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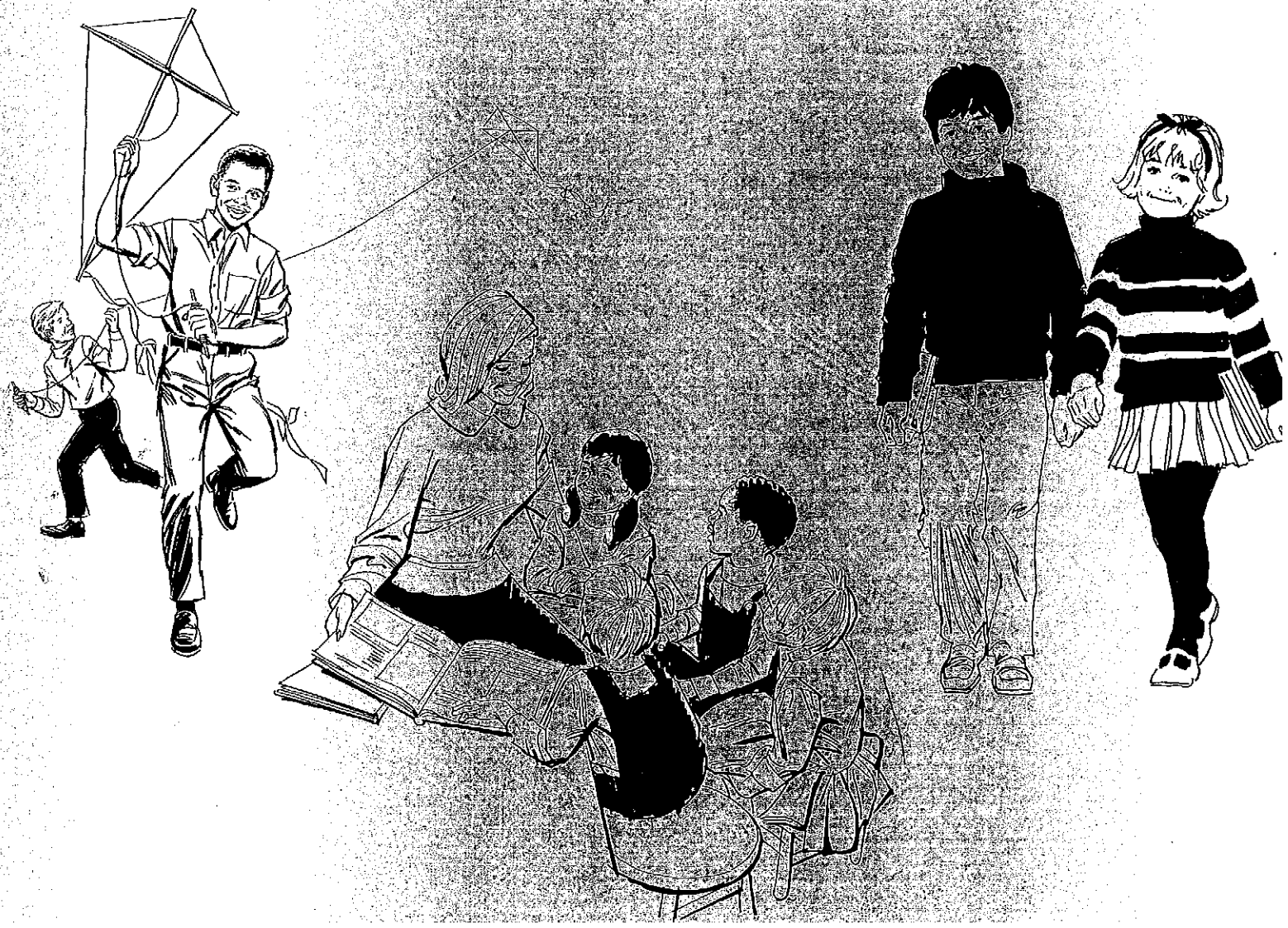

From Theory to Practice: Basic and Applied Research in Psychology[1]

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Psychology is, by definition, the science of human behavior, just as physics is the science of matter and energy and chemistry the science of the composition and properties of substances. As a science of behavior, the ultimate goal of psychology is to further our knowledge and understanding of the behavior of living organisms. It does this by developing rigorous concepts of behavior, by determinining the conditions under which certain behaviors do or do not occur, and by identifying the conditions under which behavioral development is rapid or slow. These aims are accomplished through the methods of observing behavior under natural and laboratory conditions and through controlled experimentation.

As is true of other fields, psychology as a discipline is not a unified whole. It is, rather, composed of a fairly large number of schools of thought that are at times in conflict and disagreement. In fact, the evolution of scientific psychology from its beginnings in the late 1800's until today was probably more of a response to the stimulus of disagreement among psychologists than it was an orderly development stemming from a concerted search for knowledge and understanding.

One of the dimensions along which psychologists can be said to differ is that of basic versus applied research. While the distinction between the two can be -- and should be -- blurred in practice, there are

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nonetheless distinctions that can be made between the two that deserve consideration and appraisal. It is the central contention of this paper that basic and applied research efforts require a symbiotic relationship to maximize their respective contributions to the science of psychology and to the meeting of human needs. Basic and applied research must be mutually supportive. Activity in one area should stimulate and nurture activity in the other.

To clearly separate basic and applied research is difficult, if not impossible. If one were simply to observe the overt behaviors of both applied and basic researchers as they went about their business, they would be essentially indistinguishable. Both types of researchers use the same procedures and go through the same basic steps in experimentation. Perhaps the only way to clearly differentiate between the two is through reference to their research motives, as defined by the goals that each sets for his research efforts. Basic research is primarily aimed at testing, evaluating, confirming, rejecting, or extending concepts, principles, and theories of behavior, while applied research is aimed at developing, evaluating, or improving services for an identified consumer group. This differentiation between the basic and applied researcher can also be expressed in terms of a time frame. The basic researcher is oriented towards the future, and feels little pressure to have his results utilized as or when they are produced. In fact, he usually assumes that others will pick up and use his findings at some later date. The applied researcher, on the other hand, is oriented to the here and now, and his goal is to make positive changes in human services in the short run. He needs immediate service advancements to justify the expense of his research. This attitude is supported, if not demanded, by those that fund his efforts, who must justify their expenditures in terms of improved services.

Returning to the central thesis of this paper namely that basic and applied research should be in a symbiotic relationship, this proposed relationship can be highlighted in terms of several specific examples.

The first example deals with the time lag between a basic research finding and the application of this finding to improved human services. Watson, a basic researcher, reported in 1919 his findings that the limits of human visual sensitivity to color could be measured through labatory conditioning techniques. To quote Watson (1919):

> "We start with any intermediate wave length and by the use of electric shock establish a conditioned reflex. Each time the light appears the reflex occurs. We then increase the length of the wave

> rather sharply and if the reflex appears we again increase the wave length. We finally reach a point where the reflex breaks down, even when punishment is used to restore it -- approximately at 760 millimicrons. This wave length represents the human being's spectral range at the red end. We then follow the same procedure with respect to the violet end (397 millimicrons). In this way we determine the individual's range just as surely as if we had stimulated the subject with monochromatic lights varying in wave lengths and asked him if he saw them" (p. 35-36).

It wasn't until the mid-1960s that this technique was "rediscovered" and put to use to objectively assess the hearing capabilities of difficult-to-test often non-verbal mentally retarded children (Bricker & Bricker, 1969; LaCrosse & Bidlake, 1964; Lloyd, Spradlin, & Reid, 1968; Meyerson & Michael, 1960). Had Watson himself been interested in practical application, or if he had been more closely connected to an applied research effort, then the time lag between this statement of a technique and its application could have been much reduced.

A second example concerns the dependency of applied research on basic research for its methods, principles, and theories. Basic researchers, using primarily infrahuman subjects in laboratory settings, have studied learning and behavior change under a wide variety of conditions. The rigorous concepts and principles that have been developed through their efforts have subsequently been applied to the clinical treatment of mentally retarded and emotionally disturbed individuals. Wolf, Risley, and Mees (1964) reported a classic study exemplifying the successful application of laboratory developed principles to the behavior problems of psychopathology. Their subject was Dickie, the 3 1/2 year old son of middle socio-economic class parents. Dickie had been diagnosed by various professionals as mentally retarded, diffuse and locally brain damaged, and psychotic, with the possibility of phenylpyruvic oligophrenia and hyperthyoidism. He also suffered from cataracts which culminated with the removal of his occluded lenses, making the wearing of glasses mandatory for his continued vision. He did not eat normally, lacked normal social and verbal repertoires, and exhibited severe tantrums that included head-banging, face-slapping, hair-pulling, and face-scratching. Sedatives, tranquilizers, and restraints were all tried with Dickie, without success, and he was admitted to a childrens' mental hospital at age three with a diagnosis of childhood schizophrenia.

To reduce the frequency of Dickie's temper tantrums, the authors used a contingency involving the removal of all reinforcers for a period of time. As the writers pointed out, this technique resembles Ferster and Appel's (1961) technique of time-out from positive reinforcement as an aversive stimulus -- a technique identified and tested in a laboratory setting. A similar procedure was used to remedy Dickie's problem of refusing to remain in bed at night.

Behavior shaping, or the method of successive approximations, was used to get Dickie to wear his glasses, which he had refused to do since his operation. Here the shaping was initiated by reinforcing Dickie for simply picking up, holding, or carrying his glasses. Slowly, by differential reinforcement for successive approximations, he was reinforced for bringing the frames closer to his eyes. Shaping was also used to teach Dickie socially appropriate verbal behavior. The procedure of shaping, which we now find in common practice in educational and training settings, was developed through basic research in a laboratory setting.

The principles and methods used by these authors in the treatment of Dickie's psychopathological behaviors had their origins in basic laboratory research. (Dickie's case had a very happy ending, by the way. Recent information indicates that he successfully entered and attended public school, and that he was recently elected president of his high school class -- not a bad showing in view of the usually poor prognosis for childhood schizophrenia.)

Our third example was chosen to illustrate the manner in which applied research can validate theoretical concepts and principles developed in laboratory settings. Put another way, applied research can test the generality of basic research by showing that the theoretical concepts and principles developed in the laboratory are useful in developing and improving services.

The study of discrimination learning has a very long history in psychology, beginning with the work of Pavlov before the turn of the century. A person is said to be discriminating when he responds in one way to one environmental event and in another way to another environmental event. Thus a child has learned a discrimination when he correctly refers to some animals as "kittys" and to others as "doggies." It has been argued that discrimination learning is fundamental to an understanding of behavior because nearly all behavior can be described as discriminated to certain environmental events. Examples of important discriminated behaviors include stopping at red lights and driving at green lights and, for some of us, entering rooms labeled "Men" and avoiding rooms labeled "Women."

Basic research in the area of discrimination learning has been voluminous, and it is beyond the scope of this paper to present even a brief review of its major findings. Suffice it to say that there is a well established body of principles, concepts, and techniques available that can be used to theoretically account for discrimination learning, and that can be used by the applied researcher as a basis for developing and evaluating new habilitation programs.

An example of such a development can be found in the work of Gold (1972), who bases his applied research on the attention theory of discrimination learning proposed by Zeaman and House (1963). According to these investigators, there are two sequential stages in learning a new discrimination. First, one learns the dimension of the stimulus object that is correct, as defined by leading to reinforcement. Second, one learns which cue within that dimension is correct. In a laboratory study, for example, if a child has to learn that red objects are always incorrect, he would first learn that color is the relevant dimension, as opposed to shape, position, size, etc. Subsequent to this he would learn that red, and only red, is the correct cue within the color dimension. When two stimuli such as red and triangle, from different dimensions are continually paired, the stimuli are said to be redundant. Basic research has established the fact that learning rate increases as the stimuli are made redundant. Gold used this laboratory fact to facilitate the learning of a difficult assembly task by a group of moderately and severely retarded individuals. The task was assembling a 24-piece bicycle brake system. In this study one-half of the subjects worked with the brake parts just as they came from the factory. In this case the shape of the parts were the only relevant stimuli that could be used in the assembly task. The other half of the subjects worked with brake parts that were redundantly cued by painting the surface of each part that was facing the subject when it was placed in the proper position for assembly. For this group, then, both shape and color were relevant and redundant cues. The results of the study indicated that subjects who had to rely on shape alone performed or learned at about half the speed of the subjects who had both shape and color cues to guide their assembly. Thus a principle that was developed through laboratory research suggested an experiment that was conducted in a real-life setting. A simple color-coding procedure doubled the learning and performance rate of retarded people. Studies like this are required to validate the efforts of basic laboratory researchers.

Our final example, which stems from the senior author's ongoing program of research at Western Carolina Center (Bachelder, 1974), highlights the direction and redirection that basic research can and should receive from the applied area. This research effort combines both basic and applied research with an admitted emphasis on the basic end of the continuum.

The available experimental evidence reveals little about the nature of intelligence. It was established some time ago that retarded individuals differ little, if at all, from normal individuals in their performances on basic laboratory tasks. Even when normal-retardate differences are found, it has usually been possible to remediate those differences through training, with the result that normal and retarded persons learn and perform at similar rates on laboratory tasks. Yet, in view of the obvious differences that do exist between normal and retarded individuals in natural settings, the need for a laboratory task that clearly illustrates stable normal-retardate differences is obvious. The memory span paradigm was selected as potentially meeting this requirement.

In the memory span experiment, the experimenter presents a sequence of words to the subject, and the subject's task is to imitate them in the order of their presentation. Individuals have been found to differ markedly in their ability to perform this task. College students, on the average, can easily imitate sequences of six items or more, while retarded subjects often fail on much shorter sequences. In fact, all levels of ability, ranging from near zero to the low normal range, have been observed among our retarded residents and this ability measure correlates highly with IQ scores. Training and practice on this task does not improve a subject's general span ability.

The laboratory work completed to date suggests that when individual differences in span ability are accounted for, all subjects learn verbal materials at approximately the same rate. The implication for classroom practice is clear -- the teacher should present the material to be learned in a way that is consistent with each student's span ability in order for the students to learn at optimum rates.

To illustrate this point, Bachelder (unpublished) studied the ability of retarded children to imitate complex sentences under two conditions. In one condition, the sentences were presented in their entirety, and each subject had to repeat them in their entirety. In the other condition, the sentences were presented in segments, the size of each segment being within the span ability of the subject. The result was that under the whole presentation condition the subjects not only did not learn the sentences, but they became so frustrated that frequently the experimental sessions had to be terminated. This sort of situation likely occurs repeatedly in classrooms, and teachers may conclude that children either do not like to learn or that they are unable to learn, when in fact the problem may lie in the structure of the teacher's presentation.

In the span paradigm a child behaves in characteristic ways when presented with material beyond his span ability. He may not respond at all, he may omit part of the stimulus

sequence, or he may mix up the order of his responses, all of which represent failure to learn -- from the teacher's point of view. It is all too common to conclude, as noted above, that the child is incapable of learning when in fact the teaching methods are faulty. Applied and basic research projects aimed at instructing teachers to recognize when a child has been presented material that is above his span ability and to then restructure the material to fit that individual's ability are currently being planned. Under these conditions all children should learn at optimum rates.

As we noted earlier, applied research should direct and redirect basic research efforts. It is well known that reinforcement and practice have profound effects on the acquisition and transfer of skills. Yet, to date, all efforts to improve span performance through practice and reinforcement have met with failure. This apparent contradiction has led to the development of a new theory about reinforcement, practice, and learning that attempts to reconcile basic and applied research results (Bachelder, 1974). It now appears that reinforcement and practice have effects on the performance and acquisition, respectively, of specific behavioral sequences as, for example, when a child learns his telephone number or when he learns a specific sentence such as "My name is Billy Smith," apparently reinforcement and practice have little or no effect on the child's ability to imitate or generate novel behavioral sequences, however. This conclusion has led to the realization that the psychology of learning has dealt almost entirely with the acquisition of specific sequences that may or may not be relevant to real-life situations, which almost always require the ability to generate novel sequences. This is true in the areas of language development and problem solving where the individual is expected, by definition, to produce novel verbal sequences or to arrive at novel solutions. Thus the laboratory aspects of this research program have been modified and redirected to explore ways in which a retarded person's constant and limited span ability can be applied to the solution of everyday problems. It now appears that the training of specific sequences will play a much smaller role in this effort than it has in other basic and applied research efforts.

We have attempted to show in this paper that a symbiotic relationship between basic and applied research efforts can facilitate the attainment of the ultimate goal of psychology, the understanding of behavior, and at the same time result in improved human services. This can be accomplished by reducing the time lag between laboratory research findings and their application in service settings, by the development of new principles, concepts, and methods through basic research activities, by validating basic laboratory findings through applied research programs, and by directing and redirecting basic and applied research

efforts is to combine them in the same location and in the same research staff. This is the approach that is being taken at Western Carolina Center. We feel that program development and service delivery depends on both laboratory and applied research. Effective human services require the well defined concepts and valid principles that are most efficiently developed under controlled laboratory conditions. Applied research not only establishes the generality and utility of laboratory concepts and principles, but indicates how they can be translated into service and programs. As a consequence, the researcher who is active in both types of research is likely to be a better researcher for his efforts.

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