
The Laboratory Findings and Their Interpretation

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THE disagreement that we noted in the preceding chapter, between Darwin and the post-Darwinian evolutionists, especially such leading paleoanthropologists as Julian Huxley, Dobzhansky, Simpson, Mayr, Oakley, von Koenigswald, Washburn, and Leakey we shall find repeated here. The position taken by Darwin, that man differs only in degree from other animals, is here taken, with one exception to be noted, by the experimental comparative psychologists, but on the basis of a quite different type of evidence than that available to Darwin. There was no laboratory study of human or animal behavior in his day. For his knowledge of animal behavior, Darwin relied mainly on reports from naturalists in the field; and for conceptions of the human mind and its abilities, he had to turn to the pre-experimental literature of psychology. It is, therefore, quite striking that the experimentalists whose work we shall consider in this chapter should align themselves with Darwin by interpreting their laboratory data as definitely showing, or at least tending to show, that man has no behavioral traits or abilities that animals do not also have to some degree.

In confining our attention in this chapter to the experimentalists who are for the most part American scientists, I have not overlooked the contributions made by the leading European etholo-

gists, such as N. Tinbergen of Oxford, Konrad Lorenz of the Max Planck Institut of Munich, and W. H. Thorpe of Cambridge. As Tinbergen points out in his introduction to *The Study of Instinct*, the American behaviorists have concentrated their attention on all forms of learned behavior. "The result," he writes, "has been a certain neglect of innate behavior, which has led in some instances to entirely unwarranted generalizations." [1] I will in subsequent chapters deal with the distinction between innate and acquired behavior, particularly insofar as it has a critical bearing on the question of man's difference. For the present, let it suffice to say that Tinbergen's position on that question is unclear, that Lorenz quite clearly regards man's difference as one of kind, and that Thorpe tends to agree with the American behaviorists who maintain that man differs only in degree, though when we examine his views on the subject more closely we shall find—surprisingly, in view of Tinbergen's comment—that he could not have reached this conclusion if he had taken due account of the distinction between innate and acquired behavior. [2]

We observed in the preceding chapter that the disagreement between Darwin and the leading paleoanthropologists today arises, in part at least, from the kind of evidence being examined and the problem to be solved, which affects the way the evidence is interpreted. The same observation holds for the disagreement between the paleoanthropologists and the comparative psychologists. The paleoanthropologists, comparing both living and fossil species, pay almost exclusive attention to human products, the products of technology and culture, as differentiating man from other animals; they infer distinctive human powers from the distinctive works of man. The comparative psychologists, making laboratory studies of human and animal behavior, pay almost exclusive attention to the processes of learning, problem-solving, perception, memory, and generalization that can be studied objectively and experimentally by observing the behavior of men and animals under controlled laboratory conditions.

Not only are the data being examined by the two groups of scientists quite different, but so also are the problems that each is trying to solve. The paleoanthropologists, as we have seen, focus their attention on the problem of placing and dating the advent of man on earth; they must, therefore, attempt to draw the line that separates human from non-human fossil remains, and

so they interpret their data accordingly. The comparative psychologists, like Darwin, by whom they are greatly influenced, think—wrongly, as we shall see—that they have to establish the similarity of human and animal behavior in order to uphold the evolutionary kinship of men with other animals; with that controlling aim they, too, interpret their data accordingly.

Having summarized the position of the paleoanthropologists in the preceding chapter by reviewing the evidence to which they appeal and their interpretation of it, I will now do the same for the comparative psychologists. This should put us in a better position to assess their disagreement and to come, finally, to a critical examination of the one point on which there is universal agreement; namely, that man and man alone has true language—propositional or syntactical speech. It is with respect to this one agreed-upon, observed fact that sharply diverging interpretations lead some scientists to assert, in spite of it, that men differ only in degree, while others maintain, because of it, that men really differ in kind.

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The comparative study of human and animal behavior owes its rise and development to the influence of the theory of evolution and especially to Darwin's *Descent of Man*. That book, as Professor Ernest R. Hilgard of Stanford University points out, is itself "essentially a comparative psychology." [3] In the decades following *The Descent of Man*, two opposite tendencies manifested themselves. The writings of G. J. Romanes (*Animal Intelligence*, 1882; *Mental Evolution in Animals*, 1883; and *Mental Evolution in Man*, 1888) followed Darwin in arguing for the continuity of animal and human intelligence along a scale of degrees, but tended to exaggerate the powers of animals by collecting anecdotes about their remarkable performances. The work of Lloyd Morgan (*Introduction to Comparative Psychology*, 1894, and *Animal Behavior*, 1900), based on empirical investigations rather than on anecdotes, tended in the opposite direction. Where Romanes, in trying to close the gap between men and animals, raised animals up almost to the human level, Lloyd Morgan lowered man almost to the animal level. In doing so, Morgan

applied the basic methodological principle that he had laid down for theorizing about the observed data. "In no case," he declared, "may we interpret an action as the outcome of the exercise of a higher psychical faculty, if it can be interpreted as the outcome of the exercise of one which stands lower in the psychological scale." [4]

Morgan's principles, methods, and conclusions greatly influenced the next generation of American investigators, notably Edward L. Thorndike (*Animal Intelligence*, 1898), and John B. Watson (*Behavior, An Introduction to Comparative Psychology*, 1914, and *Psychology from the Standpoint of a Behaviorist*, 1919). Animal experimentation was begun at Harvard at the beginning of the century by Thorndike and Yerkes; and animal laboratories quickly multiplied in other institutions. The names of Hobhouse, Small, Jennings, and Hunter should also be mentioned among the early experimentalists in the field of animal behavior. [5] Nevertheless, most of the critical work in this field has been done in the last forty years, and the best of it—work done with painstaking laboratory controls—has been done in the last twenty, by investigators too numerous to name. I will, in what follows, name only the scientists whose books are the sources of my summary of the findings and conclusions in this field of research.

If we go to the authors who, in recent years, not only have reviewed the vast literature of comparative psychology, both books and periodical articles, but who have also tried to assess or interpret the findings and formulate the conclusions that can be drawn from the experimental data, we cannot help noting three assumptions that are widely shared.

One is the assumption of materialism, not as a metaphysical truth, but as a working hypothesis—a procedural decision to avoid theories that employ references to mind or mental processes as something distinct from neurological processes and from observable or inferable elements of bodily behavior. Thus, for example, Donald Hebb, Professor of Psychology at McGill University, writes:

Mind and mental refer to processes inside the head that determine the higher levels of organization in behavior. . . . In this book, we shall assume that mind is an activity of the brain, and that our knowledge of it is chiefly theoretical,

inferred from behavior rather than obtained directly from self-observation (i.e., from introspection).

He goes on to say that one theory of mind is animistic, the view that "the body is inhabited by an entity . . . having nothing in common with bodily processes." The other theory is physiological or mechanistic. "It assumes that mind is a bodily process. . . . Modern psychology works with this latter theory only." To which Hebb adds: "There is certainly no decisive means available of proving one [theory] to be right, the other wrong." [6]

Similarly, Professor Charles E. Osgood of the University of Illinois tells us that psychologists must follow J. B. Watson in eliminating mentalistic constructs—such as thoughts, ideas, images—from psychological science; or, if we admit them, we must at least deny that "they partake of something other than the material world. Otherwise we should be unable to investigate them at all with scientific methods." [7] Again it is clear that the materialistic assumption is made for methodological reasons. This is further confirmed by a remark of T. C. Schneirla, Curator of Animal Behavior at the Museum of Natural History in New York. He points out that attempts to conceive such processes as thinking, reasoning, conceiving, anticipating, etc. as "constituting a single non-corporeal agency, distinct at all times from 'body,' have failed dismally as a basis for prediction in science." [8]

A second assumption that follows closely on the first is also clearly procedural. It stipulates that scientific method in the comparative study of human and animal behavior must treat human and animal subjects in the same way and under the same kind of laboratory conditions. In both cases, the data of research must be objective, i.e., observable items of behavior, including the treatment of protocol statements made by human subjects as observable units of behavior.

The third assumption is the principle of continuity. This lies at the foundation of comparative psychology—its legacy from the theory of evolution, in the context of which comparative psychology arose and developed. Implicit everywhere in contemporary psychology and behavioral science, it is sometimes explicitly stated as a controlling or regulative principle of psychological investigation and interpretation.

In an essay on "The Evolution of Learning," Professor Harry

F. Harlow of the University of Wisconsin writes: "If we are to explain learning in terms of evolutionary theory, there should be continuity from the simplest to the most complex forms of learning. The appearance of a radically new kind of learning at any evolutionary point or period, including that during which man developed, is not in keeping with modern gene theory. . . ." Harlow then criticizes Dobzhansky for saying that "man is not simply a very clever ape, but a possessor of mental abilities which occur in other animals only in most rudimentary forms, if at all." [9]

A less careful writer, C. Judson Herrick, formerly Professor of Neurology at the University of Chicago, declares the continuity of nature to be an established fact, though he also immediately concedes that that is not quite so. He first tells us that "the continuity of the series of changes in both overt action and internal structure as we pass from the inorganic through the ranks of the animal kingdom up to and including mankind may be regarded as established." Then, in the very next sentence, he admits that it is not yet established: "The apparent interruptions of this continuity are successively closed as our knowledge of the facts is enlarged." [10] Schneirla more frankly admits that "a scientifically developed evolutionary conception of man as a higher animal" must, in line with the principle of continuity, regard man as merely superior in degree, never as different in kind. [11]

In general, it can be said that the comparative psychologists and behavioral scientists acknowledge that the complete and unbroken continuity of nature is not yet fully established. They admit that the supporting evidence is still far from complete, but they also believe that all the evidence so far amassed is confirmative: no experimental findings, they claim, tend to invalidate this assumption, or even to cast doubt upon it. They therefore feel that they are justified in using it as a working assumption in carrying out further experimental work in the comparative study of human and animal behavior.

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Let me now attempt a brief summary of the state of scientific opinion in this field of research. On each point on which there is

clearly a majority or a prevailing opinion, I will indicate the dissents that exist and have a bearing on the question of man's difference.

With one exception to be noted, the prevailing opinion among comparative psychologists is that man differs from other animals only in degree, and that his marked superiority in certain respects—his uniqueness in degree in these respects—can be accounted for without positing any psychological factors or processes that would make him unique in kind. This position is taken by such representative authors as Harlow, Hebb, Osgood, Nissen, Schneirla, Maier, Heron, Scott, Leeper. [12]

The reversal in position of C. Judson Herrick is worth noting. When, in 1926, he wrote *The Brains of Rats and Men*, Herrick declared that "symbolic thinking is a new kind of function," that first appears in man. With regard to the forms of behavior to which this gives rise, he further maintained that "we have not the slightest evidence that these . . . are possessed in any degree by any of the lower mammals." [13] Thirty years later, writing *The Evolution of Human Nature*, he takes account of the more recent experimental work done by Harlow, Maier, Yerkes, Hebb, Schneirla, and others, and in consequence he reverses himself. In his recent book, Herrick adopts the now prevailing view that symbolic functions, conceptual learning, abstraction, reasoning, and insight are all found in animals. The fact that man uses verbal symbols and animals employ non-verbal symbols in learning and thinking may account for man's superiority in degree, but it does not establish a difference in kind. He explicitly rejects "the claim that 'man uses symbols; no other creature does' and that 'there are no intermediate stages' " between the lower animals and man in symbolic function. Such claims, he says, are "obviously contrary to fact." [14]

The one clear exception to the prevailing view that I have been able to find is a paper on "The Evolution of Intelligence" by Professor M. E. Bitterman of Bryn Mawr, an experimental comparative psychologist. [15] He observes the fact that from the early experimental work of Thorndike on, "learning was thought to involve qualitatively similar processes throughout the evolutionary hierarchy," [16] and it was generally supposed that "differences from species to species are only differences of degree." [17] He claims that experimental work done in his laboratory

on habit reversal and probability learning suggest that "as we ascend the evolutionary scale we do not find a pattern of intellectual continuity but one of discontinuity"—differences in kind, not just degree. [18] That Bitterman regards these differences in kind as superficial, not radical, is indicated by his statement that the "brain structures evolved by higher animals do not serve merely to replicate old functions and modes of intellectual adjustment, but to mediate new ones." [19]

This one exception hardly changes the picture, but it does raise an interesting question. Bitterman, like most of the paleoanthropologists and students of human evolution that we have examined, sees no conflict between the general evolutionary principle of phylogenetic continuity and the recognition of differences in kind, as long as these are merely superficial (i.e., based on differences in degree of complexity in the central nervous system). Why, then, do the rest of the comparative psychologists appear to think that the principle of phylogenetic continuity must exclude all differences in kind and require the showing—by experimental data—that there are only differences of degree in the scale of behavior from the lower orders through the higher and up to man?

One answer could be that they mistakenly identify all differences in kind with radical difference in kind. The latter does violate the principle of continuity. Failing to recognize superficial differences in kind as an alternative to differences in degree, they insist that all differences must be differences in degree. A more likely answer, however, is that their experimental work and their theoretical interpretations of it are dominated by Lloyd Morgan's canon—the methodological rule which says that we should not interpret an action as the outcome of a higher psychical faculty if it can be interpreted as the outcome of a lower one. The consequences of adopting this rule are manifest in the conclusions about which there is a general agreement among comparative psychologists.

There is general agreement that the same psychological factors or processes are present—in varying degrees—on all levels of animal behavior, including the behavior of the human animal. Experimental findings are said to show that at different levels in the scale of animal behavior there are only differences in degree with respect to: (1) the capacity for delayed response; (2) the

capacity for mental set, i.e., preparation for response prior to overt behavior; (3) the capacity for solving detour problems; (4) the capacity for solving problems by trial and error; (5) the capacity for being guided by cues; (6) the capacity for solving problems by insight; (7) the capacity for reasoning, i.e., for combining different parts of past experience; (8) the capacity for discrimination, generalization, abstraction, and concept-formation. [20]

Harlow, in "The Evolution of Learning," summarizes these results by saying that all the phenomena of learning and thinking (without any sharp distinction between learning and thinking), from habituation in the lower animals to abstract thought in the higher, can be ordered in a single system in which all differences can be explained in quantitative terms (i.e., as differences in degree). [21] He states his conclusion as follows:

The existing scientific data indicate a great degree of intellectual communality among the primates, and probably a greater communality among all animals, than has been commonly recognized. There is no scientific evidence of a break in learning capabilities between primate and non-primate forms. [22]

In addition, Harlow and his students have done experimental work on monkeys which, in their judgment, shows that learning—or problem-solving—for its own sake is not an exclusively human trait. [23]

Though there are conflicting data and conflicting interpretations of the data derived from experimental work on animal problem-solving by trial and error and by insight, on animal discrimination, generalization, and abstraction, and on animal reasoning, there is no difference of opinion among the leading scientists in this field that the psychological factors and processes involved in animal behavior are identical with the psychological factors and processes operative in human behavior. Stated negatively, the prevalent opinion is that *no new* psychological factors or processes are to be found in human behavior; and that *no additional* factors or processes need be posited to explain human behavior.

This last point is emphasized by the widely shared opinion that

non-verbal symbols and concepts function in animal behavior as verbal symbols and concepts function in human behavior. Abstraction, generalization, and concept-formation are not exclusively human abilities; nor is the use of symbols, if we distinguish between verbal and non-verbal symbols. [24]

Two statements by H. W. Nissen epitomize the point being made.

A major dimension of difference among animals is the sheer number of percepts and concepts available to the organism. . . . Incidentally, just where perceptions leave off and concepts begin is impossible to say; these terms represent quantitative differences on a continuum, to the extremes of which we apply different names. [25]

In all attempts to characterize the uniqueness of human intelligence, the factor of language, propositional language, is emphasized. . . . Language, or verbal mediating responses, represent an instance of extremely efficient central integration. . . . But language does not seem to introduce any really new psychological process. [26]

To which should be added the following statement by Hebb:

Animal studies have already shown us that thinking need not depend on language (since animals do not have language but do have *fairly complex mediating processes*). Human studies allow us to go further; not only do important steps of thought occur without language, they cannot be put into language after they have occurred. [27]

Finally, we must note that the most important theoretical development in recent years has been the rejection of the oversimplified stimulus-response mechanisms employed by Thorndike, Hunter, Watson, and other early behaviorists to explain animal behavior. [28] It is necessary, in the opinion of the leading theorists today, to complicate the explanatory schema by introducing what are called "mediating factors" or "mediating processes" between stimulus and response. These mediating factors or processes represent the functioning of the central nervous system as something more than a pathway of connections between

the sensory receptors on the stimulus side and the motor effectors on the response side. The difference in degree between human and animal behavior—in learning, problem-solving, thinking, concept-formation, the use of symbols, etc.—is to be explained by the presence in man of more numerous and more complicated mediating factors or processes. Thus, for example, Hebb explains man's unique possession of propositional language and its verbal symbols by "man's capacity for having several sets of mediating processes at once, relatively independent of each other." [29]

I have omitted from the foregoing summary the agreement of the experimental psychologists among themselves as well as with the paleoanthropologists and other scientists—the agreement that man and man alone uses verbal symbols and has a propositional language. It is always risky to use the word "unanimous" in reporting the state of opinion in any field of research. Nevertheless, in this case I would like to use the word as short for the statement that I have found concurrence on this one point throughout the scientific literature that I have examined. The only exception I have found turns out, on closer examination, not to stand up. I will deal with this solitary exception in the next chapter and there show why it does not require the retraction of the word "unanimous."

Even those scientists who think that there is rudimentary tool-making in other primates (or that there is a shadowy line between tool-using and tool-improvising, on the one hand, and toolmaking, on the other) concede that sentence-making is confined to man. The same can be said for those scientists who think that a shadowy line also divides cumulative from noncumulative cultural transmission; or who think that the difference between human and non-human forms of association is one of degree rather than of kind. Of the seven distinctively human performances mentioned in the preceding chapter (see p. 91) as constituting manifest differences in kind between human and animal behavior, all except the first have been doubted, challenged, or explicitly dissented from. The one exception is the observed fact that man and man alone is a maker of sentences.

This fact may be explained in various ways, but no matter how it is explained it cannot be explained away. Any observed performance that belongs exclusively to one species of animal and to no others constitutes a manifest difference in kind. If no inter-

mediates are possible between the presence and absence of that performance, as is the case with sentence-making, the manifest difference in kind is real, not just apparent—not a masking of what is really a difference in degree. But whether that real difference in kind is radical or only superficial depends on how it is explained by reference to underlying processes or factors, psychological or neurological. It is only this last point that is affected by the way in which we explain the observed difference between men and other animals with respect to the possession of a propositional language.

The problem of interpreting the uniqueness of human language is of such critical importance to the question of how man differs that I shall devote the next three chapters to it, in the first of which I will try to explain why the experimental psychologists, while conceding the fact that man and man alone has a propositional language, persist in clinging to a view that is patently inconsistent with that fact; namely, that men and other animals differ only in degree. But before I turn to these matters, I would like to conclude the present chapter with one comment on the findings and theories in the field of comparative psychology that have here been reviewed. Do they, apart from the fact that only man has propositional language, establish the proposition that human and animal behavior differ only in degree? Do they tend to confirm the assumption of a complete and unbroken continuity in nature?

My answer to both questions is negative. The methodological postulates that govern both the experimental research and the theoretical interpretation of the data could lead to no other results than those obtained. Lloyd Morgan's canon has been interpreted by the researchers as an injunction to find only differences in degree and as an admonition always to employ exactly the same theoretical constructs in explaining the observed facts of both human and animal behavior. (I will attempt to show in Chapter 9 that this is a grievous misinterpretation of Lloyd Morgan's rule which, correctly understood, will be seen as a special application of the principle of parsimony in explaining observed facts. Occam's razor is double-edged and cuts two ways, not one.)

In addition to misinterpreting Morgan's rule, the researchers operated under the restrictive postulates of metaphysical, not just

methodological, behaviorism, and were constrained by the general framework of their evolutionary views to look for evidences of the kinship between men and animals. One could, therefore, have predicted in advance that scientists, operating under these conditions, would find data in support of differences in degree; or that whatever data they did find would be interpreted by them as betokening differences in degree and as being consistent with the principle of phylogenetic continuity. Hence, the results can hardly be taken as confirming the continuity of nature or as providing us with a decisive scientific solution of the question of how man differs from other animals.