WERE THEORIES OF LEARNING NECESSARY?
A REVIEW OF N. E. MILLER'S NEAL E. MILLER:
SELECTED PAPERS¹

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This book puts in one place a large number of papers selected from those written by one of the most important figures in experimental psychology in the last 50 years. One cannot help but be impressed by the sheer bulk of the volume. Its size is all the more striking when it is realized that only a selection of the papers is included and that none of the three major books to which Miller has contributed are represented. The total bibliography lists about 150 papers, over half of which were published in the last eight years.

But more importantly, almost all of the papers contained in this volume were important and innovative at the time of their original publication. Furthermore, they retain their value as scientific products even by today's considerably more rigorous standards of judgment. Although occasionally the writing style of earlier papers will provoke a tolerant smile from current students of psychology, Miller seems to have been well ahead of his contemporaries in style of experimentation and reporting.

Even more impressive than the bulk or the quality of the research is its remarkable breadth of content. There are few areas of psychology that have not felt the mark of Miller's work. Although one may detect a central interest in learning and motivational processes, it is clear that the work has spread in many directions. These directions include application to human psychopathology (from the earliest work on conflict to the current work on instrumental training of visceral responses), contributions to the nature of reinforcement and drive, investigation of the phys-

iological bases of feeding, reinforcement, and memory, and explorations in the new fields of chemical bases of psychological processes.

This is clearly not the place to attempt a scientific critique of these research contributions. Indeed, few of us are qualified to judge the work in more than a couple of the fields that Miller has pursued. Rather, it seems more appropriate to take the occasion of the publication of this volume to make a few general comments on the research career from which it is sampled. I will comment separately upon Miller's theoretical and his empirical contributions.

Although Miller is commonly identified with one of the theory oriented traditions in psychology, he has engaged extensively neither in general theory building of his own nor in metatheoretical discussions of theory building. Nowhere in his work does one find evidence of aspirations toward the development of a general theory of behavior or even one of learning and motivation. Perhaps the presence of the monolithic Hullian theory was instrumental here; in the 1940s and 1950s that theory seemed to many to be highly successful with only minor revisions being needed, while later the failure of that approach suggested to many that such general theorizing was of limited usefulness. Yet this did not stop many of Miller's contemporaries, such as Spence and Mowrer, from making heavy commitments to theory building. In this regard, it is of interest to compare the current book of papers with that published by Spence in 1960; almost all of the papers in the Spence volume are on primarily theoretical topics, in marked contrast with those of the current volume, which emphasize empirical findings. It was not Miller, but Spence, who took up the task of the development of a general theory of behavior where Hull left off.

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Similarly, Miller has offered no new meta-theoretical notions about either the role or method of developing theories in psychology. Rather, he adopted the philosophy of science of Hull, continuing to use the hypothetico-deductive method and its attendant implications for the role of theoretical constructs. In this context, the comparison can be made between the present volume and *Cumulative Record* published by Skinner in 1961. A primary concern of the latter volume is the metatheory of doing psychology, whereas only two papers in Miller's book touch on such topics. Perhaps it is the absence of either a new general theory or a new philosophy of psychology that has prevented the development of a Miller school of psychology.

Nevertheless, Miller has had some important interactions with behavior theory. These seem to be of several sorts. First, he was one of the early psychologists to begin developing small theoretical schemes to fit particular experimental phenomena. For example, one of his earliest contributions was an account of conflict situations. Here, he explicitly laid out a number of theoretical propositions, containing a limited number of constructs. Although he was attempting to develop a scheme for understanding conflict in a wide variety of settings, the theory was intended not as a complete behavior theory, but as one of conflict.

Several characteristics of this kind of theorizing are instructive. First, each of the limited theoretical constructs introduced was closely and multiply tied to observable behaviors. Repeatedly, throughout his research career, Miller has insisted upon a tight relation between theoretical constructs and behavior. Moreover, he has been unwilling to introduce theoretical constructs unless some economy of description can be gained. In his chapter reprinted from the Koch series, he makes explicit that multiple independent and dependent variables, each tied by experiment to the construct, should precede the introduction of an intervening variable. Indeed, it is just this insistence on multiple ties that resulted in the sophisticated experimental assessment of the notion of hunger drive.

Secondly, the theoretical propositions of this conflict theory were each experimentally testable. Unlike many other theoretical structures from this tradition, for which only the theory

as a whole can really be subjected to experimental test, Miller's close tie with experimentation permitted a very nice assessment of the theoretical propositions separately from one another. In describing this research, Miller displays another characteristic that runs throughout his research—dogged and detailed examination of such testable consequences.

Finally, this miniature theory of conflict represents Miller's most quantitative effort at theorizing. Despite the obsession of the Hullian tradition with quantification of theoretical notions, Miller seemed most interested in those characteristics of his theory that were free of all but the most general quantitative assumptions. This disinterest in quantitative theories is displayed in Miller's lack of involvement in that major, but now primarily defunct, trend in theories of learning, mathematical models. Perhaps again Miller was more foresightful than his contemporaries.

There is a second way, besides this miniature theorizing, in which Miller has made use of and contributed to theorizing. Throughout his work, the Hullian model clearly serves as a backdrop for his thinking. Miller is not committed to any specific set of propositions of the Hullian model, but the general conceptualization, and indeed the vocabulary, pervade his work. As a result, his original notions can be viewed as fitting within the general Hullian framework and elaborating upon it. Good examples are the development with Mowrer of the fear-reduction account of avoidance behavior, and the expansion of drive-reduction to drive-stimulus reduction. But it is clear that little would have changed about these ideas if Miller had elected to use other theoretical vocabularies.

Finally, Miller has served as one of the most outspoken defenders of some aspects of the Hullian scheme, most notably drive reduction. To Miller, this defense represents an explicitly stated strategy of defending a probably incorrect theory with the expressed purpose of encouraging creative experimentation and alternative theorizing. Perhaps his defense becomes too far-fetched and even too reactionary at times for us to believe that this is only a strategy, but one must marvel at the ingenuity with which drive reduction is protected against apparently compromising evidence. Furthermore, surprising new predictions are often forthcoming from this wizened hypoth-

esis. The informational experiments of Egger and Miller, which have had an important impact on our thinking about conditioning, are deduced (albeit with a little sleight of hand), from a drive-reduction approach. And to take an earlier example, Miller's ability to predict and experimentally obtain "sign-gestalt" behavior where Tolman failed was a startling tour de force. Sometimes one suspects that Miller delights in generating the "right results from the wrong theory".

These characteristics of Miller's theorizing are popular with current psychologists. The low-level, situationally determined, theory that serves largely as a tool to encourage research has clearly come to be preferred to the overall theoretical scheme that attempts to provide an account for all of behavior. It is partly this distrust of global and elaborate theorizing that has made Miller's work so acceptable to a wide range of psychologists.

So far, we have talked only of Miller's theoretical contributions; but it can easily be argued that his real contributions to psychology are more experimental in character. Indeed, the selection of articles in this volume, omitting some of the more speculative theoretical works such as the Nebraska Symposium article and emphasizing the empirical papers, suggests that such a view is congruent with Miller's own evaluation. It is pertinent to notice that Miller's career does not reflect the usual pattern of data collection during the early years, followed by theoretical formulations, and ending with more metatheoretical work. Rather, Miller has continued to make primarily experimental contributions throughout his research career.

One of the most interesting characteristics of these empirical contributions is the multiplicity of their sources of motivation. To be sure, many of the experiments are designed as tests of the miniature theories or specific aspects of the more global Hullian theory. But throughout the research one can detect other origins. A good example is the recurrence of an attempt to tie experimental research to human clinical application. In the early work, this showed up as an application of the studies of conflict; indeed, much of that research is explicitly discussed in a context of examples from human life. Equally, the work on instrumental training of visceral responses, which began as a problem of learning theories,

has developed into a problem in the control of neurotic symptoms. Apparently a major goal of these researches is to produce ideas applicable to "relevant" problems. Miller might well serve as an example of how fundamental research can both be guided by and relevant to social problems.

At the other extreme, Miller has repeatedly attempted to tie his psychological constructs to known physiological function. Much of his research can be viewed as an attempt to bind psychology to physiology. It is clear that he views the separation of the two as artificial. In this regard, it is of interest to contrast Miller's approach with that of Skinner. Whereas Skinner has warned of the need for systematic behavioral description before contact with physiological and neurological findings, Miller has instead tried to elucidate behavioral findings using physiological manipulations. He has been willing to be somewhat more casual about the use of such terms as "drive" as both psychological and physiological concepts. Although the difference here is really only one of emphasis, it has generated very different research strategies. While students of Skinner have primarily investigated the behavioral manipulations affecting a few response systems, Miller has selected his independent variables and response systems from a broader range, especially including physiological manipulations. To Miller, the tie of physiology with behavior is an integral part of the discovery of laws of behavior.

This approach has led him to a considerably broader range of research topics. Indeed, the breadth of research topics reflects Miller's explicit desire to apply principles found in one area of science to apparently similar phenomena in other areas. So the breadth is an intentional aspect of the research enterprise.

Apart from the range of apparent motivation for the research, one cannot help but be impressed by the style of the research. Perhaps the most obvious characteristic is its dogged pursuit of multiple aspects of a problem and multiple avenues of attacking it. Miller has shown considerable faith in his own speculations, as indexed by the energy expended in their pursuit. The recent research on instrumental training of visceral responses exemplifies the point. Quite apart from the years spent trying to obtain the initial positive findings, the current work involves an astound-

ing amount of effort exploring the details of these results and attempting multiple extrapolation. Not content with the demonstration that such learning occurs, Miller has demonstrated its susceptibility to discrimination training, avoidance and appetitive training, its response specificity, and the ability to condition a wide variety of such responses. Equally, the early work on conflict and on hunger drive often represents tenacious experimental exploration, pushing the phenomenon and ideas behind them as far as possible. Experimentally, Miller seems able to get a great deal out of a single idea. In some cases, one might suggest that he pushes a problem until it has worn thin.

The results reflect these characteristics of the research endeavor. First, because such a range of aspects of a problem is explored, Miller has been instrumental in the development of a large number of techniques. He worked out techniques for application of electrical and chemical stimulation of the brain, for direct administration of reward to the stomach, for the study of fear motivation, for the mixing of blood systems of different rats, for the classical conditioning of licking, and for the instrumental study of visceral responses, just to name a few. He clearly can be held up as a model for any graduate student of how to develop the techniques you need to study the problem at hand.

But most importantly, his scientific findings have been repeatedly important in the ad-

vancement of psychology and related sciences. Just to name a few experiments that have had an impact on the direction of experimental psychology: the studies of ECS and consolidation processes, the fear and avoidance studies, the initial explorations of the effects of drugs on motivation, the work on brain stimulation as a tool for exploring reward and motivation, the informational experiments in conditioning, the work on conflict and displacement, and the current work on visceral responses. All of these have not only provided important data of their own, they have initiated considerable experimentation by others.

Indeed, the main impression that one obtains from this volume is one of the style of scientific research more than of the particular ideas involved. Miller has shown a willingness to bring any technique he can think of to explore the questions he has asked. He attacks a scientific problem in a systematic and unrestrained way. But it is not so much that Miller has raised new issues as that he has shown the ingenuity and perseverance to answer those issues experimentally. In an important sense, Miller's "firsts" are experimental rather than conceptual.

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