizon" that corresponds to our eye level and relates distant objects to our own bodies. For example, objects extending above the visible horizon are higher than eye level (and the horizon sections equal-sized objects in equal proportions). As Gibson put it, the horizon "is neither subjective nor objective; it expresses the reciprocity of observer and environment" (Gibson, 1979, p. 164).

Furthermore, we can *see* our own bodies, our arms and legs there *in* the world, and also our *selves* restricting our view:

> Ask yourself what it is that you see hiding the surroundings as you look out on the world—not darkness, surely, not air, not nothing, but the ego! (Gibson, 1979, p. 112)[11]

Gibson thus provided some very important resources for a mutualist approach to psychology, yet, like Skinner, Gibson was, ultimately, highly inconsistent and wary, I think, of relational thinking. He, too, ultimately attempted to "reify" the environment and treat the environment (along with "affordances" and "information") as external to the animal (Costall, 1995; Costall & Still, 1989). Thus we find in his own writings, and in that of some of his students, the assertion that environments are *not*, after all, animal-dependent (Gibson, 1979, p. 129); that affordances exist independently of animals (Heft, 2001, p. 125; Reed, 1993); and that information exists and can be defined *without reference to perceivers* (Gibson, 1961; Reed, 1996, p. 253).

In his reaction to the extreme subjectivism of standard psychological theory, Gibson, like Skinner, reverted so often to the opposite, dualistic extreme:

> Reading Gibson, one often gains the impression that his keen philosophical criticism of idealism (and "subjectivism") leads him "automatically" into the opposite camp, i.e. that of Realism. A philosophical argumentation in support of Realism, however, can hardly be found. . . .Ecological theory needs [a relational

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floor to push his feet against, actual walls to steer between, actual free space ahead to catapult into. And in a discrimination-box, he cannot 'choose' the white side from the black without actual whites and blacks continuously to support and verify such a choice. Behavior-acts. . .demand and are sustained by later coming behavior-supports" (Tolman, 1932, p. 85). Both Gibson and Tolman had studied with E.B. Holt, who had been a student of William James.

[11] "Problem: To carry out the self-inspection of the Ego. Solution: It is carried out immediately" (Mach, 1959, p. 20). See Neisser (1994) for an important elaboration of these points.

> ontology] and should not define and articulate its basic notions in terms of Idealism's direct opposite. (Tamboer & Heij, 1991, p. 18)

In fact, to find the clearest formulation of mutualism we still need to go back closer to Darwin and the writings of the early functionalist psychologists, as in John Dewey's lectures on psychological and political ethics from 1898 (Dewey, 1976):

> We commonly talk of the organism and the environment and of the adaptation of one to the other. . .as if there were first an organism and an environment and then some adjustment of one to the other; but when we come to an analysis of the factors involved, it is quite necessary to start from the unity of function and see that the distinction of organism and environment arises because of adaptation in that process, not vice versa. (p. 275)

> The increasing control over the environment is not as if the environment were something there fixed and the organism responded at this point and that, adapting itself by fitting itself in, in a plaster-like way. . . .The psychological or historical fallacy is likely to come in here and we conceive the environment, which is really the outcome of the process of development, which has gone on developing along with the organism, as if it was something which had been there from the start, and the whole problem has been for the organism to accommodate itself to that set of given surroundings. (p. 283-284)

Two final points. The principle of animal–environment mutuality is most emphatically *not* "interactionism." Animal and environment are not envisaged as essentially separable, alien entities that just "happen," at some point, to come into relation. They are aspects of a unitary, continual historical process. Animals inherit environments just as much as they do their genes, and their environment already "acknowledges" their existence—from vegetable mould surrounding the earthworm to Skinner boxes and their intended subjects. Of course, a distinction can be made between organism and environment, but it is a distinction that presupposes their relation, just as riverbeds and rivers, and beaten-paths and walkers imply one another's existence.

Finally, if we are to take the animal–environment relation as the focus of psychological research and theory, then the task becomes that of trying to understand the *various* ways that we and other animals are "inextricably immersed" in the world (Lee, 1999, p. 78). These various ways surely extend well beyond the limits of any worthwhile definition of "behavior." It might be objected that the concept of coordination or adaptation is therefore much too inclusive to distinguish psychology as an autonomous discipline distinct from, say, biology on the one hand and politics and ethics on the other. In the end, however, the absence of clear boundaries might be no bad thing. Part of our problem could be the assumption—the *very* Cartesian assumption—that psychology *ought* to be a self-contained science set apart from a wider world.

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