

THE PRESENT STATUS OF RESEARCH ON EXPLORATORY AND RELATED BEHAVIOR

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We are hearing a great deal of talk nowadays about the significance of "exploratory," "investigatory," or "orienting" activities. These terms, and they are currently used without much attention to precise definition, cover a motley collection of responses from looking through keyholes to pondering over quantum mechanics. What they all have in common is singularly hard to specify, but they all seem to involve a striving to attain some form of stimulation or other, and although they often make obvious contributions to the satisfaction of urgent biological needs like eating or escape from pain, they seem just as often to be directed toward stimuli with no manifest bearing on survival. Even lower animals, let alone man, will devote astonishing amounts of time and effort to what seem superficially like dispensable frivolities which divert them from the grim urgencies of life. Exploratory behavior is thus thrown into the same large pending tray as play and a host of other unfinished business.

REASONS FOR PREVIOUS NEGLECT

A growing number of experimenters have been eagerly impressing on us that animals will spend time looking round new environments even when they are hungry and food is present, and that they will learn a response and perform it with remarkable persistence, solely for the pleasure of seeing a light go on (11, 13, 14, 15, 18) or of looking out of a window (9). But the question is not why these forms of behavior are to be treated as important, but why experimental psychologists were so blind to them and neglectful of them until the last eight years or so. The existence of exploratory activities in animals like the rat was noted by a few experimenters in the 1930's and 1940's (e.g., 20, 21), and some "exploratory drives" were hastily engaged to look after these activities and keep them from worrying daddy while he was working. Whenever they became obstreperous, they were taken to see somebody like Dr. Freud and Dr. McDougall, who patted them on the head, prescribed their own universal remedies, and felt that the symptoms of these activities did not warrant a thorough examination.

There were perhaps two main reasons for the belatedness of their public recognition. One is the theory of evolution. Before Darwin, psychologists, which then meant, of course, philosophers, were actually

largely preoccupied with processes that would now be placed in the "exploratory" category—with finding out about the universe, whether by perceiving it or by thinking about it. But Darwin changed all that by showing that the central facts about behavior concerned its functioning as a system of devices for keeping animals alive until the age of procreation, and that any idle looking round and amusing oneself was very much a by-product or an auxiliary in the serious business of struggling for existence. So, it was only natural and reasonable for psychologists, once they had absorbed the lessons of evolution—and it took some time—and seen that they must build up theories of motivation, to concentrate on those activities whose contribution to survival and reproduction is obvious, such as eating, drinking, mating, and fleeing from danger.

The second reason for the tardiness with which exploratory behavior achieved prominence in experimental-psychology circles is the fact that human beings are very obliging. Or is it that they are easily intimidated? Whichever it may be, the truth is that human subjects will put their utmost into looking, remembering, or thinking simply because an experimenter asks them to. The desire to be polite to the experimenter or the fear of making a fool of oneself suffices for at least those subjects who are motivated enough to appear at the right time. So, almost all of the voluminous experimental literature on the psychology of perception, remembering, and thinking is devoted to perception, remembering or thinking about whatever an experimenter arbitrarily decides shall be attended to, committed to memory, or thought out. As a result, mountains of problems concerning the motivation of perceptual and ideational processes in everyday life have been lost sight of. Human beings have been known to look at things, remember things, and think about things outside laboratories when no experimenter is there to tell them to do it. Many other things that might be attended to will, of course, be ignored, but many of those that attract perceptual or ideational behavior are not ones that the individuals involved have any obvious reason for noting. And simply because it is so easy to induce artificial motives in human subjects in laboratory conditions, we have failed to study the motives that govern the direction of spontaneous perception, remembering, and thinking in everyday life. Most researches begin with the point at which the subject begins to attack a problem, but they do not deal with the factors that cause certain problems to be taken up and others to be passed over.

PRESENT STATUS

What can be said about the state of research on exploratory and related behavior, now that its importance has been amply established? Unfortunately, although dozens of research projects have by now been concerned with this area, and they have gone on in at least five countries—Canada (25, 26), France (10), Great Britain (1, 2, 13), Italy (17), and the United States (9, 19), we can only raise outstanding questions rather than provide illuminating answers.

There was at first a stage when experiments were concentrated on establishing the reality and the strength of the responses in question. At least four groups of experimenters discovered, for example, and apparently independently, that a rat will readily learn to press a bar solely for the reward of experiencing an increase in illumination (11, 13, 14, 15). But this necessary introductory stage soon gave way to a second stage, in which the stimulus properties that determine the intensity and direction of exploration were sought. Novelty was the first such property to have its suspected influence verified (1, 19). More recently, experimenters have been turning to a second, though related, group of properties, for which complexity seems the best label, although it is to some extent a question-begging one (3, 4, 5, 6, 7, 8, 27). Curiosity has now been investigated in human adults (3, 5, 6), human infants (7), apes (27), monkeys (9, 12), dogs (25), rats (1, 11, 13, 15, 19, 26), mice (14), and cockroaches (10).

UNFINISHED BUSINESS

But there are a number of tasks still waiting to be broached. We still need much more work on the determinants of exploratory behavior in animals and human beings. There are so many obvious problems yet to be taken up, many of them not even requiring much ingenuity or imagination. It is just a matter of seizing the opportunities they present and gradually working through them. This is especially so in the case of human curiosity. Here there is a special difficulty, quite apart from the difficulties due to human complexity. Because, as we have pointed out, human beings are accustomed to being told by psychologists to notice this and to learn that, it is not at all easy to call forth really spontaneous looking or remembering or thinking in, say, student subjects. They cannot believe that they are not expected to prepare themselves for some subsequent test, and, if they are not told about the test beforehand, they are apt to form hypotheses about what it will consist of and to direct their exploratory activities ac-

cordingly. It is thus necessary to think up some false cover task which will seem plausible and yet not tarnish the spontaneity of the processes that are of interest.

One urgent chore must be to tidy up the vocabulary. There are far too many relevant but imprecise words being bandied about indiscriminately. We have words like "exploration," "investigation," "inspection," and "observation." The Russians have at least four good words wasted on one and the same "reflex"—"orienting," "investigatory," "focussing," and "what-is-it?" Still more are constructed by forming compounds, e.g., "orienting-investigatory." Almost every issue of the *Voprosy Psikhologii* and the *Zhurnal Vysshei Nervnoi Deiatel'nosti* contains at least one article using these expressions. Widely used for about 25 years, they were apparently first introduced by Pavlov. But it would require a major work of scholarship to establish exactly where each of them first appeared, hampered by the fact that many of Pavlov's writings are not readily available.

On the other hand, there are a number of quite distinct forms of behavior floating round in the area. They may turn out, in the light of future research, to be manifestations of the same underlying process. But they are logically quite separable, and we might as well use words to distinguish them. There is, for example, the difference between a pigeon that steps on a pedal to turn on a light indicating where he can find food, and the rat that presses a bar to turn on a light that is apparently enjoyed for its own sake. There is the difference between a rat that approaches and inspects a particular object that he sees in the distance, and the monkey that opens a door and is glad to see any entertaining sight that happens to offer itself. There is the difference between a human being who lets his imagination roam, and one who puzzles over a mathematical proof. Are these all the same thing, as Pavlov seemed to think, and as many later writers have a little cavalierly assumed?

Next will come the task of forming a theory or model to sum up and unify all the separate facts that have been accumulated. During the 1930's and the 1940's behavior theorists were, on the whole, content to construct theories in psychological language, using their own brands of "intervening variables," and to eschew neurophysiology, which did not seem to have too much to tell them about the things that were of most concern to them in any case (e.g., 22, 24). Now, things have changed, and the last decade has seen a spate of tremendously important discoveries about the nervous system. These dis-

coveries have come so suddenly and in such numbers that psychologists are certainly not yet in a position to evaluate them and digest them, apart from realizing beyond any doubt that they will have to be reckoned with. The work that is going on in connection with the ascending reticular formation and its associated "arousal reaction" (16), a complex reaction of many components that the Russians have been quick to identify with Pavlov's "orienting reflex" (23), is one line of development that is bound to have heavy repercussions on the study of exploratory behavior.

Lastly, there is the ultimate question that has been unaccountably neglected, perhaps because it has so many possible answers that we are not yet qualified to choose between, namely, the question of the biological utility of curiosity. What does exploration actually achieve for lower animals? Does it help them to learn something about the objects that they inspect, something that they can turn to good account later at times of emergency? Does it enable them to exercise their sensory and neural equipment in a way that is necessary for their continued efficiency? Are they merely making sure that nothing is present that calls urgently for action now? Questions of biological utility are so difficult to settle experimentally and so easy to evade with scientific-sounding but totally unverified speculation. But they will eventually have to be faced. And it will not help to dispose of them hurriedly and anthropomorphically.¹

There is every reason to anticipate a rapidly expanding body of researches on these familiar yet mysterious aspects of behavior. They deserve the attention that is coming their way, not because they form a picturesque and out-of-the-way backwater that psychologists might turn to when they have nothing better to do, but because as long as we are so ignorant about them, there must be serious gaps in our understanding of even those problems that have had most investigation.

¹The writer is aware that alternatives to the Darwinian (or neo-Darwinian) picture of selection have been proposed from time to time. One of the most interesting recent contributions in this vein is that of Dr. Herman S. Forest, expounded in an article in this issue. One of the difficulties in Dr. Forest's suggestion that "biological expansion" should be recognized as an evolutionary principle additional to and distinct from that of survival is, as he admits, that it is hard to define. Moreover, there is, as yet, nothing like the vast body of empirically based theory, with associated mathematical techniques, that is at the disposal of population genetics to explain how features representing higher levels of biological expansion become established, unless they conduce to survival.

Nevertheless, the same problems with respect to exploratory behavior must arise, whatever the form evolution takes. Exploration may seem, at first glance, to promote expansion in many ways. But the precise senses in which it does so need to be carefully worked out in a precise language and subjected to painstaking experimental tests.

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