

ANALYSIS OF THE PUBLIC TRANSPORT BUS OPERATOR AS A DIRECT USER IN THE USE OF A WHEELCHAIR SECUREMENT SYSTEM

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ABSTRACT

Wheeled mobility device (WhMD) securement in large, accessible transit vehicles (LATVs) is a complex interaction between the system design and the users of the equipment (WhMD users and bus operators). In order to address usability problems with WhMD securement equipment, evaluation of the task demand of both the WhMD user and the bus operator must be done. A secondary analysis of lab-based research on wheelchair securement and natural observations of securement in the field were conducted to better understand demands placed on bus operators during WhMD securement. Design and training recommendations are included to address these needs.

INTRODUCTION

Public transportation in the United States has become more accessible for all kinds of users, especially for individuals who use WhMD. While significant strides have been made in making access to LATVs easier, several usability issues remain with WhMD securement. The most common type of wheelchair securement used in LATVs in fixed-route bus transportation is a forward-facing, four-point manual tie down system that secures a WhMD to the bus floor. These securement systems require the assistance of another person, namely the bus operator, to implement.

Historically, WhMD securement has been evaluated for usability by researchers, mainly with focusing on equipment design and passenger experience. WhMD securement is a complex system, however, and all related factors must be considered when addressing usability improvements. When considering all users who interact with the securement devices, time, space and various needs of the users, trips on LATVs will be more satisfactory.

WhMD securement systems are widely studied based on the experiences and interactions with the WhMD users and they are usually considered as the primary direct users of the system. In fact, many of the problems WhMD users have with securement relate to poor training of the bus operators, negative attitudes, compliance issues, and improper securement techniques by the bus operators (Frost et al., 2013; Ferris & Thatcher, 2013). This demonstrates the importance of considering the bus operators as additional direct users of WhMD securement systems. Addressing the needs of the bus operators in performing the task of WhMD securement on LATVs may provide significant improvements to the WhMD securement experience for all individuals involved.

WhMD users often complain that drivers have a poor or negative attitude. Thatcher & Ferris (2013) suggests that this is related to training, time constraints and the physical conditions of the bus, so the first step to solve the problem may be ensuring training in the assistance to people with disability in a respectful way and in the operation of accessible equipment. Other problems for bus operators are related to training, time constraints, and the physical conditions of the bus. Rosenbloom (2007) suggests operators experience several challenges when people who use WhMD use the bus. Bus operators may not feel confident about using the securement system. This may be the result of limited training, multiple WhMD systems encountered on different vehicles, or fear of performing the securement incorrectly (Rosenbloom, 2007; Frost et al., 2013). In addition, bus operators are often behind schedule and face time pressures, causing them to rush through or skip the securement process entirely in order to stay on schedule (Rosenbloom, 2007). Transit agencies and bus operators have also reported in previous studies that injuries of the bus operators were related to tasks involved in

WhMD securement (Frost et al., 2013; Bareira & Gwanseob, 2014).

Additionally, new WhMD securement technologies are being developed that change the demands placed on both the WhMD user and the bus operator. Among these developments are a forward-facing three-point manual tie down system and a rear-facing, automated securement system with no tie down straps that increases independence in use for the WhMD user (Perez et al., 2016; van Roosmalen et al., 2011). The automated, rear-facing system has not been widely adopted by the transit industry in the US at this time. Challenges to adoption and implementation exist including cost and compatibility, therefore continued study on the demands of the manual, tie down systems (both four-point and three-point) widely used in the industry is necessary.

Because safe WhMD securement is an important factor in public transportation needs for individuals who use WhMD, and since bus operators experience significant challenges when trying to administer safe securement techniques that impact the experience of the WhMD user, a better understanding of the task demands of the bus operator will contribute to improvements in the WhMD securement experience. The impact of more efficient and easier wheelchair WhMD securement may have a significant impact on reducing dwell times of fixed-route buses when transporting individuals who use WhMD, and increasing the willingness of WhMD users to take fixed-route public buses for their community mobility needs.

BACKGROUND

A lab study about the usability of three different securement systems (A. a traditional four-point forward-facing system, B. a fully-integrated forward-facing three point system, and C. an automated rear-facing system) was conducted to evaluate the usability of each system for individuals who use a variety of WhMD including manual wheelchairs, power wheelchairs, and scooters (Perez et al., 2016). This study discovered that the two newer WhMD securement systems are easier to use and faster to perform securement than the traditional four-point system. The rear-facing, automated system was most preferred across all user groups. The WhMD users who participated in the research were also interviewed about their experience using each device. The interview feedback suggests that an

important reason that the WhMD users preferred the automated securement system was due to the increased independence it created for the WhMD user in performing securement tasks, and the potential reduced interaction with the bus operator in the field. Feedback related to both of the manual securement systems pointed to issues with bus operator interactions during securement. These included the intrusion of personal space by the bus operator, limited training and experience of the bus operator, and poor attitudes of the bus operator (Perez et al., 2016).

Findings in this study are supported by past research where WhMD users report that bus operators feel insecure assisting people with disabilities, are afraid of injuring their backs when performing securement or positioning the WhMD, have difficulty maneuvering around the WhMD during securement, do not have adequate training to perform securement, and are sometimes unwilling to perform securement tasks (Bareira & Gwanseob, 2014; Frost et al., 2013).

This purpose of this project is to begin to analyze the role of the bus operator in wheelchair securement tasks in order to suggest design-related and training recommendations that will improve WhMD securement for both WhMD users and the bus operators. Through secondary analysis of the lab study of WhMD securement (Perez et al., 2016), and exploratory field observations, the researchers sought to evaluate the following questions:

1. Are there ways to reduce the time and physical demand of WhMD securement for bus operators?
2. Could bus operator attitude be positively changed through improved body mechanics, equipment design, or training resources?

METHODS

In order to determine effective design and training related recommendations for bus operators during WhMD securement, the researchers conducted an exploratory analysis of the results of the previous securement system lab-based research that related to bus operators. The items used in the exploratory analysis included the ratings of each securement device by the WhMD users, the qualitative feedback of the users related to interactions with the bus operator, and videos of the securement tasks in

the lab study. Researchers combined the analysis of the lab based findings with natural observations of bus operators in the field, since the lab studied used trained research staff to simulate bus operator roles. The exploratory analysis focused on the results and observed tasks related to the manual, forward-facing tie down systems, since the automated system could not be observed in use in the field, and the lab study suggest demands of the users are significantly different in use of this system.

The researchers first identified that the bus operators must also be considered as direct users of the securement systems, in addition to WhMD users, in order to conduct effective task and productivity analysis. Direct users are the users that have the most control of a system and interacts with it for a longer time, while indirect users do interact with the system but for less time or have less control, for example a maintenance person for the securement device.

A basic task analysis was completed for both direct users, the WhMD users and bus operators. WhMD users board the low-floor bus using a ramp (with or without assistance), navigate through the aisle, position their WhMD in the securement space, and lock or shut off their WhMD for securement. The bus operator prepares the bus for the boarding of the WhMD user by asking passengers in the securement space to move (when needed), assists with positioning the WhMD in the securement space (when needed), and performs securement tasks according to the system being used. The task analysis identified several areas where both the WhMD users and bus operators face problems and inconveniences, especially when the bus is crowded.

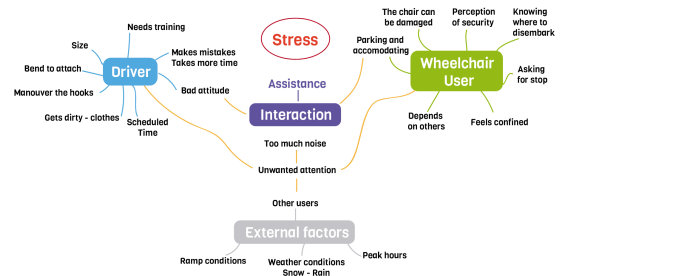


Figure 1. Mental map for user interactions

Mental maps were created to better depict the feedback and perceptions of the WhMD users and bus operators throughout the securement process (example in Figure 1) These mental maps help identify specific areas to address the needs of bus operators and WhMD users. The issues depicted in the mental map were

extrapolated from both the findings in the controlled lab environment and consider external factors observed in the field to better understand the stress for the direct users.

The researchers also mapped the time and physical demands of the securement tasks for each user (Figure 2). This visual mapping more clearly depicts how the bus operator is involved with more task demands during the securement process than the WhMD user. The map also illustrates how time is a significant factor for both users, and perceived by the users to be an important factor even for other passengers and the transit agency.

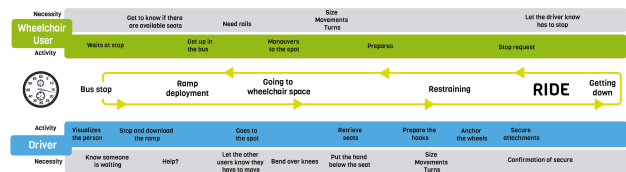


Figure 2. Task analysis map for each user

FINDINGS

The exploratory analyses of the experiences of both the WhMD users and bus operators suggest that the following are primary areas to focus for equipment design and training recommendations. WhMD device users experience difficulty with maneuvering and positioning their mobility devices in the bus and securement spaces, sometimes requiring assistance from the bus operator to do so. WhMD users report that positioning for securement and the time it takes for the driver to administer securement takes too much time. Limited experience of the bus operators can create problems during the securement process adding more time and unwanted attention during the process, and placing their mobility device at risk of damage from improper use of the system. Finally, WhMD users also report that poor attitudes of bus operators makes the whole securement experience unpleasant and undesirable.

Important areas of focus for the bus operator include the challenging physical demands of bending, reaching, and gripping involved in performing securement tasks. Additionally, these physical demands often require the bus operator to intrude into the WhMD users personal space, creating an uncomfortable situation for both users. Bus operators were observed to have gotten dirty either while on the floor or manipulating the securement straps. Due to the

wide variety of WhMD encountered, bus operators often make mistakes or do not know how to properly secure all of these devices. Each of these factors contributes to the increased time it takes operators to perform securement tasks, which creates delays in their transit schedules and negatively impacts their attitudes about WhMD securement.

Additional factors that may impact the performance and experience of both the WhMD user and the bus operator include crowding on the vehicle during peak hours, poor weather conditions, and added time constraints related to delays in traffic.

RECOMMENDATIONS

Both design and training recommendations are necessary to address user needs identified in the analyses. Recommendations may include:

1. **Graphic Guidance:** A user guide for bus operators to have onsite instructions will be helpful for scenarios when they do not know what to do (i.e. where/how to attach the securements). Additional visual indicators on the WhMD would be helpful.
2. **Compliance Indicator:** The use of an LED indicator may be helpful to let the operator and WhMD user know when the WhMD is properly secured. This indicator should be located in view of both users and with a clear display and near emergency release buttons.
3. **Smart Phone Application:** Widespread use of available applications that help the WhMD user know if there is available securement space, and notifies the driver to prepare to for a WhMD user to board and when the passenger will disembark.
4. **Securement "Hook" Redesign:** The design of a more maneuverable handle that is easier to reach without bending or kneeling, and uses a simple attachment movement would help reduce the time and effort of securement.
5. **Empathy Training:** While bus operators may receive training with WhMD users during their securement training, they may benefit from increased empathy and experiential training to better understand the needs of the passengers they serve who use WhMD. This training should additionally address how operator attitudes can impact the transportation experience for individuals with disabilities.

CONCLUSION

Better equipment design, training, and use of smart technology can facilitate decreasing the physical demands, reducing the time, and improving bus operator attitudes during WhMD securement. Including the bus operators as direct users in the analysis of time, interactions, movements involved in the securement process helps to identify important areas for future development. Perhaps future research should engage the bus operators themselves to collect information related to their own perceptions of the problems and stress related to securement.

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