

Exploration of caregiver disability orientation and attitudes towards self-directed mobility on modified ride-on car usage of children with disabilities.

by
Sarah Schaffer

A THESIS

submitted to

Oregon State University

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in partial fulfillment of
the requirements for the
degree of

Honors Baccalaureate of Science in Public Health
(Honors Scholar)

Presented May 20, 2019
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AN ABSTRACT OF THE THESIS OF

Sarah Schaffer for the degree of Honors Baccalaureate of Science in Public Health presented on May 20, 2019. Title: Exploration of caregiver disability orientation and attitudes towards self-directed mobility on modified ride-on car usage of children with disabilities.

Abstract approved: _____

Samuel Logan

Modified ride-on cars (ROCs) offer children with disabilities access to independent mobility.

Aims: 1) To examine the association between caregiver attitudes towards self-directed mobility, caregiver alignment with the medical and social models of disability, and total modified ROC driving time; 2) To compare caregiver attitudes towards self-directed mobility, caregiver alignment with the medical and social models of disability, and total modified ROC drive times between high and low-use groups. **Method:** Fourteen children used a modified ROC during a 3 month intervention. At the end of the intervention, total car use was compared with primary caregiver disability model orientation and attitudes towards self-directed mobility. **Results:** Neither caregiver disability model orientation nor attitudes towards self-directed mobility were significantly associated with drive time. When comparing high and low use groups, total drive times and medical model alignment were significantly different. Caregivers in the high use group showed stronger alignment to the medical model ($p < 0.05$). **Conclusions:** Evidence suggests that caregiver disability model orientation may influence provision of opportunities for their child to use a modified ROC. Further research is warranted to deepen our understanding of this relationship and explore other attitudinal measures which may facilitate or discourage modified ride-on car use in the real world.

Key Words: modified ride-on car, caregiver attitudes, self-directed mobility, disability model orientation, driving time

Corresponding e-mail address: schafsar@oregonstate.edu

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APPROVED:

Samuel Logan, Mentor, representing Kinesiology

Karen Elliott, Committee Member, representing Public Health

Winston Kennedy, Committee Member, representing Kinesiology

Toni Doolen, Dean, Oregon State University Honors College

I understand that my project will become part of the permanent collection of Oregon State University, Honors College. My signature below authorizes release of my project to any reader upon request.

Sarah Schaffer, Author

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Introduction

Self-Directed Mobility

Self-directed mobility is a fundamental human right regardless of disability status (Logan, Bogart, Ross & Woekel, 2018a). Self-directed mobility is the ability to control one's own mobility, either by walking independently or with the aid of an assistive device such as a cane, walker, motorized wheelchair, or other adaptive mobility technology (Logan et al., 2018a). The onset of self-directed mobility, such as crawling and walking, initiates an influx of novel experiences and information which drive continued psychological development (Anderson et al., 2013). Past research has demonstrated the importance of self-directed mobility as a facilitator of young children's independent exploration (Anderson et al., 2013; Gustafson, 1984; Karasik, Tamis-LeMonda & Adolph, 2011), spatial perception abilities (Campos et al. 2000), and the development of language, comprehension (Leonard & Hill, 2014), and social skills (Leonard & Hill, 2014; Campos et al. 2000; Whittingham, Fahey, Rawicki & Boyd, 2010).

Young children with mobility-related disabilities are limited in their ability to explore the world on their own terms, as well as access and initiate social interactions (Ragonesi, Chen, Agrawal & Galloway, 2010). As a result, these children are vulnerable to subsequent developmental delays compared to their typically developing peers with barrier-free access to self-directed mobility (Anderson et al., 2013; Butler, 1986; Logan et al., 2016a).

Powered Mobility Devices

A powered mobility device (PMD) is a battery/electronically powered, assistive technology which allows those with mobility challenges to attain self-directed mobility. The motorized wheelchair is a common type of PMD. Although the current clinical practice is typically to delay usage of a PMD until children enter their elementary years (Feldner, Logan &

Galloway, 2015), recent research suggests that introducing PMDs at an earlier age can mitigate aforementioned developmental delays in very young children with disabilities by allowing for independent mobility opportunities and facilitating positive social interactions and emotional behavior (Butler, Okamoto & McKay, 1983; Guerette, Furumasu & Tefft, 2013). The transition to a PMD is often not considered until walking-focused mobility interventions are unsuccessful. High cost, lack of commercial availability, burdensome size and negative social perceptions are all additional factors which impede early PMD access (Huang & Galloway, 2012; Feldner et al., 2015).

Modified Ride-On Cars

An emerging technology which aims to transcend these barriers is the modified ride-on car (ROC) (Huang & Galloway, 2012; Logan, Feldner, Galloway & Huang, 2016b). Modified ROCs are created through the modification of low-cost, commercially available toy cars. Modifications are relatively simple, involving the addition of a large, easily recognized and operated activation switch as well as a secure, supportive seat system that may be adjusted to each child's specific support and size needs. These support modifications are constructed from common, inexpensive supplies such as PVC pipe, Velcro, pool noodles and kickboards (Huang & Galloway, 2012). Multiple case studies and small cohort studies involving children with various disabilities and ranges of medical needs have illustrated that modified ROCs are both feasible for use by very young children and effective in promoting independent mobility and socialization (Huang, Ragonesi, Stoner, Peffley & Galloway, 2014; Logan, Huang, Stahlin, & Galloway, 2014; Huang & Chen, 2016; Logan et al., 2016b; Logan, Hospodar, Feldner, Huang & Galloway, 2018b).

Although current research supports the feasibility and benefits of modified ROC use by young children as an option for independent mobility, data regarding the amount of time children spend using their modified ROC in these studies varies greatly (Huang et al., 2014; Logan et al. 2018b; Logan et al., 2014). Over the course of a twelve week intervention, three separate studies found that participants used the modified ROC anywhere between 120 minutes and 2210 minutes total (Huang et al., 2014; Logan et al., 2018b; Logan et al., 2014). The purpose of a modified ROC is to facilitate developmental benefits by increasing a child's self-directed mobility. Therefore, it is essential that the car receives substantial use. It is important to determine what factors may contribute to high or low modified ROC use in the real world in order to inform future research and interventions involving the modified ROC.

Identifying facilitators and/or limiting factors of real-world modified ROC usage is particularly relevant to this population of very young children with disabilities, as they are double-marginalized by both their age and disability status. These children are often too young to verbally advocate for access to a modified ROC and are physically unable to access and initiate use of the device on their own. A young child's access to mobility via modified ROC requires the assistance of a caregiver to help them get seated and turn on the device. A primary caregiver should provide a child with frequent and substantial access to the modified ROC in order for a child to truly benefit from their self-directed mobility experience. Two factors which may influence a caregiver's provision of opportunities for modified ROC use are 1) caregiver attitude towards self-directed mobility and 2) caregiver orientation to either the social and/or medical models of disability.

Attitude towards Self-Directed Mobility

Attitudes towards self-directed mobility have been minimally researched. A cross sectional study of undergraduate students is the first and only study to examine this topic (Logan et al., 2018). This study found that 71.5% of participants either “agreed” or “strongly agreed” with the statement “self-directed mobility is a fundamental human right” and only 7.7% either “disagreed” or “strongly disagreed” (Logan et al., 2018a). These findings suggest that college students view self-directed mobility favorably.

The statement regarding self-directed mobility as a human right reflects only one potential aspect of someone’s overall attitude towards self-directed mobility. Research has not yet examined other potential factors that may influence a person’s attitude towards self-directed mobility, nor how those attitudes may serve to predict caregiver provision of opportunities for their child to use a modified ROC. Factors that may impact attitudes towards self-directed mobility include knowledge of current research regarding access to self-directed mobility and perceptions of PMDs. A young child’s access to self-directed mobility through assistive technology is often dependent on a caregiver’s willingness to provide or advocate for that access. Therefore, a more holistic assessment of caregiver knowledge, assumptions and beliefs regarding self-directed mobility is valuable.

Disability Model Orientation

A primary caregiver’s perception of disability might be another influential factor in their provision of opportunities for their child to use a modified ROC. The two primary models of disability to categorize a person’s perceptions and assumptions regarding disability are the medical and social models. Historically, the medical model of disability has been the more prominent view (Darling & Heckart, 2010; Llewellyn & Hogan, 2000). This model emphasizes

disability as a physiological impairment, or deviation from the ‘norm’. It suggests that disability is a medical problem that most would perceive as undesirable. This orientation highlights treatment of the condition as essential in achieving a “normal” life. At its core, the medical model asserts that it is the responsibility of the individual with a disability to adapt or change to fit more seamlessly into their environment (Darling & Heckart, 2010; Llewellyn & Hogan, 2000; Logan et al., 2018a; Olkin, 2002)

In contrast, the social model of disability suggests that it is society’s fixation on “normality” and failure to accommodate the differences of individuals with disabilities which allow those differences to be debilitating. This model views disability as a social construct and emphasizes a need for structural and cultural changes in order to foster inclusivity and allow people with disabilities to play a more active and contributory role in society (Darling & Heckart, 2010; Llewellyn & Hogan, 2000; Logan et al., 2018a; Olkin, 2002). Recent research demonstrates that alignment with the social model of disability is a significant predictor of a more favorable attitude towards self-directed mobility as a fundamental right (Logan et al., 2018a).

Purpose of Study

Previous research has yet to focus on the factors predicting caregiver provision of modified ROCs to young children with disabilities. In order to address this gap, this study utilized a series of pre-intervention assessments to measure caregiver attitudes towards self-directed mobility as well as their alignment with the medical and social disability models. These measures were compared with each child’s total drive time at the end of the intervention. There were two aims of the study. Aim 1: To examine the association between caregiver attitudes towards self-directed mobility, caregiver alignment with the medical and social models of

disability, and total modified ROC driving time. It was hypothesized that more positive attitudes towards self-directed mobility as well as stronger alignment with the social model of disability would be associated with higher total modified ROC use by the participating child. Aim 2: To compare caregiver attitudes towards self-directed mobility, caregiver alignment with the medical and social models of disability, and total modified ROC drive times between high-use and low-use groups. It was hypothesized that there would be a significant difference between total average drive time between groups. It was also hypothesized that the high-use group would show significantly more positive attitudes towards self-directed mobility and greater alignment with the social model of disability than the low-use group.

Methods and Materials:

Design

The results of this study are based on a portion of data collected within a larger study which used a prospective, descriptive observational design. The broader study investigated the multi-directional influence between in-home modified ROC use and child development and participation in daily life.

Participants

Eighteen children and caregivers were initially enrolled into the study. Only data from 14 children and caregivers is included in the final results as researchers were unable to follow up with 4 families. All enrolled children were in between the ages of 10 months and 3 years at the start of the study. In order to be enrolled, children had to meet the inclusion criteria. This criteria included diagnosis of a mobility-related disability and/or identification as delayed or at risk for delayed onset of independent mobility. Each child had to be able to sit with support in order to use the modified ROC. Enrollment in the study was dependent on at least one caregiver being

available and willing to complete the pretest/posttest questionnaires. Table 1 outlines demographic information for each participant.

Modified Ride-on Cars

Each participating child was provided with a modified ROC which they were to use for the duration of the study. Families were allowed to keep the modified ROC post-intervention. Depending on the individual seating needs, one of three ROC models was chosen to modify. Modifications to the cars included a large, touch-sensitive activation button as the bulk of the steering wheel. Additional structural and safety features, such as seat backs and a seatbelt system, were built using common, low-cost materials such as PVC pipe, Velcro, pool noodles and pool kickboards (Huang & Galloway, 2012; Logan et al., 2016b). Modified ROCs used a 6-volt, rechargeable battery and had a maximum speed of 2 mph. Figure 1 is a photo of a modified ROC representative of those used in the study. Before use, each car was evaluated for safety by an engineer and researcher.

At the initial visit, caregivers were trained to properly use the modified ROC and received instructions about how to safely set their child up in the car, turn it on, steer, and charge the battery. Caregivers were not given instructions relating to frequency with which to use the modified ROC. To maximize safety measures, caregivers were asked to maintain an arm's length supervision during all driving sessions.

Procedure

In an initial home-visit, the primary caregiver completed a series of pre-intervention surveys and questionnaires. The child was then fitted into the modified ROC, and caregivers were provided basic modified ROC usage and safety training. The study involved three months of modified ROC use, during which time there was no contact between the family and

researchers. At the end of 3 months, researchers completed a brief follow-up home visit where caregivers were asked to fill out post-intervention questionnaires and the objective tracking data indicating modified ROC use was collected. The families were then allowed to keep the ride-on car. Written informed consent and IRB approval were obtained before data collection began.

Independent Variables

Attitude towards Self-Directed Mobility

Caregiver attitudes towards self-directed mobility were assessed using a novel, 9-item self-directed mobility scale (Logan et al., in preparation) in which caregivers indicated their level of agreement with each item using a 5-point Likert scale ranging from 1=strongly disagree to 5=strongly agree. Example statements from this scale are: “Self-directed mobility is a fundamental human right”, “I believe I am an advocate for children to gain access to self-directed mobility.” and “I believe that promoting other motor skills, such as crawling, walking, or walking with an assistive device should occur prior to initiating a powered mobility device”. Research demonstrates that internal consistency is acceptable for this mobility scale with these 9 items included ($\alpha = 0.75$) (Logan et al., in preparation). Pre-intervention scales were coded and average scores were calculated for each participating caregiver. A higher average score indicates a more positive or favorable attitude towards self-directed mobility.

Disability Model Alignment.

Caregiver alignment towards the medical and/or social model of disability was determined using a disability orientation scale derived from Darling and Heckert’s (2010) Questionnaire on Disability Identity and Opportunity. This study used a 7-item social model and 8-item medical model subscale. Each item was rated using a 5-point Likert scale which ranged from 1=strongly disagree to 5=strongly agree. For each subscale, an average score was

calculated. Strong alignment to a particular model was indicated by a higher average score. It is important to note that caregivers may simultaneously be aligned with one, both, or neither of the social and medical models of disability as the two orientations are not mutually exclusive (Olkin, 2002). An example of a statement supporting the social model of disability is, “Lack of accessibility and discrimination by employers are the main reasons why disabled people are unemployed”. An example of a statement aligning with the medical model is, “People with disabilities need to learn to adjust to living in a world in which most people aren’t disabled.”

Dependent Variable

Modified ROC Use.

In order to objectively measure real-world usage of the modified ROCs, each car was equipped with a Feather Interface Tracking system (FIT) comprised of three pieces of hardware: (1) Adafruit Feather M0 Adalogger, a portable, microcontroller which includes a processor; (2) Precision Real Time Clock Featherwing, and (3) The Quicrun 60A 2S-3S Waterproof Brushed Electronic Speed Controller (Logan et al., in preparation). The combination of the Featherwing and Adalogger allow for digital timekeeping and the Quicrun controller serves to connect the Adalogger to the activation switch of the car. In order to record time-stamped switch activation data, the Arduino software, an open-sourced, computer programming software, was used to create a customized program to upload to the Adalogger. For each activation and release of the switch, this program automatically records the date, timestamp and duration of each activation (milliseconds). This text was then saved onto a micro SD card and downloaded during the follow-up visit (Logan et al. in preparation). The total amount of time spent driving during the three-month intervention period was calculated for each participant.

Data Analysis

In order to examine the impact of caregiver attitudes on their provision of self-directed mobility, the data will be analyzed both as a holistic sample, as well as grouped into high and low-use groups based on total drive time. Because of the small sample size ($n=14$) and because the data does not satisfy assumptions of normality needed to support parametric analysis, non-parametric statistical analyses will be used. Analyses will be considered significant at the .05 alpha level.

Aim 1

A Spearman's Correlation will be used to determine the association between caregiver scores on the Attitudes towards Self-Directed Mobility scale, the Disability Model Orientation scales and total driving time during the three month study. The strength of each coefficient will be interpreted based on Cohen's guidelines: small effect size = $r > 0.10$; moderate effect size = $r > 0.30$; and strong effect size = $r > 0.50$ (Cohen, 1988). The coefficients were calculated using data from all 14 participants, and then again excluding the data from participant 009. Participant 009 was excluded because it was decided that the caregiver's low social model alignment score and the child's high usage of the car both deviated enough from the average to significantly affect the statistical results.

Aim 2

Due to the small sample size and the variability of car usage data, the data were grouped by high and low use in order to determine if significant differences exist between the two groups which may have impacted total drive times. The pre-intervention medical model, social model and self-directed mobility scale scores of the 7 caregivers whose children drove the least were

compared to the scores of the 7 caregivers whose children drove the most using a Mann Whitney U test.

Results

Aim 1

Each participants' total drive time in minutes is displayed in Table 2 alongside caregiver scores on the pre-intervention medical model, social model and self-directed mobility scales. On average, children spent a total of 171.38 minutes using the modified ROC over the course of the 3 month intervention (SD= 206.05; Range: 0-791). Caregivers showed stronger alignment with the social model of disability (M = 3.93; SD=0.58) than the medical model (M=3.18; SD=0.79). The average score of the self-directed mobility scale was a 4.14 (SD= 0.31). This high average score indicates that caregivers held favorable attitudes towards self-directed mobility.

Spearman's Rho correlation coefficients (r_s) are reported in both Table 3 and Table 4. Table 3 reports the coefficients derived using data from all 14 participants. Table 4 reports the coefficients derived excluding caregiver data for participant 009. No significant association between caregiver disability model orientation scores or self-directed mobility scale scores and total drive time was found in either of the two analyses. When $n=14$, a moderate, positive association was found between caregiver score on the medical model and total drive time, but it was not significant at a 0.05 level ($r_s= 0.374, p>0.05$). When participant 009 was removed from the data, the strength of this association decreased and remained non-significant ($r_s=0.299, p>0.05$). When $n=13$, a moderate, positive association was found between self-directed mobility score and total drive time, but was non-significant ($r_s=0.350, p>0.05$)

Aim 2

Grouping the data based on total modified ROC usage revealed that the low-use group drove for an average of 62.47 total minutes during the 3-month intervention (SD=33.67). The high-use group drove for an average of 280.29 minutes total (SD=251.36). A Mann-Whitney U test indicated a statistically significant difference between the average total drive time for these two groups ($p=0.002$). There was also a statistically significant difference between the average medical model orientation score for each group ($p=0.034$), with the high use group showing a stronger alignment with the medical model of disability (M=3.66, SD=0.67) than the low use group (M=2.70, SD=0.56). The average scores for the social model orientation and self-directed mobility questionnaires did not differ significantly between groups. Table 5 shows the grouped data and results.

Discussion

Aim 1

The first aim of this paper was to examine the association between caregiver attitudes towards self-directed mobility, caregiver alignment with the medical and social models of disability, and total modified ROC driving time for each participating child. Statistical analysis did not reveal significant associations between any of the three attitudinal measures and total drive time results.

Attitudes towards Self-Directed Mobility.

Results do not support the hypothesis that more favorable attitudes towards self-directed mobility would be associated with greater total drive time. Caregiver scores for the self-directed mobility scale were consistently high across the sample. Only 4 participating caregivers averaged below a 4.0 on the self-directed mobility scale (5.0 max score), and none scored below a 3.5.

These results illustrate that these caregivers hold moderately to highly favorable attitudes towards self-directed mobility. The homogeneity of the self-directed mobility scores was not paralleled by total drive time results, which showed high variability ($SD= 206.05$). Thus, no significant association was found between attitudes towards self-directed mobility and total drive time.

All participating caregivers have personal experience with disabilities impacting self-directed mobility. It is possible that this common experience factored into the elevated scores on the self-directed mobility scale. This notion is supported by research in-preparation which found that pediatric physical therapists, who inherently have substantial experience and education regarding self-directed mobility, scored significantly higher on all 9-items of this same self-directed mobility scale than the average college student (Logan et al., in preparation).

It is worth noting that this scale was written with the intent of assessing attitudes of pediatric physical therapists rather than those of the general population (Logan et al., in preparation). To a caregiver who may not have prior knowledge regarding self-directed mobility as a formal concept, some of the items on this scale could have been challenging to interpret and answer. For example, item two on the scale is “Research suggests benefits to providing children with access to self-directed mobility”. This item assumes engagement with literature surrounding self-directed mobility, however, this is not an assumption that should be made about the general population. Any confusion that caregivers may have experienced while completing this survey could have influenced the accuracy of its results. Future research and development involving this novel self-directed mobility scale could examine adapting the items to assess the general population. Tailoring the questions to different audiences while maintaining the integrity of the assessment might provide a more accurate reflection of attitudes towards self-directed mobility.

Disability Model Alignment.

Results failed to support the hypothesis that strong alignment to the social model would be associated with higher total drive time. Neither alignment with the social or medical model of disability was significantly associated with total drive times.

Similar to self-directed mobility scale results, caregivers in this sample were largely consistent in their alignment with the social model of disability over the medical model. The primary caregiver for child 009 was the only caregiver in this sample who scored below a 3 on the social model scale and who showed stronger alignment to the medical model of disability. Child 009 happened to be the most frequent user of the modified ROC over the 12 week intervention (total drive time=791 minutes). Because of this high drive time and the caregiver's substantial deviation from the overall pattern of social model alignment, participant 009 was excluded from one part of the statistical analysis as an outlier. Although neither analysis produced statistically significant results, the results specific to participant 009 contradict the hypothesis that strong alignment with the social model would be a predictor of high modified ROC use. Although the modified ROC is an adaptive mobility device grounded in the ideals of the social model of disability, it is possible this caregiver perceived its use as a medical intervention. This perception would have appealed to her medical model orientation, potentially encouraging her to provide modified ROC use opportunities to that child.

Aim 2

The second aim of this study was to compare caregiver attitudes towards self-directed mobility, caregiver alignment with the medical and social models of disability and total modified ROC drive times between high-use and low-use groups. Grouped analysis revealed a significant difference between averaged total drive times of each group. This finding demonstrates that the

high and low use groups were divided appropriately and the other variables were worthy of examination.

Attitudes toward Self-Directed Mobility.

Results do not support the hypothesis that the high-use group would show more favorable attitudes towards self-directed mobility than the low-use group. There was no significant difference between caregiver attitudes towards self-directed mobility between high and low-use groups. The consistently favorable view of self-directed mobility across the sample likely led to this insignificant difference. Past research highlights contact with individuals with disabilities as a primary factor associated with positive attitudes towards disability (Morin, Rivard, Crocker, Boursier & Caron, 2008; Strohmer, Grand & Purcell, 1984). Positive attitudes towards disability may be associated with a more favorable view of self-directed mobility (Logan et al., 2018a). Caregivers of children with disabilities inherently have frequent and intimate contact with disability. Consequently, this population may all have similarly favorable views towards self-directed mobility, especially with regard to their own child. Because both groups showed favorable attitudes towards self-directed mobility, and individual-level analysis was similarly inconclusive, it does not seem that caregiver attitudes towards self-directed mobility are an indicator of provision of modified ROC use opportunities.

Disability Model Orientation.

The results do not support the hypothesis that the high-use group would show stronger alignment with the social model of disability than the low-use group. There was no significant difference in social model alignment scores between the high and low-use groups. This insignificant difference is likely attributable to the relative consistency of social model scale scores across the sample. While both groups, on average, aligned more with the social model,

caregivers within the high-use group demonstrated significantly stronger alignment to the medical model than those in the low-use group, with average scores of 3.66 and 2.70, respectively. The high-use group holds a somewhat favorable view of the medical model ideals while the low-use group holds a somewhat unfavorable view.

The modified ROC has been described in previous works as a “learning environment” (Huang & Galloway, 2012). It is intended to serve as an easily accessible means of exploration so that a child who may not be a candidate for traditional powered mobility interventions can engage with the world through play. The roots of the modified ROC lie in the social model of disability, with the idea that children may need access to a variety of assistive mobility devices depending on environment. With this in mind, it was predicted that a strong alignment with the social model of disability would be associated with higher drive time. The results of the study, however, suggest that a caregiver’s alignment with the medical model might have been a stronger predictor of their provision of ride-on car opportunities, with a higher medical model score predicting greater car use by the child. Analysis of the ungrouped data demonstrated a moderate, positive association between caregiver score on the medical model and drive time. Although this association is not a statistically significant one, and was weakened by the removal of outlying data, it parallels the results of this group-level analysis and supports the notion that stronger medical model alignment facilitated higher total car use.

Similar to the results discussed regarding participant 009, these grouped results suggest that caregivers in this study perceived the in-home modified ROC as a medical intervention. Perhaps caregivers viewed the modified ROC as a tool to help their child and family to achieve “normality” rather than as an adaptive device intended to enhance meaningful participation in life. If this assumption is accurate, it is logical that caregivers with a greater affinity for the

medical model and, thus, a greater desire to achieve “normality”, would be inclined to provide substantial opportunities for a child to use the modified ROC.

It is possible that caregiver perceptions of the modified ROC, and its’ role in their child’s life help to dictate their provision of opportunities for use. One explanation may be that when caregivers perceive the purpose of the modified ROC to align with their own values regarding disability, they might be encouraged to offer more frequent use. It would be valuable for future research to examine caregiver perceptions of the modified ROC, how these perceptions might limit or encourage greater use, and how pre-intervention efforts might be used to influence these perceptions.

Car Usage

It is possible that the small sample size and the large variability of modified ROC usage had a substantial impact on the relatively inconclusive nature of results. Over the course of the three months, the range of total minutes spent using the car for each child was wide, from 0 minutes to 791 minutes (SD=206.05). Only 2 of the 14 participants spent more than 3 total hours using the car. Substantially higher car use has been reported in previous research involving a 3-month intervention period and an at-home modified ROC (Huang et al., 2014; Logan et al, 2014; Logan et al., 2018b). These studies, however, each involved only an individual participant or a small cohort, utilized parent-reported usage data and involved weekly home visits from researchers to monitor progress. This current study was unique in its hands-off approach, as it did not offer caregivers guidance on how often to use the car and there was no contact between caregivers and the research team during the intervention period. Perhaps this minimal instruction coupled with objective tracking data, another novel aspect of this study, produced a more realistic view of what modified ROC-usage looks like when incorporated into a family’s routine.

Sufficient car use is inherently necessary in order to reap the intended benefits of the modified ROC. Thus, the fact that the majority of participants did not spend a lot of time actually driving the car is noteworthy. It may be necessary for future studies to help define “sufficient modified ROC use” as it relates to positive developmental gains. It is also important to continue to observe how these devices can be more seamlessly incorporated into a child’s life so that they may use them as often as possible.

Strengths and Limitations

The primary strengths of this study are its duration, the use of a novel, objective tracking method to determine total car use, and hands-off approach. The 12 week long intervention was a strength as it provided enough time for families to experiment with the modified ROC and determine how to best incorporate it into their lives. The use of objective tracking hardware to measure car use is a unique and novel aspect of this study which allowed for an accurate view of total car usage. Previous studies have only utilized parent-reporting (Huang et al., 2014; Logan et al., 2014; Logan et al., 2018b). Additionally, the lack of guidance and consistent check-ins from the research team throughout the intervention means that total drive time results could not be heavily influenced by researcher presence. Although this lack of consistent check-ins may have contributed to low drive times overall, it provides us with a valuable and realistic look at real-world modified ROC use.

A weakness of the study is its small scope. Although 14 participants in a study of in-home modified ROC use is the largest cohort to be followed to date, it is still a limited sample and includes only families living in the Pacific Northwest. This location of the study might have also been a limitation as modified ROC use may have been limited by the weather patterns of the region. The bulk of the study took place during traditionally rainy and cool-weather months. For

these reasons, the results of this study should not be generalized to the greater population. More research is warranted to include a more diverse population sample.

Conclusions

This is the first study to examine the impact of caregiver disability model orientation and attitudes towards self-directed mobility on modified ROC usage by children in a real-world setting. This study employed a novel self-directed mobility scale to assess caregiver attitudes towards self-directed mobility with a broader scope than any previous research. Although results with regard to this measure were inconclusive, the study revealed that the sample holds a favorable view of self-directed mobility. This finding is encouraging, as it suggests that caregivers are likely to see value in the fundamental purpose of the modified ROC, which is to provide an accessible, independent mobility opportunity. Thus, further development of the modified ROC and continued research into factors which may facilitate use in a real-world setting is warranted.

Results revealed this sample of caregivers showed a greater affinity for the social model of disability than the medical model. Children with caregivers showing stronger alignment towards the medical model, however, tended to use the modified ROC more. While it is unclear why caregiver medical model orientation may have facilitated greater modified ROC use, further examination into this potential relationship is warranted as it was the only significant finding of this study.

Although the attitudinal measures focused on in this study did not have strong associations with total drive time, it is important for future studies to continue to investigate factors influencing caregiver provision of the modified ROC so that future interventions can maximize modified ROC use by participating families. This is necessary because in order to shift

research focus onto the developmental benefits of the modified ROC, it must first be understand how to best promote sufficient real-world modified ROC use.

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Tables and Figures:

Table 1: Demographic information for all participants. All variables were parent reported. The motor abilities question was open-ended.

Participant	Age in Months	Gender	Primary Caregiver	Disability	Motor Abilities At Entry	Modified Ride-On Car Model
003	27.5	Female	Mother	Down syndrome	Able to walk	Lightning McQueen
004	28.6	Male	Mother	Wolf Hirshhorn syndrome	<ul style="list-style-type: none"> • Unable to walk • Able to army crawl • Able to stand in walker 	Paw Patrol
007	12.2	Female	Mother	Spina bifida, hydrocephalus, Chiarri II	<ul style="list-style-type: none"> • Uses mobile stander with parent assistance • Learning to use Bumbo wheelchair 	SpongeBob
008	16.0	Male	Mother	Global developmental delay, hypotonia, epilepsy	<ul style="list-style-type: none"> • Unable to crawl or walk • Able to roll 	Lightning McQueen
009	12.1	Male	Mother	Global developmental delay	Unable to roll, sit, crawl, stand, or walk	Paw Patrol
011	12.3	Male	Mother	Global developmental delay with mild hearing loss	Unable to crawl or walk	SpongeBob
012	17.0	Male	Mother	Spina bifida	<ul style="list-style-type: none"> • Unable to stand or walk • Able to army crawl • Uses zipzac wheelchair and mobile stander 	Paw Patrol
013	23.4	Female	Mother	Cerebral palsy, microcephaly	<ul style="list-style-type: none"> • Unable to sit • Able to scoot and roll 	Paw Patrol
014	32.5	Male	Mother	Sjogren-Larsson syndrome	<ul style="list-style-type: none"> • Unable to walk • Able to crawl • Able to pull to stand 	Paw Patrol

019	12.8	Male	Mother	Spina bifida, hydrocephalus	Limited use of legs	Paw Patrol
020	20.7	Female	Grandmother	Microcephaly	Able to walk	Lightning McQueen
023	27.8	Male	Mother	Down syndrome (trisomy 21)	<ul style="list-style-type: none"> • Able to crawl • Able to walk with walker 	Lightning McQueen
026	17.9	Female	Mother	Cerebral palsy	<ul style="list-style-type: none"> • Able sit with support • Able to roll with support 	SpongeBob
027	18.3	Male	Mother	Cerebral palsy (spastic quadriplegia), cortical vision impairment	<ul style="list-style-type: none"> • Able to walk with gait trainer • Able to scoot occasionally scoots 	SpongeBob
Sample Average (SD)	19.9 (6.9)	36% Female	Mother: 13 Grandmother: 1	N/A	N/A	Lightning McQueen: 4 Paw Patrol: 6 SpongeBob: 4

Table 2: Individual level ride-on car usage data obtained from FIT system with caregiver pre-intervention medical model orientation, social model orientation and self-directed mobility scale scores, including means and standard deviations for each variable.

Participant ID	Caregiver	Medical Model Orientation score	Social Model Orientation Score	SDM Score	Total minutes driving
019	Mother	2.88	4.00	3.78	0.00
007	Mother	3.25	3.43	4.00	35.90
020	Grandmother	2.38	3.71	4.22	67.30
014	Mother	1.63	5.00	4.44	68.60
026	Mother	2.75	4.00	3.67	80.80
027	Mother	3.25	3.57	4.00	89.80
023	Mother	2.75	3.14	4.67	94.90
004	Mother	4.25	4.57	4.11	110.50
013	Mother	4.50	4.71	4.11	130.40
011	Mother	4.13	4.60	4.14	153.20
008	Mother	3.13	3.71	4.33	165.60
003	Mother	2.75	4.57	3.89	170.80
012	Mother	3.13	3.71	4.67	440.50
009	Mother	3.75	2.29	3.89	791.00
n=14	Average	3.18	3.93	4.14	171.38
	SD	0.79	0.58	0.31	206.05

Table 3: Spearman's Rho (r_s) matrix, n=14. Associations between disability model orientation scores, self-directed mobility scale scores, and total drive time.

	1	2	3	4
1. Medical Model Orientation	1			
2. Social Model Orientation	0.360	1		
3. Self-directed Mobility Score	-0.152	0.022	1	
4. Total minutes driving	0.374	-0.069	0.181	1

Table 4: Spearman's Rho (r_s) matrix, n=13. Associations between disability model orientation scores, self-directed mobility scale scores, and total drive time. Data from participant 009 removed.

	1	2	3	4
1. Medical Model Orientation	1			
2. Social Model Orientation	0.114	1		
3. Self-directed Mobility	-0.140	-0.117	1	
4. Total minutes driving	0.299	0.166	0.350	1

Table 5: Summary of differences between High-use and Low-use groups including means and standard deviations for each variable, and P-values from Mann-Whitney U test.

		Medical Model Orientation score	Social Model Orientation Score	Self-directed Mobility Scale	Total minutes driving
High-Use Group					
	Average	3.66	4.02	4.16	280.29
	SD	0.67	0.88	0.27	251.36
Low-Use Group					
	Average	2.70	3.84	4.11	62.47
	SD	0.56	0.60	0.36	33.67
	P(T<=t) two-tail	0.034*	0.40	0.70	0.002*

*Significant at a 0.05 level

Figure 1: Example Images of Modified ROC



