

*AN ANALYSIS OF THE EXPERIMENTAL  
ANALYSIS OF BEHAVIOR (TEAB)<sup>1</sup>*

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One of the wisest sayings that Plato attributed to Socrates is: "a life unexamined, uncriticized is not worthy of man." I choose to add: "neither is the unexamined and uncriticized scientific work of man worth doing." So precious are the findings of analysis, of probing and proof, and of final synthesis and appraisal, that I prize highly this opportunity of briefly examining with this friendly audience the scientific achievements and the prospects of psychology as promoted by the movement called "The Experimental Analysis of Behavior". The strategy I propose to pursue in this discussion is to inquire into the mutually interpenetrating topics of experimentation, analysis, and behavior, in that order, using TEAB as a point of departure. Understandably, I can present only the roughest kind of sketch, details are minimal, names of persons conspicuously lacking, and only the most outstanding contour lines indicated.<sup>2</sup>

Before I begin my analysis, however, I want to avow my high regard for TEAB as a psychological movement. Without doubt it stands out prominently in the great scientific revolution that has been developing in psychology since the early decades of this century. This evaluation is founded on the assumption that

psychology can be a science only when it concerns itself with confrontable things and events, for example, organisms as they interact with environing objects and conditions. I admire TEAB because its policy is to turn away completely from every form of animistic entity or process whether called "mind", "consciousness", "drive", "sensation", "emotion", or the like.

At the same time I do not overlook the fact that TEAB is or should be a versatile and growing movement, and therefore modifiable in attitude and operation as the changing circumstances of science dictate. Granting that TEAB is well guarded against both overt and covert animistic influences, there still lurks the danger of a constrained scientific horizon limiting observation and analysis to non-human and reflex-derived behavior. An effective science surely demands in addition to sound theory a wide open perspective, that is a profound regard for relevant events. I turn now to a brief examination of:

## TEAB EXPERIMENTATION

I begin my analysis of TEAB experimentation by explaining its significance for psychological science. Since science is primarily the discovery of the characteristics of confronted things and events, great importance attaches to the manipulations aiding this discovery. Manipulative tactics are basic to experimentation. But certainly manipulation by itself is not experimentation. The random handling of things offers little if anything to science. Operations significant for scientific progress must be based upon adequate and correct hypotheses. What elevates TEAB to a lofty scientific position is that it operates with the exemplary assumption that psychological events consist of behavior, and nothing else. An excellent illustration of the necessity and value

<sup>1</sup>Invited address, delivered at the Washington, D.C., meeting of the American Psychological Association before Division 25, on September 3, 1969. Reprints may be obtained from the author, Department of Psychology, University of Chicago, Chicago, Illinois 60637.

<sup>2</sup>I am fully aware of the pitfalls of institutionalizing a number of workers and their activities into a movement, since all groups in the final analysis reduce to individuals, but I claim the sanction of the following facts: (1) the labors of the group members bespeak a common descent from, or at least a definite relationship with conditioning work, (2) the workers use a common vocabulary, (3) the investigators are enrolled under an established name, (4) the existence of a special A.P.A. Division, and (5) the communality implied by the publication of a special Journal. For convenience I shall hereafter refer to the movement as TEAB.

of the coincidence of proper postulation and fitting operation is furnished us by the history of experimental psychology.

Because Fechner, Wundt, Külpe, Ebbinghaus and their followers assumed that they were investigating psychic entities and processes, their work must be considered as nothing more than scientific fumbling. Too great a hiatus existed between their mentalistic postulates and their behavioral operations. The early experimenters treated behavior as incidental, as signs, or indicators of soul or mentality. Behavior, however, was forced upon them, since only behavioral data exist and can be confronted. Aside from their work of recording the responses of their subjects to stimuli, they were obsessed by dualistic delusions. They believed themselves to be studying the manner in which mind or psychic processes manifest themselves by means of bodily actions. Obviously, it is only when operations comport with proper postulations, that we can have authentic science. Proper postulations, of course, are those derived from prior investigations of similar events. So I conclude that TEAB gives us one of the first adequate scientific formulations of experimental psychology.<sup>3</sup>

Let us look now into the origin, scope, and basic strategy of TEAB experimentation. And first we note that there are two primary intellectual sources of TEAB experimentation. Perhaps the one most frequently mentioned is the Pavlovian laboratory studies of reflex conditioning. This work sums up the classical manipulation of adding the stimulus function for a simple reflex response to a second or third object.<sup>4</sup> A second outstanding source comprises the field and laboratory studies of the effects of rewards on the more elaborate performances of various kinds of non-human animals originally inspired by hypotheses derived from Darwinian evolution.

The scope of TEAB experimentation is symbolized by the persistent preoccupation with the conditions of animal learning behavior. A gradual change of scope is marked by

<sup>3</sup>I take this reaction of conjoining proper postulation with fitting operations as an entirely different thing from Pavlov's insistence on simply separating the physiological from the psychic. The latter he did not believe to be in-existent.

<sup>4</sup>Actually the building up of several fields with similar responses and different objects.

the shift in focus from the development of responses, to the search for the capacities of organisms to discriminate objects or visual patterns. While learning studies have been made on many kinds of animals the outstanding ones have been birds, dogs, rats, cats, and monkeys. Here I want to remind you of Titchener's condescending toleration of Watsonian psychology. Titchener was quite willing to let behaviorists dabble with the externalities of infrahuman animals while he was left free to luxuriate in the introspective study of human consciousness.

What I am calling the basic strategy of TEAB experimentation is the elaborate analysis of how reward conditions influence the development and performance of sundry kinds of actions. Undoubtedly, the TEAB movement owes its scientific character to the three factors I have just mentioned. By confining their experimental activities to certain kinds of behavior, TEAB workers maintain psychology as a naturalistic discipline. On the other hand, from the same sources arise two complementary faults, namely, (1) the simplification of all behavior, and (2) the inclination toward specialized patterns of research. As it happens, and this is not a virtue, most of the conditions of behavior are neglected in favor of one kind, that is reinforcement. If it is true that the TEAB movement is inclined to simplify data or to restrict experimentation to particular types of operation it is because it has been so strongly influenced by conditioning. However, we may not regard historical conditioning as anything more than one way of working with a certain kind of behavior performed by certain kinds of organisms. We may not regard conditioning or any other single kind as the necessary and sufficient way to deal with all behavior. To do so means uniformly to reduce all behavior to a single class adaptable to arbitrarily chosen patterns of manipulation and specialized apparatus.

At this juncture, I am most eager to make clear that I do not mention these possible TEAB imperfections by way of depreciation. On the contrary, my aim is to establish a base line for measuring growth and enhancement. Since the TEAB movement has effectively helped to establish the feasibility of an objective and naturalistic psychology by its assiduous study of how non-human organisms behave, is it not reasonable to propose its ex-

pansion to include the free investigation of human organisms? TEAB should not remain merely a specialized science of animal psychology. So important are TEAB methods and postulates that their applications are urgently required for the investigation of all types of adjustments including perceiving, remembering, thinking, and feeling behavior among other classes as performed by organisms of all genera and species. In this connection I believe TEAB should repudiate the mistaken view that it is a virtue to liquidate the traditional categories of psychology as though names were things instead of social constructs. Undeniably, it is reasonable to advocate the abandonment of the conventional names of psychology in the hope of avoiding their mentalistic connotations, but it appears a futile gesture as long as we are enlisted under the banners of psychology or psychonomics. Moreover, discriminative behavior, for example, by any other name will be no less selectional and identifying and no less integrated with sequential consummatory reactions. Once it is determined that certain kinds of behavior occur as, for example, perceiving in learning situations, what is then required is the competent analysis and description of the behavior in question, whatever be its type or complexity.

No devotee of scientific psychology can overlook the fallacious description of perceiving as it is invariably presented in our textbooks and treatises. As we know, those descriptions are based on the provocative question: what takes place between the stimulus and the response? While the worst possible answer is to say some sort of psychic process called "experience", it is not any better to say that what takes place there is some unknown neural process, which is really a psychic surrogate. It is certain that emancipated experimentation demonstrates immediately the flagrant error of separating what is a single integrated reaction of an organism into two parts, a mystical and a bioneural factor. While it is true that a few TEAB workers have ventured to describe perceptual behavior naturalistically, I suggest that a sizable experimental attack would result in an extremely valuable change in the description and interpretation of such behavior. What is true of perceiving is also true of all complex psychological events. Consider memorial behavior. Is it not highly improper

in attempting to eschew the traditional associations of mental particles, or to facilitate manipulations to reduce remembering to memorization, and memorization to retention and storage by means of invented engrams? Is it not plain that we need an experimental analysis of all psychological behavior?

Inevitably, of course, experimentation upon complex human behavior involves tremendous difficulties, as do all important pursuits, but there is no merit or profit in avoiding the hardships of urgent necessities. A trial, at least, might be made, since the scientific rewards are so great. I want to conclude this section of my discourse by some proreptic comments upon the general nature and purpose of experimentation in science.

Experimentation is no more and surely no less than the best means for the discovery of the nature of particular classes of events. Just as certain it is that experimental manipulations are not simply the contrivance of models more or less independently of the properties and relations of objects and conditions. Events and their structures are paramount. Science was not developed in order to manipulate things, to grind out data; rather, experimentation was developed for achieving knowledge about events, and perhaps later to apply that knowledge. It is from this basic fact that the rules and capabilities of science are generated. Events may require a new or enlarged definition of experimentation, one that will encourage its employment wherever it is possible. I mention two of the outstanding rules that are especially relevant for psychology.

Rule one prohibits the placing of limits upon investigation. It is not in the interest of psychological science to inhibit the investigation of intricate events because they resist the application of immediately available techniques. To a considerable extent this attitude exerts an authoritarian censorship on investigation and makes scientific study into a ritual. It is this attitude that encourages the employment of mechanical and electrical analogies, making human beings into machines of various sorts, simple automata or complex computers. In effect, this rule condemns discrimination against events not immediately subject to controlled manipulations. There are two objections to this discriminating attitude, the first of which is that it precludes the future experimental study of such events by exiling

them from the scientific domain. There are many examples of events that originally resisted investigation but only until new instruments and techniques were discovered. An excellent example from biology is the century-old awareness of the organelles called mitochondria, the nature and importance of which had to wait long for the development of the electron microscope and new ideas of biochemistry. The second objection is that experimentation is taken as something else than itself a type of interbehavior, comprising suitable ways of coping with the problems of particular disciplines.

Experimentation rule two warns against the transformation of original events into something simpler or just different to accommodate them to available apparatus, professional conventions, or some other similar circumstance. All such accommodations lead only to fatuous analogies and arbitrary descriptions, for example, speech or language becomes mere verbal utterances, and thinking behavior simple ideation or word association. In general, experimentation is not to be made into a procrustean bed to force events into conformity with prescribed specifications. I am ready now to look briefly at:

### TEAB ANALYSIS

As the title of this paper indicates, it is concerned with two levels of analysis. I distinguish between (1) General Postulational Analysis, and (2) Specific Operational Analysis. General Postulational Analysis classifies as an aspect of the Logic of Science. Consequently it is broader in scope and more rigidly discriminative: its function is primarily monitorial. Specific Operational Analysis by contrast pertains more to the local, technological, and manipulative aspects of scientific work; it functions in particular situations or projects. Though the two levels of analysis can be effectively differentiated there can be no clash between them. In fact, General Analysis consists of the summation and integration of specific analyses. In the present context, General Analysis serves as a criterion for describing and appraising TEAB analysis.

TEAB analysis appears to be primarily a specialized isolation of the variables or factors involved in animal conditioning and learning. Accordingly, the outstanding factors referred

to in the analyses are performance or non-performance, that is extinction. So far as performance is concerned, the analyses turn about such variables as frequency, ratio, latency, and rate. There is thus the suggestion of a mechanistic type of operation, or at best something analogous to the action of a purely physiological organism.

A prominent feature of TEAB analysis consists of studying the effects of varying the intervals for rewarding the performances of the subjects. In this sense, conditions of learning depend a great deal upon the reinforcement schedules arranged by the investigator, and in consequence the actions of the manipulator assume a large place in psychological data. The behavior of the manipulator becomes part of the learning event. To say the least, the total psychological situation becomes highly selective and specialized. Although TEAB analysis has moved far away from the relatively simple standpoint of the physiologist, in nature and scope it still reflects clearly its reflex-conditioning background, as well as the premise that control in science, or at least in psychology, consists of partially substituting contrived situations for original events. Accordingly, the question arises whether despite the great ingenuity and capable resources of individual TEAB workers in dealing with particular problems, TEAB analyses carry far enough to reveal the essential factors in all psychological events. At this point it is well to observe the contrast between (1) analyzing events as they occur and (2) imposing upon events attractive but not intrinsic properties. Restricted analyses imply limited perspectives with the result that all psychological behavior is reduced to events originating in some particular experimental or laboratory situation. Here is one basis for making remembering into memorization, intercommunication into verbal behavior, and reducing all complex adjustments into simple acts simply initiated. Certainly *in situ* observation is underrated and when complex human behavior is not neglected entirely it is only superficially analyzed.

Since it is my purpose in this paper to consider ways and means of enlarging TEAB analysis I suggest that it should be fully alert against building up conditioning tactics into strategies, and particular strategies into psychological principles, and in this way creating

a general bias for a reflex-generated interpretation of all psychological events. I believe it is partially because TEAB analysis halts before complex human behavior which cannot be treated by customary TEAB methods, that so much more or less legitimate opposition to it has been developed. Greatly to be deplored is the impression that until TEAB includes complex human behavior in its analyses it has created a vacuum in the psychological domain or that it has relegated such behavior to the untender mercies of current psychists. Certainly mentalistic psychologists have rushed in to fill the vacuum, for example, the psychoanalysts, the humanists, the phenomenologists, and the personalists.

In sum, then, the needs of a general naturalistic psychology require such elaboration of the TEAB analytic procedure as to greatly multiply the number of factors searched for and described. I propose that TEAB should attempt to disclose the salient components of feeling and emotional behavior, volitional and voluntary actions, the creative processes of imagination as well as the behavior called inventing, thinking, problem solving, and reasoning in whatever situations they are performed. I turn now to:

### TEAB BEHAVIOR

Since all scientific work consists of the investigation of some variety of behavior, all praise to the TEAB movement for emphasizing the experimental analysis of psychological behavior. What deserves constant reiteration, however, is that psychological behavior for TEAB is in no sense an adjunct, an indicator, or a product of cognitive, affective, or conative mentality; it is nothing else than activities of organisms and the conditions under which they behave. To place TEAB behavior analysis into relief and to point to some emendation, I consider briefly five sets of alternative approaches to the analysis of behavior.

#### *Set 1. Organismic Responses or Behavioral Fields*

The first alternative of set one favors variables or factors localizable mainly in the movements or acts of organisms without taking proper account also of contextual features. On the whole, TEAB is much more inclined toward the analysis of responses than behav-

ioral fields, a circumstance influenced by the partial reflex-conditioning origin of the movement. Recall that Pavlov as a physiologist and dualist looked upon conditioning as something pertaining exclusively to the physiological organism. That is why he was not sparing in his invention of causal or explanatory brain structures and functions. Although it is impossible to overlook the decidedly conspicuous stimulus objects, neither he nor his followers have been alert to the actual functioning of stimuli in conditioning situations. It is not surprising, then, that the conditioners could not take into account situational or setting factors aside from the time relations between the organism's contacts with the unconditioned and conditioned stimulus objects. Yet, it is certain that even reflex behavior is not exclusively organismic performances or movements. Organismic activities are only phases of larger adjustmental events. When analyzing reflexes, account must also be taken of what is done by the stimulus object in connection with organismic acts, and still further of many setting factors, that is, enabling and impeding conditions.

Hence, I submit that a careful analysis of reflex conditioning reveals a field of interrelated factors, each of which is a necessary component. Even the simple contiguity of organismic responses and stimulating objects discloses mutuality and interaction. Of extreme importance for the appreciation of behavior fields is their uniqueness and individuality. There is no fixed or universal type. Implied in the field construct is the principle that each class of behavior events must be analyzed according to its intrinsic factors. Certainly complex fields yield upon analysis a larger inventory of factors and very different ones from simpler fields. And it is imperative to be alive to the greater complexity of non-reflex behavior especially the interpersonal aspects of human performances.

Whatever may have been the basis for the inordinate emphasis of responses in TEAB analysis of behavior, whether general biological domination or specific influence of conditioning techniques, I question the propriety of the conventional  $R = f(S)$  formula. Should this not be at least an interactional equation similar to that of a reversible chemical reaction? I submit that even Professor Graham's enlargement of the formula to  $R = f(a, b, c,$

. . . n . . . t . . . x, y, z), which indicates the necessity of considering more factors than the simple  $R = f(S)$ , still symbolizes the traditional over-emphasis of the response factor in psychological events. I have repeatedly advocated the use of the symbol  $R \leftrightarrow S$  which expands to  $PE = c(k, rf, sf, hi, st, md)$ . In the expanded formula,  $c$  indicates the inclusion of all necessary factors,  $k$  the specificity of the factors for particular situations,  $rf$  the response functions,  $sf$  the stimulus functions,  $hi$  the behavioral history of the organism,  $st$  the setting factors, and  $md$  the media of stimulation contacts.

### *Set 2. Stimulus Objects or Interbehavioral Functions*

Our next set of alternatives for behavioral analysis concerns the vexing problem of stimuli and stimulation. I regret to say that TEAB does not probe deeply enough in determining the nature of stimuli. It stops short at the surface notion of a stimulus as simply an object or condition that determines a response. I suggest that while observing behavioral events we must distinguish between objects, stimulus objects, and stimulus functions. Environing things for a neonate are at first simply objects. Such objects correspond only to the random or undirected activities of the neonate, and there is at that period no psychological event or relationship. But as soon as interactions are established between the organism and surrounding objects, those objects take on specific functions while the organism builds up corresponding response functions. An obvious example of the generation of response and stimulus functions may be observed when attractive or aversive functions are developed. Contact with a candle flame is generative of noxious stimulus and response functions. When organisms and objects acquire matching stimulus and response functions a full-fledged psychological situation is engendered. We may then predict what kind of stimulation and responsiveness will be available as between a given organism and object in specific settings. The matching functions constitute specific adjustments. Psychological evolution comprises the development of such adjustments. A comprehensive survey of psychology yields the conviction that only by observing these behavioral distinctions can complex psychological events be adequately

described in a naturalistic manner. I will refer to this point again. In the meantime, I suggest that the assumption of a stimulus being merely an object or condition which generates or reinforces a response is untenable. That construction stands upon a triply stratified foundation of which all three of the strata, even when taken together, are unable to sustain it.

The bottom stratum consists of an entirely false philosophical notion of cause. Stimuli are taken to be prior independent entities or energies that bring about an effect which succeeds it in time. Here the theological assumption of a creative power peeps through.

The next stratum is the biological model of a reflex action. Primarily, emphasis is placed upon the anatomical and physiological properties of tissues which can be forced into action by some sort of excitant. The model here is a biological laboratory preparation.

The uppermost stratum comprises the laboratory tactics of controlling organisms. However effective and useful the control process may be, the gap is wide between animal training devices and the investigative procedures designed to discover the intricate interrelations of the factors in the genesis and later occurrence of psychological events.

Implied in the above analysis of behavior analysis is the unacceptability of the notion that behavior is emissive instead of mutually corresponsive. In the simple reflex the correspondence depends on biological evolution, while in more complex behavior situations there is a psychologically evolved mutuality of stimulus and response functions. In the interest of effective behavior analysis I also question the familiar convention of dependent and independent variables. There seems to be here a confusion of events and constructs. The dependence and independence are not inherent in the events but only in the manipulative procedures of investigators. Behavior analysis can be improved not only by always distinguishing between behavior events and the constructs built upon them, but also by an appropriate use of constructs. For example, it is inappropriate to borrow the terms "independent" and "dependent" variables from the mathematicians and then load them with priority and posteriority, causality and effectuality when the mathematicians simply use the terms in a purely conventional and arbitrary

way to indicate a commutative relationship. Mathematical functions simply imply absolute equivalence of variants and no existential or causal dependence or independence.

### *Set 3. Stimulational Media or Causal Powers*

While discussing the analysis of stimuli I mentioned that only by distinguishing between stimulus objects and stimulus functions could a thoroughly naturalistic psychology be constructed. An excellent illustration of this point is available in the classical analysis of perceptual behavior. In contrast to the conventional analysis, in which light rays or air waves, for example, constitute causal powers for the production of color or tone "experiences", a naturalistic psychology holds that such factors are media or enabling events making it possible for organisms to get into contact with stimulus objects. The conventional putative chain of events consisting of (1) receptorial excitement, (2) impulse transmission, (3) central brain processing, that is production of mental qualities, and (4) the final projection of the qualities to the source of stimulation constitutes a fantastic invention of mentalistic psychology. In pursuance of my aim to enhance the TEAB movement I propose that the analysis of perceptual events among other complex behavior be included in its program.

### *Set 4. Setting Components or Reinforcements*

To undertake behavior analysis is immediately to face the problems of depth of probing, and the direction the probing is to take. To understand the conditions of behavior it is insufficient to limit observations to rewards, instead of seeking for an enlarged spectrum of circumstances. To limit behavior analyses to rewards bespeaks an undue regard for specific kinds of behavior situations. For psychological behavior in general there are obviously many other conditions localizable in and around the organism and its stimuli. For example, the hygiene of the organism, its habituation or past behavioral history, what behavioral circumstances it has recently or just previously passed through, the presence or absence of confining objects and numerous others. In human situations, of course, there are such circumstances as rivalry, compliance,

and competition, as well as the unique needs and desires of the behaving individual. It is a relevant comment here that though anyone can claim the semantic license to refer to every kind of behavior condition by the word "reinforcement", this is certainly not to the advantage of behavioral analysis.

### *Set 5. Organismic Determiners or Organic Components*

As the final set of alternatives for the analysis of TEAB behavior analysis, I suggest a brief glance at the place of muscular movements, glandular secretions, notably hormones, and neural structures and functions in psychological events. Admittedly this item, like some others, concerns the depth to which we probe into behavioral units. However, it is certainly not advisable to pass organismic factors by in silence, since such factors inevitably operate in all psychological behavior with undoubted effects. How elaborate this analysis should be must be decided, of course, on a criterion of sufficiency. While some behavior situations may not require much reference to organismic factors this is surely not the case when a wide spectrum of behavior is envisaged as performed by both human and non-human organisms. What actually do organismic factors do when behavior is occurring? Psychological literature discloses two prominent alternatives. One postulates that organic processes are determiners of psychological behavior while the other regards them as salient components of the response features of interactional fields. The first alternative treats the organic as explanatory constructs while the second regards all organic factors as participants in the response phase of behavioral fields that give shape and support to the behavior patterns. Upon occasion, too, of course, organismic factors constitute stimulus objects and perhaps more frequently they serve as setting factors. Properly to evaluate the place of organic factors in psychological behavior is to add greatly to the advancement of psychological science.

## SUMMARY

Anyone interested in the progress of psychology as a science must acknowledge the importance of the TEAB movement in helping psychology rid itself of its centuries-old domi-

nation by animistic postulates. That TEAB was enabled to contribute to this end may be accounted for by its origin in reflex conditioning and in the study of the behavior development of non-human organisms. It is undeniable, however, that this double origin of TEAB led to some severe limitations as a complete psychology. For example, the extreme emphasis upon non-human behavior resulted in a highly specialized movement with little attention to human behavior. But more serious is the fact that when human behavior is considered it is either fitted into a reflex framework or inadequately treated. There has no doubt been too great stress on the view that non-human experimentation provided laws for all psychological behavior including the human.

It appears not inappropriate, then, to propose such modifications in the TEAB movement as will eventuate in building upon its non-mentalistic foundations a comprehensive naturalistic psychology, covering, in principle at least, all varieties of psychological behavior. Such modifications concern each of the three phases of TEAB, namely, Experimentation,

Analysis, and Behavior. It has been suggested that TEAB experimentation should be expanded to include research on perception, remembering, feeling, and so on, as they occur in human as well as in non-human situations. Analysis should also not be confined to variables in arbitrarily controlled situations but amplified to range over a more generous sampling of psychological events. As to behavior, I have suggested that the interest of a global psychology analysis should not be limited to the factors isolated exclusively from the movements or performances of organisms but must also take account of total behavioral fields. It is proposed that only in this way can we obtain an essential sampling of the effective conditions of behavior and at the same time differentiate between the factors that mediate the behavior contacts of the organism and stimulating objects from the fallacious constructs that lead straight to animistic descriptions. Such a modification of behavior analysis, I believe, will make possible not only the inclusion of complex human behavior in a psychological system but also conform to the basic rules of natural science.