REINFORCEMENT OF VISUAL ATTENDING IN CLASSROOMS FOR DEAF CHILDREN¹

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The efficacy of immediate tangible reinforcement in increasing appropriate visual attending for entire classes of deaf children was examined. The subjects were three classes (seven children each) in a residential school for the deaf. Boxes were installed on each child's desk, with lights that were flashed immediately contingent upon 10 sec of visual attending. Light flashes were backed up by M & M's, cereal bits, or tokens. In two of the classes, extinction sessions were also scheduled. For all classes, the reinforcement procedure increased visual attending by 50% or more, maintaining it at rates above 82%. Withdrawal of tangibles decreased attending back to baseline levels. The results support analysis of attending as operant behavior and demonstrate the applicability of reinforcement procedures in modifying these behaviors for young deaf children in a classroom setting.

The operant characteristics of attending responses have been well established (Holland, 1957, 1958; Schroeder, 1967). As such, attending is subject to methods of behavioral modification that have proved successful for a wide range of response classes. Coupled with the recent success of behavioral modification programs in the classroom (Birnbrauer, Bijou, Wolf, and Kidder, 1965; Birnbrauer, Wolf, Kidder, and Tague, 1966; Hewett, 1967; Nolen, Kunzelmann, and Haring, 1967; O'Leary and Becker, 1967; and Valett, 1966), these experiments provide a basis for attempts to alter attending behavior in a classroom situation. In an unpublished paper, Brown (1967) reported a procedure that increased attending behavior with four deaf-retardates on an individual basis. Also, Lennan (1967) described a pilot project with a class of emotionally-disturbed deaf boys in the California School for the Deaf, Riverside, which involved a Hewett-type classroom procedure dealing

broadly with "attention" as an initial developmental step.

To date, no behavior modification research has been reported for classrooms of "average" deaf children. However, visual attention is especially essential to the deaf child's classroom education. Because he is virtually cut off from the ubiquitous auditory stimuli surrounding those who hear, his eyes must assume the burden of collecting information from the environment. If the deaf child does not look directly at the information-bearing stimulus, he is categorically prevented from acquiring that information (except for gross sensory information). In the classroom situation, the instructional stimuli—from the teacher and from fellow students who contribute to the discussion—must become the discriminative stimuli for visual orientation, with competing stimuli excluded from the direct observational field.

Despite the importance of these unidirectional observing responses, deaf children in many classrooms typically show a marked lack of appropriate visual attending. Visual and tactual stimuli that compete with those being presented by the teacher serve as frequent distractors. One crucial effect of the reduced auditory input is that the deaf child misses most of the feedback information that reinforces the responses of the hearing child. If the deaf child speaks, he has little or no knowledge about the accuracy of his vocal produc-

¹This research was supported by OE Contract No. 3-16-043. The authors express appreciation to the staff of the Western Pennsylvania School for the Deaf for their cooperation on this project; to Mrs. Dorothy Jones and Miss Joanne Finklestein for their assistance in observing and recording; and to Dr. Ernest Burgi, Dr. James G. Holland, Dr. Jack Matthews, and Dr. George H. Shames for their counsel and advice. Reprints may be obtained from Helen B. Craig, Department of Special Education and Rehabilitation, 160 North Craig, University of Pittsburgh, Pittsburgh, Pennsylvania 15213.

tion—neither the articulatory accuracy nor the correctness of content—until it is approved, confirmed, denied, or corrected by a listener. Such feedback, however, is second-hand, frequently ambiguous, and delayed. Lipreading requires considerable guesswork, and sign language is at present both incomplete and imprecise. In addition, the demands and restrictions of the classroom situation usually prevent immediate reinforcement, even of this second-hand type.

Auditory deprivation thus critically affects the classroom attending behavior of the deaf child in two ways: (1) he must maintain more concentrated visual orientation than the hearing child; and (2) reinforcement for appropriate responses is often delayed for him, since obviously the immediate aural approval (available to the hearing child) is absent. The purpose of the present study was to increase visual concentration upon the appropriate instructional stimulus by compensating for the delayed or absent reinforcement for these instructionally oriented responses. That is, this procedure sought to increase the frequency of appropriate observing responses, for entire classes of deaf children, by providing immediate and tangible reinforcement for visual responses oriented toward the relevant teaching stimulus.

METHOD

General Procedure

Since this study was designed to enhance the standard educational arrangement in a school for the deaf, the subjects and procedures remained as close to the everyday teaching situation as possible while the relevant variables were manipulated. The study was composed of three experiments, exploring the effectiveness of some specific modifications in the same basic operant technique. The first experiment ran for over three months (74 sessions), the second and third for seven months (99 and 103 sessions respectively).

Each class was initially observed and both attending and non-attending behaviors were listed. The limits of behavior to be tabulated as "attending" were then specified and deviant behaviors were categorized and coded as in Table 1. Basically, a child was defined as "attending" if he were seated and if his eyes were directly oriented toward the relevant teaching stimulus for the full time period during which he was being observed.

Baseline measurement for each class was made by having two recorders serially observe each individual child for 10 sec for standard sessions consisting of 15 observations per child. A child was recorded as "attending" if his

Table 1
Coding and Classification of Non-attending Behaviors

A. Looking someplace other than at teaching stimulus
Aa—Looking at another child (looking, signing, gesturing)
Ab—Looking at Recorder
Ac—Looking someplace else (out door or window, at self-hands feet, knees, <i>etc.</i> , at attention apparatus, at floor, wall, <i>etc.</i>)
B. Fiddling
Fiddling with hands, feet, shoes, hair, with hearing aid or glasses, with class material, with watch, gun, hairband, chair <i>etc.</i>
C. Gross motor behavior
Getting up, walking or running around room, crawling, hitting or punching someone, stamping feet or pounding desk, rocking, bouncing, or jumping over desk.
D. Responses related to teaching stimulus but inappropriate at time
Talking out of turn, looking at right thing at wrong time (<i>e.g.</i> , at wrong part of black-board), still out of seat when turn at board is over, out of seat before turn, <i>etc.</i>
<i>The following two classes of behavior were observed only in Study #1 and are discussed only in that study:</i>
E. Temperamental Behaviors
Crying, sulking, waving hands of paper in front of face, signing insults to teacher, <i>etc.</i>
F. Incomplete cooperation
Not talking or reading or writing when asked to (although watching); reading when should be watching teacher or writing; writing when should be reading or watching; calling out "Finished" or "I know" when should raise hand.

behavior fit the above definition for the full 10 sec; if he did not attend for this period, his specific non-attending behavior was recorded in the appropriate coded category. As previous trials had indicated practical problems in coordinating a random sequence with the observation and reinforcement of behavior, a fixed observation schedule was selected. The children were observed in serial sequence, Child 1 through Child 7. This raised a possibility of a time discrimination due to a fixed-interval schedule; however, in practice the observing and reinforcing sequence was still variable rather than fixed. This was due to the fact that if a child being observed stopped attending at any time during the 10-sec period, the recorder marked his non-attending response and immediately began observing the next child. Thus, if Child 1 were attending but Child 2, 3, 4, 5, 6, and 7 were not, the time between the first reinforcing of Child 1's behavior and the next reinforcing of his attending might be 16 sec (the time taken to record six non-attending responses plus the time—10 sec—taken to observe the first child again). However, if every child were attending, then the time between reinforcements for this child would be 70 sec (10 sec per child). Actual inter-reinforcement time varied between these two extremes.

After the baseline responses had been recorded, the reinforcement procedure was begun. In all three classes, the children were presented with the teaching stimuli (written, spoken, or pictured) according to ordinary classroom procedure (*i.e.*, the children sat at their desks or around a large table with the teacher at the center, and the teacher presented information to be read or lipread. The children were then called upon to contribute.) In front of each child was a small box containing a light that was flashed contingent upon his visual attending. A recorder (or the teacher, in Exp. III) flashed the individual lights by pressing corresponding buttons on a control panel. The light flash provided the immediate reinforcement; the number of light flashes subsequently earned for the child a corresponding number of M&M's, cereal bits, or tokens. Non-attending behaviors were systematically ignored. Variations in this general reinforcement procedure were designed for each class and are reported below. In each class, non-attending behaviors were also recorded.

After attending had been conditioned, positive reinforcement was withdrawn in two of the classes. Further, non-attending behaviors were no longer ignored. A recorder was also present throughout the period to tabulate attending and non-attending responses.

Interobserver Reliability

Interobserver reliability was determined by computing a percentage of agreement for those specific sessions recorded simultaneously by two recorders during the baseline, reinforcement, and extinction conditions. An overall interobserver percentage of agreement was computed by dividing the total number of responses in the reliability sessions into the total number of agreements in the coded responses for each child at each observing time during these sessions. Reliability was computed for attending *vs.* non-attending behavior and for specific non-attending behaviors.

In Exp. I, agreement on "attending" was 91.28%. In Exp. II, general agreement was 95.45%; agreement on specific non-attending responses was 85.09%. In Exp. III, general agreement was 92.89%; agreement on specific non-attending behaviors was 79.44%.

Subjects

In each of the experiments, the subjects were all the regular members of classes (with seven children each) in a large residential school for the deaf. In Exp. I, the seven subjects were a "Lower Elementary" class that was considered by the school as being at the lower limit of the "normal" range of classroom behavior. These subjects were five boys and two girls, 9 or 10 yr old, with a mean WISC IQ of 93.43, and a hearing loss range from 73 db (for the range from 500 to 2000 Hz in the better ear).

The subjects for Exp. II and III were the only two first-year primary classes in that school. These students were in a classroom, rather than in a formal tutoring situation, for the first time, although all had been in kindergarten the previous year. Each class included five boys and two girls, all 6 or 7 yr. old. In Exp. II, hearing loss for the class ranged from 70 db to 110 db, and Leiter intelligence scores averaged 92.7. In Exp. III, the average hearing loss range was from 65 db to 110 db, the mean Leiter IQ, 106.3.

EXPERIMENT I

Preliminary Observations

Observations were made before Exp. I to determine general classroom conditions. Typically, for a language lesson, the teacher presented a picture of an object from home or asked for some "news" item relating to the activities of the child, and then required each child to say and write a sentence on the board. After each child had finished writing, all the children read the sentences and either copied them in their notebooks or used the pictures, and words or phrases left on the board to construct (or reconstruct) "original" sentences that they wrote in their notebooks. These two major activities will be referred to as "presentation" and "seatwork" portions of the lesson, respectively, with the latter again categorized as to "copywork" and "original composition" periods.

Procedure

The responses for the first daily session were tabulated for the "presentation" portion of the lesson (when the teacher was presenting the instructional stimuli), the responses for the second session during the written or "seatwork" portion of the lesson. Four "presentation" periods and four "seatwork" periods were observed. Two of the latter required "original" seatwork, the other two required "copywork"; the differences in attending behavior for these two types of "seatwork" indicated that their separate analysis might provide useful information.

Once the baseline behavior had been tabulated, the reinforcement procedure was initiated and carried through for 66 sessions (until the end of the school year). First, the reinforcement apparatus—the boxes on each child's desk and the accompanying control panel—was installed and three days were allowed for the children to adapt to the new equipment. The subjects were then informed of the purpose of the boxes, and reinforcement was begun, the light boxes providing the flashes (secondary reinforcers), which were later followed by primary reinforcers.

An unobtrusively placed observer-recorder flashed each light individually by pressing the appropriate button when an attending response was made. The recorder wore dark glasses to minimize detection of her visual

orientation. In the same manner as for the baseline computations, the required period of attending was 10 sec, and each child was observed serially for an equal number of 10-sec periods per child.

For the first 16 reinforcement sessions, separate observations for eight "presentation" sessions and eight "original" and "copywork" sessions were made. For all three types of sessions, the observer recorded the number of attending responses for each child and gave the record to the teacher who counted and passed out the M&M reinforcers.

At the end of Session #24, some procedural changes were made in order to explore other aspects of attending behavior. These included: (1) a gradual raising of the requirements for behaviors to be reinforced; (2) attempts to transfer appropriate attending to all other teaching periods of the day and to the teacher as the discriminative stimulus; and, (3) the construction of a token reinforcement system and the use of a wider variety of reinforcers.

The shaping and transfer procedures were primarily heuristic in nature and non-quantifiable. The token reinforcement procedure, on the other hand was sufficiently controlled to provide quantifiable results. To implement this extension, a variety of primary reinforcers was selected. A token system was set up whereby one mark was given for every light flash, and one red card was given for every 15 light flashes or attending marks. The cards were then put onto key rings, which each child owned and kept in his desk, and could be saved or "spent" as the child chose. A store-type arrangement was set up with items labelled as to cost. These items ranged from candy to knitting privileges and included toy cowboys and Indians, yo-yos, balls, dolls, puzzles, toy money, hand-made booklets, miscellaneous trinkets, and special privileges (such as extra tutoring).

One attempt was made to promote attending as a group activity. The children worked, as a group, for green token cards during one special period for the last four days of school. A class "ice cream and cupcake trip" was made contingent on every child earning three green cards (45 points) during the specified time.

RESULTS

The overall procedure for this experiment resulted in an increase of appropriate attend-

Fig. 1. Average percentages of attending for entire class: Exp. I. Comparison of baseline, M&M reinforcement, and token reinforcement conditions.

ing from an average baseline of 25.00% to an average of 85.07% during the M&M reinforcement sessions and of 88.32% for the token reinforcement sessions. An initial task-related differential, observed in the baseline, was also minimized by the experimental procedure. These results are presented in Fig. 1 and 2.

In the baseline sessions, attending responses comprised an average of only 20.00% of the responses in the "presentation" period, 19.29% during the "original composition" period (requiring original written language), and 45.71% during the "copywork" period (requiring the copying of written language from the blackboard). It may be noted that the percentage of attending for original composition tasks was almost identical to that requiring observation of the teacher (during her "presentation")—19.29% and 20.00% respectively—

whereas the "seatwork" requiring only the copying of completely available material was attended to more than twice as frequently. This difference can be seen in Fig. 2.

During the first 16 reinforcement sessions, appropriate attending responses increased from the baseline average of 20.00% to an average of 82.27% for the "presentation" period, a gain from 19.29% to 83.40% for the "original composition" and from 45.71% to 94.64% for the "copywork". Again, the percentages for the "presentation" and "original composition" sessions are more similar than for the "copywork" (82.27% and 83.50% for the former and 94.64% for the latter), but this task-related difference was cut from 26.07 to 11.76 percentage points, and the conditioned attending percentage for "original seatwork" and "presentation" sessions combined was 37.17 percentage points higher than the "copywork" attending percentage for the baseline sessions. If the first 24 sessions are considered as a whole, the average baseline attending percentage was 25.00%, the average for the M&M reinforcement sessions increasing to 85.07%.

In the remaining 50 sessions of this experiment, the average attending rate was maintained and increased slightly to 88.32%. In the initial 15 token sessions (25 through 39) the mean attending percentage was 86.29%; the next 10 sessions (40 to 49)—with both recorders present simultaneously—81.19%; in the 21 later token sessions (50 to 70)—91.29% and in the four group token sessions (71 to 74)—97.04%. Differences across sessions were generally minimal, suggesting that attending behaviors remained constant from one time of day or one type of educational activity to another, once the reinforcement procedure had been instated.

As can be seen from the tabulated results, the token reinforcement system may have been slightly more effective than the M&M reinforcers in maintaining a high level of attending. Of the other results of using token reinforcers, one of the most interesting was the popularity of the small illustrated booklets that were made to supplement the reading lesson, and which were sold in exchange for the tokens earned by attending. These booklets were always in high demand, despite the fact that the children in this class were reported to "hate reading". Another popular item was the extra tutoring time that could

Fig. 2. Percentages of appropriate attending for Exp. I. Comparison of attending to: language presentation, original composition, and "copywork" during baseline sessions and sessions of M&M reinforcement.

be bought with the tokens. Exchanging of tokens also supplemented the arithmetic lessons, and the need to accumulate tokens to exchange for the more costly items provided experience in saving.

As indicated in Fig. 3, individual variations in attending did occur, with Child 3 and Child 7 in particular exhibiting more deviant behavior than the others. It might also be noted, however, that Child 3 also showed more progress through the reinforcement sessions than did the others, moving from a baseline average of 20.00% to an average of 98.33% in the final four group token sessions. The attending of all children was consistently higher in the reinforcement sessions than during the baseline sessions.

EXPERIMENT II

Procedure

In Exp. II, the procedure was geared to a class of deaf children who were in a classroom situation for the first time. The age group was selected in an attempt to establish instructional stimuli as discriminative stimuli before responses to competing and incompatible

stimuli had time to become firmly established. An extinction procedure was also included.

The children were again presented with the teaching stimulus according to ordinary classroom procedure. (The skills being taught were primarily reading, lipreading, and speech, with some number-work.) The teacher presented the information to be read or lipread and called upon the children to contribute. Baseline data were collected for 31 sessions, once or twice daily for approximately 30 min a session.

For the reinforcement condition, the light boxes were set up in front of each child, with the light flashes (presented by the recorder) providing the immediate reinforcement contingent on the full 10 sec of visual attending. The teacher was instructed to ignore non-attending behavior. At the end of the session (15 observations per child, 30 to 45 min), the recorder informed the teacher of the number of flashes per child and wrote the number for each child beside his name on the blackboard. The teacher then gave to each one the corresponding number of M&M's. This procedure was followed for a total of 32 sessions. Reinforcement sessions occurred at different times

Fig. 3. Average percentages of attending for individual children in Exp. I. Comparison of baseline with M&M reinforcement and token reinforcement conditions.

of the day, in order to avoid a spurious temporal effect.

After the attending behavior had been increased, extinction was instituted. For 25 sessions, the recorder ceased reinforcing attending responses, the teacher ceased ignoring non-attending behavior, and the light boxes were removed. Responses were tabulated as before but with no reinforcing consequences.

RESULTS

Experiment II produced essentially the same results as Exp. I, only with a younger class of children and with the addition of the extinction condition. The average percentage of attending behavior recorded during the 31 baseline sessions was 26.13%. Appropriate attending then increased to an average of 82.86% by the final sessions of the reinforcement condition, decreasing to 32.22% in the final sessions of extinction. These effects are charted in Fig. 4.

Of the deviant behaviors in this class, during baseline sessions, 75.62% involved "inappropriate looking" (with 60.40% looking at other children, 6.29% at the recorder, and 8.93% at other classroom stimuli); 12.78% consisted of "fiddling"; 8.31% of "gross motor

activity"; and 3.29% of "related but inappropriate responses". Concurrently with their decrease in proportion to total behavior, the percentage of deviant behaviors emitted during reinforcement sessions shifted away from the more disruptive toward the less disruptive responses. One example is the decrease in "gross motor responses" from the baseline of 6.14% to the total responding to 0.007% during reinforcement. This activity remained at approximately the conditioned level through the recorded extinction sessions.

For the individual children, the range of average attending in baseline was from 19.55% to 36.56%. All children increased their attending during the reinforcement condition, with appropriate responses in the last five reinforcement sessions ranging from 71.11% to 100.00%, with a mean of 83.80%. In the final extinction sessions, average attending ranged from 16.67% to 55.00%, with a mean of 32.22%. Five of the children had reverted to approximately their baseline behavior by this period; the other two showed somewhat more resistance to extinction. These two students had also reached the highest consistent rates of attending during the reinforcement condition (with 100% and 93.33% in the last five ses-

Fig. 4. Average percentages of attending for entire class: Exp. II. Comparison of baseline, reinforcement and extinction conditions.

sions). Percentages of response for the individual children during the different experimental conditions (average over five-session periods) are illustrated in Fig. 5.

EXPERIMENT III

Procedure

Although Exp. III was also geared to deaf children in a classroom situation for the first time, an additional aim of this experiment was to permit the teacher to control the attending behavior of the class without the help of an observer-recorder. For this purpose, an automatic counter system was set up and separate social and tangible reinforcement sessions were scheduled.

Baseline data were collected in the same way as for Exp. I and II, utilizing the same definition of "attending", the same list of non-attending behaviors, and recorded for the same length of time (10 sec per child, 15 observations per child per session). Thirty-six baseline sessions were recorded. Again, recorder reliability was checked periodically through this and the succeeding phases of the experiment.

The apparatus utilized for the reinforcement consisted of seven individual mercury pulse counters connected with the reinforcement lights. Whenever the teacher delivered reinforcement—pressing the button to flash the light in his box—the reinforcement was automatically recorded on the child's counter, now mounted on a score-board in the front of the room.

Social reinforcement. At first, the teacher gave *only social reinforcement, smiling at the students who were attending and ignoring those who were not.* She also made comments such as, "Good, Johnny is watching!" or "All of you were watching this time!" One of the recorders was also present during these sessions, tabulating both the attending behaviors of the students and the reinforcing behavior of the teacher. Fifteen social-reinforcement sessions were presented.

Tangible reinforcement. The second step in the reinforcement procedure required the teacher to use the reinforcement apparatus. The teacher continued to smile selectively, but now she also pressed the appropriate button contingent upon a child's attending. At the end of the teaching period (30 to 45 min)

Fig. 5. Average percentages of attending for the individual children in Exp. 2. Comparison of baseline, reinforcement, and extinction conditions.

the teacher presented the number of cereal bits indicated by the number on the counter and also wrote this number on the board opposite the child's name. (An observer was present to record actual attending in the same manner as during the baseline sessions.) There were 18 such sessions.

As a final step before extinction, the observers both recorded and presented the immediate (light-flash) reinforcers. These were still followed by cereal at the end of the session. That is, the same procedure was used at this time as was used with Classes I and II. This step was continued for one week (five sessions).

Extinction procedure. The extinction procedure for this class reversed the basic two-step reinforcement procedure. First, tangible reinforcement was discontinued, but the teacher still provided social reinforcement (contingent smiling) and the number of attending responses recorded by the observers was tabulated on the blackboard. Later, the teacher ceased systematic reinforcement of attending behaviors and systematic ignoring of non-attending behaviors, and no tabulations were entered on the board. Thirteen sessions were recorded for the first step of the extinction procedure; eight were recorded for the second phase.

RESULTS

Experiment III produced results similar to those of Exp. I and II, but with additional findings on the relative effectiveness of social *vs.* tangible and teacher-controlled *vs.* observer-controlled reinforcement. For this experiment, the average attending recorded during the 40 baseline sessions was 44.68%. During the 15 sessions of social-reinforcement only, average attending increased to 63.66%, followed by additional increases during tangible reinforcement, to 79.19% by the last sessions of teacher-controlled, and to 94.61% during the sessions of recorder-controlled tangible reinforcement. On the withdrawal of tangible reinforcers, average attending decreased to 67.11% (by the final sessions of this condition); and on the withdrawal of social as well as tangible reinforcers, attending responses decreased to an average of 43.10% over the last four sessions. These results are presented in Fig. 6.

The social-reinforcement only sessions were

grouped for analysis into three periods of five sessions each. The average attending for each period was 60.19%, 68.52%, and 61.88%. For each of these periods, the frequency of specific social reinforcement provided by the teacher was recorded by the observer as 101, 62, and 127 reinforcers (directed smiles). However, the measurement of the social reinforcement provided was imprecise in that the overall behavior of the teacher appeared to be much more positively reinforcing than during the baseline sessions, and the observer reported that it was difficult to differentiate between the increased generalized smiling and a specifically directed smile. No observer reliability data were gathered on the teacher's smiling behavior.

Fig. 6. Average percentages of attending for entire class: Exp. III. Comparison of baseline, reinforcement, and extinction conditions.

The sessions of teacher-controlled tangible reinforcement were grouped into four periods of five sessions each, with the first period showing an average attending percentage of 69.22%, the second, 76.67%; the third, 73.12%; and the fourth, 79.19%. As might be expected, the immediate tangible reinforcers (light flashes) were somewhat less frequent and less consistently provided by the teacher than by the recorders. The actual immediate reinforcement (as tallied on the automatic counters—and therefore directly corresponding to the number of times the lights were flashed) was 52.16%, 58.33%, 46.67%, and 58.00% respectively of the possible reinforcement (observed and tabulated by the recorders) for these periods. In the last five sessions of tangible reinforcement, when the recorders were controlling the reinforcement apparatus, average attending increased to 94.61%.

During the first 15 sessions of extinction, with social reinforcement still available, attending in the three five-session periods averaged 75.15%, 77.68%, and 67.11%. When all reinforcers were withdrawn, a continued decrease in attending was evidenced, from a 56.67% average for the first four to a 43.10% average for the final four extinction sessions.

The percentage of deviant behaviors in this experiment followed the same pattern as that for Exp. I and II, *i.e.*, the deviant behaviors that occurred in the reinforcement conditions generally appeared to be a replacement of more socially acceptable behaviors for the socially inappropriate ones that occurred in the baseline. During the extinction sessions, the general pattern of Exp. II was again evidenced in that the proportion of "gross motor activity" remained low, although total deviant behavior increased again to baseline level.

The range of average attending in baseline was from 35.96% to 56.26%, with a mean of 44.68%. All the children increased attending during the reinforcement condition, although with individual differences as to the relative effectiveness of social and tangible reinforcement. In the final tangible reinforcement ses-

sions, with the recorders controlling the light flashes, every student increased his average attending to over 90.00%. Again, as in Exp. II, every child decreased attending during extinction, this time showing a progressive decline as first tangible, then social, reinforcers were withdrawn. The data for the individual child are presented in Fig. 7.

The extent of conditioning and of extinction were fairly consistent for all these children. The primary individual differences were in the relative effects of the social and tangible reinforcement and, in the latter, of the teacher-controlled *vs.* recorder-controlled reinforcement. Child 2's behavior, for example, indicated that social approval was as reinforcing to him as were tangibles when these reinforcers were presented on the same basis. His average attending was recorded as 76.67% and 71.37% in the social reinforcement and teacher-controlled tangible reinforcement conditions respectively, and as 71.56% in the 15 sessions of extinction with tangible reinforcement withdrawn but social reinforcement still in effect. When tangible reinforcement was provided on a more systematic basis—with recorder-control—his attending increased to 90.59%. (With no

Fig. 7. Average percentage of attending responses for individual children in Exp. 3. Comparison of the six experimental conditions.

reinforcement scheduled, his attending decreased to 56.67%, somewhat higher than his baseline of 49.30%.)

The behavior of Child 6 provides a striking contrast in the effectiveness of the social reinforcement, with an average increase of only 7.98 percentage points from baseline to social reinforcement, but a mean increase of 50.25 percentage points from social to tangible reinforcement. For this child, the variable of teacher *vs.* recorder control of the tangible reinforcement was nil, as his attending had already reached 100% before the recorder-control was instated. Once his appropriate attending had been established through the tangible reinforcement, social reinforcement alone seemed sufficient to maintain it at a high level (96.00%)—at least for 15 sessions.

With the exception of Child 6, the individual differences between the effects of social and tangible reinforcers were overshadowed by the effect of the scheduling of these reinforcers. However, even the rather unsystematic presentation of social and/or tangible reinforcers did increase the attending responses for every child by at least 14.34% and as much as 58.23%, and the removal of these reinforcers resulted in decreased attending for every child to within eight points of baseline level.

DISCUSSION

All three experiments in the present study resulted in a measurable increase (50% or over) in appropriate attending responses for entire classes of deaf children. This increased attending was maintained while the reinforcement contingency was in effect, dropping to the original baseline level in the two classes in which this reinforcement was withdrawn. These results support the use of behavioral modification techniques with deaf children in a classroom situation and again demonstrate the utility of considering attending as operant behavior.

The baseline responses for these experiments indicate that appropriate attending was not promoted by the present education procedures (at least in these three classes). If from 50% to 75% of the children's classroom behavior had been inappropriate to the presented learning task, then it would follow that only 25% to 50% of the learning opportunities would have been utilized. One contributing

factor here was that non-attending seemed to be reinforced by the attention of both teacher and peers (and probably by approval of the peers as well) while appropriate looking was frequently not reinforced at all. Young deaf children have such limited acquaintance with most material to be lipread or read that the teaching stimulus may seem ambiguous and confusing to them, rather than providing an informational reinforcement for attending. This is especially true at this early primary level, when correspondence between spoken or written linguistic symbols and the things or abstractions represented is not yet clear.

The operant procedure in all three experiments increased the appropriate attending to over 82%. In the process, the non-attending behaviors necessarily diminished to under 18% of the total response. Thus, with the reinforcement procedure, it was possible to reverse the proportion of attending/non-attending behavior provided by the ordinary classroom routine.

The problem of the transition from tangible to more socially acceptable reinforcers was answered in part by the extinction data from the two experiments providing for withdrawal of the tangible reinforcement, and in part by the results (in Exp. III) of social reinforcement alone. In the first two cases, attending returned to the baseline level when tangible reinforcers were withdrawn, but this return was more gradual than was the increase to the reinforced attending level. In Exp. III, the social reinforcement provided a middle ground between the conditions of no reinforcement and of tangible reinforcement. These combined results suggest that, with more systematically scheduled social reinforcement (and probably with definitive provisions for making the instructional stimuli as reinforcing as the stimuli competing for attention), the increased attending behavior may very well be maintained without constant tangible reinforcement.

For the deaf child, with his diminished auditory feedback and consequent lack of immediate reinforcement, the necessity of obvious external reinforcements may well carry over to a greater extent and for a longer time than for the normal, hearing child. Thus, the transition from tangible reinforcement should probably be very gradual and dependent upon a number of factors, including: (1) the age at

which scheduled tangible reinforcement is begun; (2) the schedule used for phasing into more subtle reinforcement; and (3) the presentation of materials that are reinforcing (and would therefore "in themselves" control appropriate attending).

One primary recommendation indicated by the present experiments is that this type of behavioral modification program should be started as early as possible, at least in the first year of actual classroom work, and possibly with an introduction in the kindergarten situation. The tutoring arrangement in the kindergarten classes allows more immediate reinforcement than is conventionally possible in a classroom, but the initial year in the classroom provides too many opportunities for the conditioning of non-attending behaviors. The importance of other children as distractors from instructional stimuli has been shown in this study by the much greater frequency of this than of any other non-attending behavior recorded. By early establishment of appropriate attending, through tangible reinforcement, later transfer to primarily social reinforcement should be more easily accomplished.

This study further suggests that it is important to begin to reinforce attending behavior on a continuous schedule until the behavior has reached a high stable level. After that, reinforcement could be scheduled at less frequent intervals and on an increasingly thinner schedule. Increasing variety in the reinforcers could be provided, as in the token reinforcement system utilized in Exp. I. Social and tangible reinforcers of varied types could thus be presented in a number of combinations, with the proportion of tangibles scheduled to decrease once the attending behavior had become well established.

The results, particularly of Exp. I, would suggest that the material to be presented should also be scheduled in smaller steps. In that experiment, it was noted that children who had previously balked at writing or speaking at all seemed more willing to try when they saw that perfect performance was not being required and that material reinforcers were contingent simply on attending to the task and "trying". It would also seem that the materials themselves should be more explicit and concrete. If they provided both more definite visible information and more clear-cut knowledge of results than is commonly

provided by language lessons (especially lip-reading and speech), instructional materials should be able to compete more effectively with outside distractors.

This series of experiments has raised several questions relevant to the use of behavioral techniques with the deaf, especially in the modification of their visual attending responses. Although recent studies have dealt with operant procedures in classrooms for the emotionally disturbed or mentally retarded, there is need for such studies in classrooms both for normal children and for children who are deaf or blind. Studies of basic attending in these settings, for example, could provide additional insights on: (1) the varying parameters of attention—visual, auditory, and tactile; (2) the comparative effects of modification of visual and tactile attending (for the deaf), auditory and tactile attending (for the blind), and multi-sensory attending (for the normal child); and (3) the reciprocal effects of increased student and teacher attention and reinforcement on classroom interactions. This study supports the expanded use of operant procedures both in classrooms for the deaf and in the evaluation and control of basic attending behavior.

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Received 25 June 1969.

(Revised 12 January 1970.)