AN ANALYSIS AND REDUCTION OF DISRUPTIVE BEHAVIOR ON SCHOOL BUSES

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Thousands of children are injured or killed each year in school bus accidents. A significant number of these tragic incidents is precipitated by disruptive child behavior that distracts the drivers from their difficult task. Two experiments were conducted which addressed this problem. For both experiments an automated sound recording device (referred to as a Noise Guard) selectively responsive to frequencies above 500 Hz (i.e., unresponsive to bus drone) recorded both the duration and frequency of noise outbursts above a tolerable threshold. Additionally, an observer made in situ measurements of other disruptions including roughhousing and getting-out-of-seat. In the first experiment, following baseline measurements of these behaviors, middle-school students received feedback for noise outbursts. That is, when "Noise Guard" was activated, it in turn operated one of several lights on a panel visible to all passengers. Each day students were allowed to listen to high-appeal taped music while riding the bus and to participate in a raffle for prizes, provided the number of outbursts on the preceding day remained below a specified criterion indicated on the light panel. This intervention resulted in drastic reductions of noise outbursts with a concomitant reduction in other disruptive behaviors. Comparable results were obtained in the second experiment which eliminated the raffle from the intervention.

DESCRIPTORS: disruptive behavior, noise control, transportation safety, community behavior analysis, adolescents

In the classroom, a particularly popular setting for behavior analysis research, an extensive technology has been developed to manage noise outbursts, out-of-seat, and other disruptive behaviors emitted by students which may jeopardize the educational process (Allen, Hart, Buell, Harris, & Wolf, 1965; Barrish, Saunders, & Wolf, 1969; Coleman, 1970; Hall, Panyan, Rabon, & Broden, 1968; Madsen, Becker, & Thomas, 1968; O'Leary, Becker, Evans, & Sau-

dargas, 1969; Ramp, Ulrich, & Dulaney, 1971; Schmidt & Ulrich, 1969; Strang & George, 1975; Wilson & Hopkins, 1973). It is especially ironic, therefore, that this technology abruptly ends with the school bell even though these same disruptions occur on school buses where they may jeopardize the safety of the passengers, the driver, and community citizens.

Approximately 200 fatalities and 7,200 injuries occur in school bus accidents each year (Accident Facts, 1977, 1978). Such tragedies represent only a small portion of the total number of fatalities occurring on the nation's highways. Nevertheless, fatalities from bus accidents are incurred at a much higher rate than fatalities incurred in automobile accidents: .08 vs. .03 accidents per million vehicle miles (National Transportation Statistics, 1977).

It is impossible to ascertain the proportion of

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accidents precipitated by disruptive behavior of students, but two pieces of evidence suggest that disruptions affect the driver's ability to operate the vehicle safely. First, the popular press routinely reports incidents in which drivers, unable to manage or tolerate disruptions, have forced passengers off the bus, driven them to jail, and even assaulted them (cf. Richards, 1977). Second, in a survey conducted by the authors, an overwhelming majority of drivers in Leon County, Florida, acknowledged that disruptive behavior on the bus interfered with their concentrating on safely operating the vehicle. Moreover, 25% of the resignations of Leon County drivers were reported to be a direct function of an inability to manage or tolerate disruptive behavior (Barber, Note 1).

In an early study of disruptions on a school bus (Ritschl, Mongrella, & Presbie, 1972) the out-of-seat behavior of 25 educable mentally retarded children was reduced by a teacher who boarded the bus with a cassette recorder and played rock-and-roll music for as long as students remained seated. If a student stood up, the teacher shouted a warning ("sit down") and terminated the music for 5 sec unless the student was seated within 1 sec.

In another study (Campbell, Adams, & Ryabik, 1974) four observers boarded a bus of 21 students ranging in age from 7 to 15 years. Out-of-seat, improper seating posture, and fighting behaviors were reduced when an observer blew a whistle contingent upon their occurrence and the driver stopped the bus until 20 sec passed without an incident. This procedure, although effective, remained in effect for only 4 days.

These two studies provided the beginnings for additional research which should be performed on the basis of several considerations. First, an analysis should be provided of those disruptions that may not be easily measured but that are of greatest concern to drivers. For example, although disruptive noise was acknowledged as problematic in previous studies it apparently was not measured, perhaps due to the

technical obstacles associated with a mobile and already noisy environment. Second, it is important to provide objective definitions for all target behaviors in the analysis. Such definitions were not reported in previous research. Finally, a practical procedure for reducing disruptions must be developed for use on larger vehicles. Minibuses (passenger occupancy = 25) were the settings for previous research but it is doubtful that a portable tape recorder (cf. Ritschl *et al.*, 1972) could effectively deliver music to 44 passengers (2 to a seat) on standard-size buses or that one or more vigilant observers could always ride these buses to manage disruptions (cf. Campbell *et al.*, 1974). Similarly, it may be impractical as well as dangerous to expect the driver, who is preoccupied with operating the vehicle, to manage disruptions or to stop the bus in the midst of traffic.

The following two experiments present the development and analysis of a practical treatment to reduce the disruptions that drivers themselves consider most distracting. Specifically, of the drivers surveyed in Leon County, 61%, 48%, and 31%, respectively, considered noise outbursts, out-of-seat, and roughhousing (horseplay) to be among the most distracting behaviors emitted by students. Accordingly, these behaviors were subjected to analysis in the following experiments.

EXPERIMENT 1

METHOD

Subjects and Setting

This study was conducted during afternoon routes on one bus which transported 6th through 8th grade students from a middle school, Tallahassee, Florida, to their homes in an upper-middle class subdivision. The Transportation Director indicated that some of the most acute and chronic behavior disruptions had occurred on this bus. It typically operated at full capacity: 44 students, 2 in each seat. An average of about 25 min was required to complete the route.

Apparatus

Noise Guard. To measure disruptive noise, a sound recording device was constructed to operate directly from the 12-volt DC power source of the bus. Input to the device, referred to as Noise Guard, was provided by an Arista microphone (200 ohm, Model No. 601) held securely by a padded clamp bolted to the ceiling directly above the driver's head (approximately 1 meter). Noise Guard was equipped with a mechanism for adjusting a threshold such that only sound levels above that threshold activated it. To ensure that low frequency bus drone and rumble did not activate Noise Guard, it was constructed with a filter set to pass at 500 Hz.

Noise Guard contained and operated two counters (SODECO Type TCeZHE No. 315): One counter recorded the number of events or outbursts that exceeded threshold (frequency counter) while the other recorded the amount of time these outbursts remained above threshold (time counter—in tenths of a second). For example, a noisy outburst could occur and register one count on the frequency counter. The outburst could be quite brief or it could last for several seconds thereby registering several counts on the time counter. Thus, at the conclusion of the route the counters indicated the total number of noisy outbursts which exceeded threshold during the route and the total time accounted for by these outbursts.

Setting the Noise Guard threshold. Drivers reported that excessive noise and other behavior problems were uncommon during morning routes to school and that although students did

converse with one another during morning routes, sound levels were so subdued in comparison to afternoon routes that they were rarely a distraction. Casual observation by the authors verified the drivers' report and, therefore, the threshold of the Noise Guard was adjusted during morning trips so that noise levels during these trips rarely, if ever, activated the Noise Guard. This threshold setting was subsequently determined to be at 93 dB SPL.

Light display. During certain experimental conditions (treatment), a panel of 10 red "cat's eye" clearance lights (SAE Model PCE-69 No. 150) was mounted above the windshield at the front of the bus clearly visible to all passengers (each light was 8.7 cm high by 7.5 cm at its widest point). Each light on the panel represented a digit or place in binary digit code (i.e., 1's, 2's, 4's, 8's . . . 512's) as shown in Table 1. Noise Guard, when activated, in turn operated this binary digit lighting sequence to provide feedback for every 0.1 sec above threshold. Thus, the light panel provided feedback to the passengers on the amount of time (in tenths of seconds) their noise levels exceeded threshold.

Behaviors

In addition to noise outbursts, occurrences of the following behaviors were recorded:

Out-of-seat. Any posterioral disconnection with the seat except instantaneous postural adjustment; included sitting on books or other objects.

Roughhousing. Any aggressive nonverbal interaction such as wrestling, grabbing, hitting, pinching, or spraying with water.

Table 1

Visual feedback for disruptive noise: Binary digit lighting sequence represents time above threshold.

Cat's Eye Light Time (Seconds) Represented	()	()	()	()	X	()	X	X	()	()
	51.2	25.6	12.8	6.4	3.2	1.6	.8	.4	.2	.1

Note: "X" indicates an illuminated light. Thus, in this example, the total amount of time that noise has exceeded threshold is equal to $.4 + .8 + 3.2 = 4.4$ sec.

Coercive comments (by driver). Included threats, warnings, reminders, and commands to behave appropriately; arguing, repeatedly calling a child's name (twice within 3 sec), or calling a child's name once without a following comment within 3 sec.

Observation System and Recording

An observer, equipped with a clipboard, coded data sheet, and tape recorder with an earplug, rode in the back seat of the bus during most afternoon trips. The recorder announced 15-sec observation intervals alternating with 5-sec recording intervals. During each observation interval the observer counted the number of children engaged in each target behavior and recorded this number on the data sheet during the 5-sec recording interval. Intervals during which students exited the bus were not scored for out-of-seat.

The driver's comments were recorded on most afternoons by a small cassette tape recorder situated beneath her seat with a microphone placed on the dashboard. The tape was reviewed after each trip to determine the number of coercive comments emitted by the driver.

Ten days of informal data collection preceded baseline to allow observers to refine their definitions and students to adapt to the observer's presence.

Reliability

Reliability of behavior definitions and observations was assessed at least once during each

experimental condition. That is, a second observer accompanied the primary observer to record all target behaviors emitted by the students. Reliability coefficients for these behaviors were derived by dividing the number of intervals for which the observers agreed on the occurrence of the target behavior by the total number of intervals for which the observers agreed and disagreed on the occurrence of the behavior.

Reliability on observations of coercive comments was derived by dividing the smaller number of coercions recorded by the larger number of coercions recorded.

The mean and range of reliability coefficients for each behavior during each condition are presented in Table 2.

Experimental Procedures

Baseline. Passengers were provided the cursory explanation that a "safety survey" was being conducted by the Transportation Department. They were told that as part of the survey, audio recordings would be made and a person (the observer) would be riding in the back of the bus but would not be able to respond to any questions or comments.

Treatment (lights, music, raffles). A cassette tape player with four speakers (two on each side of the bus) was installed and the panel of lights was mounted above the windshield.

On the first day of treatment the experimenter explained to the students on the bus that the Transportation Department was concerned with

Table 2
Means and Ranges of Interobserver Agreement for Experiment 1
(Bus #70)

	Baseline	Music/Raffle	Baseline	Music/Raffle	Daily Movie (Phase- out)
Out-of-Seat	.920 (.880-.926)	.962 (.929-1.00)	.965	.979 (.967-1.00)	.952
Roughhousing	.797 (.600-.846)	.917 (.899-1.00)	.839	.808 (.583-.938)	.750
Driver's coercions	.857	.846 (.750-.889)	.938	1.00	1.00

the safety of school bus passengers and drivers; that excessive noise levels on buses jeopardized safety by interfering with the driver's concentration; and that the Department was anxious to encourage safer, quieter bus trips home. The experimenter further explained that: (a) The panel of lights would operate whenever, and for as long as, noise levels were excessive (above Noise Guard threshold). (b) Music would be available to the students free on the first treatment day; however, each afternoon thereafter, music would be played only if noise levels during the preceding afternoon had not exceeded threshold for more than a specific amount of time (cutoff criterion). (The cutoff criterion was indicated with red tags above the lights on the panel). (c) In conjunction with the music, a raffle for four hamburger coupons from Burger King restaurant would be held each day provided that the cutoff criterion was not exceeded during the preceding afternoon. Students could participate in the raffle by writing their names on slips of paper and dropping them in a suggestion/raffle box at the front of the bus as they exited. Thus, on Tuesday afternoon, for instance, the music and the burger raffle would be available provided the cutoff criterion had not been exceeded on the preceding Monday. Before the bus departed from school that Tuesday, four names would be drawn from the box and burger coupons awarded to the winners. In addition to writing their names on the slips of paper, students could also list music selections which would then be taped by the authors or a local radio station. (d) A raffle for 10 movie passes would be held after every 5 consecutive successful days, i.e., days when cutoff criterion was never exceeded.

Finally, the students were told that if any one individual precluded the group from earning these privileges by deliberately activating lights then the driver would report the individual to the principal. (This procedure was included to avoid the problem reported in Barish et al., 1969).

The driver was told to continue to do whatever she felt was necessary to manage the students and not to be concerned if she activated the lights.

Each day that the music was played, the sound level was adjusted before the students boarded the bus so that it registered no more than 86 or 87 decibels on a sound level meter (BSR Model SLM-1) placed next to the Noise Guard microphone. The acoustics changed when students boarded the bus so that the sound level of the music was reduced by a very noticeable but indeterminable amount.

Treatment phaseout. In the last weeks of the experiment, the burger coupon raffle was eliminated. In addition, the schedule for delivering movie passes was changed from 10 passes contingent on five successful bus trips to 2 passes daily contingent on a successful bus trip on the preceding day. The music continued to be available in the same manner.

Setting the cutoff criterion. The students could exceed threshold for a limited amount of time before the music and raffle privileges for the following day were forfeited. For the first day of treatment cutoff criterion (indicated by red tags on the light panel) was set at 26.0 sec—the least amount of time students had exceeded threshold on an afternoon (baseline) trip. On the second treatment day cutoff criterion was reduced by one-half (13.0 sec). On the third treatment day and every day thereafter, the cutoff criterion was set at 5.0 sec—the amount of time students had exceeded threshold on the morning trip.

Experimental Design

The effects of the treatment procedures were analyzed according to an ABABC (reversal) design. Following the first baseline and treatment conditions, baseline conditions were reinstated, i.e., the light panel was removed from the bus and the music and raffle privileges were not available. The treatment procedure was then reinstated and remained operative for 54 days at

which time the treatment phaseout condition was initiated.

Consumer Satisfaction Questionnaire

In the last week of the experiment the opinions of students regarding the safety program (treatment) were solicited with questionnaires. Most of the items on the questionnaire required the students to use a 5-point rating scale to express their opinions or satisfaction with respect to various aspects of the program. (The regular driver was unavailable to complete a similar questionnaire prepared for her.)

RESULTS

Figure 1 presents the frequency and duration (in seconds) at which noise levels exceeded Noise Guard threshold. Under normal operating circumstances (first baseline condition) an average of 624.1 noise outbursts exceeded threshold each trip. These outbursts accounted for an average duration of 62.3 sec per trip. During the first treatment condition, when the lights provided feedback for excessive noise and music and raffles were available to students contingent on reductions in the duration of noise outbursts, the

frequency at which children exceeded threshold decreased to a mean of 27.7 per trip, while the mean seconds above threshold dropped to 1.6. With the reintroduction of baseline conditions the frequency and duration of noise outbursts above threshold recovered to an average of 437.9 instances and 49.4 sec per trip, respectively. Reinstatement of treatment conditions reduced the frequency and duration of noise above threshold to a mean of 89.2 instances and 7.2 sec per trip, respectively. During the treatment phaseout condition, (i.e., with the elimination of the hamburger raffle and the re-scheduled delivery of movie passes) the suppression was maintained. Noise exceeded threshold an average of 68.5 times for 4.6 sec per trip.

The duration of excessive noise remained below the cutoff criterion of 5.0 sec (and consequently reinforcement was provided) on a majority of bus trips during treatment conditions. Specifically, the duration of excessive noise remained below this criterion on 100% of the trips during the first treatment condition and on 75% of the trips during the second treatment condition. During the final treatment phaseout condition, excessive noise remained be-

Fig. 1. Frequency and duration (in sec) of noise outbursts above threshold (93 dB SPL).

low cutoff criterion on 62.5% of the trips. (Treatment phaseout continued through the second to last week of school—a period when exceeding criterion became most frequent). As Figure 1 indicates, even when the cutoff criterion was exceeded during treatment phases, excessive noise rarely approached the levels recorded during baseline conditions.

Figure 2 indicates that the treatment procedure, designed and applied directly for reductions in excessive noise, effected a generalized (but temporary) suppression of other disruptions. The percentage of intervals in which a student was out-of-seat, for example, decreased from a mean of 86.9% during the first baseline condition to 52.6% during the first treatment condition. With the return to baseline, the occurrence of out-of-seat recovered to an average of 86.9% of the intervals but was again reduced to 69.1% during the second treatment

condition. Figure 2 indicates, however, a gradual increase in out-of-seat behavior over the course of this second treatment condition. Finally, during treatment phaseout students were observed out-of-seat during 63% of the intervals.

Figure 3 depicts the percentage of intervals in which children were observed engaging in horseplay (roughhousing). During baseline, 31.1% of the intervals contained instances of one or more children engaged in this behavior. Only 5.2% of the intervals contained instances of a child roughhousing during treatment, but this increased to 35.9% when baseline conditions were reinstated. A decrease in the percentage of intervals containing roughhousing was evident during the second treatment condition (19.1%) as well as during treatment phaseout (15.3%).

The driver coerced students less often during treatment conditions. Coercions dropped from

Fig. 2. Percentage of intervals in which a student (or students) was out-of-seat.

Fig. 3. Percentage of intervals in which a student (or students) was roughhousing.

19 per trip during baseline to 2.2 during the first treatment phase (Figure 4). Coercions during the second baseline rose to 19.2 per trip but fell to 5.3 per trip during the second treatment phase and remained at a mean of 2.7 coercions per trip during phaseout.

Finally, from the responses to the satisfaction questionnaire (Table 3) it is clear that students not only enjoyed the treatment program but felt it contributed to a quieter, safer, and generally improved bus trip home.

DISCUSSION

The results of Experiment 1 show that the automated system which provided visual feedback for excessive noise, in conjunction with the music and raffle incentives, substantially reduced the frequency and duration of noise outbursts. Moreover, these reductions were maintained for

70 bus trips extending through the last weeks of school when the treatment incentives were diminished (treatment phaseout). Even on trips during which cutoff criterion (5.0 sec) was exceeded, noise outbursts rarely approached the levels exhibited during baseline conditions. Typically, it was not until the last part of these trips that cutoff criterion was exceeded.

The treatment procedures also effected a generalized suppression of other disruptions. In the absence of direct consequences for out-of-seat and roughhousing, a reduction in the occurrence of these behaviors ensued with the application of the contingency to reduce noise. It perhaps is difficult for a middle-school adolescent to engage in such disruptions quietly.

Another positive side effect resulting from the treatment procedure was a reduction in the frequency of the driver's coercions. More-

Fig. 4. Number of coercive comments made by the driver each trip. "S" indicates substitute driver.

over, it appeared that because the driver's elevated voice could also activate the lights, her instructions were more readily followed by the students.

Finally, it is evident from the satisfaction questionnaire that the safety program (treatment procedure) was well received by the students. An overwhelming majority of the students indicated that the bus trips home were, in their opinion, quieter, safer, and more enjoyable.

There are, however, limitations to this first experiment, two of which were addressed in Experiment 2. First, despite the generalized suppression of out-of-seat and roughhousing, these behaviors recovered to some extent over the course of the second treatment condition. From casual observation it appeared that this recovery may have been attributable, in part, to students discovering that the threshold setting of Noise

Guard afforded some leeway to engage in out-of-seat without activating many lights. Unfortunately, this occasionally precipitated an entire disruptive chain: progressively more students would get up from their seats more often; noise levels would gradually escalate; progressively more lights would illuminate; and ultimately cutoff criterion would be exceeded.

This observation provided the basis for a procedural modification in Experiment 2. Specifically, if a lower threshold were established, it might, through the activation of the lights, provide interruptive feedback for disruptions earlier in the chain before these disruptions spiraled beyond the control of the students. Accordingly, in the second experiment, the threshold was set at a level much closer to the quietest sound levels observed during the morning trips. This afforded students less leeway in the level of

Table 3
 Percentage Distribution of Students' Responses to Satisfaction Questionnaire
 (Bus #70 and #16)

Since the safety project began, riding on the bus has been:					
	<i>Much More</i>	<i>More</i>	<i>No</i>	<i>Less</i>	<i>Much Less</i>
	<i>Fun</i>	<i>Fun</i>	<i>Different</i>	<i>Fun</i>	<i>Fun</i>
Bus #70:	16.7	74.3	5.7	2.9	0
Bus #16:	20.3	40.6	18.6	15.2	5.1
Since the safety project began, riding on the bus seems to have been:					
	<i>Much Safer</i>	<i>Safer</i>	<i>No</i>	<i>Less</i>	<i>Much Less</i>
			<i>Different</i>	<i>Safe</i>	<i>Safe</i>
Bus #70:	2.8	57.1	34.3	5.7	0
Bus #16:	8.5	47.4	38.9	1.7	1.7
Since the safety project began, the students on the bus have been:					
	<i>Much More</i>	<i>More</i>	<i>No</i>	<i>Less</i>	<i>Much Less</i>
	<i>Noisy</i>	<i>Noisy</i>	<i>Different</i>	<i>Noisy</i>	<i>Noisy</i>
Bus #70:	2.8	0	11.4	74.3	11.4
Bus #16:	3.4	1.7	15.2	64.4	15.2
Since the safety project began, the driver yells at the students:					
	<i>Much More</i>	<i>More</i>	<i>About the</i>	<i>Less</i>	<i>Much Less</i>
	<i>Often</i>	<i>Often</i>	<i>Same</i>	<i>Often</i>	<i>Often</i>
Bus #70:	0	2.8	21.4	42.8	22.8
Bus #16:	6.8	3.4	13.6	44.1	32.2
Since the safety project began, the driver seems able to concentrate:					
	<i>Much More</i>	<i>More</i>	<i>No</i>	<i>Less</i>	<i>Much Less</i>
	<i>Easily</i>	<i>Easily</i>	<i>Different</i>	<i>Easily</i>	<i>Easily</i>
Bus #70:	17.1	54.3	28.6	0	0
Bus #16:	20.4	47.4	25.4	3.4	1.7
If you had to choose just one part of the safety project, which part would you want to keep the most:					
	<i>The Burger Raffle</i>		<i>The Movie Raffle</i>		<i>The Music</i>
Bus #70 only:	0		25.7		62.8
The songs that have been taped for us to listen to are usually:					
	<i>Very Good</i>	<i>Good</i>	<i>Fair</i>	<i>Poor</i>	<i>Very Poor</i>
Bus #70:	25.7	60.0	14.3	0	0
Bus #16:	19.2	32.3	30.5	11.8	10.2
Starting safety projects like this one on other buses would be a:					
	<i>Very Good</i>	<i>Good</i>	<i>Neither Good</i>	<i>Bad</i>	<i>Very Bad</i>
	<i>Idea</i>	<i>Idea</i>	<i>Nor Bad Idea</i>	<i>Idea</i>	<i>Idea</i>
Bus #70:	40.0	51.4	0	0	0
Bus #16:	38.9	37.3	15.2	3.4	3.4
Do you think the project would work as well without the lights?					
	<i>Yes</i>	<i>No</i>			
Bus #70:	8.6	88.6			
Bus #16:	30.5	67.7			
What grade have you been in this year?					
		<i>6th</i>	<i>7th</i>	<i>8th</i>	
Bus #70:		31.4	20.0	45.7	
Bus #16:		30.7	30.7	38.5	

Note: Not all students responded to every item. Therefore, percentages for any particular item may not sum to 100%.

noise they could produce before activating Noise Guard.

A second limitation of Experiment 1 is that its treatment procedure is complicated by a de-

pendence upon business establishments within the community to supply raffle prizes. This complication might preclude wide-scale adoption among school districts. Therefore, the second

experiment was conducted to examine the extent to which only the feedback lights and music would reduce the disruptive behaviors.

EXPERIMENT 2

METHOD

Subjects and Setting

This study was conducted during afternoon routes of another bus which transported 6th through 8th grade students from the same school to the same subdivision as in Experiment 1. Like the first bus, the bus in this experiment had been identified by the Transportation Director as presenting some of the most acute and chronic behavior problems. It typically operated at full capacity: 44 students, 2 in each seat. About 22 min were required to complete the route.

Apparatus

The same apparatus as used in Experiment 1 was used in this second experiment except that only 8 lights instead of 10 were mounted on the panel. The same procedure for setting the threshold of the Noise Guard, with the modification previously described, was also followed. The threshold setting was subsequently determined to be at 90 dB SPL.

Behaviors, Observation, and Reliability

The observation system in Experiment 1, whereby all of the students' target behaviors were observed and recorded during every 15-sec interval, was modified. Specifically, observation and recording of out-of-seat and roughhousing occurred in alternating 15-sec observe/5-sec record intervals. Also, whereas in Experiment 1 observers recorded whether any student (i.e., one or more) emitted these behaviors, in Experiment 2 the observers noted whether the behaviors were emitted by one or more students or by two or more students. This modification was included because it was not uncommon for at least one student in a group of 44 to be out-of-seat during any particular interval. Therefore, by also recording whether at least two (or more)

Table 4
Interobserver Agreement for Experiment 2
(Bus #16)

	Baseline	Con- tin- gent Music	Baseline	Con- tin- gent Music
<i>Out-of-Seat</i>				
(1 or more)	.900	.800	.942	1.00
(2 or more)	.700	.750	.667	.875
<i>Roughhousing</i>				
(1 or more)	.800	.833	.625	.846
(2 or more)	.667	1.00	.333 ^a	.778
<i>Driver's Coercion</i>	.884	.857	.812	.800

^aLow interobserver agreement associated with infrequent behavior occurrences (2).

students were out-of-seat or roughhousing, a more sensitive measure of the effect of treatment was obtained.

The methods for recording the driver's coercions and for deriving reliability coefficients for each behavior remained the same. Reliability coefficients obtained for all behaviors during each condition are presented in Table 4.

Experimental Procedures

Baseline. This experimental condition was conducted identically with that of Experiment 1.

Treatment (lights and preferred music). The treatment procedure was introduced and conducted in the same manner described in Experiment 1 except that no raffles were available. In addition, the cutoff criterion was reduced more gradually in this experiment. Cutoff criterion on the first treatment day was 88.0 (the best baseline performance); 25.6 sec on the second day (the performance achieved on the first treatment day); 12.8 sec on the third day (one-half of preceding day's performance); and 6.4 sec thereafter.

Experimental Design

An ABAB (reversal) design was used to analyze the effects of the treatment procedure. That is, baseline (A) and treatment (B) conditions alternated in sequence.

Consumer Satisfaction Questionnaire

The questionnaire used in Experiment 1 was also used in Experiment 2 except that items pertaining to the raffles were omitted. A similar questionnaire was completed by the driver.

RESULTS

The results from Experiment 2 indicate that the treatment procedure, which included only the lights for feedback and contingent music, was highly effective in reducing disruptive behavior on the bus. The frequency of noise outbursts above threshold dropped precipitously from a mean of 648.6 per trip during baseline to 14.4 during the first lights/contingent music condition. Noise outbursts per trip recovered to 517 during the second baseline but were again suppressed to 11.1 during the second lights/contingent music phase.

Similar effects on the mean duration of noise above threshold were observed throughout the experiment. (Because of the lower Noise Guard threshold in this experiment, noise outbursts typically remained above threshold for a longer period than recorded in Experiment 1.) The duration of noise outbursts fell from a mean of 369.4 sec to 6.4 sec per trip during the first conditions of baseline and contingent music, respectively. After the duration of noise above threshold increased to a mean of 194.9 sec per trip during the second baseline, it again plummeted to less than 3 sec per trip during the second treatment phase.

During the first and second contingent music conditions, noise duration remained below the cutoff criterion (6.4 sec) for 100% and 94.1% of the trips, respectively.

Figure 6 presents the percentage of intervals during which one or more and two or more

Fig. 5. Frequency and duration (in sec) of noise outbursts above threshold (90 dB SPL). Arrow indicates a trip when students on this bus were stopped at an intersection and a second bus of peers pulled beside them and barraged them with gravel. Asterisk indicates a trip where the Noise Guard was activated by sudden ambient noise after the trip had been successfully completed by students but before observer could record data. Asterisk is set at cutoff criterion.

Fig. 6. Percentage of intervals in which one or more and two or more students were out-of-seat. Arrow indicates gravel barrage.

students were out-of-seat: 59.1% and 28.0% during baseline; 17.6% and 4.6% during the first treatment; 62.8% and 39.3% during the second baseline; and 22.6% and 6.0% during the second treatment condition.

One or more and two or more students, respectively, were observed roughhousing during 24.6% and 23.3% of the intervals during the first baseline phase; 19.6% and 3.9% of the intervals during the first treatment phase; 41.9% and 24.2% of the intervals during the second baseline condition; and, 16.2% and 5.4% of the intervals during the second contingent music condition (Figure 7).

Figure 8 shows that the implementation of contingent music was instrumental in reducing the frequency of the driver's coercions each trip from a mean of 153.5 (baseline I) to 4.3 (treatment I) and from 79 (baseline II) to 6 per trip (treatment II).

The responses of the students to the satisfaction questionnaire (Table 3) were similar to the response of the students in the first experiment. That is, not only did students favorably

receive the treatment procedure but they acknowledged that the quality of afternoon bus trips had been enhanced. Finally, the driver's responses to a similar questionnaire were equally favorable. (A copy of this questionnaire and the driver's responses is available upon request from the first author.)

GENERAL DISCUSSION

Although this analysis was not as protracted as Experiment 1, it appears that even with elimination of all raffles the light display/contingent music procedure effected comparable, if not more substantial, and consistent suppression of all disruptions. Moreover, although conclusions must be tempered by the length of the analysis, it appeared that the lowered threshold setting provided immediately and interruptive feedback for disruptive chains.

There are several respects in which this series of experiments has advanced the technology for analyzing and reducing disruptions on school buses. First, Noise Guard provided an

Fig. 7. Percentage of intervals in which one or more and two or more students were roughhousing. Arrow indicates gravel barrage.

analysis of excessive noise on school buses—the distraction most frequently identified among Leon County drivers.

mediated an advancement in the technology for reducing disruptive noise on school buses. That is, Noise Guard, in addition to measuring noise outbursts, operated a visual feedback display

Second, this advancement in instrumentation

Fig. 8. Number of coercive comments made by driver each trip.

contingent on their occurrence. This display, in conjunction with an economical and readily available incentive (taped music), comprised the components of a treatment procedure which effected a reduction of disruptive noise on school buses. (It should be noted that although Noise Guard could have been designed to deliver and terminate the music immediately, informal observations during pilot studies seemed to indicate that such interruptions diminished the student's listening pleasure, i.e., the reinforcing value of the music.)

Third, the light display/contingent music procedure successfully effected a generalized reduction in other disruptive behavior: out-of-seat and roughhousing. Thus, adults were not required to monitor the students during the entire trip to regulate music (Ritschl et al., 1972) or to signal the driver to stop the vehicle (Campbell et al., 1974). Moreover, it appears that the driver's preoccupation with disciplining students is diminished. Relieved of this burden, drivers were free to devote full attention to the safe operation of the vehicle.

Finally, the procedure avoids any subjectivity associated with deciding whether students are entitled to the privileges and incentives that comprise the treatment. That is, the recordings of an electronic device are not as readily disputed as the recordings of a human observer.

Additional research is needed to determine the effectiveness of the treatment with students of different ages and socioeconomic backgrounds. Other treatment alternatives should also be examined which may include taped recordings produced by the students themselves or audiovisual materials which are not only entertaining and captivating but educational as well (e.g., Sesame Street).

Finally, as these alternatives are refined, more fundamental issues must be considered. These include determining the relationship between improved conduct on school buses and the incidence of school bus accidents and the rate of driver turnover.

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