Attention and Mental Retardation

KENNETH G. CROSBY BURTON BLATT Boston University

"Attention", even as it relates to so restricted an area as the mentally retarded, cannot be treated comprehensively within the confines of this paper. Our discussion is necessarily selective, some aspects of the subject being merely outlined; however, the bibliography (though itself selected) will direct the reader to further exploration of the broader dimensions of the field.

Attention and Distraction

There is a substantial literature on attention, the study of which was begun in psychology as the introspective investigation of a mental faculty or power (see Woodworth & Schlosberg, 1954). Thus Titchener sought to measure "attensity," the clearness or vividness of a sensation achieved by concentrating attention upon it, and from this approach has come the notion of attention as having a focus (or center) and a fringe (or periphery)—like the beam of a flashlight. With the disenchantment with introspection as a source of reliable data, the topic of attention was largely abandoned as such, although the "orienting reaction"-called by Pavlov the "investigatory" or "what-is-it reflex"-by which animals (including man) orient themselves to new stimuli, became a central concept in classical (respondent) conditioning. It has been said that "the 'orienting reflex' is an operationally defined concept which corresponds in part to the conditions of usage of the consciousness-centered concept of 'attention' [Maltzman & Raskin, 1965, p. 10]," though it has not been established that it invariably accompanies attention. The recent revival of the study of attention, however, has been mainly due to the importance in military and industrial technology of tasks requiring vigilance (the monitoring of a stimulus display for the detection of intermittent signals over an extended time period) or responses to simultaneous and competing stimuli, and such study has centered on attending behavior rather than on attention as a mental process or entity (Treisman, 1966).

Because the information-carrying capacity of his nervous system is

limited, man can respond to only part of the stimuli impinging upon him at any given time. He must, therefore, select from these stimuli, and it is this process of stimulus selection that constitutes attention. It may be useful to further conceptualize attention as two subprocesses: scanning or sampling the available stimuli (the stimulus field), and responding to those stimuli which are relevant to on-going activity or the task at hand while inhibiting response to those that are irrelevant. This approach to the study of attention has two advantages: selective responses can be observed and measured without recourse to introspection, and, like all responses, they can be dealt with in terms of the laws of learning. It is difficult to see how the teacher, for example, can manage the attensity of a pupil's experience, but it is possible to manipulate stimuli so as to increase the likelihood of selective response to them. At the same time, this approach need not deny the importance of the neurophysiological processes (perhaps reflecting individual differences or various kinds of impairment) which subserve attention and which, thus, constitute the causal relations between the stimulus-input and behavior-output which are the concerns of psychology. Russian psychologists, much of whose work has an educational focus, have been especially interested in individual differences in the neurally-mediated orientation reaction, which renders the individual more sensitive to incoming stimuli and without which, it is held, conditioning (i.e., learning) cannot occur (see Lynn, 1966). Workers in operant conditioning, on the other hand, have studied the "observing response" which makes available a stimulus display for further response, holding that it represents operant behavior subject to environmental control (see Holland, 1958).

Inseparable from the concept of attention is that of distraction. Early psychologists sought to measure the power of attention by means of the amount of distraction necessary to disrupt it, but these investigations eventually showed that since what is distracting to one individual (in terms of reducing his level of performance on a task to which he is supposed to be attending) may not be distracting to another, there is no such thing as a distractor which inherently has the power to distract, no separate class of stimuli which can be labeled distractors. In response terms, distraction is not a separate class of attending response, but describes attending to task-irrelevant stimuli instead of or in addition to task-relevant ones. Thus, when a teacher describes a child as distractible, he usually means that the child is attending to something-or to many things-other than that to which the teacher would have him attend. When a teacher describes a child as inattentive, he usually means that the child is not attending to the task at hand, and perhaps that he is unaware of the stimuli to which the child is attending. When the child is described as having a short attention span, the teacher may mean either that the child does not attend to all necessary aspects of a situation (all

relevant stimuli in the field) or tht he does not attend to the same task for a sufficient length of time.¹ While attention and distraction are thus often evaluated in terms of the degree to which one individual (e.g., a pupil) conforms to directions given by another (a teacher), the successful meeting of environmental demands requires of any organism a certain level of ability in scanning a stimulus field and selecting those stimuli that are relevant to on-going activity, and a fundamental deficit in this ability could be maladaptive irrespective of particular interpersonal encounters.

Attention, Intelligence, and Retardation

A positive correlation between intelligence and the ability to maintain attention to a task was assumed by most early mental test developers. However, the few studies made of this relationship—while severely limited by the range of performance, age, and intelligence included—have failed to support this position (see, for example, Shacter, 1933). There is, however, general agreement that the ability to sustain attention increases with age. These data notwithstanding, professional opinion, derived from educational and clinical experience, has long identified impairment of attention as a general trait of the mentally retarded, and descriptions of this group commonly mention "inability to concentrate," "distractibility," or "short attention span" as educationally relevant characteristics.

Beyond the attribution of a general, indefinite attentional deficiency to the mentally retarded, at least four theorists have posited specific attention deficits in an attempt to account for certain learning impairments evidenced by retardates as a group. Zeaman and House (1963; Zeaman, 1965) have postulated that a low initial probability of attending to the relevant dimensions (e.g., color or form) of a stimulus display, rather than an inability to learn which cue (e.g., color) of the relevant dimension is correct, is responsible for the impairment shown by retardates in visual discrimination learning. Such a deficit might be understood in terms of the scanning and selection processes mentioned above and, as the authors point out, might lead to behavior characterized as distractible. While their studies have been limited to visual discrimination learning in moderately retarded children, Zeaman and House believe that their attention theory is applicable to other kinds of learning in other kinds of children. On the basis of their own work, O'Connor and Hermelin (1963) have also opined that retardate learning difficulties result from defective acquisition, rather than poor perception, retention, or transfer, and that acquisition is impaired because of an inability to focus attention on relevant stimuli. Again, such inability might well

1. Psychologists use the term "span of attention" to denote the number of units that an individual can perceive in a single perceptual act, the duration of attention to a task being called the "interest span."

lead to behavior called "distractible." Denny (1964, 1966) has attributed the impairment which retardates show in both discrimination learning and incidental learning to an attention deficit. A foremost Russian worker in retardation, Luria (1963), has maintained that the defective orienting reaction of the retarded, which prevents efficient attention to novel stimuli, is responsible for their learning failures.

Apart from any deficiency in attention which might be expected on the basis of a general developmental lag, a number of theories have been proposed to account for an attention deficit in the retarded. Consistent with their psychoanalytic orientation, M. Hutt and Gibby (1965) have opined that attentional defects shown by retardates are a function of their persistent anxiety. Inasmuch as they offer no evidence to support this view, nor is such evidence found elsewhere in the literature (see Heber's 1964 review), it appears that their position is based on an assumption that an impairment of attention necessarily reflects underlying anxiety. Zigler (1066) has suggested that distractibility, rather than being an inherent characteristic of the retarded, results from the outer-directedness which characterizes the problem-solving style of this group. He has provided experimental support for the proposition that the retardate, because of his history of failure when relying upon his own resources, looks to others for problem-solving cues and, through generalization, becomes compelled to try to attend to too many of the stimuli impinging upon him. Adopting a somewhat similar position within the framework of social learning theory, Cromwell (1963) has reviewed evidence for the hypothesis that retardates respond in terms of an external, rather than an internal, "locus of control," and are thus attentive to extratask rather than intratask cues, though he has not applied this conception to the generation of behavior which might be labeled distractible.

Denny (1964, 1966) has concluded that both the attention deficit shown by the retarded and their deficiencies in classical conditioning are manifestations of a more basic inhibition deficit which renders them "stimulus-bound." Workers in the Pavlovian tradition hold that all "higher nervous activity" is characterized by a varying degree of equilibrium between excitatory and inhibitory processes. Luria (1959) has written that a disturbance of this equilibrium in retardates, with excitation predominating, results in an inability to refrain from responding and, thus, produces distractible and impulsive behavior. He has also proposed (1963) that defective cortical functioning in retardates frequently results in an absence of the orientation reaction (OR) to stimuli of low and medium intensity, coupled with a failure to habituate the OR to strong stimuli, so that it continues to be given to such stimuli whether or not they are relevant to the task at hand, thus producing distractibility. Furthermore, due to the dissociation of verbal and motor systems characteristic of the retarded, verbal instruction does not maintain the

OR to moderate stimuli and thus enable the direction of attention by this means, as it does in normal persons.

Goldstein's (1943) theory holds that distractibility is symptomatic of the impairment of abstract attitude, found in retardates and schizophrenics as well as in persons with known cortical damage, whereby the individual's attention is continually and passively shifted from one stimulus to another in order to avoid an inadequate response which might precipitate the catastrophic reaction. An alternative kind of protection is afforded by perseveration, in which attention is maintained to a stimulus to which an adequate response can be made; the means of defense adopted depends upon the characteristics of the situation. Building on Goldstein's work with adults and extending it to children but, unlike Goldstein, limiting their theory to so-called brain-injured retardates, Strauss and Lehtinen (1947) distinguished two aspects of distractibility: a forced, passive responsiveness to irrelevant stimuli, and an instability or abnormal fluctuation of figure and ground in perception. They also emphasized the disinhibition produced by injury to the cortex. In a further development of the theory, Strauss and Kephart (1955) reformulated distractibility as an inability to structure or integrate the elements of perceptual and goal fields, due to a disturbance of the "patterning activity" of the brain, whch, in their view, is also organized on the basis of figure and ground. Schulman and his co-workers (1963) originally ascribed distractibility to an abnormality of control or inhibition, but in a later report (1965) they attributed such behavior to a disruption of neural integration.

While much remains to be learned, a good deal is now known about the neural substrate of attention, in which a central role is played by the brainstem reticular formation, with its connections to and from the sensory pathways and the cerebral cortex. Hernández-Péon (1966a,b) has shown that, during attention to a stimulus, sensory impulses evoked by the stimulus are facilitated, while other sensory input is inhibited. These effects are mediated by the reticular formation, and they occur whether the subject attends to an external stimulus or concentrates on an idea or memory. Finding abnormalities in the electroencephalographic records of retardates during attention tasks, Hernández-Péon has concluded that the cortico-reticular mechanisms necessary for initiating and maintaining attention are defective in such persons.

Many psychological theories employ the construct of a "stimulus trace" to account for effects (e.g., immediate memory) which persist beyond the duration of an objective stimulus. The increased latency and diminished amplitude in evoked potentials recorded by Hernández-Péon could be interpreted in terms of an impoverished stimulus trace, and Ellis (1963) has proposed that a deficit in intensity and duration of the trace may account for some of the acquisition impairment shown by retardates in learning tasks, particularly that attributable to processes involving short-term as contrasted with long-term memory. A related proposition is that retardates are less responsive than normal individuals to stimuli of relatively low intensity and short duration as stated by Berkson (1963) and Karrer (1966). As noted above, Luria (1963) has also reported deficient responsibility in retardates, in the form of an absent or diminished orienting reaction to low and medium intensity stimuli.

Berkson has related the responsivity deficit of the retarded to the diffuse, rather than focal, brain pathology commonly found in this group, and has raised the possibility that diminished reactivity may be a function of abnormality in the reticular formation. Lindsley (1957) has also speculated that retardates may suffer from dysfunction of the reticular activating system, with concomitant disruption of normal arousal and activation processes. A long series of animal studies by Windle and coworkers (for summaries see Windle 1966a,b) suggest some support for these hypotheses. Although not mentioned by the investigators, the diminished responsivity to the environment shown by brain-injured children tested in a free-field situation (C. Hutt, S. Hutt, & Ounsted, 1965) strikingly resembles the diminished responsivity of Windle's asphyxiated monkeys in the same circumstances (Saxon, 1961). Rosvold (1967), reviewing a number of lines of evidence from both human and animal investigations, has suggested that the parts of the brain involved in retardation are probably diffuse, deep-lying, integrating structures, rather than cortical, and that at least some types of retardation may be due to dysfunctions in the activating pattern of the brain. It would appear that there is some neurological as well as behavioral evidence of the existence of impaired responsivity in at least some retardates.

Research on Attention in the Retarded

Despite the obvious educational importance of an alleged attentional deficit in the mentally retarded, the problem has not been adequately investigated. Using incidental learning as a measure of responsiveness to extraneous stimuli, Golden (1956) found no significant differences between normal, endogenous retarded, and exogenous retarded children of equal MA. Incidental learning appears to be inappropriate as a measure of distractibility, however, since the latter implies an inability to maintain attention long enough for learning to occur; Denny (1966) has attributed the impairment which retardates show in incidental learning situations to just this kind of attention deficit. Ellis *et al.* (1963) studied oddity learning in retarded and normal children, using test objects previously scaled for attention value, the theory being that high-interest objects would be distracting during the test. Although an analysis of variance showed neither main effect nor interaction with object attention value to be significant, the investigators concluded from performance

curves that high attention value seemed to facilitate normals and impede retardates toward the end of training. It may be that the range of attention value of the objects employed in this interestingly conceived study was insufficient to test distractibility, and the hypothesis that "the uniqueness of stimuli reaches some optimal value in terms of discriminability and, as they assume more characteristics beyond this, the added features serve to distract [p. 577]" seems worthy of further study. Uninterpreted by the investigators was the finding that the presence of a mirror during testing facilitated the performance of the normal children but had no efffect on the retardates.

One of the authors of the preceding study, Jones (1964), found that, contrary to prediction, the performance of so-called familial retarded but not that of brain-damaged retarded or normal children was impaired when they copied geometric designs while distracted by flashing lights. It may be questioned, however, that a complex visual-motor task, which itself involves many variables, is suitable for identifying distraction effects. Furthermore, in this study as in many others, the distraction employed was not meaningfully related to the performance. Extraneous stimuli that are meaningfully related, though irrelevant, to the task at hand are more distracting than those not so related, and meaningful distraction would appear to be more pertinent to the educational situation. There would seem to be an important distinction, for example, between a child who is distracted from his reading by an occasional loud noise or sudden flash of light, and one who is distracted by the oral reading of another or by other words on the page he is reading. Additionally, many studies have failed to consider the fact that, since continuous distractors are habituated, intermittent ones have more effect, and that this effect is mainly evident on tasks requiring sustained rather than shortterm performance (Woodworth & Schlosberg, 1954).

Two studies of vigilan9ce performance by retardates have been reported. Semmel (1965) found that retarded children showed a significant decrement during the first 20 minutes of a one-hour watch, while normal children of the same chronological age showed no significant decrement until after 40 minutes. This finding is potentially important, for such a deficit could confound the effects of treatments requiring sustained attention over an appreciable period, but whether it represents merely a low-MA deficit is undetermined, since no MA comparison group was used. Ware *et al.* (1962) employed no comparison groups but reported that the performance of teen-age retardates on a 3-hour task did not differ significantly from that of normals previously studied under the same conditions, except that knowledge of results (i.e., informing the subject of missed signals) did not eliminate a significant decrement over time in retardates as it did in normals.

While the investigations mentioned above have compared retarded and

normal individuals, a number of workers have studied attention and distractibility in retardates alone, the favorite "target" being brain-damaged vs. non-brain-damaged performance. Frequently cited in the literature is the study by Cruse (1961) who found that non-meaningful distraction did not significantly increase reaction time (RT) to a light stimulus in either brain-damaged or familial retardates. Those of the braindamaged group with a more determinate diagnosis, however, were slower than familials in the absence of the distraction condition, and this fact appears to have been unjustifiably interpreted by Cruse and others as indicating inherently greater distractibility in these subjects. The slower RT of brain-damaged retardates had been previously demonstrated (Bensberg & Cantor, 1957). More important, RT appears to be an inappropriate criterion variable for the study of distractibility, since the ability to maintain attention during the short interval between a ready signal and a stimulus is not equivalent to the ability to sustain attention over an appreciable period of time, and distraction, again, has been shown to effect mainly the latter kind of performance. Pascal (1953) reported that the RT of a heterogeneous group of retardates to a light stimulus was increased by a loud noise, the increase being negatively correlated with MA and CA, though adaptation was rapid.

Gallagher's (1950) study has been cited by Cruse and others as supporting the hypothesis that brain-damaged retardates are more distractible than familial ones, but actually the only data on distractibility in this investigation came from a single item on a behavior rating scale, on which six teachers, rating from two to nine children each, rated braindamaged children more distractible than non-brain-damaged ones. Cromwell and Foshee (1960) found no differences between "organic" and familial retardates on a card-sorting task with or without non-meaningful distraction. Schlanger (1958) reported that the performance of brain-damaged retardates on an auditory word discrimination test was not impaired by non-meaningful auditory distraction. Schulman and his co-workers (1963,1966) have attempted to develop objective measures of distractibility in brain-damaged retardates, but these tests actually involve such complex and unspecified variables as to render performance on them uninterpretable.

Brown and Clarke (1963) found that the object-naming performance of educable retardates was disrupted by meaningful rather then meaningless auditory distraction, while the performance of severely retarded individuals was impaired by either condition, leading the investigators to suggest that training of the latter group might best be conducted in silence. In subsequent studies Brown (1946b) found no difference between brain-damaged and non-brain-damaged retardates in copying designs under visual distraction. Distractibility was positively correlated with early institutionalization, a finding in agreement with Zigler's

hypothesis, but the appropriateness of the criterion variable may again be questioned. A similar correlation with institutionalization was obtained in another study (Brown, 1964a) employing object counting with meaningless auditory distraction. Large verbal-performance IQ discrepancies appeared to be associated with distractibility, but two further experiments failed to support hypotheses derived from this observation. Meaningful distraction was again shown to be more disruptive of performance. Although initial performance on the animal-naming task employed in the final experiment was not correlated with IQ, the correlation increased with trials, leading Brown (1966) to conclude (from 16 significant r's out of 36) that low intelligence was associated with high distractibility over the experiment as a whole. While adaptation to the continuous distraction used was rapid, Brown noted that the disruption was most evident during the initial learning stage and that even greater impairment might be expected under the intermittent type of distraction commonly found in training situations. Finally, Brown's data, as he has pointed out, fail to support the proposition that brain-damaged retardates are more distractible than non-brain-damaged ones, or that there is necessarily a correspondence between the brain-damaged label and distractibility.

The delayed response (DR) task, frequently used to measure a kind of attention in animals, especially those with cerebral lesions, was employed by Baumeister and Ellis (1963), who found that the performance of a heterogeneous group of retardates improved under non-meaningful visual distraction. The investigators interpreted this result as support for an arousal hypothesis (i.e., that the extraneous stimuli maintained alertness during testing), as well as being contrary to the notion that the learning of retardates is impaired by their distractibility. Of crucial importance in this study, however, is the fact that the DR trials were subject-paced: the subject pressed a button to start each trial. While this procedure was intended to force the subject to attend to the DR display, it also necessarily permitted him to attend when he was ready to do so, such as between periods of attention to the distractor. A test of sustained attention, on the other hand, requires an experimenter-paced task to which the subject must attend not intermittently as he is ready, but continuously as he is directed. Safford (1966), also interested in an arousal hypothesis, administered 16 different tests to a heterogeneous group of retardates in distracting and distraction-free environments. While 13 of 15 significant comparisons favored the hypothesis that performance would be facilitated by increased stimulation, 49 of the total 64 comparisons failed to reject the null hypothesis. In general, and as might be expected, immediate memory and visual-motor performance were unaffected by distraction, performance on tests of fine motor coordination and speed were either unaffected or facilitated, and performance on tests of higher cognitive processes was impaired.

In factor analyses of the Wechsler Intelligence Scale for Children (WISC), Baumeister and Bartlett (1962) found a factor in the performance of retarded but not normal children which seemingly had to do with immediate memory and which they interpreted in terms of stimulus trace. Osborne and Tillman (1967) have recently reported another factor analysis of WISC scores, using younger children, in which they also found a factor unique to the retardates, but which seemed to involve attention rather than memory and which they labeled "freedom from distractibility." There need be no contradiction between these two conceptions; in animal studies, in particular, one investigator has called "attention" what another has called "immediate memory." It is obvious that attention is crucial to learning, and apparently some difficulty in this area is reflected in retardate WISC performance.

As this necessarily brief review indicates, studies of attention and distractibility in retardates have yielded inconsistent results, which is not surprising in view of the variety of definitions, subjects, tasks, and methods employed. Very few investigators have compared retarded and normal children, avoided the confounding of retardation and institutionalization by studying noninstitutionalized retardates, employed appropriate criterion variables, used tasks which definitely required sustained attention, utilized meaningful distraction, or derived their procedures from a theoretic rationale. There is some evidence, from the work of Brown and from Brown and Clarke, that for optimally effective training meaningful distraction should be minimized, especially during the early stages of learning and particularly with more severely retarded subjects. There is little evidence that there is any necessary correlation between brain damage and distractibility, nor is there support for the proposition that retardates so labeled necessarily require a different educational methodology. Insofar as distractibility is relevant to educational processes, it is its presence or absence in behavior with which the educator must be concerned. Though no one would deny that attention is a crucial variable in learning, the question of whether mentally retarded children are less able to sustain attention to a task and are more susceptible to distraction by extraneous stimuli than non-retarded children remains unanswered²

Implications for Educational Practice

Where does this leave the teacher of the retarded? What has been the impact of the aforementioned theories and research on educational practice? Probably, on the whole, very little—but this is not necessarily to be regretted. Most teachers are doubtless aware of Strauss and Lehtinen's injunction to reduce extraneous stimulation in the learning environment

2. One of the present writers (Crosby) is currently studying this problem.

of the brain-injured retardate, but as a procedure to be applied to all children so labeled this admonition has little experimental support and its adoption has seemed premature. Ellis (1963), whose own stimulus trace theory has obvious implications for teaching (regarding temporal relations in presentations, for example), has specifically cautioned against the precipitate application to the classroom of laboratory findings, let alone the application of unconfirmed hypotheses. As Zeaman and House (1963) have pointed out, however, many of Strauss and Lehtinen's methods have the end function of directing the pupil's attention to relevant stimuli and thus may be helpful, regardless of the adequacy of their theoretical base, insofar as they enable the teacher to manage the learner's attention. Zeaman and House's own theory, of course, holds that this management of attention is the crucial aspect of training and, certainly, many teachers, whether or not they have ever heard of this theory, devote major efforts to this end. Techniques to increase the attention value of stimuli and augment the prominence of relevant cues (e.g., using 3-dimensional stimuli and kinesthetic presentations, employing more than one sensory modality) are consistent with this theory, as is the practice of proceeding from easy to difficult discriminations. Whether or not some fundamental attention deficit not found in the normal child exists in the retarded is, after all, irrelevant to the teacher insofar as his task is always to improve the efficiency of stimulus scanning and selection. The elucidation of a specific deficit might further emphasize the need for attempting management and even suggest remedial strategies, though the cynic could state, with some justification, that the acknowledgement of a special defect has too often been accompanied by an abandonment of efforts to surmount it.

In seeking means of increasing the attention value of presentations, the teacher may secure some general help from experimental psychology, especially the research findings on the determinants of attention to advertising displays (see Woodworth & Schlosberg, 1954). So-called stimulus variables thus identified have included size, intensity, color, figureground contrast, repetition, position, and motion, which is to say that the larger the display, the more intense the stimulus, and so on, the greater the likelihood that it will be selected for attention. It is important to note, however, that these factors have relative rather than absolute values: doubling the size of a display, for example, does not necessarily double its attention value, which will also be dependent upon the other stimulus variables involved. The attention value of any stimulus, in other words, is complexly determined, not a simple function of any one factor or sum of factors. Furthermore, learning probably plays a part in determining the attention value of these factors, even though the term "stimulus variable" seems to imply some quality inherent in the stimulus itself. Novelty, for example, though sometimes labeled a stimulus variable,

obviously depends upon the observer's history as much as it does upon the stimulus. Again, in our culture the upper-left quarter of a page receives most attention, but it seems unlikely that this would obtain in cultures with different styles of written language. Thus, the classification of attention determinants as stimulus variables or subject variables such as past experience, interest, emotional appeal, or set—is not clearcut. Rather than trying to separate input, central, and output variables (which may not be possible in the first place, since all measures involve complexly-determined responses), it may well be more useful to simply investigate the characteristics of stimuli to which responses are made and the conditions under which these responses occur. Surely the crucial point for education is that attention as stimulus selection is, at least within rather broad limits, a learned response and therefore susceptible to manipulation by the teacher.

In the simplest paradigm, the learner is confronted with a number of stimuli and the teacher wishes him to select one of them. The teacher may conceptualize this process in terms of reinforcement theory or operant conditioning-employing such constructs as deprivation state, discriminative stimuli, differential reinforcement, generalized reinforcers, reinforcement history and contingencies, and extinction-or he may conceptualize it in more traditional fashion in terms of basic needs, desires for competency, exploration, novelty, self-image, timespace orientation, or cultural expectancies. In practice, most teachers probably use a combination of these, though it can be argued that the more systematic the approach, the more effective it is likely to be. Different workers find different conceptual schemes most useful, as do the authors of this paper. In the end, however, the pupil's attention (or what the teacher can know of it) is behavior: the selective response to a stimulus. In this area, as in others, mentally retarded pupils may display inadequate behavior, and it is the teacher's job to try to generate, through the deliberate and creative application of his methods, more adequate behavior. This, it would seem, is the most important lesson for the educator to glean from current theory and research on attention in mental retardation.

References

- Baumeister, A. A., & Bartlett, C. J. Further factorial investigations of WISC performance of mental defectives. American Journal of Mental Deficiency, 1962, 67, 257-261.
- Baumeister, A. A., & Ellis, N. R. Delayed response performance of retardates. American Journal of Mental Deficiency, 1963, 67, 714-722.
- Bensberg, G. J., & Cantor, G. N. Reaction time in mental defectives with organic and familial etiology. American Journal of Mental Deficiency, 1957, 62, 534-537.
- Berkson, G. Psychophysiological studies in mental deficiency. In N. R. Ellis (Ed.), Handbook of mental deficiency. New York: McGraw-Hill, 1963. Pp. 556-573.

- Brown, R. I. Distraction in subnormals. In J. Oster (Ed.), Proceedings, International Copenhagen Congress on the Scientific Study of Mental Retardation, 1964. Copenhagen: Danish National Service for the Mentally Retarded, 1964. (a)
- Brown, R. I. The effect of visual distraction on perception in subjects of subnormal intelligence. British Journal of Social and Clinical Psychology. 1964, 3, 20-28. (b)
- Brown, R. I. The effects of extraneous auditory stimulation on learning and performance. American Journal of Mental Deficiency, 1966, 71, 283-290.
- Brown, R. I., & Clarke, A. D. B. The effects of auditory distraction on institutionalized subnormal and severely subnormal persons. *Journal of Mental Deficiency Research*, 1963, 7, 1-9.
- Cromwell, R. L. A social learning approach to mental retardation. In N. R. Ellis (Ed.), Handbook of mental deficiency. New York: McGraw-Hill, 1963. Pp. 41-91.
- Cromwell, R. L., & Foshee, J. G. Studies in activity level: IV. Effects of visual stimulation during task performance in mental defectives. *American Journal of Mental Deficiency*, 1965, 60, 248-251.
- Cruse, D. B. The effects of distraction upon the performance of brain-injured and familial retarded children. American Journal of Mental Deficiency, 1961, 66, 86-92. (Reprinted in E. P. Trapp & P. Himelstein (Eds.), Readings on the exceptional child. New York: Appleton-Century-Crofts, 1962. Pp. 492-499.)
- Denny, M. R. Learning and performance. In H. A. Stevens & R. Heber (Eds.), Mental retardation: A review of research. Chicago: University of Chicago Press, 1964. Pp. 100-142.
- Denny, M. R. A theoretical analysis and its application to training the retarded. In N. R. Ellis (Ed.), *International review of research in mental retardation*. Vol. 2. New York: Academic Press, 1966. Pp. 1-27.
- Ellis, N. R. The stimulus trace and behavioral inadequacy. In N. R. Ellis (Ed.), Handbook of mental deficiency. New York: McGraw-Hill, 1963. Pp. 134-158.
- Ellis, N. R., Hawkins, W. F., Pryer, M. W., & Jones, R. W. Distraction effects in oddity learning by normal and mentally defective humans. *American Jour*nal of Mental Deficiency, 1963, 67, 576-583.
- Gallagher, J. J. A comparison of brain-injured and non-brain-injured mentally retarded children on several psychological variables. *Monographs of the Society for Research in Child Development*, 1957, 22 (2, serial no. 65).
- Golden, B. A comparison of the distractibility of intellectually normal and mentally retarded subjects. (Doctoral dissertation, University of Illinois) Ann Arbor, Mich.: University Microfilms, 1956. No. 18140.
- Goldstein, K. Concerning rigidity. Character and Personality, 1943, 11, 209-226.
- Heber, R. Personality. In H. A. Stevens & R. Heber (Eds.), Mental retardation: A review of research. Chicago: University of Chicago Press, 1964. Pp. 143-174.
- Hernández-Péon, R. Attention, sleep, motivation, and behavior. In P. Bakan (Ed.), Attention. Princeton, N.J.: Van Nostrand, 1966. (a)
- Hernández-Péon, R. Physiological mechanisms in attention. In R. W. Russell (Ed.), Frontiers in physiological psychology. New York: Academic Press, 1966. (b)
- Holland, J. G. Human vigilance. Science, 1958, 128, 61-67. (Reprinted in D. N. Buckner & J. J. McGrath (Eds.), Vigilance: A symposium. New York: McGraw-Hill, 1963. Pp. 247-264. And in R. Ulrich, T. Stachnik, and J.

Mabry (Eds.), Control of human behavior. New York: Scott, Foresman, 1966. Pp. 53-64.)

- Hutt, C. Hutt, S. J., & Ounsted, C. The behavior of children with and without upper CNS lesions. *Behavior*, 1965, 24, 246-268.
- Hutt, M. L., & Gibby, R. C. The mentally retarded child. (2nd ed.) Boston: Allyn & Bacon, 1965.
- Jones, R. W. Cross-sectional views of visual reproduction and the effects of distraction on visual reproduction by brain-damaged retardates, familial retardates, and normal children. (Doctoral dissertation, University of Miami) Ann Arbor, Mich.: University Microfilms, 1964. No. 6408838.
- Karrer, R. Autonomic nervous system functions and behavior: a review of experimental studies with mental defectives. In N. R. Ellis (Ed.), International review of research in mental retardation. Vol. 2. New York Academic Press, 1966. Pp. 57-83.
- Lindsley, D. B. Psychophysiology and motivation. In M. R. Jones (Ed.), Nebraska symposium on motivation. Vol. 5. Lincoln, Neb.: University of Nebraska Press, 1957. Pp. 44-105.
- Luria, A. R. Experimental study of the higher nervous activity of the abnormal child. Journal of Mental Deficiency Research, 1959, 3, 1-22. (Reprinted in N. R. Ellis (ed.), Handbook of mental deficiency. New York: McGraw-Hill, 1963. Pp. 353-387.)

Luria, A. R. The mentally retarded child. Oxford: Pergamon, 1963.

- Lynn, R. Attention, arousal, and the orientation reaction. Oxford: Pergamon, 1966.
- Maltzman, I., & Raskin, D. C. Effects of individual differences in the orienting reflex on conditioning and complex processes. *Journal of Experimental Re*search in Personality, 1965, 1, 1-16. (Reprinted in P. Bakan (Ed.), Attention. New York: Van Nostrand, 1966. Pp. 95-121.)
- O'Connor, N., & Hermelin, B. Speech and thought in severe subnormality. New York: Pergamon, 1963.
- Osborne, R. T., & Tillman, M. H. Normal and retardate WISC performance: an analysis of the stimulus trace theory. American Journal of Mental Deficiency, 1967, 72, 257-261.
- Pascal, G. R. The effect of a disturbing noise on the reaction of mental defectives. American Journal of Mental Deficiency, 1953, 57, 691-699.
- Rosvold, H. E. Some neuropsychological studies relevant to mental retardation. In G. A. Jervis (Ed.), *Mental retardation: A symposium*. Springfield, Ill.: Thomas, 1967. Pp. 167-185.
- Safford, A. L. The effects of distracting stimuli upon mentally retarded minors in the performance of different kinds of tests. (Doctoral dissertation, University of Southern California) Ann Arbor, Mich.: University Microfilms, 1966. No. 66-11586.
- Saxon, S. V. Differences in reactivity between asphyxial and normal rhesus monkeys. Journal of Genetic Psychology, 1961, 99, 283-287.
- Schlanger, B. B. Results of varying presentations to brain-damaged children of an auditory discrimination test. American Journal of Mental Deficiency, 1958, 63, 464-468.
- Schulman, J. L., Kaspar, J. C., & Throne, F. M. Brain damage and behavior. Springfield, Ill.: Thomas, 1966.
- Schulman, J. L., Throne, F. M., Kaspar, J. C. & Brown, J. W. Studies on the behavioral correlates of organic brain damage. In O. Stur (Ed.), Proceedings of the Second International Congress on Mental Retardation, Vienna, 1961. Pt. II. Basl: S. Karger, 1963. Pp. 76-82.

- Semmel, M. I. Arousal theory and vigilance behavior of educable mentally retarded and average children. American Journal of Mental Deficiency, 1965, 70, 38-47.
- Shacter, H. S. Intelligence as a causal factor determining differences in sustained attention in preschool children. *Journal of Applied Psychology*, 1933, 17, 478-488.
- Strauss, A. A., & Kephart, N. C. Psychopathology and education of the brain-injured child. Vol. II. New York: Grune & Stratton, 1955.
- Strauss, A. A., & Lehtinen, L. E. Psychopathology and education of the brain-injured child. New York: Grune & Stratton, 1947.
- Treisman, A. Human attention. In B. M. Foss (Ed.), New horizons in psychology. Baltimore: Penguin, 1966. Pp. 97-117.
- Ware, J. R., Baker, R. A., & Sipowicz, R. R. Performance of mental deficients on a simple vigilance task. American Journal of Mental Deficiency, 1962, 66, 647-650.
- Windle, W. F. An experimental approach to prevention or reduction of the brain damage of birth asphyxia. Developmental Medicine and Child Neurology, 1966, 8, 129-140. (a)
- Windle, W. F. Role of respiratory distress in asphyxial brain damage of the newborn. *Cerebral Palsy Journal*, 1966, 27, 3-6. (b)
- Woodworth, R. S., & Scholsberg, H. *Experimental psychology*. (Rev. ed.) New York: Holt, Rinehart & Winston, 1954.
- Zeaman, D. Learning processes of the mentally retarded. In S. F. Osler & R. E. Cooke, (Eds.), *The biosocial basis of mental retardation*. Baltimore: Johns Hopkins Press, 1965. Pp. 107-127.
- Zeaman, D., & House, B. J. The role of attention in retardate discrimination learning. In N. R. Ellis (Ed.), Handbook of mental deficiency. New York: McGraw-Hill, 1963. Pp. 159-223.
- Zigler, E. Personality structure in the retardate. In N. R. Ellis (Ed.), *International review of research in mental retardation*. Vol. 1. New York: Academic Press, 1966. Pp. 77-108.