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Original Research

Use of electronic prompt to reduce problematic behavior in the classroom in children with ADHD

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Abstract

Background: In the present study, a baseline, treatment, and a follow-up research design was used to treat two boys, who were diagnosed as having ADHD. They were trained to reduce problematic behavior in the classroom using a mobile wireless communication system combined with receiving rewards for reducing the problematic behavior.

Method: A baseline-score of the following behavioral domains were assessed: Disturbance, it was defined as verbal and physical outbursts toward other students; Movement, it was defined as restless behavior of standing up or turning around without permission; and Speaking, it was defined as any speaking without the permission of the teacher. Training was conducted, during six sessions, by sending an auditory prompt through a wireless device to signal that a problematic behavior was taking place and that an appropriate behavior should be performed instead. Rewards were given for success in reducing these problematic behaviors. Following the training, of six sessions, another set of six observing sessions were given to assess the changes in the three observed behavioral domains. Three weeks later, a follow-up was performed to assess the maintenance of the acquired behavior.

Results: The results showed a clear reduction in problematic behaviors from pre-training to post-training periods. A slight increase in these behaviors in the follow-up period did not impair the overall reduction in the problematic behaviors.

Conclusions: The results allowed the researchers to conclude that an auditory prompt given through a mobile wireless communication system combined with a reward system, can provide an effective procedure in reducing the problematic behavior of children diagnosed as having ADHD in the classroom. The data for this study was conducted, and data was collected in 2010

INTRODUCTION

Children with an attention deficit hyperactivity disorder (ADHD) were characterized as having problems in attention, hyperactivity, and impulsivity. These children have various behavioral, cognitive, and emotional problems, some of which should have been present before the age of seven [1].

Prompting is one method used in behavior modification. Miltenberger claimed, "Prompts are used to increase the likelihood that a person will engage in the correct behavior at the correct time. They are used during discrimination training to help the person engage in the correct behavior in the presence of the discriminative stimulus (SD)" (p. 207) [2]. Others [3], called it cueing when he referred to the same stimuli. A prompt can be verbal, gesture, modeling and physical, and its purpose is to inform the person who receives the prompt about the possible appearance of a known problem. Prompting can be a very effective way to remind, trigger, or give a signal to perform or to prevent a known behavior [2].

Prompting was found to be effective in improving the impulse regulation of boys who were diagnosed as having ADHD [4]. Rapp, Miltenberger, and Long [5] developed an instrument named Awareness Enhancement Device to reduce the behavior of a finger sucking and chronic pulling of one's own hair by using prompting. Various studies showed that an electronic device, which emitted a sound whenever the hand

approached the mouth or the hair, was effective in reducing the finger sucking or hair pulling [6, 7]. Other researchers used an auditory prompt to teach developmentally disabled toilet training [8]. When an inappropriate behavior appeared, such as wetting the pants, an auditory prompt was sounded automatically; it signaled to the child the need to go to the toilet. The results showed that the procedure was effective in seven out of eight children. Similar use of a wireless device was used by different researchers [9]. They used vibrating pager to prompt successfully students with disabilities to engage in specific instructional activities in the classroom. Today automatic prompting is probably one of the most common methods to reduce nocturnal enuresis and hair pulling.

Despite the relative wide use of prompting and automatic prompting for bed-wetting, finger sucking, and hair pulling, there were only a few studies that have used electronic devices as a prompt to improve other problematic behaviors in the classroom. This is the reason that literature review in this area is limited. Children who were diagnosed as ADHD can be a good target population to develop new behaviors and to reduce their behavioral problems in class, since they often have many problems. This situation makes it difficult for them to study; in addition, their behavior distracts the normal course of the class. The uniqueness of the present study is an attempt to improve the behavior of children with ADHD in the class through a combination of wireless electronic prompting and a reward system to acquire appropriate behaviors.

The purpose of the present research was to assess the influence of auditory prompt for inappropriate behavior and to signal that an appropriate behavior will be performed. The prompt was given through mobile wireless communication (known as a walkie-talkie), it was combined with a reward system to reinforce the appropriate behavior. It was hypothesized that the use of a mobile communication system combined with a reward system would reduce problematic behavior in children who were diagnosed as having ADHD in the classroom.

METHOD

Participants

Two boys participated in the study. One participant was a 12 year and 1 month old. He studied in the sixth grade, and he lived with his parents in a medium-sized town. He was diagnosed by a child psychiatrist as having ADHD-combined type when he was in the fourth grade. He did not use medications, and was not in psychological treatment. The boy was recruited for the study with the help of the school counselor, who was not successful in treating him. The second participant was an 11 years old who studied in the sixth grade. He was diagnosed as having ADHD-combined type when he was in third grade. He lived with his parents, and he had stopped taking Ritalin after a short trial about a year before the beginning of the study, he was not in psychological treatment. Both participants were selected for the study since their parents preferred not to use treatment of medications or any psychological intervention.

The ethics committee for human subjects' research of Yezreel Valley College approved the study. The parents signed a written informed consent before the study.

Instruments

Conners' Teacher Rating Scale-Revised-Long Form (Conners, 1998) [10] was used to assess the level of various behavioral domains related to the ADHD of the participants. The questionnaire has 59 items divided into 13 behavioral measures. As with the other Conners' scales it was standardized, validated and is considered reliable, based on a large population. The questionnaire was translated and adapted for Israeli children [11].

A two-way mobile communication system (Walkie-Talkie, model W-2107) was used to transmit messages from the observers to the participants. The instrument (weighing 700 grams) was designed for receiving and for transmitting messages. An earphone was attached to the receiver of the mobile communication system and subsequently on the child. A red button on the transmitter allowed the experimenters to send an auditory signal, in a form of a beep, to the participant.

A 'reinforcement review page' was constructed, and used specifically for this study, allowing the experimenters to select a reinforcement based on the children's preference as was found by their responses on the 'reinforcement review page.' This information was used later to select a tangible reinforcement given for reducing inappropriate behavior in the learning phase of the study.

Procedure

The study was planned as a (1) baseline, (2) treatment, and (3) a follow-up research design with the first participant tested one week prior to the second participant. The study was performed in the children's natural school environment.

Assessment of the participants' problematic behaviors was carried out by four trained neutral observers, two for each child. Classroom observation was done for each child independently throughout the study. The observers sat at the back of the classroom where they

could see the participant without disturbing the normal class routine. Observations were performed at set intervals by using direct observation of the behavior on the "analysis of causes of complicated behaviors checklist" [12]. To make an observation and recording easier only three problematic behaviors were selected in the present study. These specific observed behaviors were selected in a short pilot study where the children were observed to see the most common problematic behaviors. These behaviors observed were: **Disturbance** was defined as verbal and physical outbursts toward other students (here the participants were instructed to stop their outburst and to be silent when they heard the prompt). **Movement** was defined as restless behavior of standing up or turning around without permission (here the participants were instructed to return to their seat and to sit down facing the teacher when they heard the prompt). **Speaking** was defined as any speaking without the permission of the teacher (here the participants were instructed to stop speaking when they heard the prompt). A stopwatch was used to measure the exact times of each observation. The procedure included the following seven phases:

In the **first phase,** the two participants were selected from two different schools. Professionals diagnosed the participants previously as having ADHD. A psychiatrist performed the diagnoses of the children prior to the beginning of the study. It was based on meetings of the psychiatrist with the children, interviews of the psychiatrist with the parents to assess the nature of the problem and developmental histories of the children, and rating scales to the parents. To confirm the diagnosis of each child and to assess the severity of his problems, the class teacher evaluated each participant by answering the Conners' Teacher Rating Scale-Revised-Long Form [10]. At that point, the parents were asked to sign an informed consent, and the child was asked to participate in a study to reduce the problematic behavior he had in class.

The **second phase** was the pre-training phase. Six observation sessions in six different lessons were performed. The recording method was a non-continuous partial interval recording. It was used in order to rate the problematic behavior of the child in the pre-training. Each observation of one lesson was divided into 45 segments of 15 seconds each followed by five-seconds interval to enable recording the results. The observations were carried out in separate lessons with the same teacher and the same participant. Each observer carried out the observations individually. The final rating of the two observers was the average of the two raters.

In the **third phase,** there was a meeting of the two observers, the school psychologist, and the classroom teacher together with the child. At that point, the child was informed of the exact details of the program and what was expected of him, which was: (1) no verbal or physical aggression toward the teacher or the other students is allowed (here the participants were instructed to stop talking when they heard the sound in their earphone). (2) Standing or walking around the classroom, is done only with permission from the teacher (here the participants were instructed to return to their seat and to sit down facing the teacher when they heard the sound in their earphone). (3) Speaking during the lesson is allowed only after receiving permission from the teacher (here the participants were instructed to stop speaking when they heard the sound in their earphone).

At that time, the child completed the 'reinforcement review page'; this was the preference of the child for reinforcement, which was used as a reward for progress in learning to reduce inappropriate behavior later during the fourth phase.

In the **fourth phase**, the training for reducing problematic behaviors was performed in six separate lessons; overall, there were 300 minutes of training (five lessons, each one 50 minutes). When an inappropriate behavior was recognized, the observer pressed the transmitter and a sound was heard through the earphone of the participant. The behaviors should have been performed immediately following the signal had been defined exactly before the beginning of the training phase (see the second phase). The behavior that followed the signal was recorded.

In the **fifth phase**, reinforcement for success in reducing the problematic behavior was awarded. Achieving an appropriate behavior of stopping immediately the problematic behavior was reinforced at the end of each lesson in the following manner (based on the 'reinforcement review page' completed previously by the participants): (1) One success - received a sticker. (2) Two successes - received free time in the class. (3) Three to five successes – received a disk of computer game. (4) Six or more successes, a letter was sent to the parents to inform them about the progress of the child in the program. Because of the specific research design, it was impossible to reinforce the participants immediately in the middle of the lesson, and therefore, a delayed reinforcement procedure was used.

The **sixth phase** was a post-training assessment; it was carried out after the end of the previous learning phase. In this phase, a direct observation was performed, with the same observers as before. Six observations were carried out in a similar manner as in the second phase.

In the **seventh phase**, a follow-up was performed. In this phase, an observation of the child's behavior in a

manner similar to the second and the sixth phases was carried out. This phase was performed three weeks after the sixth phase. At this time, the class teacher again filled out the Conners' Teacher Rating Scale-Revised-Long Form.

Consistency among observers of was assessed by the correlations between the two observers of the two participants. Assessing 270 observations (15 segments in each lesson, multiplied by 18 lessons for each child) yielded a correlation of 0.93 between raters for the first participant and a correlation of 0.94 between raters for the second participant.

The data for this study was conducted, and data was collected in 2010.

RESULTS

Participant Number 1

The main measures of the study included comparing the observed behaviors before the learning phase, learning phase, and in the follow-up phase performed three weeks after completion of the training. The results showed a reduction in disturbance, movement, and speaking from pre-training to post-training. In the follow-up phase, there was a small increase in all three variables, although the increase was minimal and the overall improvement was maintained. These results can be seen in Table 1 and Figure 1.

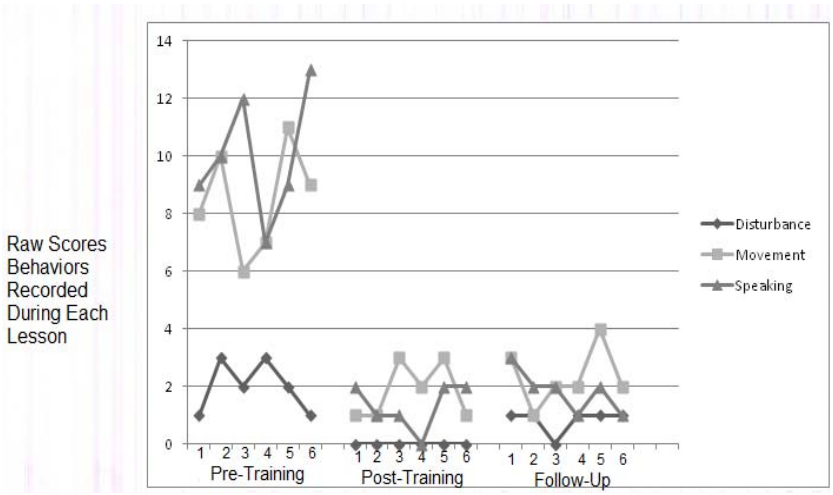
Table 1. Problem Behaviors in Pre-Training, Post-Training, and in Follow-Up

Participant Number 1.																		
Behavior	Pre-Training Lessons						Post-Training Lessons						Post-Training Lessons					
Lessons	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Disturbance[a]	1	3	2	3	2	1	0	0	0	0	0	0	1	1	0	1	1	1
Movement[b]	8	10	6	7	11	9	1	1	3	2	3	1	3	1	2	2	4	2
Speaking[c]	9	10	12	7	9	13	2	1	1	0	2	2	3	2	2	1	2	1
Participant Number 2.																		
Behavior	Pre-Training Lessons						Post-Training Lessons						Post-Training Lessons					
Lessons	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Disturbance[a]	9	7	9	10	7	11	2	0	1	1	2	0	0	0	1	0	0	0
Movement[b]	7	5	4	6	5	7	1	1	2	1	1	0	1	3	4	2	1	3
Speaking[c]	9	10	10	13	12	12	1	4	3	3	2	2	5	4	5	6	3	5

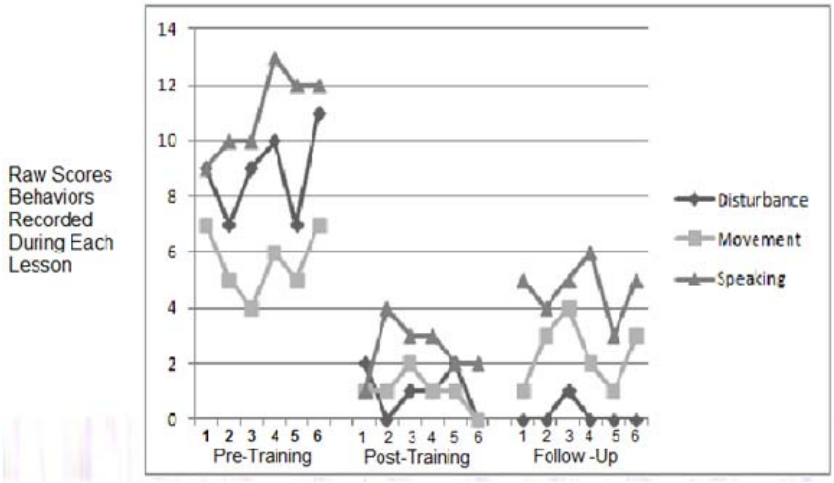
Notes: [a] **Disturbanc**e = Verbal physical outbursts toward other students; [b] **Movement** = Restless behavior, of standing up or turning around without permission; [c] **Speaking** = Speaking without the permission of the teacher.

Figure 1. Summary of Problem Behaviors in Pre-Training, Post-Training, and in Follow-Up.

Participant Number **1**.



Participant Number 2.



The results of the questionnaire, the Conners' Teacher Rating Scale-Revised-Long Form [10], showed that the participants had very high scores indicating problematic ADHD behavior before the beginning of the study. In the follow-up phase, the results showed that in 10 out of 13 measures of the questionnaire there were improvements from pre-training scores (phase one), to follow-up (phase seven). In two additional measures of the Conners' Teacher Rating Scale-Revised-Long Form (inattention and impulsivity-hyperactivity), the diagnostics criteria of the DSM-IV-TR[1], there was also a reduction. In the measure of attention, there was a reduction from seven to five criteria in the follow-up; while in the measure of impulsivity-hyperactivity, there was a reduction from eight to three criteria in the follow-up. These results are shown in Table 2.

Table 2. Results of Conners' Teacher Rating Scale-Revised-Long Form, Pre-Training, and in Follow-Up of Participant Number 1

Variable	Pre-Training		Follow-Up	,
	Raw Score	T-Score	Raw Score	T-Score
Oppositional	6	63	4	57
Cognitive Problems	20	79	13	66
Hyperactivity	16	85	10	70
Anxiety-Shy	4	59	4	59
Perfectionism	3	52	4	56
Social Problems	6	67	3	56
Conners' Global Index	31	84	21	71
Restless-Impulsive	18	90	10	69
Emotional-Liability	0	45	0	45
ADHD Index	18	78	10	62
DSM-IV Inattentive	24	80	19	72
DSM-IV Hyperactive-Impulsive	24	90	14	71
DSM-IV Total	48	88	33	74
Inattentive Symptoms	7	-	5	-
Hyperactive-Impulsive Symptoms	8	-	3	-

Participant Number 2

Results of the observed behaviors showed improvement in all three variables from the pre-training to the post-training. In the third variable, speaking without the teacher's permission, there was a small increase in the follow-up. These results can be seen in Table Number 1 and Figure 1.

Assessing the results of the Conners' Teacher Rating Scale-Revised-Long Form [10] showed improvement in 14 out of 15 measures of the questionnaire (not in social problems). The greatest reduction was in Emotional-Liability problems and Oppositional behavior. These results can be seen in Table 3.

Table 3. Results of Conners' Teacher Rating Scale-Revised-Long Form, Pre-Training and in Follow-Up of Participant number 2.

Variable	Pre-Training		Follow-Up	
	Raw Score	T-Score	Raw Score	T-Score
Oppositional	12	85	5	62
Cognitive Problems	17	68	14	63
Hyperactivity	15	74	9	62
Anxiety-Shy	10	77	6	63
Perfectionism	10	73	9	70
Social Problems	1	48	1	48
Conners' Global Index	31	77	21	65
Restless-Impulsive	14	73	9	62
Emotional-Liability	9	88	4	64
ADHD Index	23	81	13	64
DSM-IV Inattentive	22	70	15	61
DSM-IV Hyperactive-Impulsive	20	74	13	63
DSM-IV Total	42	74	28	63
Inattentive Symptoms	8	-	6	-
Hyperactive-Impulsive Symptoms	8	-	4	-

DISCUSSION

The improvements reported in the results of the observations during the post-training were maintained in the follow-up performed three weeks after the completion of the training period. The results of the Conners' Teacher Rating Scale-Revised-Long Form [10] administered before training and in the follow-up periods, showed a definite reduction in the problematic behaviors in the pre-treatment period when compared with that of the follow-up period. These results allowed the researchers to conclude that an auditory prompt given through a mobile wireless communication combined with appropriate reinforcement system may provide an effective procedure in reducing the problematic behavior of children diagnosed as having ADHD in the classroom.

The observers assessed the most notable findings; there was a reduction in all three variables assessed in the research: (1) verbal and physical outbursts toward other students; (2) restless behavior of standing up or turning around without permission; and (3) speaking without the teacher's permission. These findings are similar to the results of Hansen (1979) [13] who reported the use of a prompt for the reduction of enuresis during the daytime. Similar results found that another method using an electronic device (Awareness Enhancement Device) could reduce finger sucking and chronic hair pulling [6, 7].

A slight reversal of gains in the problematic behaviors measured was observed for both participants in the follow-up, although the overall improvement was maintained for both participants. Reversal of gains is known in clinical research as the time interval between the behavioral intervention and measuring its effect increases [14]. Possible ways to reduce reversal of gains is to increase the time of training, or occasional use of short training sessions such as was used in the fourth phase.

Mobile phone-based monitoring systems were used in medicine to monitor and facilitate guided self-management of various health problems, such as asthma [15, 16]. The idea behind such systems was to monitor the early phase of medical problems, to diagnose the problem, to promote effective self-management by consulting with a clinician, and to assist in the maintenance phase. Some components of these systems may be incorporated into the self-management of various behavioral and emotional problems. For example, such as reducing hyperactive behavior in response to a signal, moving the head in the right direction in case the child does not look at the teacher during a lesson, and sitting down in the chair as a response to a signal indicating an inappropriate action of standing up in the middle of a lesson. It may be beneficial if automated prompt were adopted for behavioral problems; such as was done in toilet training, finger sucking, and chronic hair pulling. These ideas should be investigated in future research.

Limitations of the study were that this was a field study performed in the regular classes of the participants during everyday lessons. It was hard to control all the variables such as having different teachers and to avoid the observers from knowing which part of the experiment they observe, the pre-treatment and treatment phases. An additional follow-up, such as six months after the end of the training, should be used to assess if the behavioral improvements were still maintained. An alternative procedure of using A-B-A-B research design [2] could be used to shorten the length of the intervention, to sustain improvement over time, and to prove the effect of the method used in this research with greater certainty. Regardless of the limitation, these results allowed the researchers to conclude that an auditory prompt given through a mobile wireless communication system combined with a reward system, can provide an effective procedure in reducing the problematic behavior of children diagnosed as having ADHD in the classroom.

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