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Perceived barriers before and after a three-month period of modified ride-on car use

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Abstract

Purpose: The purpose of the study is to examine how perceived barriers change before and after a 3-month period of modified ride-on car use.

Methods: This study used a qualitative content analysis of perceived barriers. Fourteen caregivers (13 mothers; one grandmother) responded to a single-question, free-response survey before and after a 3-month period of modified ride-on car use.

Results: A total of 11 and 20 perceived barriers were reported before and after the 3-month period. Environmental barriers were the most frequently reported before and after the 3-month period.

Conclusions: Pediatric physical therapists need to be aware of the potential perceived barriers that families may experience in regard to young children with disabilities using modified ride-on cars and determine strategies to support families on an individual basis.

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Introduction

Children with disabilities as young as 6 months of age can learn how to use early powered mobility devices, such as motorized wheelchairs, for self-directed mobility resulting in increased exploration of the environment, select aspects of cognitive functioning, and social skill development.¹⁻⁷ Modified ride-on cars are an emerging option for self-directed mobility. Commercially available, battery-powered, ride-on cars are modified by installing a large, accessible activation switch on the steering wheel. Common materials, such as polyvinyl chloride (PVC) pipe, swimming kickboards, and Velcro, are used to build a customized seating system for support.^{8,9} Despite the emergence of modified ride-on cars as an early powered mobility option, discussion is lacking about the practicality for families and children to integrate use of cars within their daily life.

Researchers have studied modified ride-on car interventions for young children with disabilities who have not been considered traditional candidates for powered mobility devices due to their young age or diagnosis.¹⁰⁻¹³ Children have (a) the ability to independently press the activation switch to use the modified ride-on car, (b) enjoy driving sessions,¹⁰⁻¹³ and (c) advance mobility skills based on the Pediatric Evaluation Disability Inventory.^{12,14} 2 studies have used an innovative modified ride-on car model that requires the child to pull from sit-to-stand to activate the switch, both of which had feasibility and positive outcomes.^{15,16} However, modified ride-on car studies report a variety of use patterns, and often demonstrate low rates of total use across intervention periods.^{10-13,15} Assessing intervention effectiveness has been limited by low fidelity to the intervention protocol, prompting a need to better understand perceived barriers associated with modified ride-on car use.

A recent study developed a coding structure of perceived barriers to modified ride-on car use through a content analysis of previously published studies.¹⁷ The codes of perceived barriers identified were: device, environmental, child-related factors regarding health, tolerance, and abilities, and caregiver-related factors regarding physical requirements, time, and motivation. A total of 43 perceived barriers were identified from 11 previously published modified ride-on car studies. Device (25%) and environmental (19%) perceived barriers were the most reported. Previous literature has not explored how perceived barriers may change over time. Therefore, the purpose of the current study is to examine how perceived barriers change before and after a 3-month period of modified ride-on car use.

Method

Research Design

This study was descriptive using a qualitative content analysis of perceived barriers before and after a 3-month period of modified ride-on car use. This study is part of a larger study that tracked real-world modified ride-on car use by young children with disabilities.¹⁸ Institutional Review Board approval and written informed consent from the parent/legal guardian of children were obtained prior to data collection. Participants were enrolled and completed the study from August 2017 to June 2018.

Participants

Participants were identified and recruited from social media, emails to community pediatric physical and occupational therapists in the first author's professional network, and word of mouth. Inclusion criteria were that: children were (a) between the ages of 10 months and 3 years of age at entry into the study, (b) able to sit with minimal or moderate support, and (c) were diagnosed with a mobility-related disability.

Seventeen children with disabilities and their primary caregiver enrolled in this study. Four families were not able to be contacted for follow up, resulting in a final sample of 14 children and caregivers (13 mothers; one grandmother). See Logan et al. in press for a full description of demographic information of the children.

Modified Ride-On Cars

Ride-on cars were modified with a large, easy-to-press activation switch (AbleNet; Big Red© switch; \$59) and additional structural support using common materials, such as PVC pipe and pool noodles. An engineer verified all modifications for each ride-on car as safe prior to the child's use. Three ride-on car models were used to best match the child's seating needs (Lightning McQueen: n = 4; Paw Patrol: n = 6; SpongeBob: n = 4). All three ride-on car models were designed for children up to 36 months of age, had a maximum speed of 2 miles per hour in the forward direction only, used a 6-volt battery, and were of similar size and weight. Modifications to off-the-shelf ride-on cars is an unlabeled use of a commercial product.

Procedures

Children were individually fit with a modified ride-on car and were provided an opportunity to explore the activation switch and make the car go. Families were required to demonstrate the ability to safely place and secure their child in the modified ride-on car, turn the car on and off, charge the battery, and provide arm's length supervision at all times. Families were instructed to use the modified ride-on car as much as they would like as time allowed in the family routine, over the course of 3 months. Families were instructed to contact the researchers if the modified ride-on car broke. Otherwise, researchers did not assist families during the study period in order to understand how perceived barriers would emerge without regular contact and support.

Measures

Since the focus of this study was to specifically understand perceived barriers to modified ride-on car use, a single-question, qualitative free-response survey was created expressly for this study. The primary parent/caregiver responded to the question: "At this time, do you have any perceptions about any factors that may serve as barriers to modified ride-on car use?" Responses were provided in writing before (i.e. previous to any experience with using a modified ride-on car) and after a 3-month period of modified ride-on car use.

Data Analysis

Our research team consisted of 5 PhD researchers (1 of whom is a certified pediatric physical therapist), and 3 graduate students in kinesiology (1 of whom is a certified pediatric

physical therapist). Five of the 8 researchers have prior experience and formal training in qualitative methods. A content analysis was completed to determine frequencies and of perceived barriers of modified ride-on car use. This was an iterative process as recommended for descriptive studies¹⁹ and was a deductive process.²⁰ This included analysis of caregiver responses to the single-question, free-response survey. The same coding structure of perceived barriers of modified ride-on car use that were identified in a previous study was used to code caregiver's responses.¹⁷ The codes of perceived barriers included: device, environmental, child-related factors regarding health, tolerance, and abilities, and caregiver-related factors regarding physical requirements, time, and motivation. The first and second authors independently identified, extracted, and coded perceived barriers reported before and after the 3-month period. Initial comparison resulted in >95% agreement, and any disagreements were resolved via discussion until 100% agreement was reached.

Results

The majority of families (11 out of 14) engaged in driving sessions lasting, on average, less than 20 minutes (child IDs 1, 2, 3, 6, 8, 9, 10, 11, 12, 13, 14). Only 3 families (child IDs 4, 5, and 7) engaged in longer driving sessions averaging between 25–33 minutes. Half of the families (child IDs 2, 3, 4, 9, 10, 11, and 13) used the modified ride-on cars 7 times or less across 3 months. Only 3 families (child IDs 5, 6, and 7) engaged in 14 or more sessions across 3 months. The coding of perceived barriers of modified ride-on car use before and after 3 months for each family, and the mean minutes per driving session and number of driving sessions across 3 months are in Table 1. A total of 11 perceived barriers were reported before and 20 after the 3-month period (Table). Before modified ride-on car use, environmental perceived barriers (n = 7) were the most reported, followed by child-related perceived barriers: abilities (n = 2), and tolerance (n = 1), and device-related perceived barriers (n = 1). After modified ride-on car use, environmental perceived barriers were the most reported (n = 7), followed by device-related perceived barriers (n = 5), child-related perceived barriers: abilities (n = 4), tolerance (n = 3), and caregiver-related perceived barriers: time (n = 1).

Discussion

The purpose of the current study was to examine how perceived barriers change before and after a 3-month period of modified ride-on car use. Results indicate that the number of reported perceived barriers increased in frequency from 11 to 20 from before to after the 3-month period. This suggests that as families gained experience with using the modified ride-on car that additional or unanticipated perceived barriers emerged and likely inhibited use.

The number of perceived barriers related to the device (i.e. modified ride-on car) increased from 1 (child ID 12) to 5 (child IDs 2, 8, 11, 14) from before to after 3 months of modified ride-on car use. This was the largest increase among any code of perceived barrier. The reported perceived barriers after modified ride-on car use include the quick acceleration, loud sound, duration of battery life, size of steering wheel, and overall size of the modified ride-on car. A majority of these perceived barriers could be addressed. For example, a

second battery could be purchased and one battery can be used while another battery is charging. Although this increases the cost it may reduce a perceived barrier to modified ride-on car use. The quick acceleration and size of the steering wheel could also be addressed. A potentiometer is an electrical component that provides manual control of the output voltage and can be installed in the wiring of the modified ride-on car. This allows the speed of the modified ride-on car to be adjusted easily with the turn of a knob. A lower speed setting would result in slower acceleration. The size of the steering wheel could be addressed through additional modifications such as replacing the circular steering wheel with a handlebar design that allows for greater directional control.

The number of perceived barriers related to the environment stayed the same before ($n = 7$) after ($n = 7$) modified ride-on car use and remained the most frequently reported code of perceived barrier at either time point. There were 2 types of environmental perceived barriers reported including weather and inadequate space. Four caregivers (child IDs 7, 8, 12, and 13) reported weather as a perceived barrier before, but not after modified ride-on car use. Two caregivers (child IDs 5, 9) reported weather as a perceived barrier after, but not before modified ride-on car use. This suggests that the perceived barrier of weather was a different experience depending upon the family. This may have been due to the time of year when each familiar received the modified ride-on car. In regard to inadequate space, families in the study had a mixed experience. Two caregivers (child IDs 7, 11) reported inadequate space as a perceived barrier before and after modified ride-on car use, one caregiver (child ID 13) before but not after, and 2 caregivers (child IDs 4, 9) after but not before modified ride-on car. Further research is warranted to understand the interplay between device and environmental barriers. For example, the weather and the size of the device may not be a perceived barrier for families with adequate space such as a large home, spacious backyard, and availability of sidewalks to use a modified ride-on car.

Our results align with previous findings that suggests environmental and device-related perceived barriers are the most commonly reported.¹⁷ These results should be interpreted cautiously due to the use of a single-question free-response survey to assess families' perceived barriers. For example, 4 of the 10 families did not report any perceived barriers before or after the 3-month period. It is unclear whether families did not perceive any barriers or if they simply did not report them. Another example is that 4 families reported the weather as a perceived barrier before the 3-month period, while only 1 of these families also reported weather as a perceived barrier afterwards. It is unknown if these families experienced favorable weather for using the modified ride-on car, developed a plan to use the car elsewhere, or simply did not report weather as a perceived barrier. Further research is warranted to understand how perceived barriers to modified ride-on car use may change over time.

The results of the study also highlight that the perceived barriers related to the child, such as their tolerance and abilities, may play a critical role in modified ride-on car use. The number of perceived barriers related to the child (i.e. tolerance and ability) increased from 3 (child IDs 9, 13, 14) to 7 (child IDs 5, 7, 9, 12, 13, 14) from before to after 3 months of modified ride-on car use. Several previous studies of modified ride-on cars involved bi-weekly home visits from a researcher to observe and encourage children's use of modified ride-on cars,

brainstorm new activities, and support the families and address perceived barriers related to child-related factors.^{10–13,15} No support was provided to children and families throughout the 3-month period. A lack of systematic and targeted support may be common for children who receive modified ride-on cars in the community and are not involved in a research-based intervention. The higher reporting of child-related perceived barriers in the current study may be due to the lack of ongoing researcher support. This may provide initial evidence that support may mitigate some of the perceived barriers families experience with modified ride-on car use. This presents an opportunity for future collaborative work between researchers and pediatric physical therapists to design, evaluate, and implement evidence-based strategies to increase adherence and use of modified ride-on cars, and potentially other powered mobility devices, throughout an intervention.

The reported modified ride-on car use over a 3-month period in the current study was low compared to previous studies,^{10–13,15} and may be due to the lack of support provided from researchers¹⁸ and the reported perceived barriers. The overall low use of modified ride-on cars makes it difficult to interpret how use may have been related to the perceived barriers reported by each family. One interesting finding is that child 5 used the modified ride-on car the most and reported no perceived barriers before and 2 perceived barriers after the 3-month period. Furthermore, this family lived on the 3rd floor of an apartment complex with limited indoor space yet using the modified ride-on car was clearly a priority. Child 5 seems to be an example where the family's motivation appeared high despite actual environmental barriers to modified ride-on car use. In contrast, other families reported zero perceived barriers and modified ride-on car use was very low (Child 1, 3, 6, and 10). It is unclear whether these families actually experienced no perceived barriers, or if they were not invested or engaged in the research study and chose not to answer the single-item free response survey. Future research is warranted to further understand how perceived barriers directly or indirectly relate to modified ride-on car use. A possible direction for future work is to examine how motivation and behavior change processes can be included in modified ride-on car interventions to facilitate greater use for a sustained period of time.

There were strengths and limitations of the current study. A strength is that this is the first study to describe how perceived barriers of modified ride-on car use may change over time. Another strength is the relatively large sample size ($n = 14$), since a majority of previous modified ride-on car research has been limited to case reports and case series with few participants. One limitation is that it is unclear if families experienced more and/or different perceived barriers than were reported. Another limitation is the use of a single question free-response survey to assess perceived barriers of modified ride-on car use. Interviews or administration of a multiple question survey asking families targeted questions about several categories of perceived barriers may have yielded additional knowledge such as ideas from parents about how to reduce perceived barriers and facilitate modified ride-on car use.

What this case adds to evidence-based practice

This study is an important first step to understanding the perceived barriers that families may experience when providing their child with a modified ride-on car during an initial 3-month period. Perceived barriers may be especially salient for families who are not regularly

supported by researchers or pediatric physical therapists on strategies to reduce perceived barriers and facilitated modified ride-on car use. Although the underlying reasons as to why perceived barriers may have changed over time were not fully understood, our findings provide important knowledge to pediatric physical therapists. Our results may allow pediatric physical therapists to anticipate some of the perceived barriers that families may experience with modified ride-on cars. This knowledge will contribute to pediatric physical therapists in providing practical strategies on an individual basis to overcome perceived barriers of modified ride-on car use.

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Conflicts of Interest and Sources of Funding:

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Table 1.

Coded Perceived Barriers and Driving Data of Modified Ride-On Car Use.

| Child ID | Before 3-months of modified ride-on car use | After 3-months of modified ride-on car use | Change in perceived barriers from before to after 3-months of modified ride-on car use | Mean Minutes per Driving Session during 3-Months of Modified Ride-On Car Use | Number of Driving Sessions During 3 Months of Modified Ride-On Car Use |
|----------|--|--|--|--|--|
| 1 | No response | No response | N/A | 17.1 minutes | 10 sessions |
| 2 | No response | • It would be great if the steering wheel was a little bigger for the child/parent to turn (Device) | +1 Device | 15.8 minutes | 7 sessions |
| 3 | No response | No response | N/A | 12 minutes | 3 sessions |
| 4 | No response | • Inadequate space (Environmental) | +1 Environmental | 33.1 minutes | 5 sessions |
| 5 | No response | • Weather (Environmental) • Child is unable to sit straight in car (Child: Ability) | +1 Environmental +1 Child: Ability | 30.4 minutes | 26 sessions |
| 6 | No response | No response | N/A | 10.9 minutes | 14 sessions |
| 7 | • Weather (Environmental) • Inadequate space (Environmental) | • Inadequate space (Environmental) • Child willingness (Child: Tolerance) | -1 Environmental +1 Child: Tolerance | 25.9 minutes | 17 sessions |
| 8 | • Weather (Environmental) | • Bulky to transport (Device) | -1 Environmental +1 Device | 16.3 minutes | 8 sessions |
| 9 | • Child does not respond well to movement (Child: Tolerance) | • Weather (Environmental) • Inadequate space (Environmental) • Lack of time (Caregiver: Time) • Child does not enjoy movement (Child: Tolerance) | +2 Environmental +1 Caregiver: Time | 17.1 minutes | 4 sessions |
| 10 | No response | No response | N/A | 0 minutes | 0 sessions |
| 11 | • Inadequate space (Environmental) | • Inadequate space (Environmental) • Weather (Environmental) • Length of time the battery lasts (Device) | +1 Environmental +1 Device | 16.8 minutes | 4 sessions |
| 12 | • Weather (Environmental) • Length of time the battery lasts (Device) | • Steering was difficult, we focused on reaching motor milestones as they became obtainable (Child: Ability) | -1 Environmental -1 Device +1 Child: Ability | 10.6 minutes | 9 sessions |
| 13 | • Weather (Environmental) • Inadequate space (Environmental) • Lack of trunk control of child (Child: Ability) | • Steering was difficult (Child: Ability) | -2 Environmental | 13.5 minutes | 6 sessions |
| 14 | • Child unable to independently steer or stop the car (Child: Ability) | • Child did not enjoy the ride-on car (Child: Tolerance) • Lack of enjoyment may be due to his low vision (Child: Ability), the quick acceleration (Device) and sound of the ride-on car (Device) | +1 Child: Tolerance +2 Device | 11.2 minutes | 8 sessions |

Table 2.

Frequencies of Reported Perceived Barriers

| Code of Perceived Barrier | Before 3-months of modified ride-on car use | After 3-months of modified ride-on car use | Change |
|----------------------------------|---|--|---|
| Environmental | 7 | 7 | 5 additional environmental perceived barriers were reported after compared to before 3-months of modified ride-on car use. 5 environmental barriers that were reported before were not reported after. This resulted in no net change of frequency of environmental perceived barriers. |
| Device | 1 | 5 | 5 additional device perceived barriers were reported after compared to before 3-months of modified ride-on car use. 1 device perceived barrier that was reported before was not reported at after. This resulted in a net change of +4 device perceived barriers. |
| Child: Health | 0 | 0 | No change |
| Child: Tolerance | 1 | 3 | 2 additional child tolerance perceived barriers were reported after compared to before 3-months of modified ride-on car use. This resulted in a net change of +2 child tolerance perceived barriers. |
| Child: Ability | 2 | 4 | 2 additional child ability perceived barriers were reported after compared to before 3-months of modified ride-on car use. This resulted in a net change of +2 child ability perceived barriers. |
| Caregiver: Physical Requirements | 0 | 0 | No change |
| Caregiver: Motivation | 0 | 0 | No change |
| Caregiver: Time | 0 | 1 | 1 additional caregiver time perceived barrier was reported after compared to before 3-months of modified ride-on car use. This resulted in a net change of +1 caregiver time perceived barrier. |
| Total: | 11 | 20 | |