Brief Note

Teaching Pedestrian Safety Skills to a Child With Autism Who Exhibited Dangerous Behavior in the Street: A Case Study

Kosuke TAKAHASHI and Fumiyuki NORO

For individuals with developmental disabilities to be able to live independently in a community setting, they have to have pedestrian safety skills. In the present study, we taught a boy with autistic disorder who exhibited dangerous behavior in the street to decrease that behavior and walk safely. In the response-cost procedure, he lost a reinforcer (his favorite card) every time that he showed problem behavior. In the DRO procedure, he got a reinforcer when he walked without any problem behavior. The results suggest that the response-cost procedure and the combined use of response cost and DRO were effective in reducing the problem behavior in the street and maintaining safe walking. After the conclusion of the present study, the boy could walk safely when he went to and from school.

Key Words: pedestrian safety skills, response cost, differential reinforcement of other behavior, child with autism

Introduction

For individuals with developmental disabilities to be able to live independently in a community setting, they have to have pedestrian safety skills. Many activities (e.g., shopping, going to work, or going to the theater) that we perform in our community are available only to those who have pedestrian safety skills.

In several studies pedestrian safety skills have been taught to individuals with developmental disabilities (e.g., Batu, Ergenekon, Erbas, & Akmanoglu, 2004; Marchetti, McCartney, Drain, Hooper, & Dix, 1983; Matson, 1980).

In Batu et al. (2004), for example, five students with developmental disabilities were taught three different pedestrian skills (crossing the street using a pedestrian overpass, crossing the street using the walk light, and crossing the street independently, without assistance from a traffic patrol or facilitator). These skills were taught in a simulated setting, using a most-to-least prompting procedure. The results showed that all the students learned each of the skills and generalized those skills to actual city settings.

Graduate Course of Disability Sciences, University of Tsukuba
K. Takahashi & F. Noro

However, we were able to find no published study that tried to teach pedestrian safety skills to individuals who intentionally exhibited dangerous behavior in the street. Therefore the present study examines whether a boy with autistic disorder who exhibited problem behavior in the street on the way to school could decrease the problem behavior and learn pedestrian safety skills.

Since pedestrian skills are a group of safety skills, it is important to be very careful when teaching these skills. If the participant made an error or engaged in some problem behavior when vehicles were passing by, the participant might get injured.

Because of the risk of harm to participants, punishment may be preferable to reinforcement-based treatments, because the problem behavior must be suppressed rapidly to prevent serious harm. Response cost is a punishment method in which reinforcers (e.g., tokens) are lost contingent on each instance of the problem behavior. Many previous studies using response-cost procedures successfully decreased a variety of problem behaviors immediately (e.g., Ashbaugh & Peck, 1998; Barnard, Christophersen, & Wolf, 1977; Falcomata, Roane, Hovanel, & Kettering, 2004).

The present study examined the effectiveness of a response-cost procedure for decreasing problem behavior in the street.

Several authors have suggested that combining punishment with reinforcement may increase the likelihood that punishment can be faded successfully (see Lerman & Vorndran, 2002). Therefore in addition to the response-cost procedure, we used a procedure in which delivery of a reinforcer was contingent on the absence of the problem behavior (i.e., Differential Reinforcement of Other behavior, DRO).

The purpose of the present study was to examine the effectiveness of the response-cost and DRO procedures in reducing the boy's problem behavior in the street and teaching him safety pedestrian skills.

Method

Participant

The participant was a 10-year-old boy who had been diagnosed with autistic disorder. On WISC-III, he had a measured verbal IQ of <43, performance IQ of 89, and full-scale IQ of 60. He was enrolled in a special education class at a public elementary school in his community. At the university, he showed good compliance when he studied individually with a teacher. But when he was alone, off-task behaviors (e.g., walking around or being absentminded) increased. His mother reported that he showed a similar behavior pattern at his school. He could use and understand two- or three-word sentences, but could not understand abstract words such as "mannaka (middle)" or "hashi (side)".

The boy had not learned ordinary pedestrian safety skills, and his mother reported observing him engaging in the following dangerous behavior: (1) walking in the middle of road, (2) not dodging vehicles spontaneously, (3) not stepping aside when a driver sounded the car horn, (4) attempting to run in front of vehicles, and

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(5) suddenly darting into the road. During baseline, we observed him trying to touch a passing motorcycle. Because of these problem behaviors, one of his parents or his grandmother had to walk to and from school with him every day.

Before the start of the present study, we conducted several interventions for his problem behavior, using positive reinforcers in a simulated setting. Also, during the baseline of the present study (between the second and third trials), interventions using positive reinforcers were tried when he was on his way to school (e.g., prompting and reinforcing appropriate walking behavior, and self-instruction). However, his problem behavior did not decrease.

Possible reasons that these interventions were not effective include the following: (1) the reinforcers for the problem behavior (e.g., a car stopped in front of him) were greater than the reinforcers programmed contingent on correct responses, (2) these interventions did not include any strategy directly targeting the problem behavior directly, and (3) it was difficult for the boy to identify which behavior had been defined as a correct response (e.g., walking at the side of the road).

Setting

Instruction was conducted in the actual setting, that is, the street that he used to go to school (the "school route"), and in simulated settings (two streets within the university campus: "road A" and "road B").

The boy's route to school was about 300 m long. The street he used was about 6 m wide, and had no sidewalk or signals (see Fig. 1). It is not a very busy street. He was able to go between his home and the school without turning any corners.

Road A was a straight road, about 80 m long, and about 8 m wide (see Fig. 2). There was no sidewalk or signals there either. But many safety cones were lined up along the side of the road to prevent illegal parking.

Road B was a winding road about 160 m long and about 4 m wide, with no sidewalk or signals (see Fig. 2). No motor vehicle used this road, but there was much bicycle traffic.

One trial was defined as going from the start to the end of one of these routes, that is, one way.

Dependent Variables and Data Collection

On the basis of the information from his mother, as well as the authors' direct observations, the boy's problem behavior was defined as follows: being in the middle of the street (about 1 m away from the side of the road), running in front of moving vehicles or starting to do that but being stopped by the instructor, and running. The target behavior was defined as going along these routes without engaging in the problem behaviors.

All trials (except for the follow-up test) were recorded on video tape. The data were collected using 5-s interval recording. If the boy exhibited any problem behavior during an interval, the observer recorded it as an interval with problem behavior. The percentage of intervals in which problem behavior occurred was calculated by
dividing the total number of intervals in which problem behavior occurred by the total number of intervals in the trial.

Procedure

An ABABCD design was used to compare the baseline and probe conditions, the response-cost condition, the response-cost/DRO condition, and the DRO condition. Baseline and intervention sessions were conducted for 16 months (from August, X year, to December, X + 1 year). One session included 1 to 4 trials, and took about 15-30 minutes. All sessions were conducted either on the school route or in the university settings, between 9:30 a.m. and 2:00 p.m., usually once a week, but sometimes only once a month.

Baseline and probe conditions. First, the boy was told to walk safely. During all trials, the trainer followed him. If it appeared that he was going to run in front of a vehicle or looked unaware of a vehicle moving toward him, the trainer stopped him and took him immediately to the side of the road. The trainer did not interfere with other problem behavior in the baseline and probe conditions. When the boy walked safely, the trainer praised him occasionally (e.g., “good walking”). One trial took about 10 minutes on the school route and about 5 minutes on Road B.

The baseline condition included 3 trials on the school route, conducted for 2 successive days. Several interventions using positive reinforcement procedures were

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**Fig. 1** School Route

*Notes.* The school route was about 300 m long, and the road about 6 m wide. There was no sidewalk, and there were no signals.
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carried out between the second and third trials. The first probe condition (PR#1) included 2 trials on road B, conducted for 1 session. The second probe condition (PR#2) included 4 trials on the school route and on road B, conducted for 2 sessions.

**Response-cost condition.** There was an interval of about 5 months between the first baseline condition and the first response-cost condition. The boy's mother reported no improvement in his pedestrian safety skills during the period.

In the response-cost condition, the boy was given some of his favorite character cards. He was told that if he exhibited problem behavior, he would lose a card. However, he could keep all the remaining cards if he walked safely.

When the boy exhibited any problem behavior, the trainer stopped him immediately and took one card. The trainer repeated this procedure until they arrived at the end of that route. When the boy walked safely, the trainer praised him occasionally. One trial took about 3 minutes on Road A and about 5 minutes on Road B.

The response-cost condition (RC) included 17 trials on road A and road B, conducted for 9 sessions.

**Response-cost/DRO condition.** One trial was divided into time intervals. If the boy exhibited any problem behavior in an interval, he lost one of his favorite cards, as in the response-cost condition. If he exhibited no problem behavior in an interval, he

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**Fig. 2** Roads A and B at the University

*Notes.* Road A was a straight road about 80 m long and about 8 m wide, with no sidewalk or signals. Road B was a winding road about 160 m long and about 4 m wide with no sidewalk or signals. There was no vehicular traffic other than bicycles and motorcycles.
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was praised and was given one card. The trainer repeated this until they arrived at the end of that route. The duration of the time interval was lengthened every trial (20 s, 40 s, 60 s, 120 s, and 180 s). These gradual increases in the duration of the time interval were introduced because (1) his appropriate behavior (i.e., other behaviors) were reinforced many times in the shorter time intervals, and (2) these behaviors could be maintained with fewer reinforcers as the time intervals were gradually increased. Finally, the interval was distance-based (i.e., a one-trial interval). That is, he got one card if he exhibited no problem behavior from the start of the route until he arrived at the end, and he lost one card if he exhibited any problem behavior before getting to the end of that route.

A visual cue was introduced to help the boy discriminate his own behavior during the intervals and trials. When he started an interval or trial, he was handed one “correct” card, a white 10 cm by 10 cm card on which “O” was written in black ink. The “correct” card was exchanged for an “incorrect” card (a white 10 cm by 10 cm card on which “X” was written in black ink) immediately if he exhibited any problem behavior.

All trials in the response-cost/DRO condition were conducted on Road B; each trial took, on the average, 5 minutes.

The response-cost/DRO condition (RC/DRO) included 14 trials on road B, and conducted for 7 sessions.

DRO condition. Before starting out on a route, the boy was handed one “correct” card. If he exhibited no problem behavior while walking the route and arrived at the end of that route with the “correct” card, he was praised and given a few of his favorite cards. If he exhibited any problem behavior, the trainer exchanged the “correct” card for an “incorrect” card immediately. When the boy arrived at the end of a route with an “incorrect”, card, he was not given any of his favorite cards. One trial took about 10 minutes on the school route, and 5 minutes on Road B.

The DRO condition (DRO) condition included 12 trials on road B and the school route; this condition was conducted for 5 sessions.

Follow-up. Four months after the end of the intervention, a follow-up test was conducted on the school route. His mother observed him as he walked to and from school, and rated his behavior (specifically, staying toward the side of the road, and walking) on a 4-point Likert scale (agree, somewhat agree, somewhat disagree, disagree) for successive 5 days.

Inter-observer Agreement

Two observers independently recorded the occurrence of problem behavior during 44% of the baseline and probe trials, and 30% of the intervention trials. Inter-observer agreement was calculated for each trial by summing the agreed-on intervals, dividing by the total number of intervals, and multiplying by 100. During the baseline and probe trials, the mean percentage of agreement was 96% (range, 91% to 100%). During the intervention trials, the mean percentage of agreement was 99% (range, 91% to 100%).
Results

Figure 3 shows the percentage of intervals with problem behavior in the baseline and probe trials, response-cost, response-cost/DRO, and DRO conditions. Settings are indicated as follows: open rectangles are data from the school route; filled circles, from road A, and filled diamonds from road B. During baseline, the problem behaviors occurred in a high percentage of intervals (range 87%-95%). There were no differences between the second and third trials, in which interventions using positive reinforcers were conducted. When response-cost was implemented, the problem behavior decreased immediately. The percentage of intervals with problem behavior was under 16% in the last 5 trials. In the probe trials, problem behavior increased again (73% and 74%). When the response-cost procedure was re-implemented, however, the low rate of problem behavior (12%, 14%, 0%, and 8%) re-occurred. In the response-cost/DRO condition, there was no problem behavior in 10 out of 14 trials. The boy did not engage in any problem behavior in the last two trials in which the distance-based interval (i.e., one-trial interval) was used.

In the first trial in the DRO condition, the rate of problem behavior increased to 20%. However, after that trial, he showed a low level of problem behavior on the school route (8%, 0%, and 7%). At the university, he could walk safely, showing no problem behavior, on 7 out of 8 trials.

**Fig. 3** Percentage of Intervals with Problem Behavior

*Notes.* Settings are indicated as follows: open rectangles are data from the school route; filled circles, from road A; filled diamonds, from road B. BL = baseline condition, RC = response-cost condition, PR = probe condition, RC/DRO = response-cost/DRO condition, and DRO = DRO condition.
In the second probe condition, he exhibited a low rate of problem behavior on both road B and the school route (0%, 3%, 2%, and 2%). His mother reported that he walked without running in front of vehicles, and that she no longer had to hold his hand all the time.

On the follow-up, the mother rated both behaviors (staying toward the side of the road, and walking) "agree" on 3 out of 5 days. She reported that a problem behavior (running in front of a vehicle) occurred on one of the days in which she rated his behavior "somewhat agree" (see Figs. 4 and 5).

Of all the problem behavior observed in all the experimental periods, 85% were being in the middle of the street, 13% were running in front of moving vehicles or having that behavior stopped by the instructor, and 2% were running. On the school.

![Graph](image)

**FIG. 4** Mother's Ratings of the Boy's Behavior of Staying Toward the Side of the Road When He Was Going to and From School During 5 Days

![Graph](image)

**FIG. 5** Mother's Ratings of the Boy's Walking Behavior When He Was Going to and From School During 5 Days

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route, 85% of the problem behaviors were being in the middle of the street, 14% were running in front of moving vehicles or having that behavior stopped, and fewer than 1% were running. On road A, 71% of the problem behaviors were being in the middle of the street, 29% were running in front of moving vehicles or having that behavior stopped. The boy did not run when he was on road A. On road B, 93% of problem behaviors were being in the middle of the street, 1% were running in front of moving vehicles or having that behavior stopped, and 6% were running. Being in the middle of the street was the most frequent problem behavior in all settings.

Discussion

Response-Cost Procedure
The present study suggests that response-cost may be an effective procedure for reducing problem pedestrian behavior, as well as the other problem behaviors reported in previous research by others.

The boy’s problem behavior decreased immediately when response-cost was introduced. Particularly, in the response-cost condition, running in front of vehicles did not occur except on the first trial. On road B, although the percentage of problem behavior was low, he had no problem behavior at all on only one of the trials. Most of problem behavior observed in Road B was being in the middle of the street. This difference may have occurred because he had to discriminate the end of the street more often when walking on Road B, which has many curves. He showed problem behavior at the start of trials or in the middle of trials. After one of his favorite cards was taken away, he walked for the rest of that trial with no problem behavior.

DRO Procedure
It is difficult to examine the effect of the DRO procedure alone on reducing the boy’s problem behavior. However, the DRO had some positive effect on his walking. For example, in the response-cost/DRO procedure, he showed stable safe walking (10 out of 14 trials) on road B, whereas in the response-cost condition, he walked on road B without problem behavior on only one trial out of seven.

Visual Cue Cards
There is a possibility that the visual cue cards ("○" and "×") had some effect on decreasing the boy’s problem behaviors. First, the cards promoted his learning as immediate consequences, because each card became a conditioned reinforcer or punisher through his being reinforced or punished when he had them. For example, he refused to accept an incorrect card on the 7th trial of the DRO condition. That is, the incorrect card had become an aversive stimulus for him. Thus, the card might have maintained his problem behaviors at a low level because it was a punisher in the DRO condition. Second, it is possible that the cards promoted self-monitoring of his walking behavior, which might have decreased the problem behavior on road B. Several studies have reported that self-monitoring could decrease problem behavior.
or increase appropriate behavior (e.g., Mace & Kratochwill, 1988).

**Maintenance**

During the first probe condition, the effect of the response-cost intervention was not maintained. However, the boy showed the lowest level of problem behavior in the next probe condition, the one that followed the response-cost/DRO condition and the DRO condition. Two possibilities related to this are discussed below.

First, it is possible that he did not learn safe walking well enough in the initial response-cost condition. In the first response-cost condition, he could walk without any problem behavior for 4 trials on road A. Although he showed a low rate of problem behavior, he could not, however, walk with no problem behavior before the first probe on road B in which the probe condition was conducted. On the other hand, he could walk with no problem behavior on road B for a total of 19 trials (except for the first 4 trials on road A) before the second probe condition.

Second, as mentioned in the introduction, these results might have come from the combined effect of punishment and reinforcement. That is, combining the response-cost procedure with the DRO procedure may have promoted successful fading of the intervention procedure and maintenance of the effect in the second probe condition.

**Limitations of the Present Study and Suggestions for Future Research**

The present study has some limitations. First is the absence of a generalization probe on the school route. Therefore, we could not examine systematically the generalization of the procedures conducted in the university setting. Because teaching pedestrian skills in actual setting opens the participant to many dangers, it is desirable to do as much training as possible in simulated settings, if the procedure would then be effective in actual settings. Thus, it should be observed whether reduction of problem behavior in the streets of simulated settings generalizes to actual settings.

Second, ratings conducted in the present study were insufficient to assess the extent of maintenance of the effect of the intervention in the school route. That is because (1) only one person (i.e., the boy's mother) rated his performance, and (2) we instructed her only once on how to rate his performance, and that might have been insufficient for accurate rating. Future research should include direct observation by several trained observers, ratings by other independent observers, or more training sessions for raters.

Third, it was unclear whether the DRO procedure had an effect on the successful fading of the response-cost procedure and the maintenance of the observed effects. In the present study, we did not control the number of trials, and the criterion performance of the problem behavior was different before the two probe conditions. A better-controlled study is needed to clarify the effect of DRO in maintenance of the improvement resulting from a punishment procedure. Furthermore, that would make the response-cost procedure more acceptable.
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Fourth, the present study did not examine the effect of the DRO or the visual cards alone on the problem behavior in the street. Conyers, Miltenberger, Maki, Barnez, Jurgens, Sailer, Haugen, and Kopp (2004), for example, compared the effectiveness of response-cost and DRO implemented class-wide with preschool children. The results indicated that both response cost and DRO were successful in reducing the number of disruptive behaviors In the Conyers et al. (2004) research, DRO was found to be more effective initially, whereas response cost was more effective over time.

In behavioral interventions, when non-aversive procedures are implemented and result in a decrease in problem behavior, punishment procedures are not necessary (Miltenberger, 2001). In addition, it is important for pedestrian safety skills training that the participants can perform the skills independently. The training using the visual cards, which prompted the boy to monitor his own behavior visually, could be an effective procedure for teaching pedestrian safety skills. Thus, it is necessary to clarify the effect of DRO or visual cards alone in reducing problem behavior in the street and teaching pedestrian safety skills.

Finally, the present study was conducted over a long period of time. Further research is necessary to examine the effectiveness of the interventions used in the present study but for shorter experimental periods.

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References


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