Attention: Its Meaning and Its Control in the Classroom

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ATTENTION: ITS MEANING
AND ITS CONTROL IN THE CLASSROOM

by

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INTRODUCTION

Everyone knows what attention is. It is the taking possession by the mind, in clear form, of one out of what seem several simultaneously possible objects or trains of thought. . . . An education which would improve this faculty would be the education par excellence. But it is easier to define this ideal than to give practical directions for bringing it about.

William James, 1890.

Pardon the way that I stare,
There's nothing else to compare,
You're just too good to be true,
Can't take my eyes off of you.
Popular Ballad, 1968.

For many generations the control of another's attention has been the fantôme désir of teacher (and parents, and spouses, and single girls). The association of attention with learning in school is especially firm and long standing. Yet the supportive data and the integrative theory for the concept of attention are to be found, not in the literature of education, but in that of psychology.

In the late 19th and early 20th centuries, attention was seen as one of the core problems in psychology. In 1866, Helmholtz theorized a lawful connection between attention and motivation:

We are not in the habit of observing out sensations accurately, except as they are useful in enabling us to recognize external objects. On the contrary, we are wont to disregard all those parts of the sensations that are of no importance so far as external objects are concerned (p. 155).

But, his contemporaries and successors gave divergent interpretations to this relationship. The functionalists thought of attention as an active process in which the mind took possession of the object or stimulus. James (1890) saw this "voluntary faculty" as "the very root of judgment, character, and will" (p. 449). The structuralists...
identified attention with "the clearness of conscious contents" (Bakan, 1966, p. 64), that is, with the clarity of the stimulus to the senses: its intensity, form, temporal relations, movement, and novelty. Thus, Titchener (1910) sought to measure "attentivity," the vividness of a sensation achieved by concentrating attention on it.

With the general disenchantment with introspection as a reliable source of knowledge, the topic of attention was largely abandoned as such, although the orienting reaction or investigatory reflex, by which an organism orients itself to new stimuli, has become a central concept in classical conditioning (Crosby and Blatt, 1968).

The last three decades have seen a revival of the study of attention, initiated mainly by industrial and military concerns with vigilance and response to competing stimuli (Smith, Lucaccini, Groth, and Lyman, 1966). The pragmatism of the technological age, then, redefined this classical topic as one concerned with attending behavior rather than with a mental process or entity.

Currently, the mental health professions make extensive use of the term attention in their literature. A psychiatric dictionary (Hinsie and Campbell, 1960) defines attention as "the application of energy in the sphere of consciousness by the individual aware of the application of the energy." The theoretical model most commonly advanced by psychiatry is found in ego psychology. The dynamics of attention are a function of the ego strength of the individual, which in turn depends on an accepting environment in which the libido can be cathexed. . . . The remedy, then, for a more effective use of attention lies in a more relaxed, more nurturant, and more empathetic...
environment for the child, both at home and at school" (Gilmore, 1968, P. 64). Other psychiatrists describe attention in terms of personality factors such as "uninhibited receptivity" (Maes, 1968), an analysis which would make the practical problems of classroom attention appear hopeless to many teachers. In any case, the usefulness of these contributions is not clear.

Educational literature admits that educational theory has merely accepted attention as an obvious and fundamental given (Durrell, 1968). The scant data comes from research on academic achievement, and it indicates that attention is one of the variables differentiating high and low achievers (Gilmore, 1968). In one study (Lahaderne, 1968), a positive relationship was found between students' attention and their scores on achievement and intelligence tests, with no relation between attention and attitudes toward school. The author speculates that

ability to attend may be an integral part of intelligent behavior. . . . The less able students may have been limited in their capacity to attend just as they were in their capacity to achieve academically . . . . The extent to which the students responded appears to have been tied to general ability rather than to the pupil's attitude toward school (p. 324).

Fortunately for children, there are other possible conclusions about this relationship.

In another study, verbal self-reports of college students were collected, their reported problems of concentration quantified and then analyzed in terms of "internal personal conflicts," "a kind of self-sabotaging," "poor study skills," and "slow reading rate" (Schneyer, 1961). If attention is essential to learning and if,
as these analyses imply, attention can be modified only by modifying "general ability, capacity to achieve, and internal personal conflicts," then such a task is hopelessly vague and deservedly unattractive. It is no wonder, then, that the educational writers have usually been content to recommend practices based on a combination of psychoanalytic theory and client-centered therapy. To motivate students to study, the writers advocate preparing materials that are "intrinsically interesting and meaningful" (Kirk and Johnson, 1951), or using materials and procedures which combine interest value and high probability of success, such as the Montessori method (Standing, 1962) or Moore's "Responsive Environments" (Pines, 1963), and also a system of grading that is always supportive (Pines, 1963). To deal with classroom inattention or disruption, some suggest a policy of accepting the child's feelings, verbalizing them for him, and draining them off through vigorous activities (Read, 1955); others prescribe a policy of nonintervention, following careful preparation of a specified environment aimed at "canalizing the energy" and developing "inner command," with of course a minimum dose of instruction and correction (Standing, 1962); and still others counsel teachers to support both desirable and undesirable behaviors and to give non-emotional punishment (Taylor, 1954). Educators admit that adherence to these precepts produces equally inconsistent results (Mostofsky, 1968); and when some degree of success does emerge in the classroom, "it is usually not at all clear what conditions and principles may or may not have been operative" (Harris, Wolf, and Baer, 1964, p. 9).

Modern psychology, with its rapidly increasing emphasis on a
science of behavioral consequences, offers a substantial and useful body of literature on attention. Perhaps the most thoroughly documented explanation of attention is that offered by B. F. Skinner (1953; 1968). In his analysis, attention is the control exerted by a discriminative stimulus (SD), that is, by an object or situation in the presence of which responses are followed by reinforcing consequences. This is not to imply that all types of attending behavior are simply relationships involving consequences. Some mechanisms of attention are sense-specific and genetic; some stimuli elicit instinctive responses. But beyond this reflexive attention, which the introspectionists called "primary attention" (Grastyn, 1959), most of the behaviors we call "attention" are the result of a learning process based on the consequences which follow attending to a stimulus. Skinner (1953) offers an easily reproducible laboratory illustration: if we arrange to give a pigeon food only when it pecks a key while a light above the key is flickering, the pigeon soon forms a discrimination in which it responds to the key only when the light is flickering. But we also notice that the pigeon begins to watch the light; the light begins to hold the pigeon's attention because of the animal's history of conditioned reinforcement. Likewise

the student can be induced to act selectively to special features of the environment by arranging contingencies of reinforcement. Roughly speaking, he can be taught that some features of the environment are "worth responding to." The central process is discrimination, and instruction consists simply in arranging appropriate contingencies (Skinner, 1968, p. 121).

But our analysis is, to this point, incomplete. Attention is more than looking at something. We know we can attend to something
without looking at it (e.g., Skinner's examples of listening to the clarinets in a symphony, or looking at the center of a page while attending to details at its edges); and we can also look at an object without attending to it. We need not conclude that such attending is an inferior sort of attending behavior.

If attention is not a form of behavior, it does not follow that it is, therefore, outside the field of behavior. Attention is a controlling relation - the relation between a response and a discriminative stimulus. . . . An organism is attending to a detail of a stimulus, whether or not its receptors are oriented to produce the most clear-cut reception, if its behavior is predominantly under the control of that detail (Skinner, 1953, p. 123).

The criterion for attention, then, is whether the stimulus is exerting any effect upon behavior.

Such an approach to attention has several other advantages. Selective responses can be observed and measured without recourse to introspection, and 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 and practical to manipulate stimuli so as to increase the likelihood of selective responses to them.

Another advantage of this view of attention is the ease with which related behaviors can be integrated. Many authors in the fields of education and mental health speak of attention, distractibility, short or rigid attention span, and hyperactivity as distinct phenomena (Martin and Powers, 1967). 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 predefined task) 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 (Crosby and Blatt, 1968). Skinner's interpretation places emphasis on behavior which interferes with attending, as well as to the attending behavior itself. Thus, when a teacher describes a child as easily distractible, she usually means that the child frequently attends to something - or to many things - other than that to which the teacher would have him attend. The inattentive child is usually the child who is not attending to the prescribed task, and perhaps the teacher is unaware of the stimuli to which the child is attending. When the teacher says a child has a short or rigid attention span, she may mean either that the child does not attend to all the stimuli which the teacher feels are relevant, or that he does not attend to the same task for a length of time which the teacher thinks sufficient. Clearly, the differences among the behavioral referents of these concepts are difficult to specify.

Similarly, there is a tendency to think of such behavioral phenomena as symptoms of an underlying faculty, genetically determined and therefore not modifiable to any degree. As we have already noted, there is more to behavior than consequated relationships. A blind person cannot attend to visual stimuli, nor a deaf organism to auditory stimuli, no matter what the consequences. While attention and distraction can usually be evaluated in terms of learning history and environmental conditions, a successful meeting of environmental demands (e.g.,
improved classroom attention) requires of any organism a set of organic and neurally-mediated abilities which render the organism sensitive to specific stimuli without which some forms of learning cannot occur. Recent research on the neurophysiological basis of attention, while highly inconclusive, is interesting. Hernandes-Peon (1966) found that during attention to a stimulus (either an external stimulus or an idea or memory) sensory impulses normally evoked by the stimulus are facilitated while other sensory input is inhibited, with such effects being mediated by the reticular formation. He speculated that abnormalities in the electroencephalographic records of retardates indicate defects in the cortico-reticular mechanisms necessary for initiating and maintaining attention. Grastyan (1959) found evidence in a hippocampal theta pattern of large, slow waves to ascribe to the hippocampus at least a major role in the organization of conditioned attention. He suggested this might be an interesting elucidation of the old clinical observations concerning the relation of Korsakov's syndrome (associated with alcoholism, Vitamin B deficiency, and memory defect for recent events) to lesions involving both amygdaloid and hippocampal lesions. Pagano and Gault (1964) also found that a measure of the electrical fast activity of the basolateral amygdala throughout the arousal continuum (from light sleep through extreme arousal) is quite sensitive and stable over time, with a high degree of correlation between amygdala and cortex activity.

These and other studies make it appear that there is some neurological as well as behavioral evidence for the existence of impaired responsivity in at least some retardates, though the results are vague.
and sometimes inconsistent. But there is no support for the proposition that some children (e.g., retardates) have a genetically rigid attention span that requires a different educational methodology. And in this connection, another advantage of the Skinnerian analysis of attention is that it admits the importance of neurophysiological processes which subserve attending behavior as a subset of causal relations between the stimulus-input and the behavior-output relations. But these later relations are the basic concerns of psychology. And the educator is concerned only with attention's presence or absence in school behavior.

It is easy to see how reference to child-specific attention spans would tend to impede the education of many children. Various educational activities are not likely to be attempted if the educator's theoretical concept offers little hope of success (Ulrich and Stachnik, 1965).

But such hopelessness is usually unfounded. An experiment by Martin and Powers (1967) can serve to illustrate the mass of empirical data supporting the above points. Retarded children were first conditioned individually to operate a lever for food or drink until they achieved a stable performance rate on an FR10 schedule (every tenth response was reinforced by tokens which were immediately exchangeable for food or drink). During the first four conditioning sessions, no subject earned all 50 possible reinforcers during the 20-min. sessions, due apparently to frequent incompatible responses, such as crouching, climbing, banging on the door, etc. From the fourth session on, all subjects came to "pay attention" to the task and consistently earned
the maximum available reinforcers. Then confederates were introduced into adjoining chambers (with visual and auditory feedback between the two). The confederates exhibited behaviors varying with respect to the frequency and intensity of the auditory and visual stimuli they provided to the subject. Some sat quietly and read; others operated another lever and received food or juice on an FI30 second schedule, while others operated the lever on an FR30 schedule. In all three test conditions, the introduction of a confederate produced a temporary disruption of the children's stable responding, but the stability was soon recovered, indicating that adaptation to the "distracting stimuli" had occurred. In other words, children whose inconsistency was explained as a native or at least unmodifiable "rigid attention span" came to "pay attention" maximally through a process of reinforcing only the task of concern. The authors also report demonstrations that the attention span of brain-damaged children can be increased through manipulation of reinforcement variables.

The development and extension into human settings of both the science and the technology of operant conditioning has been especially rapid during the last decade. The work of Ayllon and Michael in a psychiatric hospital setting (1959) is generally regarded as the initiating landmark for this extension. For several subsequent years, efforts were largely directed toward ward problems in a variety of institutions concerned with behavioral deficiencies and disorders (for examples, see Lindsley, 1959; Hutchinson and Asrin, 1961). Soon operant psychologists began to experiment with procedures and variables
in a variety of human settings, especially educational, but the principal target behaviors were still maladaptive, calling for extinction and counterconditioning procedures. Zimmerman and Zimmerman (1962) shaped and maintained adequate and efficient behavior in two emotionally disturbed boys in a special class by carefully manipulating the social consequences of their behavior. Dyer (1968) achieved similar results for a 17-year-old emotionally disturbed girl, and special classes for learning problems were dramatically handled in much the same way (Walker and Buckley, 1968; Whelan and Haring, 1966). Aggressive and hyperactive classroom behavior has been successfully modified using a variety of delayed reinforcement techniques, including counters, flashing lights, tokens, and points (Quay, Sprague, Werry, and McQueen, 1967; Patterson, 1965; O'Leary and Becker, 1967; Wolf, Giles, and Hall, 1964; Brown and Elliott, 1965; Patterson, Jones, Whittier, and Wright, 1965; Sprague and Toppe, 1966). Elaborate educational environments are now beginning to be designed and tested, using immediate and explicit reinforcement contingent upon accurate completion of programmed academic units, and the reported results include rapid modification of disruptive and antisocial behaviors and an academic increase typically of two grade levels over a three month period of half-day class work (Cohen, Filipczak, and Bis, 1967; Skinner, 1966; Michael, 1967; Keller, 1968; Staats and Butterfield, 1965; Nolen, Kunzelman, and Haring, 1967).

The designs for prevention and for acceleration are developing almost as a byproduct of the effort to cure the abnormal. Though this emphasis on the maladaptive was imposed by a sceptical and intro-
spective tradition, hopefully operant psychology is now in a position to come of age with a true science of public education.

And it is a credit to the profession that, despite the rapidity of this growth, the scientific character of applied behavioral analysis has been preserved. Behaviorism is still generally "a self-examining, self-evaluating, discovery-oriented research procedure" (Baer, Wolf, and Risley, 1968, p. 91). And in the process, many variables, laws, and procedures particularly relevant to education have received at least tentative description.

Ayllon and Michael (1959) emphasized the variable of social reinforcement, given or withheld contingent upon a desired class of behavior. Contingent social response is still the most readily available and most widely used single reinforcer. In educational settings, the effectiveness of teacher attention, praise, and physical contact has been repeatedly demonstrated. A pertinent example is the study of Madsen, Becker, and Thomas (1968a) on the effects of various social reinforcers and stimuli available from the teacher. They found that instructions alone had little effect, but that a combination of ignoring inappropriate behavior and showing approval for desired behavior was very effective, though the procedure of merely ignoring inappropriate behavior turned out to be difficult and unpleasant for the teacher. The implications of their conclusion, that "showing approval for appropriate behaviors is probably the key to effective classroom management" (p. 139), are not completely clear. Surely the approval procedure was the most effective of the three variables examined. But in another study by the same authors (1968b) the results
were not as clear and immediate, and they concluded this study by noting that classroom behavior can be influenced by many stimuli other than teacher's praise or criticism. And Harris, Wolf, and Baer (1964), in attempting to modify crying, isolate play, and passivity behaviors of individual children by manipulating adult social reinforcement, found that in some cases adult attention was not reinforcing; "clearly adult attention must be or become positively reinforcing to a child before it can be successfully used to help him achieve more desirable effective behaviors" (p. 16).

We have here an illustration not only of the varying strength of social reinforcers, but also of the numbers problem in education. Harris, et al., encountered no great difficulty in shaping adult attention into a reinforcing stimulus where called for in a single child's relationships; and indeed it seems highly desirable that they did so, in view of its adaptive value in human society. But a classroom of unselected, captive children with a motley set of experiences presents additional questions. Birnbrauer, Wolf, Kidder, and Tague (1965) offer a preliminary examination of this variability. With a class of 15 retarded children they discontinued a long-standing token economy for 21 days and noted that five of the children showed no change in performance, six showed an increased error rate, and the remaining four children showed an increased error rate, a decline in the amount of time spent in study, and an increase in rate of disruptive behavior. Apparently, for some students social reinforcement and/or success was sufficient; for most students it was not, at least in that setting and with that specific programming. The variability
In their findings is consistent with the results of studies comparing the strength of various reinforcers in children (Terrell, 1958; Brackbill and Jack, 1958). It is impossible to control the history of the pupils' experiences with adult attention; expectedly, therefore, a class of pupils will not be equally reinforced by such attention.

The teacher's complex role in social reinforcement compounds the variability. As one might expect, Hall, Lund, and Jackson (1968) found that the effectiveness of social reinforcement in controlling student study behavior varies with the verbal and self-discipline skills of the teacher herself. Deficits in these skills are often very difficult to override. Furthermore, in the absence of careful experimental control, social approval is often available to children on a "noncontingent" basis, that is, not directly related to the responses of the teacher. Recent work by Wohler (1967) indicates that unless the teacher strongly supports desirable classroom behaviors with consequences that are stronger than any other competing consequences, the children's behavior will be controlled by other children in ways likely to interfere with the teacher's objectives.

So it has become apparent that the use of a single reinforcer, even the strongest and most general of them, and especially if it is selected by the experimenter, is probably unrealistic in educational settings. To meet this problem, elaborate token economies with a variety of back-up reinforcers have been devised to accelerate educational progress, and have produced significant results along many behavioral dimensions (Bushell, Wrobel, Michaelis, 1968; O'Leary and Becker, 1967).
Returning more specifically to attending behavior, Sprague and Toppe (1966) have shown that hyperactivity (i.e., fleeting and inadequate attention to stimuli predefined as desirable) has, per se, an adverse influence on learning, and this is of course consistent with a Skinnerian analysis of attention and learning. Some studies have already been carried out in which behavioral principles and techniques like the above were applied in an attempt to maximize pupils' attending behavior. Walker and Buckley (1968) raised the rate of attending behavior (defined generally along physical parameters of eye direction, body posture, and writing activities) of an underachieving 9-year-old from an average of 25% of total time to a rate of 90% or better. A brief reversal indicated that points, exchangeable for toy models, were controlling the variation in attention. Hall, Lund, and Jackson (1968), using contingent teacher attention with six elementary students, achieved significant but less dramatic results on study behavior, as did Thomas, Becker, and Armstrong (1968) with a class of 28 elementary students.

Most of these studies involve conditioning attending behavior of a single child or several children serially. Occasionally a group design for five or six students is attempted. Only rarely has the attention of a whole classroom been considered, and in most of these cases the focus was directly on a small subgroup and only indirectly on the attention of the whole class. Schmidt (1967), though concerned with noise level rather than attention in a classroom, has shown that a class of students can be treated as a single responding organism.
Many such designs necessitate the active presence of an experimenter other than the teacher. As Hall, et al. (1968), suggest, it would seem practical and more effective to place control of the study behavior of the whole class in the hands of the teacher without demanding extra personnel or elaborate procedures.

While considerable progress has been made in defining reinforcing stimuli to motivate student attention, another potential source of control is the use of discriminative stimuli. We already have a great body of data supporting some general principles about stimulus control, some of which appear to be of relevance to attention in the classroom.

Johnson and Cumming (1968) have shown that frequently the control of attention is by only one or a few of the several stimulus properties correlated with reinforcement. They have also demonstrated that the extent to which a pigeon "pays attention" to an $S^D$ (in terms of stimulus control) is determined by how well it previously learned to discriminate that stimulus and its various properties from another.

The question of stimulus control being a form of differential reinforcement is complex and not fully resolved. But there is considerable evidence to indicate that stimulus control may not be able to be established simply by repeatedly reinforcing an operant in the presence of one stimulus. Terrace (1966) believes that "it is necessary to introduce a second stimulus which is either never correlated with reinforcement, or which is correlated with a different schedule of reinforcement" (p. 273). Also relevant is his suggestion that the use of a progressive training method in which the final $S^+S$- difference is progressively approached from a larger $S^+S$- dif-
ference is a more efficient procedure for sharpening control than the traditional method, which maintains the $S+\bar{S}$ difference at a constant value throughout discrimination training.

Zeigler and Wyckoff (1961) demonstrated that overt observing responses could be extinguished once the discriminative functions of the stimuli, produced by the observing response, were abolished.

Wolf (1963, p. 343) illustrated how "a combination of discriminative stimulus components from the same as well as from different sense modalities has a summative effect" similar to that of CSs reported by Hull and Pavlov.

In traditional educational practices, some approach to stimulus control is attempted through the use of verbal instructions and rules, reminders and threats, sudden movement, loud noise, bright color and animation. But as Skinner remarks (1968, p. 121), "none of this teaches the student to pay attention, and it may actually make him less likely to pay attention to things which are not on their face interesting." This discouraging prospect is supported by the stimulus control research outlined above. Many of these educational stimuli may elicit reflex or instinctive responses, that is, they may "get attention." But this is not a learned response; in fact, the student may adapt out rather quickly. Nor is this response necessarily correlated (surely not systematically) with reinforcement. When it is, significant results can be achieved. Surratt, Ulrich, and Hawkins (1969) increased the study behaviors of four first-graders by associating light stimuli (on and off) with work and nonwork, and then reinforcing work with delayed access to play activities.
And finally there sometimes arises the very fundamental question: "Why isolate student attending behavior at all?" It is argued that attending behavior is a self-management skill, precursory to the goals of education; the most direct and efficient design for education is one which isolates the various terminal behaviors which, taken as a whole, we call knowledge. Thus, the development of appropriate knowledge behaviors would be programmed by use of successive approximation, small and realistic steps, and systematically applied reinforcement to maintain and maximize rate. In such a system, attention would take care of itself, because the predefined objects of attention would in themselves be adequate stimuli for the response of maximum attention.

While the radical idealism and apparent parsimony of this approach are appealing, it is inadequate for two reasons. First, the day when a thorough and scientifically sound educational environment is commonplace in our public education may be fast approaching; at least let us hope so. But that day is clearly not yet. Many such systems, with varying degrees of control, are currently being developed in experimental settings and in a few "normal" settings. But the Skinnerian educator or psychologist interested in educational application is typically stalled not only by the incompleteness of his own technology (and his science?), but also by the arguments about tradition, finances, individuality, creativity, and naïveté. Such arguments may not always be valid or relevant, but they are usually the variables in control of renovation.
Also, and perhaps of more lasting significance, even where such a program can be implemented, it may still be insufficient for many students.

It is important to teach careful observation. . . . There are two ways to teach a man to look before leaping: he may be severely punished when he leaps without looking or he may be positively reinforced (possibly "sparingly") for looking before leaping. He may learn to look in both cases, but when simply punished for leaping without looking he must discover for himself the art of careful observation, and he is not likely to profit from the experience of others. When he is reinforced for looking, a suitable program will transmit earlier discoveries in the art of observation. . . . To attend to something as a form of self-management is to respond to it in such a way that subsequent behavior is more likely to be reinforced. The precurrent behavior may be learned or unlearned. . . . There are two stages: 1) attending to a given state of affairs and 2) responding to it in some other way. In the normal course of events the reinforcement of the second stage strengthens the first.

In sink-or-swim instruction, reinforcement is also contingent on the second stage. We set tasks which demand attention and reinforce the student when he is successful or punish him when he is not, presumably because he has or has not paid attention. He is left to discover how to pay attention for himself. The method often works. . . . But a better technique is to teach the precurrent behavior directly. . . .

Some techniques of attending to a stimulus are learned only slowly, if at all, when reinforcement is confined to the second stage. Specific contingencies may be needed to teach a baseball batter to "keep his eye on the ball," particularly because natural contingencies are opposed to the behavior (it is dangerous to look at a ball at the moment of impact, and the flight of the ball a moment later is the principal reinforcing consequence). Simply reinforcing a child when he reads a text correctly may be much less effective than special contingencies which induce him to read from left to right or to read a block of words at a glance. Another way to attend to stimuli so that one may respond to them more effectively is to construct supplemental stimuli . . . .

In short, much of the elaborate art of looking and listening cannot be taught simply by reinforcing the student when he responds in ways which show that he has previously looked and listened carefully. Direct instruction is needed (Skinner, 1968, pp. 122-123).
This study is an attempt to contribute to that objective. Relying on the results of the research previously outlined, and operating within a normal elementary school system which already incorporates some degree of immediate and systematic reinforcement for academic behaviors, this study attempts to develop a simple, economical (in terms both of money and effort), teacher-controlled method for maximizing student attention, while at the same time exploring several dimensions of the situational and controlling variables.
GENERAL PROCEDURES

Subjects and Setting

This study was conducted in four classrooms of the Elementary School in Indian Lake, a small rural-village community in southwestern Michigan. The school had, for the previous two years, been the scene of a gradually developing experimental program in behavior modification. Several of the teachers, including the third- and sixth-grade teachers in this study, had received college credit for an introductory extension class in classroom behavior modification, and at the time of this study most of the classes were on some form and degree of token economy (Ulrich, Wolfe, and Bluhm, 1968).

Kindergarten

The kindergarten class of 32 children met two and one-half hours daily. The experiment was conducted during the introduction-to-reading period. Typically the teacher would present a new ITA sound printed on large cards. For about 10 min, the teacher would lead the children in sounding it out, pronouncing words with that sound in it and identifying its position in the word. Then she would give each child a worksheet which required the child either to identify a word and draw its picture or vice versa. The total reading period lasted about 30 min, each day. Also included in their half-day schedule was a numbers period, milk-and-crackers, gym or playground, and library or records or story time.
Third Grade

The third grade had 34 children who collectively had gained a reputation as the scourge of the school district since first entering kindergarten. Many anecdotal explanations for this were popular, including the "wave theory" of periodic hyperactive classes. A "reading group" period, held three days a week for 30 min. each day, was chosen for this experiment. The teacher met in a front corner of the room with the same eight students and led them in reading, spelling, and discussion of meanings of words and interesting points in the story. During this period the other 26 students were expected to engage in independent work, as listed for them on the board, such as spelling exercises, math problems, study guide questions for a reading assignment. If all the assigned tasks had been completed, the student was expected to read for the remainder of the time, though students rarely if ever completed the entire list in a given day.

Fifth Grade

The fifth grade of 25 children was studied during its 50-min. reading period three days a week. The procedure for this period was changed somewhat midway through the experiment. During baselines and the first two days of Instructions Only, the teacher led one-half of the class in reading and discussion of the text and its meaning, while the other half was given instructions, written on the board and summarized verbally at the beginning of the period, for independent work in reading, writing reports or drawing illustrations of stories they
had read. The teacher alternated her involvement from day to day between the two groups. During the last three days of Instructions Only and for the rest of the experimental sessions, the procedure was that all students were expected each day to do private reading, write short reports on each book or story, or prepare a worksheet given to individual students by the teacher. During this time the teacher would hold 5- to 10-min. conferences at her desk with individual students, meeting with each student once a week. Here the student would describe what he had read the past week, turn in and discuss his reading reports and any worksheets he had been given. The list and order of conferences was listed daily on the board, as were the instructions for independent reading.

Sixth Grade

The sixth grade of 30 students was studied during its 50-min. Social Studies period three days a week. The procedure in this class was less uniformly structured. In general it almost always included about 25 min. of teacher-led discussion and common reading from their text, about 20 min. of private study and writing answers to questions from the same text, and frequently a short closed-book quiz. Occasionally 5 to 10 min. would be given over to special student reports. On two occasions a movie was shown for most of the period and on these days no data was taken.
Recording

The observations and recording were carried out simultaneously by the teacher and the experimenter. The teacher used a stopwatch (during Baseline 1) or a timer-light device. A Cramer 1/100 sec. timer, housed in a 3 in. x 5 in. (75 mm x 125 mm) metal box, with a silent, single-throw, mercury switch, was on the teacher's desk; a red light (40 watt) on a flat 3 in. x 3 in. (75 mm x 75 mm) wooden stand was placed either on the teacher's desk or on a portable stand, but in either case it was positioned so as to be prominent to the students. The timer was connected to a wall socket, and the light to the timer by a long cord. When the switch was flipped up, the timer began running and the light went out; when the switch was flipped down, the timer stopped (without resetting) and the light went on. The experimenter sat to the side, near the front of the room, with a panel of 4 Cramer 1/100 sec. timers, each operated by a silent, single-throw, mercury switch. Within each of the four classes observed, sometimes the experimenter was able to see the teacher's light; usually he was not. This variability even within the same grade was due to periodic changes in student-elected seating arrangements.

The recorded behavior was student attention, defined as 1) body, head and eyes in a position appropriate to the task; 2) appropriate silence; 3) following instructions. Inattentive behaviors included the following: head or eyes turned away from the book, paper, board, or teacher as per instructions; out of seat without permission; talking
to a neighboring student or to oneself to an extent that was audible
to teacher or experimenter; kicking the desk or chair; scraping feet;
dropping objects, doing written work when discussion was called for;
doing other unauthorized academic work. Class attention was defined
as the above attention exhibited concurrently by all students.

The teacher engaged the timer only when in her observation every
student was attending; if one or more students were inattentive as per
the above definition, she disengaged the timer and turned on the light.
Except for this, she proceeded as usual with her teaching, supervising,
and commenting.

The experimenter, however, rated the cumulative attending time
of only four students, randomly chosen, whose identity remained unknown
to the teacher. The same four students were rated during each session
of the experiment for each grade.

The cumulative attention times were tallied from the five timers
at the conclusion of each session, and the five corresponding percen­
tages were calculated by dividing each timer reading by the total time
for the session.

Reliability Checks

Two investigations of reliability were carried out. In one,
reliability checks on the experimenter's measures were taken during
all phases of the experiment. Undergraduate students in psychology
or education were given a brief description of the study, a list of
attentive and inattentive behaviors, and several practice sessions;
they were not told what phase the experiment was currently in. Each correlation check was two min. long, and all checks for a given experimental phase ran consecutively. Table 1 lists the results for each phase and each grade. In general, the 76 correlational checks on the attention measures for the 16 individual students yielded a product moment correlation coefficient of .967.

In addition, an attempt was made to evaluate the teacher's measure of the attention of the class as a whole. Since the teacher's role in this study was to carry on her normal teaching activities while also recording the attending behaviors of the class as a whole, it was presumed that her observation would be intermittent and imprecise. A direct check on her measurements would therefore be expected to contribute no more than a confirmation of the obvious. But of basic concern to this study is the degree to which, given the teaching activities currently valued in public education, the individual teacher can observe and measure the attention of the class as a whole with enough accuracy to be the basis for applying contingencies with significant control over all her students. In this study the experimenter's exclusive concern with the attention of four students was designed not only to investigate the effects of the teacher's measurement and consequation on the attending behavior of a random sample of the population, but also to investigate the possible correlations between individual and class changes in attention from phase to phase. To this end, a second reliability analysis was computed for each class by first computing the mean percent attention rate of each of the four students for each phase considered as a whole, then averaging these four means for this
same entire phase, computing a similar mean of the teacher's rating for each phase of the study, and finally comparing the consecutive interphase variation of these two sets of means. Table 2 presents the results of this analysis. In general the product moment correlation coefficients for the four grades ranged from .91 to .98.
Experimental Conditions

Baseline 1 (B₁)

The teacher, as unobtrusively as possible, used a stopwatch to measure attention of the class as a whole, as described above. The experimenter measured the attention of four students. No announcement or explanation of this procedure was given to the students. The teacher was instructed to react to the behavior and performance of her students under the same norms (including manner and frequency) as those on which she had relied before the study began.

Baseline 2 (B₂)

The teacher now began using the timer-light device to measure attention of the class. There were no contingencies or instructions, and any questions regarding the light were answered with "We will tell you about it later." This phase was introduced to study and, if necessary, to stabilize any novelty effects of the apparatus on attention.

Instructions Only 1 (IO₁)

At the beginning of this phase, the teacher told the class she would like to explain to them why the light was going on and off during class. She then stated the kinds of attention she wanted from them (position of body and eyes, no inappropriate noise, following instructions), wrote them on the board, and gave several examples of inattention in each category. She then explained that when one or more
students were inattentive in any one of these ways, she would turn
the light on, and when all students were paying attention she would
turn the light off. The exact phrasing of these instructions varied
somewhat, especially to the kindergarten and third-grade students.
But in all cases the instructions lasted from 4 to 6 min. and were
briefly (30 to 60 sec.) summarized at the beginning of each subse-
quent session of this phase.

Reinforcement 1 (R1)

Contingencies were explained to the students by their teacher.
She briefly reviewed the behavioral specifications just as she had
the day before; she then added that three points per student (in the
fifth and sixth grades) or three tokens (temporarily in the third grade,
before they too went to points) or an activity such as gym or recess
(in the kindergarten) would be contingent on the class as a whole
reaching a specified criterion. This criterion also varied from
class to class, since it was established at a slightly higher value
than the performance capability which each class had previously de-
monstrated during Baselines and Instructions Only phases. A bonus
of two extra points or tokens (or, for the kindergarten, five extra
minutes of activity) was contingent on the class exceeding the cri-
terion by 5% or more. These two criterion numbers for normative and
bonus performance were written on the board at the beginning of each
reinforcement session. At the end of each session, after a quick
calculation, the teacher's rating of the class's attention for that
session, expressed as a percentage of total, was written on the board
under the criterion numbers, and the teacher briefly verbalized the comparison and the consequences (e.g., "Your attention as a class today reached 60%; this is 2% short of our goal, so nobody gets any extra points today.").

The meaning of these numbers as percentages of class attention was briefly explained to the fifth and sixth graders, who had already dealt with percentages in their mathematics classes; to the third grade and kindergarten classes, these numbers were simply presented as target numbers. With no class was there any attempt to determine the degree to which the students grasped the mathematical or behavioral significance of these numbers, except by measuring the change in their attending behavior.

If criterion was reached on a given day, the teacher announced that she would give each student three points. In no class were the points or tokens given out immediately; the teacher's normal pattern was to dispense points (or tokens) in the students' pointbooks after school (in conjunction with her evaluation of some assignment sheets) and/or at one or two other specified times during the day. In rewarding attention, the individual teachers followed their normal dispensing procedures. For the kindergarten class, the reinforcing activity, when earned, usually followed the experimental session immediately; on several occasions it was delayed for about half an hour because of scheduling difficulties.
Instructions Only 2 (IO₂)

A reversal to the previous IO₁ conditions was carried out in the fifth and sixth grades. The teacher, as before, reminded the students of what the light meant on and off; she then added, without elaboration, the comment that she wouldn't be giving out points any more for this behavior, but that she still expected the same amount of attention as before.

A different and unplanned reversal occurred in the third grade. Five months before this study began, the third-grade teacher had imposed an all-or-nothing contingency on her class: if she discovered any instance of token theft, she would cancel all aspects of the token economy for all students. Subsequently, individual students would on occasion complain that their tokens had been stolen, and the teacher would always suggest that the student search his desk and notebooks thoroughly and then report back; inevitably the missing tokens were found - until after the 20th session of this study. As a result, the token economy and the sessions on attention were discontinued for two weeks; then a point system, with new procedures and a somewhat modified list of purchasable reinforcers, was introduced, along with the reinforcement phase of the attention study preceded by a one-day measure of baseline attention (Session 22).

Reinforcement 2 (R₂) and Reinforcement 3 (R₃)

The same procedures and conditions as in R₁ were applied for the fifth and sixth grades in this phase (and for the third grade when
their point system was introduced), except that a lower-limit response cost contingency was also introduced. If the class failed by more than 5% to meet normative criterion, the teacher deducted three points from their pointbooks.

R3, carried out only in the kindergarten, involved the same procedures as R2 but the academic setting changed considerably. At this time the teacher judged that the children were ready to begin small reading groups. This meant that from Session 26 on, the teacher worked with six to eight students in one corner of the room while the other 25 or so children were expected (for the first time in their school experience) to engage themselves for about 30 min. in independent work (worksheets, picture-word books, coloring) without the advantage of the fairly constant teacher-class interaction to which they were accustomed.
RESULTS AND DISCUSSION

Table 2 presents averaged results from each grade. The Pearson product moment correlation coefficients computed from this data confirm the high correlation between class attention (as measured by the teaching teacher) and individual student attention, thus indicating that the teacher's measure can be used reliably to evaluate and con­sequent individual day-to-day student attention.

Figures 1 through 4 graphically present the results of the study. Several features appear to be common to all four sets of data.

The attention of an individual child often varied greatly both in relation to his own past performance and in relation to another child's current performance (e.g., Figure 3, B₁). A teacher might describe this as a "good days, bad days, high and low days" phenomenon; behaviorally it is clear that in a classroom situation, even where serious attempts have been made to begin to control student behavior carefully, there is a wealth of interesting variables interacting and competing for the attention of the students, many of them not clearly related to the objectives of education.

The attention of the class as a whole also showed consistency in its inconsistency, both during baselines and IO₁ (e.g., Figure 1).

The timer-light device, when introduced without explanation (B₂), appeared to have no clear effect on attention in either direction, except possibly in the sixth grade (Figure 1) and, if then, only for one session.
Invoking explicit graduating reinforcement contingencies for attention to academic work with feedback from the red light \((R_1)\) not only dramatically increased and maintained the attention of the individual students at a high percentage, but also reduced their variability significantly, if not immediately (as in Figure 2, \(R_1, A, B,\) and \(C\)), then at least after five or six sessions (e.g., Figures 3 and 4, \(R_4\)). The same effect is seen in the measure of attention for the class as a whole; bidirectional variability is replaced by variability in the positive direction.

The degree of increase in percent attention time appears to be fairly constant between classes and for all individual children. All individuals measured eventually reached an apparently stable rate of 90-100%. The class as a whole leveled off, in two cases at about 70% (Figure 3, \(R_2\); Figure 4, \(R_3\)) and in two cases at about 80% (Figures 1 and 2, \(R_1\) and \(R_2\)). It appears also that the degree and speed of increase may be somewhat dependent on the base rate; in Figures 3 and 4, in which maximum class performance eventually reached 70%, the base rates were found to average at 0% (i.e., rarely were all students attending concurrently) and 9% respectively; whereas in Figures 1 and 2 maximum class performance reached 80% and did so much more rapidly, but from a higher base rate, namely 20% and 28% respectively. The same kind of dependence can be seen in the measures of some individual students (e.g., Figure 4, A and B).

Instructions with associated stimulus (red light) but without explicit consequences \((I0_1)\) had mixed effects on attention. In two of the classes (Figures 3 and 4) there was only marginal improvement,
if any, in class attention, though several individual students (Fig-
ure 3, A and C; Figure 4, B and D) seemed at least temporarily to
have improved as a result. In the other two classes (Figures 1 and
2) the effect of these instructions and stimuli was immediate and
significant for most students, but the improvement rather quickly eva-
porated toward baseline performance. The reason for the difference
between these two sets of grades is not clear. It may have been a
function of the individual teacher's 'personality and approach' or of
the amount of student experience with academic contingencies, since
the two grades that responded temporarily to instructions were rela-
tively older than the two that did not; or it may have been simply a
reflection of recent past and current environmental contingencies;
the two grades that did not respond to instructions were the grades
with very low baseline levels of class attention. When the students
are not attending to school work, they are usually attending to other
non-academic involvements, presumably because the reinforcers are
stronger for these behaviors, strong enough to override the added con-
tingencies involved in verbal discriminative stimuli for academic at-
tention. In any case the data here seems to argue strongly against
relying on instructions from the teacher for the maintenance of class-
room attention.

Reversals (Figures 1 and 2, IO2) resulted in class and individual
attention times gradually approaching performances hardly distinguish-
able from baseline and IO1, except possibly by the day-to-day vari-a-
bility, and given a few more reversal sessions that too might have re-
appeared clearly.
Connecting the red light again with explicit reinforcement and graduating criteria ($R_2$) reestablished within five sessions a 90-100% level for individual students and an 80% average for the class as a whole.

In the kindergarten "reading group" phase (Figure 4, $R_3$) the more demanding attention requirements resulted in the class attention level dropping 30 percentage points for four unreinforced sessions, but rising quickly again to a steady level of 65-70%. A proportionate drop and recovery was seen also in the attention of the four individual students measured.

Interestingly, this "change-of-task" facet so typical of many class routines never became an attention problem in this study, except for the kindergarten as just described. The sixth grade Social Studies class, for example, involved a variety of tasks every session (p. 23); the fifth grade, midway through the experiment, completely changed its procedure for its reading period (p. 22). But when somewhat different behaviors were required, the teacher simply stated them once, after which the light seemed to be able to correct any new attention problems.

Teacher reaction to the study proved interesting. Two of the teachers (third and fifth grades) agreed rather eagerly to participate in the study. The other two were reluctant at first; they were not impressed with its potential usefulness ("hogwash," as one rural teacher described it), and they were hesitant about the demands it would make on their class time. They finally agreed to begin the study only on the condition that they would be free to discontinue it when-
ever they felt it had become inconvenient. "I'll give it a try for a few days, but I'm telling you my heart's not in it." As the graphs indicate, all the teachers who began the study completed it, even putting up with reversal; and they continued the procedure and their own daily measuring after the experimenter finished taking his data, reporting a steady or rising class attention level. In addition they, as well as other teachers in the school, began using the same procedure and equipment for other classes and study halls, and reported they were very pleased with the results.

It is clear from this study, as well as from many of the studies cited above, that success in motivating all the students in a given class to a particular behavior such as consistent attention is largely dependent on a reinforcer system that is sufficiently general to appeal to all students, such as a type of token economy with many backup reinforcers determined by the children themselves. If this is not the case, then the effectiveness of the attention stimulus procedure described here would be proportionately diminished. On the other hand, an impressive array of reinforcers may not be adequate alone to motivate a high rate of academic progress and the necessary precurrent behaviors, especially if these precurrent behaviors, such as consistent attention, are not already strongly developed and maintained.

The results do not indicate whether the light, automatically connected inversely with the teacher's timer, functioned as a discriminative stimulus, a conditioned reinforcer, a conditioned punisher, or as all three. Following the suggestions of Terrace (1966), two contrasting stimuli (light off, light on) were used in this study, the one correlated
with reinforcement and the other with non-reinforcement, and by using
a built-in training method the target $S+S-$ difference was progressively
approached from a larger $S+S-$ difference. After the students were ex-
posed to the program, the red light probably also acted as a conditioned
reinforcer and punisher. When a student who had been paying attention
to the teacher or to his book for some time noticed that the light was
off, he was probably reinforced at that time for maintaining similar
behavior for the next few minutes. Similarly when a student, prompted
by the red light going on, ceased a specific inattentive behavior and
immediately noticed the light go off, he was probably reinforced for
this desirable change. But the procedure may also have involved punish-
ment, i.e., suppression of inattentive behavior, as when a student be-
gan to be inattentive or had been so for some time and then noticed
the light turned on or already on. The precise nature and interaction
of these various effects would be very difficult to analyze precisely,
since the two sets of behaviors are themselves so diffuse; and it is
not clear that such precision would significantly improve the effective-
ness of this procedure.

In any case the light provided constant intrasession feedback to
the students. The precise extent and durability of its effect was not
analysed systematically, but subjectively the teachers and several ob-
servers were impressed with (and often amused by) its power. At the
very least, the red light allowed the students to discriminate very
expertly between when they could get away with extracurricular attention
and when they could not. Presumably the use of the light also lessened
the danger of a student not attending in order to get some reinforcing attention from the teacher, since with the light the teacher could avoid verbal reprimand and other stereotyped dramas associated with such problems. It is probably safe to assume that not too many of these rural elementary children had a history of being reinforced by attention from a red light or even in its presence, and whatever moral issues are involved in beginning such a history in young children will have to be weighed against its other advantages.

Even more feedback of this type would ideally be desirable and helpful, for example by means of an automatic cumulative time-thermometer joined to the teacher's timer and prominently displayed to indicate minute-by-minute progress toward criterion for that period. Such added devices were rejected in this study on the grounds that their expense would make the results of this study less generally applicable to the typical classroom.

Another control factor implied but never directly analyzed in this study is that of peer control. Presumably students can function in competition with the teacher and materials as a stimulus for the attention of others, and interaction with other students is a strong reinforcer for many. To the extent that this is true, then a program of reinforcing attention would be proportionately enhanced by making peer approval or disapproval contingent on a student's attention to task, and a behavioral analysis of peer control would be of great value to education. Subjective observation and other anecdotal evidence from all four classes in this study indicated considerable peer interaction.
of this type. Though such pressure never reached the "back alley trouncing" stage, there were frequent instances, both during and after classes, of students not hesitating to remind or even scold a classmate for "keeping the light on," and even several reported instances of congratulating an improved student. And of course exceeding the criterion, especially by 5%, was always cause for common student celebration, an outburst which the teachers did not seem to mind at all.

Although the critical features of this procedure seem to have been the specific reinforcement contingencies coupled with the intra-session feedback from the light, several other explanations of the results should be considered in summary. These results cannot be accounted for by the novelty effects of the apparatus, since its introduction without contingencies had no noticeable effect (B1), even though stimuli were correlated with attentive and inattentive behaviors just as they would be later in reinforcement phases. Specific instructions from the teacher, though repeated daily and coupled at the end of each session with verbal and social stimuli such as praise for improvement or admonitions to do better, led to temporary improvement at best. Peer pressure may have accounted for some of the improvement, but since this factor seemed to have its effect only during reinforcement phases, its own power is probably a mediating one and in turn explainable best by reference to the reinforcement contingencies themselves. Differences among subjects (and probably their teachers), though very apparent in the base rates, were mostly eliminated after several sessions under token reinforcement. The effect of simple pas-
sage of time is eliminated as a significant factor by reference to the reversal stages. Variations in the tasks defined as attentive for each grade cannot account for the improvement in attention, since the improvement was similar for all grades despite this diversity. Even when, as in the kindergarten, the task was suddenly made more difficult, the decline in rate of improvement was only as temporary as was the increase in rate with the introduction of specific instructions, and its subsequent increase showed every sign of being as high and as stable as for other tasks and other grades. And finally, since the measures of attention were not fully and automatically mechanized, there is the possibility that human bias or error accounted for the changed attention levels. Such an explanation is shown to be highly improbable, not only by the correlation checks made on the experimenter's measures (Table 1), but also by the high degree of correlation, phase by phase and for every grade, between the experimenter's measures of four individual attention levels and the teacher's measure of the attention of the class as a whole (Table 2).

Taken all together, then, the results indicate that we have here an inexpensive and easily manageable procedure whereby the teacher can maximize the attention of each student though she relies only on her less than precise measure and consequation of the class as a whole. Though this study makes no attempt to evaluate the long-range effects of student attention thus maximized on academic progress as traditionally measured, the implications of such a procedure for general education today, at least on the elementary level, are poten-
tially impressive. Educators and behavioral psychologists agree that many aspects of content, organization, and scheduling in current elementary education could be greatly improved. But they also agree that despite these defects the methods and content of public elementary education are very effective for many students. It has also been shown that the instances of ineffectiveness, i.e., chronic low achievement in many students, is highly and invariably correlated with patterns of inattention in school. One approach to the problem is to search for the causes of this inattention, which (if we ever would complete the list) may turn out to be multiple, varied, and vague. The cure for these causes might then turn out to be equally unmanageable. Another approach is to attempt to eliminate the inattentive behavior, whatever its causes in the individual child. Such an approach, especially if it is effective, economical, and easily managed by the average teacher without the assistance of an experimenter, would offer a practical way to maximize the effectiveness of the educational content and of the teacher's presentation methods on all students, but especially on the chronically inattentive. Presumably this would minimize the educational retardation of the so-called underachiever.

An education which would improve this faculty (of attending) would be the education par excellence. But it is easier to define this ideal than to give practical directions for bringing it about (James, 1890, p. 449).

This study illustrates a practical and effective approach to this ancient phantom.
REFERENCES


Fig. 3. Third Grade.
Fig. 4. Kindergarten.
TABLE 1

RELIABILITY CHECKS BY AN OUTSIDE OBSERVER (O) ON THE MEASURES OF THE EXPERIMENTER (E)

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\[ r_{xy} = \begin{bmatrix} .97 \\ .93 \\ .98 \\ .96 \\ .98 \\ .98 \end{bmatrix} \]
**TABLE 2**

**COMPARISON OF INDIVIDUAL AND CLASS SCORES**

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Legend:  
MA: Mean Percent Attention Time Per Phase  
MMA: Mean of MA  
PPM: Pearson Product Moment Correlation Computed by Phase for the Two MMA Scores