A case study is presented that documents changes in eye contact duration following a program of sensory stimulation. Stimulation was provided by bouncing, being pulled on a scooter board, quick rocking, and use of an electric toothbrush. Data indicated that longer eye contact, decreased self-stimulation, and improved learning occurred. These results lend support to the hypothesis that some hyperactive children are underaroused and need stimulation. The rationale for treatment of these individuals is discussed.

Improving the attending behaviors of profoundly retarded adults is often a difficult task. Some of them engage in self-stimulation for prolonged periods of time and continue to self-stimulate despite frequent reinforcement of appropriate behaviors. When asked to perform a task, they look at it only briefly, work on a trial and error basis, then quickly stop working. A theory developed for hyperactivity in children may have implications for improving attending behaviors in profoundly retarded individuals.

The inverted U, a relationship between arousal and performance, was discussed in an article by Brodemus and Swanson (1). It was theorized that an individual's best performance will occur at his or her optimum arousal level. This optimum level will vary from task to task and over time, but will fluctuate around a certain point for each individual (Figure 1).

A person at point B (Figure 1) may feel "nervous" and restless and have trouble concentrating. He is overaroused and may feel a desire to calm down, perhaps by reducing the noise and visual stimulation in the environment or by taking a tranquilizer. An individual at point A who is driving a car might find himself falling asleep. He might
drink coffee or take another chemical stimulant in an effort to stay awake.

Brodemus theorized that the hyperactive child is at point A (low arousal) and that stimulant drugs decrease the child's stimulus seeking by increasing his or her arousal level. Support for this low arousal model was found by Prichep and others (2). They studied auditory-evoked potentials—a measure of arousal—in hyperkinetic children. The children showed low arousal levels and, when treated with stimulants, their arousal levels became more like those of normal children.

Just as sleepy car drivers could increase their arousal with chemical stimulants, they could also increase their arousal through increased sensory input. Examples might be turning on the radio, opening the window, or shaking their head. In like manner, hyperactive children can be treated with chemical stimulants or with sensory stimulation. This model is complicated by the fact that individuals who are either significantly over- or underaroused may display similar behaviors (a short attention span and high activity level) for opposite reasons.

In two articles, Zentall discussed treating hyperactivity by providing stimulation in the environment (3, 4). In one of these articles, hyperactive children were evaluated in low and high stimulation rooms. The low stimulation room consisted of low lighting, low-level white noise, and bare walls. The high stimulation room contained rock music, pictures on the walls, bright light, flashing Christmas tree lights, and five mice in a transparent Habit Trail. The children were less active in the stimulating room, and their performance was not adversely affected. This finding contradicted a common belief that hyperactive children are too distractable and should be treated in a low-stimulus environment.

In a study of six first grade classrooms, Koester compared the stimulus-seeking/activity of children showing high and low arousal levels in traditional (low stimulus) and open (high stimulus) classrooms (5). Arousal level was measured by skin conductance and pulse rate. During the school year stimulus seeking declined for both groups in the open classrooms, but increased in the traditional classrooms. The high arousal group showed a decrease in task performance in the open classroom, as predicted.

The different response to stimulation between high and low arousal children in these studies could be explained by the results of a study by Kinnealey (6). She studied the responses of 20 severely retarded hyperactive children to sensory stimulation and was able to differentiate two subgroups on the basis of their aversive or nonaversive reactions. The nonaversive group, which she called hyporesponsive, required a high level of stimulation before showing a response. The second group responded aversively to even low levels of stimulation and was referred to as hyperreactive.

The hyporesponsive group may fit the low arousal model of hyperactivity. If the stimulation normally present in the environment evokes little or no response, and causes little if any increase in arousal, the individual will have to seek out very intense, prolonged stimulation to raise his arousal level. In contrast, the group showing an aversive response to low levels of stimulation would compare with the high arousal children in Koester's study who demonstrated diminished performance in a stimulating environment.

The purpose of this study was to examine the stimulation-arousal model by determining the effect of sensory stimulation on eye contact in a profoundly retarded adult.

### Method

**Subject.** The subject in this case study was a 30-year-old profoundly retarded male who was able to walk short distances with a broad-based gait. No abnormalities of muscle tone were apparent. He was nonverbal and disliked being touched. He engaged in self-stimulatory behavior when not performing a task.

<table>
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<th>Table 1 Length of Eye Contact*</th>
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*Measured in seconds, averaged for each month. Figures in parentheses are the number of trials conducted that month.
including playing with his hands, putting his fingers in his mouth, hitting himself on the chin, and making back vowel and lip closure sounds.

Apparatus. The experimental setting was in a lighted classroom. Five other retarded adults were in the same room. The following equipment was used to provide sensory input: 1. a wooden rocking chair with arms and a high back; 2. a Broxident electric toothbrush, (plug-in type); 3. a scooter board 45.7 cm (18 inches) x 81.3 cm (32 inches); and 4. a bouncing board made of two 61-cm (2-foot) square pieces of 1.3-cm (1/2 inch) plywood, with one 10.1-cm (4 inch) spring between each corner.

Procedure. In this single subject study the number of seconds of eye contact were measured while environmental stimulation was manipulated. The basic design consisted of measuring eye contact, providing stimulation, and measuring eye contact again. These three steps comprised one trial.

Step 1. The subject was seated in a chair facing the seated staff member. Their faces were approximately 61-cm (2 feet) apart. The staff member said, "M, look at me," and timed the number of seconds eye contact was maintained.

Step 2. One of the following stimulation conditions was given to the subject:

Stimulation A (Scooter Board). The subject was pulled quickly for 7.6 meters (25 feet) while seated on the scooter board.

Stimulation B (Bouncing). The subject was bounced quickly 20 times while seated on the bouncing board.

Stimulation C (Rocking). The subject was rocked quickly back and forth 20 times while seated in the rocking chair.

Stimulation D (Toothbrush). The subject was given an electric toothbrush with toothpaste, which he could hold in his mouth for as long as he wished (usually for 30 to 60 seconds).

Step 3. The subject was seated in the chair used in Step 1. The staff member said, "M, look at me," and timed the number of seconds eye contact was maintained.

There was a five-minute interval between trials. No reinforcers were given contingent upon eye contact. All trials were conducted at the same time each day.

During the first month, stimulation conditions A, B, and C were used. This resulted in three trials (one each) per day. During the second month, conditions A and B were discontinued because they were difficult to administer. Stimulation conditions C and D were used for the second, third, and fourth months. This resulted in two trials (one each) per day. During the third month, a check was performed to see whether merely sitting in the chair and measuring eye contact twice was confounding the results. Step 1 was done, followed by a one-minute wait during which both the staff member and the subject remained seated and did nothing. Step 1 was repeated, then Steps 2 and 3 were carried out as before.

Results

The number of seconds of eye contact was averaged monthly for each step (Table 1). The results indicated a marked increase in eye contact following stimulation. The increase occurred following each form of stimulation, and for all four months. All stimuli at least doubled eye contact except for the scooter board. Whether this was a form of stimulation that was not as effective, or whether the subject was not pulled fast enough or for an ineffective period of time is not clear. During the fourth month, eye contact more than tripled. Repeating Step 1 during the third month did not result in a significant increase in eye contact, indicating that being given the command twice did not by itself contribute to the increased eye contact. Narrative reports from the teacher indicated that he put his hands in his mouth less, hit himself
on the chin less, and attained goals faster in fine motor and language tasks. Neither his hands nor his chin were chapped, a condition common for him.

Discussion
These results, although not definitive, appear to support the stimulation-arousal model. However, the study was flawed by the lack of a baseline. The measurement technique did not appear to confound the data during the third month, but a formal baseline would have strengthened the results.

There did not appear to be any long-term improvements in eye contact. The increases in goal attainment may have been related to the short-term improvements in eye contact. The stimulation would seem to be most useful if given just prior to learning tasks.

Therapeutic Implications
The stimulus seeking behaviors in which profoundly retarded individuals engage could result from a number of causes acting alone or in combination. These may include:

1. Contingent reinforcement: Although inadvertent, giving attention for “bad” behavior, or allowing the individual to avoid tasks because he becomes unmanageable is common. Several studies have demonstrated impressive improvements in hyperactive children's performance by the use of behavior modification techniques (7-9).

2. Anxiety or emotional disturbances: Includes many of the classifications of mental illness. In a review by Prout, biofeedback was proposed to be very effective with some hyperactive children (10).

3. Organic causes: Biochemical or structural abnormalities. It would appear that, in some instances, abnormal responses to sensory stimulation may have an organic basis (2, 3, 6).

In a review of ways to predict children's response to stimulant drugs, Barkley found that measures of a short attention span or poor concentration were the best predictors of a good response to medication (11). High activity levels correlated closely with a short attention span. In reviewing 36 drug studies, it appeared that good responders failed to show homogeneity in physiologic, neurologic, psychologic or sociologic measures, rating scales, familial predictors, or diagnostic categories unless a measure of attention span was used. In a study of good drug responders, Ullman and others were unable to find homogeneity in the behavioral symptoms of their hyperactive subjects (12).

Since it appears that the observable behavior of hyperactivity could be caused by a number of factors, a differential diagnosis should be attempted before treatment is begun.

I differentiate hyper- and hyporeactive individuals by noting their reactions to inhibitory and facilitory stimulation over several trials. Those individuals who become markedly quieter when removed from the classroom and placed in a quiet dark room are considered hyperactive. If further decreases in behavior result quickly from inhibitory techniques administered in the quiet room, it confirms the diagnosis. The more rapid the change in activity level, the more dependent the individual's arousal level is on the amount of stimulation present in his or her environment.

The hyporeactive individual will become more active when placed in a quiet dark room. Inhibitory techniques will often be rejected, or will cause further increases in activity. If facilitory stimulation causes a measurable increase in attending behaviors or a decrease in activity, the diagnosis of hyporeactivity is confirmed.

If no change occurs in the individual's activity level after 15 minutes in a quiet dark room, providing stimulation may not alter the behavior. Other possible causes of the behavior should be examined.

The level of stimulation present in the environment must be carefully controlled for hypo- and hyperresponsive clients. In general, hyperresponsive individuals should be treated in a quiet environment, and hyporesponsive patients treated in a very stimulating environment. Farber and Huss developed a list of techniques thought to be generally excitatory or inhibitory to the central nervous system (13). Inhibitory techniques included slow movement, pleasant smells, and decreased noise and illumination levels. Excitatory techniques included fast movement, noxious smells, increased noise and illumination, and vibration.

If an individual has been diagnosed as hyperactive, treatment should be carried out in a nonstimulating environment. Distractions should be controlled so that the individual is not drawn from the task. If the individual appears to be overaroused at any time during the session, stimulation can be reduced and inhibitory techniques administered. Overarousal may lead to higher activity levels, underarousal may cause drowsiness. From day to day, and within sessions, the amount of stimulation needed will change, demanding continual reassessment. These techniques were successfully used with a hyperactive child by Smith and Phillips (14).

Hyporeactive individuals can be treated through an excitatory stimulation program. A variety of stim-
ulation should be given, and an objective measure used to note behavior changes. Special emphasis should be placed on providing stimulation through the senses the individual most frequently uses when seeking stimulation. An effective stimulation should decrease activity and increase attending within the first few minutes after it is presented. The client must accept the stimulation offered. Since stimulation can be reinforcing, as noted by Rehagen (15), with vibration, behavior modification techniques must be employed to ensure that desired behaviors are reinforced and that stimulus seeking is not reinforced.

If the client rejects all forms of stimulation offered, a stimulation program should not be carried out. Further consideration should be given to other possible causes of the high activity level.

Once a form of stimulation has been found that the client accepts and results in increased attending behavior, or decreased stimulus seeking, duration and intensity for the stimulation must be determined. If the intensity can be varied, the client should control it. Tolerance appears to vary widely from day to day in an unpredictable fashion. If the client rejects or withdraws quickly from a previously enjoyable stimulation, it should be offered again, but not forced. The maximum duration should be determined by the therapist. The client may overstimulate himself, which could cause his arousal level to change to a level not conducive to learning. Some type of continual objective assessment is required to determine whether the client is being given too much or too little stimulation.

Further research is needed. Several of the studies cited in this paper manipulated the subject’s environment (3-5). This study reported the results of stimulating the client directly.

Many questions remain—is direct stimulation more effective than environmental stimulation? Will direct stimulation work with hyperactive children? What is the effectiveness of sensory versus chemical stimulation? Is placement in a quiet, dark room a reliable means of diagnosing hyper- and hyporesponsive individuals? Answers to these and related questions could provide an effective conservative approach to assisting hyperactive clients.

Summary
Attending behaviors may be increased by providing sensory stimulation to some profoundly retarded hyperactive individuals. Potential clients are those who show increased activity when placed in a nonstimulating environment. A form of stimulation must be found that the individual accepts. The therapist must be alert to the possibility of overstimulation. Individuals whose activity level increases as stimulation increases and decreases in a quiet environment should be treated in a low stimulus environment. Inhibitory or excitatory stimulation may be introduced as needed to keep the individual at an optimal level of functioning. When used with objective measures and effective teaching and behavior modification techniques, altering stimulation can result in a decrease in hyperactive behaviors.

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