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THE EFFECTS OF SHOPPING CART DESIGN AND PRIOR BEHAVIORAL HISTORY ON CHILDREN'S STANDING IN CART SEATS

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Abstract—Twenty one males 17–22 months old took part in an experiment of the effects of shopping cart design on standing in the seat section of the cart and speed of standing. Two different cart designs were examined. It was predicted that standing would be more likely in the over-the-counter vs deep basket type of cart since the former is less confining because of a larger seating area and larger leg holes. In fact, standing was slightly more likely to occur in the deep basket cart. The strongest predictors of standing, however, were subjects' prior incidents of standing in the cart seat and climbing out of the cart seat in grocery store settings. Thus, inter-individual differences in learning history may determine a child's risk of injury around shopping carts more than features of the cart's design. Copyright © 1996 Elsevier Science Ltd

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INTRODUCTION

It has been reported that in the U.S. about 14,000 young children are seriously injured each year in accidents involving shopping carts (Friedman, 1986). These accidents typically involve falls from the cart, being caught between objects inside the cart and striking an object or persons while riding a cart (Friedman, 1986; Ferrari and Baldwin, 1989a, b). A recent observational study (Harrell, 1994) of children in grocery carts suggests this risk of injury may in fact be much higher, with an actual risk of minor injuries equal to 43 injuries per 1000 child shopping visits. Factors predictive in Harrell's study of a child's risk of injury in shopping carts included being inside the cart basket vs outside the cart or in the cart seat, attempting to climb out of the shopping cart, and poor parental supervision (Harrell, 1994). With respect to parental supervision, Harrell found that parental monitoring was a causative agent in injuries primarily for those children placed in the cart basket rather than outside the cart or in the cart seat. For those children inside the basket, risk of injury was significantly higher if an accompanying parent lost sight of the child or was too far from the child to react quickly enough to prevent an injury. In contrast, children confined in cart seats were significantly less likely to be injured, even if parents were negligent in their monitoring of the child. Harrell speculates that the confining nature of the cart seats tended to reduce the child's ability to move, compared to the freely roaming children in the cart's basket. These latter children often incurred minor bruises and scrapes while moving in the basket or attempting to climb out.

The present experiment was designed to investigate the impact of shopping cart design, particularly the seating area, on risky behaviors. It was believed that design features found in certain styles of grocery cart seats would make it more difficult for a child to stand in the cart seat and injure himself by falling or jumping from the seat or by climbing into the basket area. The design features addressed in this study were the volume of the seating area and the size of the leg holes at the front of the seat. In addition, information on a child's prior shopping cart habits were gathered for each of the children taking part in the experiment. It was expected that children with a history of standing in the cart seat or jumping from the seat would be prone to repeat this behavior in the laboratory. Finally, it was expected that children who had been injured in a shopping cart accident would be deterred from standing in the seat.

METHOD

Subjects

Twenty one boys between the ages of 17 and 22 months participated. Subjects were recruited by using newborn announcements of boys born 17–22 months

prior to the experiment as leads for contacting parents by telephone to enlist their participation. Subjects were paid U.S.$20 for taking part plus U.S.$2 for parking.

Apparatus

Grocery cart seats. Two grocery carts were used in this experiment. The first is a United Steel and Wire over-the-counter style of cart (model 1588). The seat in this cart is rectangular in shape, with a flat bottom 8 inches wide, a vertical seat back 7 inches high by 17.75 inches long, sides 10.5 inches high by 8 inches wide, and a vertical front portion with leg holes that are 17.75 inches long and 7.75 inches high. This seating area is approximately 1491 cubic inches in volume. The leg hole section of the seat is 36.8 square inches. Each leg hole is 7.75 inches high by 4.75 inches wide.

The second cart is a traditional deep basket cart by Cari-All (Technibilt, model 220). It presents a more complicated seating area. Both the seat back and front flare out, such that the top part of the seat is 11 inches wide and the bottom 5.75 inches wide. The front of the seat is approximately 21.5 inches wide, and the back 16.75 inches high. Both the front and backs are approximately 7.5 inches high. This seating area is approximately 1260 cubic inches. The leg hole section of the front is 30 square inches per hole. Each hole is 6 inches high by 5 inches wide.

It was felt that leg hole size would affect the child's ability to remove his legs from confinement, thereby increasing the likelihood of standing in the seat. Thus, the Cari-All cart, with smaller leg holes, was expected to be more confining. Also, it was felt that the smaller cubic area of the Cari-All cart (1260 cubic inches vs 1491 cubic inches) should give a child less room to maneuver, presenting more difficulties of escape than the OTC cart. On the other hand, it could be argued that the flared Cari-All seat, with a top width of 11 inches vs the 8 inch wide of the OTC seat, would allow a child to lean back and leverage himself so that he could stand up.

Cart placement. The two carts were placed in a large child activity room at the University of Alberta. The two carts were situated 15 feet apart. Each cart was cushioned inside the basket and around the sides and back of the cart by a layer of foam rubber. Mats were arranged on the sides of each cart and below the carts. Both carts were stabilized with wooden blocks in front of and behind each wheel. The wheels and blocks were taped to the floor to further assure stability.

Recording devices. A portable VHS videotape recorder was mounted on a tripod to record subject behavior at each of the carts. In addition, the experimenter used a stop watch to record the speed of standing in the cart seat.

Interview schedule. An interview schedule was used to question the subject's parent about past shopping practices, incidents involving grocery carts, and the subject's habits around carts. The parent of each subject was provided with a Release Statement, outlining the purpose of the study, assuring the parent and subject of confidentiality, and permitting the parent to discontinue the study at any point.

Procedure

Upon arrival, each subject and his parent were greeted by the experimenter and a research assistant. Because of the novelty of the situation, subjects were allowed to play in the activity room prior to beginning the experiment in order to adjust to the laboratory setting. During this time, the experiment was fully explained and the Release Statement provided. Parent was then questioned from the interview schedule. Following this, the experimental procedure was outlined. It was explained that the child would first be placed in one of the cart seats for a period of time. While in the seat, his behavior would be recorded. The parent had been asked to bring a favorite toy or food for the child. This was to be placed in the cart basket in an effort to entice the child to retrieve these items. (This strategy was used since prior research showed that children in grocery stores frequently stand in cart seats in order to reach objects on shelves, in the cart basket, or to escape from the seat.)

After sitting in the seat for 5 minutes, the child was removed, held for 5 minutes, then placed in the seat again for a second 5 minute trial. Again, a 5 minute recess was observed, then the subject was returned to the cart for a third trial. Often this third trial was difficult to collect since the subjects became frustrated and irritable. Indeed, while all but 5 of the 21 children were able to complete three trials for the first cart they were placed in, only 7 of the children were able to complete three trials for the second cart. Because of this, only two of the trials will be analyzed.

With the collection of the third trial, a 20 minute rest was taken, during which the child was allowed to play in the activity room. Following this, the child was placed in the second cart seat, and the sequence of three trials was repeated. The order of carts was alternated, so that some subjects received the OTC cart first, followed by the deep basket cart; others received the reverse order.

For each trial, the parent was asked to put the child in the cart seat. The research assistant stood opposite the child as he sat in the seat. The parent took a position at the front of the cart. This was done so that the child's attention would be directed to the

basket portion of the cart behind him where the toy or food was placed.

Both the parent and assistant acted as "spotters" in case the child began to fall from the cart. In the event that a child climbed or crawled into the cart basket, he was allowed to sit there a brief time and then taken out.

Variables

Standing. A "stand" was defined as occurring if the child had both feet free of the leg holes in the cart seat, had both feet planted inside the cart seat, and was relatively upright.

Speed of standing. This was measured as the elapsed time from when one of a child's feet was clear of the leg hole in the cart seat and the child was upright. This speed was measured by hand timing these movements during the session and by confirming these measurements from the videotapes of each child.

Questionnaire items. A number of questions were posed concerning the frequency of shopping trips, the length of the trips, where the subject was placed in the cart during the trip, whether or not seatbelts were used, whether or not the child ever grabbed items from the store shelves or from within the basket, whether the parent ever lost sight of the child, whether the parent ever had to prompt a child not to stand up, and whether the parent was ever farther than 10 feet from the child. For multivariate analysis of standing and speed of standing, a number of items were included which addressed a child's past history of shopping cart behavior. In particular, the parent was asked whether or not the child had ever climbed from the cart seat into the basket, whether the child had ever stood up in the cart seat, whether the child had ever climbed out of the cart seat to the outside, and whether the child had ever been hurt around a shopping cart. All of the questionnaire items analyzed in this study had simple yes and no answers.

RESULTS

Questionnaire results

All of the subjects were confined almost exclusively in the cart seat in shopping carts when their parents took them shopping in local grocery stores. The median shopping trip lasted 75 minutes, with a range from 30 to 120 minutes. All but two parents reported that they remained at all times within arm's length of their child. Only three parents reported ever losing sight of their child during a shopping trip. Eighty one percent ($n=17$) reported never using a seatbelt on a grocery cart. Sixty seven percent ($n=14$) reported their child grabbed items from the shelves, and 95.2% ($n=20$) reported grabbing items from the cart itself. No child had ever fallen from a cart, but 19% ($n=4$) had been hurt by the cart. The majority of subjects (85.7%; $n=18$) had not climbed from the seat to the basket, but a majority (71.4%; $n=15$) had stood in the seat. Only a minority of subjects had actually climbed from the seat to the outside of the cart (33.3%; $n=7$). Seventy seven percent of parents ($n=13$) had to remind their child not to stand up or climb out of the seat.

Predictors of standing in the cart seat

Fifty two percent of subjects stood on both trials, and 41.2% stood on neither trial. Only 5.9% of subjects stood on only one of the two trials. Fifty four percent of subjects stood on the first trial, and 58.8% on the second.

There were no significant differences between the two carts on this variable, though there were trends for a greater likelihood of standing in the deep basket than in the OTC cart. On the first trial, 47.6% of subjects in the OTC cart stood 61.1% of subjects in the deep basket cart ($\chi^2<1$, n.s.). Fifty six percent of subjects in the OTC cart stood on the second trial compared to 62.5% of deep basket cart subjects ($\chi^2<1$, n.s.). Overall, 55.5% of subjects in the OTC cart stood on at least one trial vs 62.5% of subjects in the deep basket cart ($\chi^2<1$, n.s.).

A logistic regression was carried out for each trial, regressing whether or not a subject stood on the type of cart and the four measures of prior cart standing, climbing out and cart-related injuries. For the first experimental trial, only whether or not subject had stood and climbed out of carts in the past predicted standing in the experimental cart ($b=1.82$, $p<0.05$). Subjects who had climbed out in the past were more likely to stand on this first trial. These subjects with a prior history of standing and climbing out had a likelihood of standing on the first experimental trial of 0.79. Those with no prior history had only a probability of 0.4.

For the second trial, none of the predictors was significantly related to standing.

A repeated measures ANOVA over the two trials with type of cart as a factor variable and the questionnaire items as covariates found no significant main effects for either the within subjects factor or cart type. However a prior history of standing in the cart seat and climbing out ($\beta=0.49$, $t=2.24$, $p<0.05$) was related to a greater likelihood of standing.

Predictors of speed of standing

Speed of standing increased from a mean of 12.38 seconds (SD = 20.35) on the first trial to a mean of 7.55 seconds (SD = 10.20) on the second trial.

Standing speed ranged from 1 to 85 seconds on trial 1, and 1 to 44 seconds on trial 2. Also, there were only minor differences between the two types of carts in speed of standing. On the first trial, the OTC cart subjects had a mean standing speed of 12.10 seconds (SD = 4.93) and the deep basket cart subjects a speed of 12.64 seconds (SD = 7.44). On the second trial, a mean of 7.10 seconds (SD = 6.57) was observed for the OTC cart and 8.0 seconds (SD = 13.26) for the deep basket cart. A repeated measures ANOVA found neither the within subjects nor the cart type main effects were significant. Whether a subject had stood in cart seats before ($\beta = -0.68$, $t = 2.51$, $p < 0.05$) and prior injuries ($\beta = -0.62$, $t = 2.31$, $p < 0.05$) were significant. Subjects with a history of standing in cart seats tended to stand more quickly than subjects without this history. Prior injuries in a shopping cart were related to faster standing times, showing a nondeterrent effect of prior accidents.

As was the case with the standing variable, none of the predictors were significantly related to speed on the second trial.

DISCUSSION

A slight majority of subjects in this experiment stood on both trials (52.0%). If a child stood on the first trial, it was highly likely ($p = 1.0$) that he would stand on the second. Conversely, a child who did not stand on the first trial was likely not to stand on the second ($p = 0.88$). There was, thus, no evidence of improvement in children who failed to stand the first time due to becoming accustomed to the apparatus, becoming more confident, or more adept at standing. Similarly, while there was an overall improvement of almost 5 seconds for those who did stand on both trials, this change was not significant.

In spite of the very obvious design differences in the seating areas for the OTC and deep basket carts, these differences were not measurably significant in affecting either the probability of a child standing in the cart seat or the speed of standing. There is the possibility that real differences might emerge with larger samples of subjects, however. Thus, on the first trial, 13.5% more of the subjects exposed to the deep basket cart stood up. On the second trial, 6.5% more of the subjects in this style of cart rather than the OTC style stood up. It was our observation that the vertical (90°) back of the OTC cart seat made it more difficult for a child to free one of his feet from the leg hole in the front portion of the seat. Once a foot was free of the leg hole, however, a child would tend to place this foot on the floor of the seat and use it for leverage to stand up in the seat, thereby freeing the remaining foot from the leg hole. In contrast, in the deep basket cart, the flared out upper portion of the seat permitted a child to lean back and remove a foot from the leg hole. More research is needed to confirm whether this feature of the two seat designs is critical to constraining a child. It should be noted that our initial expectation was that the larger seating area and larger leg holes found in the OTC cart would increase the likelihood of standing as well as speed of standing in this type of cart. The trends noted here are clearly counter to this expectation.

The strongest predictors of likelihood of standing and speed of standing were the questionnaire items dealing with the child's past history of standing and climbing out of cart seats. Children with such histories were significantly more likely to stand during the first trial. Also, their speed of standing was on the average faster. It is significant, however, that the prior history indicators were not predictive of standing on the second trial. This suggests that children with prior experience with standing in grocery store carts had an advantage only initially in the laboratory. Once suitable inducements were offered and children gained familiarity with the laboratory setting, those children with no prior history quickly caught up and matched the performance of their more experienced counterparts. This shows that the learning necessary to master the physical movements of standing in a cart is brief, requiring a single 5 minute trial.

Prior accident history had a surprising effect on standing speed, with subjects who had been hurt around shopping carts showing faster rather than slower standing times. All of the injuries had been minor, e.g. being pinched by movable parts on the basket, hitting one's mouth trying to climb from the cart, and being hit by the cart while outside it. This suggests that the injuries were likely not severe enough to deter subsequent standing in the seat. While prior injuries were negatively correlated with standing in the cart seat ($r = -0.23$, $p = 0.08$), they were positively correlated with standing and climbing out of the seat ($r = 0.15$, $p = 0.36$). Thus, children who had been injured also had a tendency to stand and climb from the seat. It therefore should not be surprising that they showed quicker standing times in our experiment.

Some comment should be made concerning the findings from the interviews conducted in this study. The vast majority of parents reported not using seatbelts to secure their children in carts. This is consistent with our findings from actual grocery store observations where we have seen only 2.78% of parents with children in cart seats use seatbelts (Harrell, 1992). Ferrari and Baldwin (1989a, b) also observed low rates of seatbelt use. It is our belief that parents fail to use seatbelts for a number of reasons; e.g. they

are not available on all carts, they become entangled in the cart and thus are inaccessible (Harrell, 1992), parents do not perceive the risk of falling and therefore fail to see the need to use a belt, or children rebel against being confined by the belt. One of the parents in the present study reported that her child could easily unfasten the belt, and she stopped using them because they were perceived as ineffective.

A second interview result was that almost all parents reported staying close to their children and not losing sight of them. We have found, however, that 80% of parents lose sight of their child at least once in a shopping trip, and 75% were 10 feet or more from their child at least once (Harrell, 1994). The most likely explanation for the differences between what we observed in grocery stores and what parents reported about their supervision is that shopping with children is such a busy and complicated task that most parents are simply not aware of the risks that they might expose their children to, including the risks created by not closely supervising their children.

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