EXAMINING MULTIPLE INTERVENTIONS TO DETER ACCESS AISLE PARKING VIOLATIONS

By

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Abstract

Access aisles, or the diagonally marked spaces adjacent to accessible parking spaces, provide many people with disabilities the extra space they need to get in and out of their vehicles. If this area is blocked even a small amount, a person with a disability may not be able to exit or enter their vehicle. To date, the research focused on specifically the access aisle is very limited. The purpose of this study was to deter the number of parking violations in which drivers encroach upon or park on top of the area designated by the access aisle. First, a qualitative study solicited the participation of people with disabilities who use access aisles for a focus group in order to gain more insight regarding both the frequency and severity of access aisle parking violations. Second, a quantitative study tested the effects of multiple interventions to reduce access aisle parking violations. The effectiveness of various signs and pavement markings to deter access aisle parking violations was investigated at Site 1 using an A-B-A-C design, where the interventions were not observed to have an effect. A quantitative study at a separate parking lot, Site 2, tested the effects of parking space width manipulations using an A-B-C-A design. The Site 2 manipulations were observed to demonstrate experimental control between the decreased width of the accessible parking space and subsequent access aisle parking violations. These findings suggest that current state initiatives to address access aisle parking violations (e.g., signs and pavement markings) may not be effective alone in deterring the frequency and severity of these violations. Instead, future policy may refer to these findings, which suggest that the width of the parking space itself influences the frequency and severity of access aisle parking violations.

Keywords: accessible parking, handicapped parking, access aisle

Dedication

This thesis is dedicated to my fiancé, Kyle Goddard. From the start, Kyle has fully dedicated himself to assisting me with this project. From climbing a ladder to access data, to scrubbing asphalt in the heat of summer, to building huge yellow barriers over Labor Day weekend, I will always be grateful for everything he has done. I love our late-night conversations about science, behavioral theory, and philosophy. If Kyle is my independent variable, then the dependent variables that have undergone the biggest changes are my love of learning and quest for knowledge. I am thankful every day that he has instilled those values in me. It is truly the greatest gift he could have ever given.

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My gratitude also goes out to the store managers who worked with me to conduct this research. While they were excited about this research, I appreciate their work to advocate to their corporate headquarters as to the value this research may bring to people with disabilities.

This project would have not been possible without funding, which brings me to the acknowledgement of a research grant from the General Electric Company (GE) under the aegis of the Dole Institute of Politics’ 2015 “Commemorate ADA” initiative (grant number 2930000-725). I am very grateful for the funding that I received to conduct this research, and for Audrey Coleman’s oversight and collaboration throughout this work.

As Dr. White always reminds me, the purpose of research is not simply its conductance, but its application to solving real-world issues that affect people within our society. The researchers on this project have been diligent in partnering with the Kansas Commission on Disability Concerns (KCDC), the Kansas Division of Vehicles, and the United States Access Board to pursue conversations that aim to address these accessible parking concerns. Therefore, we would like to acknowledge these organizations for their continued partnership and support for community change. With this true purpose of research in mind, I hope to stand on the shoulders of giants to create a better future for people with disabilities in our communities.

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As accessible driving options expand for people with disabilities (e.g., vehicle modifications, adaptive driving classes/driver's licenses, and accessible parking), so, too, do the options for community participation increase (Carpenter, Forwell, Jongbloed, & Backman, 2007). Driving provides the approximately 65% of people with disabilities who drive a car or other motor vehicle increased independence and choice to navigate around their communities (U.S. Department of Transportation, 2002). According to the Centers for Disease Control and Prevention (CDC), roughly 36.2 million Americans, or 15.1% of the population, have some type of physical functioning difficulty (2014). The National Institutes of Health (NIH) estimates that, of these 36.2 million Americans with physical disabilities, 19.7% (3% of the total population) use a cane, walker, or crutches to assist with mobility, and 6.7% (1%) use a wheelchair (2012).

However, the representative number of people with disabilities living within the community does not appear to correspond with the number of reserved accessible parking spaces required for community parking lots. According to the regulations outlined in section 208.2 of the 2010 ADA Standards, 4% of all total parking spaces are mandated to be accessible in small-sized parking lots (U.S. Department of Justice, 2010). For example, in a parking lot of 25 spaces, only one of those spaces is required to be accessible. That one space will also be designated as van-accessible as section 208.2.4 states that one in six accessible parking spaces, or fraction thereof, must be van-accessible (U.S. Department of Justice, 2010). According to the section 208.2 scoping requirements, as the number of the lot's parking spaces increase, the percentage of accessible parking spaces required decreases (U.S. Department of Justice, 2010). For example, in a large parking lot consisting of 500 parking spaces, only nine parking spaces, or 1.8%, of these spaces are required to be accessible. Of these nine, only two spaces would be designated as van-accessible. While NIH data suggest that 15 people out of 500 will need an accessible parking

space and 5 people out of 500 will need a van-accessible space, the scoping requirements do not align and support the NIH data.

It is important to note that this deficit only considers the amount of people with some type of mobility limitation that use assistive technology. The remaining 11.1% of people with physical functioning difficulties, as described by the CDC statistic above, is not factored for in terms of this illustration. The deficit becomes greater after factoring in people who are aging, people with other types of disabilities (e.g., low vision), or people with chronic health conditions (e.g., cardiac, diabetic, or pulmonary conditions) – all of which may qualify as a disability for accessible parking placards or license plates in most states (Department of Motor Vehicles, 2012). Parents of children with autism can also qualify for an accessible parking permit if their child meets the criteria of a, "severely limited ability to walk at least 100 feet due to an arthritic, neurological, or orthopedic condition" (Center for Autism Research, 2013). These severe deficits do not account for accessible placard and license abuse. Illegal usage may take many forms, such as the forging of Doctor's signatures to obtain a placard, the purchase of a placard on the black market, theft of a placard, renewal of a placard from a deceased owner, use of a placard without the registrant present, etc. In a report issued by the Alexandria Police Department in Virginia, police found that "90 percent of the placards checked were being used illegally" (Shoup, 2011, p. 39).

However, the described deficiency of reserved parking spaces and misuse of accessible placards and license plates are not the only factors that may limit a person with a disability's options to park. Also to be considered is the misuse of the accessible parking spaces themselves. Insufficient marking and labeling of parking spaces, objects frequently blocking the spaces (e.g., snow, motorcycles, shopping carts), and lack of enforcement are identified factors that may

affect the usability of existing accessible parking spaces. Individuals violating the accessible parking spaces may state, “I’m just going to be a minute.” It is not long before all of those “minutes” can add up to hours and more.

Wheelchair users are perhaps the most limited in terms of the parking environment, when considering all the people who require accessible parking. Ideally, van-accessible parking spaces should be reserved for people with disabilities who drive ramp- or lift-equipped vehicles. Van-accessible spaces are unique in their requirement by the ADA to have enough space for people to deploy their ramps or lifts and negotiate their wheelchairs beyond the deployed ramp for exit. This extra space is referred to as an “access aisle,” and is usually marked with yellow, white, or blue diagonal stripes. For van-accessible spaces, two standardized layouts may be acceptable according to section 502.2 outlined in the 2010 ADA Standards: 1) an eight-foot accessible parking space with an adjacent eight-foot access aisle or 2) an eleven-foot accessible parking space with an adjacent five-foot access aisle. See Figure 1 for an illustration of the two standardized layouts according to the 2010 ADA Standards for van-accessible parking spaces. Standard accessible parking spaces are required to have access aisles, too, but they are only required to have an eight-foot accessible parking space with an adjacent five-foot access aisle. These aisles function to accommodate people with disabilities who use wheelchairs, walkers, and other assistive devices to provide needed extra space to enter and exit their vehicles. If these areas are blocked even a small amount, a wheelchair user may not be able to exit or enter their vehicle. See Figure 2 for an example of a van-accessible parking space that is usable and unusable for a wheelchair user. Additionally, if a person with a disability finds a car parked over or on top of an access aisle upon their return, they may have to wait hours until the violator moves their vehicle.

Not only are the odds against people who drive ramp- or lift-equipped vehicles when it comes to finding a van-accessible space, but these are the only spaces in which they can usually park, especially if they are entering or exiting their vehicle using a ramp or lift. Additionally, many people violate the space designated by the access aisle, making even an “available” van-accessible space unusable. These environmental barriers can reduce the capacity for wheelchair users to participate in the community. Not only is participation limited at an antecedent level by the fewer number of accessible parking spaces as described above, but it may also be limited at the consequent level. If, after a community outing, a wheelchair user comes back to find that someone has parked over the access aisle and they cannot reenter their vehicle, this may act as a punisher for future community outings.

The previously described parking concerns can also be a deterrent to employment if wheelchair users with ramp- or lift-equipped vehicles are not able to exit or reenter their vehicle, which may affect their punctuality for work or other community meetings. According to the United States Bureau of Labor Statistics, only 17.5% of people with disabilities were employed in the labor force in 2015, compared to 65% of people without disabilities (Bureau of Labor Statistics, 2016). Oftentimes, however, it is not a person’s ability that limits employment and educational opportunities; it is their ability to reliably get from one place to another that limits these opportunities (Lubin & Deka, 2012). In addition to limitations in employment and educational opportunities due to issues surrounding transportation, people with disabilities may also experience limitations in social participation, civic engagement, independent living, and general quality of life. A recent study found that 61.6% of people with disabilities felt like they missed out on employment or social opportunities due unreliable transportation (Samuel, Lacey, Giertz, Hobden, & LeRoy, 2013). Since driving increases the availability of transportation, it is

important to note that a study conducted by Norweg, Jette, Houlihan, Ni, and Boninger (2011) found that driving was significantly associated ($p < 0.001$) with employment opportunities for people with physical disabilities.

As frustrations climb surrounding unusable van-accessible parking due to access aisle violations, so, too, do creative solutions surface to address these frustrations. At the grassroots level, people with disabilities are employing the power of social media to educate the public about access aisles. Community Facebook groups such as “Stop Access Aisle Abuse,” “Handicap Parking Violators,” and “The Wheels of Shame” use social media as a platform to shame accessible parking violators and as an advocacy tool to get the word out about the importance keeping the access aisle free of barriers. Parking Mobility (https://www.parkingmobility.com), a Smartphone application designed to address accessible parking abuse, allows users to upload photos of accessible parking violators within their community and subsequently upload the report to a local municipality. Thus, for cities that have made the decision to partner with Parking Mobility, this Smartphone application allows community volunteers to issue reports by using their Smartphone that in turn issues tickets to violators as a consequence.

BraunAbility (https://www.braunability.com), an American manufacturer of ramp- and lift-equipped vehicles, invested company resources into an educational campaign initiative, into what they term a “parking revolution,” to better educate access aisle violators about the importance of reserving the space for people with disabilities. BraunAbility’s campaign includes several components: 1) Customers can order a free “Parking Kit” that includes Save My Spot sticky note “tickets,” a bumper sticker, two window clings, and a baseball cap; 2) A #savemyspot social media campaign; 3) The development of an accessible parking infographic; 4) The

development of a short animated clip about the importance of keeping the access aisle free of barriers linked to YouTube that can be shared on virtually any social media site; and 5) Downloadable parking notes with the message, “You’ve put me in a bit of a tight spot,” that include a short explanation as to why the access aisles should be reserved, as well as an invitation to a website link to learn more.

While the previously described interventions have included grassroots efforts to address this problem, policymakers have also been included in the conversations to find a solution. A study conducted by Professor of Law Donald Stone (2007), titled *You Take My Space, I Take Your Air* in reverence of the pre-ADA mantra, cited that sixty-nine percent of surveyed “public accommodation” parking lots were deficient in access aisle designation and only eight percent of lots had a designated “No Parking in Access Aisle” sign. Since this study, some states (e.g., Hawaii, Maryland, and South Dakota) have taken the initiative to go beyond federal regulations to require these “No Parking in Access Aisle” signs, and the Paralyzed Veterans of America (PVA) suggests in a 2011 news report that some municipalities are placing flexible flat pylons in the front center of access aisles. While the 2010 ADA Standards do require marking of van-accessible parking spaces by sign identification, the regulatory markings of access aisles are not specified at a national level. According to section 502.3.3, “Access aisles shall be marked so as to discourage parking in them” (US Department of Justice, 2010). However, to date, no known study has empirically evaluated what type of markings (e.g., signs, pavement markings, pylons, parking layouts, etc.) may do better to discourage parking in the access aisles.

As described above, there has been a multitude of grassroots and political efforts to help reduce the occurrence of access aisle violations. However, to date, no known empirical study has examined environmental interventions that may do better to deter access aisle violations. While

research does exist that examines issues surrounding accessible parking in general (e.g., deterring vehicles without accessible placards or license plates from parking in accessible parking spaces), research with a specific focus on access aisles was not found in this literature review. A search using the key term “access aisle” in the University of Kansas “Psychology and Behavioral Sciences Collection” database, which contains a search of 540 journals and magazines, yielded no results. An additional search using the term “access aisle” in the PsycINFO, PubMed, and Web of Science databases yielded no results. Data reported by Zhang (2015) in an unpublished thesis does report that, across 82 sessions, access aisle violations occurred during 30 sessions (36.6%), although this was not the primary focus of the study.

Although there is a paucity of research specifically designed to address concerns regarding the access aisle, research has been conducted related to deterring the illegal use of accessible parking spaces (i.e., drivers who park in an accessible space without an accessible placard or license). Interventions found to be effective in deterring illegal parking in accessible spaces include vertical signs and ground markings (Jason & Jung, 1984), signs that warn of fines (White, Jones, Ulicny, Powell, & Mathews, 1988) and public surveillance (Cope & Allred, 1991), police enforcement (Suarez de Balcazar, Fawcett, & Balcazar, 1988), and a message dispenser with citizen citations (Cope & Allred, 1991). A study conducted by Fletcher (1995) analyzed the demographic characteristics related to illegal parking in accessible spaces, and found that violators were more likely to be male, under the age of 25, and non-white. An additional study related to the demographics of people who illegally park in accessible spaces also noted that a shorter duration of time parked, smaller lot size, and rainy weather may contribute to illegal parking rates (Cope & Allred, 1990). While no research has examined interventions specifically devoted to deterring the frequency and severity of access aisle parking

violations, it may be helpful to refer to some of these earlier studies in order to better understand which interventions may be effective in addressing related accessible parking concerns.

While no known research has specifically examined access aisle violations or interventions that may do best to deter them, this study presents initial trials to better understand this issue. The purpose of this study was to examine the effectiveness of various environmental interventions to deter the number of violations in which drivers park on top of or encroach upon the area designated by the access aisle.

Qualitative Study: Focus Group

A focus group was conducted in order to gain more insight regarding the frequency and severity of access aisle violations, the effects of these violations, and suggestions for deterring these violations from people with disabilities who use the access aisle to get in and out of their vehicles. The qualitative study was first used as an effort to better inform the content of the quantitative study, or the intervention to deter access aisle parking violations.

Method

Participants. The focus group consisted of eight participants, one moderator, and two assistant moderators. Of the eight members of the focus group, four members were male and four were female. The average age of the group was 61 years old, with a range of 49 to 70 years. Seven of the group members were Caucasian, while the eighth member was Native American. Five of the eight members had completed a master's or doctorate level degree, one had completed a bachelor's degree, and the final two members had both completed at least one year of college or a specialized training program. With one exception, all members of the focus group had a disability. One member in the group represented each of the following disabilities: Incomplete Quadriplegia, Partial Paraplegia, Spina Bifida, Cerebral Palsy, and Neuromyelitis

Optica. The final two members of the group with disabilities had both experienced a Spinal Cord Injury. The eighth member of the focus group with no disability was an informal caregiver to another member of the group. Of the seven members of the focus group with a disability, the amount of years with a disability ranged from 5 to 59, with the average being 24.13 years. Of the seven members of the group who had a disability, three members used a power wheelchair, three members used a manual wheelchair, and one member used both. Only one member of the focus group was not able to enter and exit their vehicle on their own.

Procedures. Recruitment of participants was carried out in several ways. First, the research team contacted a list of individuals that had assisted in a previous research study that involved accessible parking. Researchers also distributed fliers pertaining to the study at a local Center for Independent Living, and contacted a company that sells and rents ramp- or lift-equipped vehicles to ask for the study information to be distributed among customers. The research team also attended the Kansas Disability Caucus and distributed information pertaining to the study, including the researchers' contact information.

The focus group was conducted with multiple members of the research team. At the beginning of the focus group, members were asked to sign an informed consent statement, which included a brief description of the purpose of the study that was to be conducted and permission to record the group's discussion using an audio recording device. Group members were informed that, by participating in the current focus group, they could potentially help to reform current accessible parking policies and influence future policies. Focus group participants were then asked to complete a basic demographic questionnaire about themselves and about their disability. The University of Kansas Institutional Review Board (IRB) approved all research materials provided at this meeting.

Throughout the duration of the two-hour focus group, members were asked several questions about their experiences with accessible parking. These questions included topics on (1) overall experience with accessible parking and access aisles, (2) limits of available parking, (3) encroachment violations in access aisles and why encroachment occurs, (4) how often encroachments occur, (5) factors that influence access aisle encroachment, (6) non-vehicle items that limit usability of access aisles, (6) strategies implemented when a ramp or lift is blocked, (8) awareness of consequences for access aisle encroachments, (9) insufficient markings and signage, and (10) suggestions for strategies and interventions that will reduce access aisle violations. At the end of the two-hour period, focus group members were asked to complete an evaluation of the focus group, and were asked if they were willing to help the research team with the study in the future. After the completion of the focus group, participants were reimbursed with a $50 pre-paid debit card. The audio recording from the focus group meeting was then transcribed into a script, and was uploaded into an ATLAS.ti software program for qualitative data analysis.

Results

Focus group members expressed many shared concerns about the status of accessible parking and access aisles. Using the ATLAS.ti software, the transcribed script was coded into six recurrent emerging themes. These themes included (1) lack of usable van-accessible parking spaces, (2) frequently referenced objects that block the access aisle or parking spaces, (3) unique parking strategies, (4) reasons for access aisle parking violations, (5) insufficient marking and labeling of access aisles, and (6) ways to decrease access aisle violations. Each theme will be discussed in greater detail below.

Lack of usable van-accessible parking spaces. When asked about the overall experience of finding accessible parking spaces with usable access aisles, focus group members expressed that it is difficult to find usable accessible spaces because many parking lots have the "skinnier access aisles, but not the wider ones." One member mentioned that, even if parking spaces do have the wider access aisles, they are not always specified as "van only" parking spaces, which usually leads to smaller vehicles occupying the spaces. Another member mentioned that having a ramp- or lift-equipped vehicle makes it more difficult to travel, so they try to only patronize places that they know to have van-accessible parking spaces.

Frequently referenced objects that block the access aisle or parking space. Members of the focus group mentioned many objects that can frequently be found in an access aisle or a parking space that can prohibit them from parking. Items included things like abandoned shopping carts, hastily parked motorcycles, and plowed snow in the access aisles or parking spaces. The careless placement of these items even further limits the ability of a driver of a ramp- or lift-equipped vehicle to park.

Unique parking strategies. When focus group members cited instances in which they were unable to find a van-accessible space that will allow them to lower their ramp or lift into the adjacent access aisle, they identified many strategies that still allow them to park. Many members mentioned that they would circle the parking lot numerous times, waiting for a van-accessible space to become available. One member said that he would intentionally park next to a curb so that he could get out of his van directly onto the sidewalk. A majority of the focus group members said that they would park at an angle, taking up two or even three spaces, toward the back of the parking lot. Although this works in many places, it can often be dangerous for people who use wheelchairs to park long distances from a building's entrance because it can be

very difficult for other drivers to see wheelchair users passing behind their vehicles. This obstructed view could increase the chance that a wheelchair user may be hit by a driver that did not see them. Additionally, there is always the risk that someone will park next to their ramp- or lift-equipped vehicle, blocking them from being able to deploy their ramp or lift. Another strategy mentioned by a focus group member was to park at the end of an aisle and wait for traffic to clear so that they could quickly get out of their vehicle. In many cases, focus group members mentioned that, when everything else does not work, they "just go home."

Reasons for access aisle violations. Another common problem that participants mentioned was the prevalence of access aisle parking violations. Focus group members provided numerous possibilities as to why people park over or on top of the access aisle. Possible reasons included answers such as laziness, uneven surfaces, entitlement, lack of parking enforcements, curbs that are factored into the width of the parking space, and ice accumulation in parking spaces, among others. A sentiment echoed throughout the group, however, was that people often do not know the purpose of access aisles for people with disabilities, and that people do not know the difference between standard-accessible and van-accessible parking spaces. One focus group member stated that, "people don't realize that just being in the space a foot or two is a problem for people that use lifts or ramps… a lot of people just don't think about it, they don't understand that all of the space is needed, or they don't care."

Insufficient marking and labeling of access aisles. There are many inconsistencies in the way that access aisles are signed and marked. Focus group members mentioned that the presence of "No Parking in Access Aisle" signs is effective in decreasing the amount of parking violations that they see. However, other members of the group said that do not see very many of those signs, if they have seen any at all, because they are not legally required in parking

facilities. Members also indicated that they noticed a difference in the amount of violations in parking lots that have been freshly painted or clearly marked. Although frequently repainting a lot can be beneficial, it can also be disadvantageous. This is especially true if the spaces have been marked with different overlaying paints because it causes people to become confused about the boundaries of the parking spaces.

Ways to decrease access aisle violations. Focus group members had numerous suggestions on how access aisle violations could be decreased. Many of the suggestions focused on changing the signs that are present in the area of the access aisle and the way that the ground is marked. Focus group members agreed that the "yellow [marking] doesn't mean much" to most people. Alternatively, focus group members suggested that red hash marks would be useful in the access aisle. Another member proposed that "No Parking" should be painted within the hash marks of the access aisles. If signs were to be implemented in parking facilities, the placement of the sign would be extremely important. The sign would have to be in an optimal position that would allow it to be seen, while still guaranteeing enough spaces for the deployment of a ramp or lift. Other solutions focused on educating people who receive accessible placards and license plates. Members recommended that there should be a piece of literature that drivers are required to read when they renew their licenses and a part of the curriculum that is required to pass the driver's test, in addition to a public service announcement about accessible parking and access aisles. Members also suggested the implementation of educational programs, where children would be educated about accessible parking at school, with the hope that they would share the knowledge with their parents at home. Members mentioned that brochures and warning stickers could be useful in the education campaign as well. An alternative program suggested would ticket, tow, and place boots on cars that are illegally parked, and incorporate social media in the

program as well, with the goal of making the images go viral. These campaigns could “give the access aisle a name to regular people,” causing decreases in access aisle violations.

Quantitative Study: Site 1

A quantitative study at Site 1 was conducted to test the effectiveness of “No Parking in Access Aisle” signs combined with “No Parking” pavement markings. The combined signs and pavement markings were employed per the suggestion of the focus group as an environmental intervention that may help to deter access aisle parking violations.

Method

Measurement by permanent product. Permanent product recording for this study included vehicles parked in any of the four van-accessible parking spaces or adjacent access aisle identified at Site 1. See Figure 3 for a diagram and photo of the Site 1 parking layout.

Setting. A grocery store parking lot in a medium-sized Midwest community was selected as a site due to its high parking turnover and observed rates of access aisle parking violations. Upon the selection of the site, the community ADA Coordinator was asked to provide a letter of support for the research project. The Site 1 store manager was approached during a scheduled face-to-face meeting and was provided the support letter and a short presentation regarding the rationale and methods for the research project. After approval for the study was obtained from the University of Kansas Institutional Review Board (IRB), permission was obtained from the store manager and the corporate office to conduct the research study in the store parking lot.

Observation and measurement. Data collection took place for 12 hours per day between the hours of 7:00 a.m. to 7:00 p.m. from June 6, 2016 to August 28, 2016 at the Site 1 parking lot. Data collection occurred on consecutive days, with a few pauses in between to give time for the researchers to process and analyze data. Data were collected using two time-lapse

video cameras (i.e., Day 6 Outdoors™ PlotWatcher Pro). The time-lapse video cameras were placed in security boxes and were secured to parking lot light poles. The security boxes were spray painted to match the color of the light poles and were placed under pre-existing "Because we care: These premises are recorded!" signs to limit reactivity effects.

Dependent variables. The primary dependent variable of interest for this study was the occurrence and non-occurrence of access aisle parking violations. The occurrence of a violation was defined as a vehicle parked in the accessible space and/or access aisle for one minute or more whose tire was observed to be over the interior portion of the four-inch parking line (i.e., the line closest to the access aisle). A non-occurrence was defined as a vehicle parked in the accessible space for one minute or more whose tire was not observed to be over the interior portion of the four-inch parking line (i.e., the line closest to the access aisle). Access aisle encroachment violations were broken down into three additional categories: 1) slight violations, 2) moderate violations, and 3) severe violations. Slight violations were defined as the occurrence of a violation, with more specific criteria of a violation in the space greater than zero inches to less than eight inches from the parking line. Moderate violations were defined as the occurrence of a violation, with more specific criteria of a violation in the space eight inches or greater to less than 26 inches from the parking line. Severe violations were defined as the occurrence of a violation, with more specific criteria of a violation in the space 26 inches or greater from the parking line. In addition to encroachment violations, a fourth category, full violations, was defined as the occurrence of a violation with more specific criteria in that no part of the tire could occupy any part of the accessible parking space. Full violations were reported separately from encroachment violations due to the inability to designate them to a single parking space. Access aisle severity levels were measured by placing a four-inch strip of duct tape at the end of the

access aisle in correspondence with the appropriate measurement. Researchers were instructed to use a straightedge on the viewing screen to determine the frequency and severity of access aisle parking violations when analyzing data using the time-lapse video recordings.

Independent variables. Two independent variables were employed for Site 1. The design employed for Site 1 was an A-B-A-C design (baseline phase, followed by an intervention phase, baseline reversal phase, and new intervention phase).

First intervention. After analyzing initial baseline data, two Hawaii "No Parking Access Aisle" signs were installed using a weighted portable post with a sign on each side. The Hawaii sign was initially selected over the Maryland- or South Dakota-sanctioned access aisle signs because of its large contrasting text and clear visual layout. In combination with the Hawaii access aisle signs, a "No Parking" stencil with 8'' lettering was placed with blue chalk aerosol paint (i.e., Montana™ ChalkSpray). The "No Parking" stencil was arranged across two lines (i.e., "No" over "Parking"), and was centered within the access aisle, approximately two feet above the bottom line. See Figure 4 for photos of this intervention.

Second intervention. After analyzing baseline reversal data, two South Dakota "Wheelchair Access Aisle [symbol for accessibility] Absolutely No Parking" signs were installed using a weighted portable post with a sign on each side. The South Dakota sign was subsequently selected due to feedback from the focus group that some people may not know what the access aisle is used for. Therefore, a state-sanctioned sign that better indicates the purpose of the access aisle was chosen in an effort to represent a more salient intervention. Underneath each South Dakota sign, two "$50-$100 Penalty" signs were also installed. The specific penalty used is specific to Kansas state legislation under 2015 Kansas Statute § 8-1,129. In combination with the South Dakota access aisle and Kansas-specific penalty signs, a "No

Parking" stencil with 12'' lettering was placed with white chalk aerosol paint (i.e., Montana™ ChalkSpray). The "No Parking" stencil was arranged on one line (i.e., "No Parking"), and was centered just under the access aisle, approximately two inches below the bottom line. See Figure 5 for photos of this intervention.

Interobserver agreement. Two research assistants were trained to conduct reliability observations by viewing the time-lapse video recordings. Reliability researchers were trained on the application of operational definitions and scoring forms with supervised performance feedback until they reached 100% interobserver agreement for two consecutive sessions. Reliability was assessed for 33% of the sessions in each experimental condition by selecting every third video for review. Reliability researchers were instructed to conduct observations independently and not to confer with anyone while viewing the time-lapse video recordings. Interobserver agreement for violation frequency was reported as a percentage and was calculated by dividing the total number of agreements (i.e., occurrence or non-occurrence, irrespective of violation severity) by the total number of agreements plus disagreements and multiplying by 100. Interobserver agreement for violation severity was reported as a percentage and was calculated by dividing the total number of agreements (i.e., corresponding violation severity counts) by the total number of agreements plus disagreements and multiplying by 100.

Results

Violation frequency. Figure 6 illustrates the frequency of access aisle parking violations per 12-hour session. For Site 1, the effectiveness of the signs and pavement markings to deter the frequency of access aisle parking violations was empirically tested. The x-axis denotes the number of sessions (1 - 61); the y-axis denotes the number of access aisle parking violations per 12-hour session. Graphs labeled Space 1, Space 2, Space 3, and Space 4 indicate the number of

encroachment access aisle violations (ranging from slight to severe) observed, while the graphs labeled Access Aisle indicate the number of full violations observed. Results from the four experimental conditions (i.e., baseline, first intervention, baseline reversal, and second intervention conditions) are described below.

Space 1 encroachment violations. During the initial baseline condition (sessions 1 to 14), the mean number of access aisle parking violations was 9.64 per 12-hour observation. During the first intervention condition (sessions 15 to 34), the mean number of access aisle parking violations was 9.4. During the baseline reversal condition (sessions 35 to 48), the mean number of access aisle parking violations was 10.07. During the second intervention condition (sessions 49 to 61), the mean number of access aisle parking violations was 9.54. Statistical analyses (t-tests) show that the difference between the means was not significant at the 0.05 level when comparing the frequency of access aisle violations between each of the experimental conditions.

Space 2 encroachment violations. During the initial baseline condition (sessions 1 to 14), the mean number of access aisle parking violations was 2.64 per 12-hour observation. During the first intervention condition (sessions 15 to 34), the mean number of access aisle parking violations was 1.95. During the baseline reversal condition (sessions 35 to 48), the mean number of access aisle parking violations was 1.79. During the second intervention condition (sessions 49 to 61), the mean number of access aisle parking violations was 1.77. Statistical analyses (t-tests) show that the difference between the means was not significant at the 0.05 level when comparing the frequency of access aisle violations between each of the experimental conditions.

Space 3 encroachment violations. During the initial baseline condition (sessions 1 to 14), the mean number of access aisle parking violations was 1.07 per 12-hour observation. During the first intervention condition (sessions 15 to 34), the mean number of access aisle parking

violations was 1.3. During the baseline reversal condition (sessions 35 to 48), the mean number of access aisle parking violations was 0.71. During the second intervention condition (sessions 49 to 61), the mean number of access aisle parking violations was 0.92. Statistical analyses (t-tests) show that the difference between the means was significant at the 0.05 level when comparing the frequency of access aisle violations between the first intervention and baseline reversal conditions (p=0.05). However, it is important to note that this difference was in the opposite direction than what was hypothesized. That is, access aisle parking violations decreased during the baseline reversal condition (i.e., in the absence of the signs and pavement markings).

Space 4 encroachment violations. During the initial baseline condition (sessions 1 to 14), the mean number of access aisle parking violations was 3.07 per 12-hour observation. During the first intervention condition (sessions 15 to 34), the mean number of access aisle parking violations was 3.6. During the baseline reversal condition (sessions 35 to 48), the mean number of access aisle parking violations was 2.79. During the second intervention condition (sessions 49 to 61), the mean number of access aisle parking violations was 3.85. Statistical analyses (t-tests) show that the difference between the means was not significant at the 0.05 level when comparing the frequency of access aisle violations between each of the experimental conditions.

Access aisle full violations. Across the 61 sessions, there were four total occurrences of full violations. The first occurred during session 7 (initial baseline condition) between Space 1 and 2; the second occurred during session 41 (baseline reversal condition) between Space 1 and 2; the third occurred during session 50 (second intervention condition) between Space 3 and 4; and the fourth occurred during session 52 (second intervention condition) between Space 1 and 2.

Violation Severity. Figure 7 illustrates the number of occurrences and non-occurrences of parking violations, along with the respective violation severity levels. For Site 1, the effectiveness of the signs and pavement markings to decrease the severity of access aisle parking violations was empirically tested. The x-axis denotes the number of sessions (1 - 61); the y-axis denotes the number of access aisle parking violation occurrences and non-occurrences, along with the respective violation severity levels, per 12-hour session. Graphs labeled Space 1, Space 2, Space 3, and Space 4 indicate the number of non-violations (NV), slight violations (SV), moderate violations (MV), and severe violations (XV) observed. Results from the four experimental conditions (i.e., baseline, first intervention, baseline reversal, and second intervention conditions) are described below.

Space 1 encroachment violations. During the initial baseline condition (sessions 1 to 14), the mean number of non-violations was 5.57, the mean number of slight violations was 3.36, the mean number of moderate violations was 4.57, and the mean number of severe violations was 1.57. During the first intervention condition (sessions 15 to 34), the mean number of non-violations was 6.1, the mean number of slight violations was 3.15, the mean number of moderate violations was 4.5, and the mean number of severe violations was 1.7. During the baseline reversal condition (sessions 35 to 48), the mean number of non-violations was 5.21, the mean number of slight violations was 3.5, the mean number of moderate violations was 4.86, and the mean number of severe violations was 1.71. During the second intervention condition (sessions 49 to 61), the mean number of non-violations was 5.3, the mean number of slight violations was 3.62, the mean number of moderate violations was 4.38, and the mean number of severe violations was 1.54.

Space 2 encroachment violations. During the initial baseline condition (sessions 1 to 14), the mean number of non-violations was 11.57, the mean number of slight violations was 1.5, the mean number of moderate violations was 0.93, and the mean number of severe violations was 0.14. During the first intervention condition (sessions 15 to 34), the mean number of non-violations was 12.7, the mean number of slight violations was 1.25, the mean number of moderate violations was 0.55, and the mean number of severe violations was 0.05. During the baseline reversal condition (sessions 35 to 48), the mean number of non-violations was 11.57, the mean number of slight violations was 1.14, the mean number of moderate violations was 0.43, and the mean number of severe violations was 0.21. During the second intervention condition (sessions 49 to 61), the mean number of non-violations was 9.77, the mean number of slight violations was 1.0, the mean number of moderate violations was 0.46, and the mean number of severe violations was 0.31.

Space 3 encroachment violations. During the initial baseline condition (sessions 1 to 14), the mean number of non-violations was 8.43, the mean number of slight violations was 0.5, the mean number of moderate violations was 0.5, and the mean number of severe violations was 0.14. During the first intervention condition (sessions 15 to 34), the mean number of non-violations was 7.3, the mean number of slight violations was 0.9, the mean number of moderate violations was 0.35, and the mean number of severe violations was 0.05. During the baseline reversal condition (sessions 35 to 48), the mean number of non-violations was 8.57, the mean number of slight violations was 0.36, the mean number of moderate violations was 0.36, and the mean number of severe violations was 0.0. During the second intervention condition (sessions 49 to 61), the mean number of non-violations was 8.38, the mean number of slight violations was

0.69, the mean number of moderate violations was 0.15, and the mean number of severe violations was 0.08.

Space 4 encroachment violations. During the initial baseline condition (sessions 1 to 14), the mean number of non-violations was 7.79, the mean number of slight violations was 1.57, the mean number of moderate violations was 1.64, and the mean number of severe violations was 0.14. During the first intervention condition (sessions 15 to 34), the mean number of non-violations was 7.7, the mean number of slight violations was 2.0, the mean number of moderate violations was 1.4, and the mean number of severe violations was 0.2. During the baseline reversal condition (sessions 35 to 48), the mean number of non-violations was 6.5, the mean number of slight violations was 1.57, the mean number of moderate violations was 1.14, and the mean number of severe violations was 0.07. During the second intervention condition (sessions 49 to 61), the mean number of non-violations was 7.38, the mean number of slight violations was 2.15, the mean number of moderate violations was 1.54, and the mean number of severe violations was 0.15.

Interobserver agreement. Reliability researchers conducted observations for 21 out of 61 (34.43%) sessions for Site 1. For each experimental condition across the four parking spaces and access aisle, at least 33% of sessions were assessed. For violation frequency, the mean calculated for interobserver agreement was 96.53%, and ranged from 76.92% to 100%. For violation severity, the mean calculated for interobserver agreement was 94.18%, and ranged from 69.23% to 100%.

Quantitative Study: Site 2

A quantitative study at Site 2 was conducted to test the effects of the parking layout on access aisle parking violations. It was suggested by the focus group that uneven surfaces may be

a potential reason for access aisle parking violations. After observing high rates of parking violations at Site 1 in Space 1, it was hypothesized that the width of the parking space (i.e., 7’9”) combined with the uneven terrain adjacent to the curb may be a contributing factor to the high rates of access aisle parking violations observed in that space. Since low rates of access aisle parking violations were initially observed at the Site 2 location, leading to its exclusion from the initial signs and pavement markings intervention, it was hypothesized that the parking layout may contribute to the low instances of access aisle parking violations in these spaces. Specifically, it was hypothesized that the width of the parking space (i.e., 9’8”) combined with a four-foot diagonally-marked “courtesy aisle” adjacent to the curb may be responsible for deterring access aisle parking violations. In order to test this hypothesis, the researchers developed a procedure to obstruct the extra space designated by the “courtesy aisle” and the parking space to test the effects of the existing layout on deterring access aisle parking violations.

Method

Measurement by permanent product. Permanent product recording for this study included vehicles parked in either of the two van-accessible parking spaces, adjacent access aisle, or “courtesy aisle” identified at Site 2. See Figure 8 for a diagram and photo of the Site 2 parking layout.

Setting. A grocery store parking lot in Lawrence, Kansas, was initially selected as a site due to its high parking turnover. The Site 2 store manager was approached during scheduled face-to-face meeting and was provided the City of Lawrence ADA Coordinator support letter and a short presentation regarding the rationale and methods for the research project. Permission was obtained from the store manager and the corporate office to conduct the research study in the

store parking lot. However, upon the observation of pilot data, low rates of access aisle parking violations were observed. Due to the low levels of violation occurrences, Site 2 was not selected for the initial intervention, which sought to evaluate the effectiveness of various signs and pavement markings to deter access aisle parking violations. However, upon analyzing the parking layout of Site 2 and developing the described hypothesis regarding the effects of the parking layout, Site 2 was again selected for the research study.

Observation and measurement. Data collection took place for 12 hours per day between the hours of 7:00 a.m. and 7:00 p.m. from August 16, 2016 to September 29, 2016 at the Site 2 parking lot. Data collection occurred on consecutive days, with a few pauses in between to give time for the researchers to process and analyze data. Data were collected using two time-lapse video cameras (i.e., Day 6 Outdoors™ PlotWatcher Pro). The time-lapse video cameras were placed in security boxes and were secured to trees in an unobtrusive location to limit reactivity effects.

Dependent variables. The dependent variables measured were the same as observed for Site 1. See pages 15-16 for a complete description.

Independent variables. Two independent variables were employed for Site 2. The design employed for Site 2 was an A-B-C-A design.

First intervention. After analyzing baseline data, a four-foot temporary barrier was installed in order to block off the extra four-foot space designated by the “courtesy aisle.” The width of the parking space itself was left alone at nine-foot eight-inches. The temporary barrier was constructed out of ¾” plywood and painted yellow. For purposes of clarity, the parking space with the barrier obstructing the room available on the driver’s side will be termed the “driver’s side,” and the parking space with the barrier obstructing the room available on the

passenger's side will be termed the "passenger's side." Thus, two constructed temporary barriers (each measuring 12' x 4' x 10") were placed adjacent to both the driver's side and passenger's side accessible parking spaces. A strip of yellow tape measuring four-inches was placed parallel to and 16" from the yellow barriers in order to recreate the four-inch parking line, thus meeting the eight-foot accessible parking space width requirement. See Figure 9 for a photo of this intervention.

Second intervention. After analyzing data from the first intervention, an A-B-C-A design was employed in that the width of the constructed barrier further increased to block off an extra one-foot eight-inches within the accessible parking space. Thus, the previously measured nine-foot eight-inch parking space width was altered to meet the federally required eight-foot parking space width. The intervention described in the first intervention section was kept intact, and an extra inter-locking addition to the temporary barrier was constructed out of ¾" plywood and painted yellow. Thus, two constructed temporary barrier additions (each measuring 12' x 16" x 10") were added to the existing barriers placed next to both the driver's side and passenger's side accessible parking spaces. The total size of each new barrier was 12' x 5'4" x 10". A strip of yellow tape measuring four-inches was placed directly parallel to the yellow barriers in order to recreate the four-inch parking line, thus meeting the eight-foot accessible parking space width requirement. See Figure 10 for a photo of this intervention.

Interobserver Agreement. Reliability was conducted in the same way as measured for Site 1. See page 17 for a complete description.

Results

Violation frequency. Figure 11 illustrates the frequency of parking violations per 12-hour interval. For Site 2, the effects of systematically decreasing the parking space width to

increase access aisle parking violations was empirically tested. The x-axis denotes the number of sessions (1 – 43); the y-axis denotes the number of access aisle parking violations per 12-hour session. Graphs labeled Driver's Side and Passenger's Side indicate the number of encroachment access aisle violations (ranging from slight to severe) observed, while the graphs labeled Access Aisle indicate the number of full violations observed. Results from the four experimental conditions (i.e., baseline, first intervention, second intervention, and baseline reversal conditions) are described below.

Driver's side encroachment violations. During the initial baseline condition (sessions 1 to 13), the mean number of access aisle parking violations was 0.15 per 12-hour observation. During the first intervention condition (sessions 14 to 24), the mean number of access aisle parking violations was 2.0. During the second intervention condition (sessions 25 to 34), the mean number of access aisle parking violations was 5.6. During the baseline reversal condition (sessions 35 to 43), the mean number of access aisle parking violations was 0.56. Statistical analyses (t-tests) show that the difference between the means was significant at the 0.05 level when comparing the frequency of access aisle violations between each of the experimental conditions ($p < 0.0001$).

Passenger's side encroachment violations. During the initial baseline condition (sessions 1 to 13), the mean number of access aisle parking violations was 0.31 per 12-hour observation. During the first intervention condition (sessions 14 to 24), the mean number of access aisle parking violations was 1.0. During the second intervention condition (sessions 25 to 34), the mean number of access aisle parking violations was 2.6. During the baseline reversal condition (sessions 35 to 43), the mean number of access aisle parking violations was 0.33. Statistical analyses (t-tests) show that the difference between the means was significant at the 0.05 level

when comparing the frequency of access aisle violations between each of the experimental conditions ($p \leq 0.01$).

Access aisle full violations. Across the 43 sessions, there were eight total occurrences of full violations. Five occurred during the initial baseline condition, two of which took place adjacent to the driver's side parking space, and three of which took place adjacent to the passenger's side parking space. Two full violations also occurred adjacent to the driver's side parking space during the first intervention condition. Finally, one violation occurred during the baseline reversal condition adjacent to the passenger's side parking space.

Violation severity. Figure 12 illustrates the number of occurrences and non-occurrences of parking violations, along with the respective violation severity levels. For Site 2, the effects of systematically decreasing the parking space width to increase the severity of access aisle parking violations was empirically tested. The x-axis denotes the number of sessions (1 - 43); the y-axis denotes the number of access aisle parking violation occurrences and non-occurrences, along with the respective violation severity levels, per 12-hour session. Graphs labeled Driver's Side and Passenger's Side indicate the number of non-violations (NV), slight violations (SV), moderate violations (MV), and severe violations (XV) observed. Results from the four experimental conditions (i.e., baseline, first intervention, second intervention, and baseline reversal conditions) are described below.

Driver's side encroachment violations. During the initial baseline condition (sessions 1 to 13), the mean number of non-violations was 13.15, the mean number of slight violations was 0.15, the mean number of moderate violations was 0.0, and the mean number of severe violations was 0.0. During the first intervention condition (sessions 14 to 24), the mean number of non-violations was 12.91, the mean number of slight violations was 1.36, the mean number of

moderate violations was 0.64, and the mean number of severe violations was 0.0. During the second intervention condition (sessions 25 to 34), the mean number of non-violations was 8.5, the mean number of slight violations was 3.3, the mean number of moderate violations was 1.7, and the mean number of severe violations was 0.6. During the baseline reversal condition (sessions 35 to 43), the mean number of non-violations was 15.33, the mean number of slight violations was 0.33, the mean number of moderate violations was 0.22, and the mean number of severe violations was 0.0.

Passenger's side encroachment violations. During the initial baseline condition (sessions 1 to 13), the mean number of non-violations was 10.92, the mean number of slight violations was 0.31, the mean number of moderate violations was 0.0, and the mean number of severe violations was 0.0. During the first intervention condition (sessions 14 to 24), the mean number of non-violations was 12.27, the mean number of slight violations was 0.64, the mean number of moderate violations was 0.27, and the mean number of severe violations was 0.09. During the second intervention condition (sessions 25 to 34), the mean number of non-violations was 9.3, the mean number of slight violations was 1.7, the mean number of moderate violations was 0.7, and the mean number of severe violations was 0.2. During the baseline reversal condition (sessions 35 to 43), the mean number of non-violations was 13.11, the mean number of slight violations was 0.22, the mean number of moderate violations was 0.11, and the mean number of severe violations was 0.0.

Interobserver agreement. Reliability researchers conducted observations for 15 out of 43 (34.88%) sessions for Site 2. For each experimental condition across the two parking spaces and access aisle, at least 33% of sessions were assessed. For violation frequency, the mean calculated for interobserver agreement was 96.05%, and ranged from 78.57% to 100%. For

violation severity, the mean calculated for interobserver agreement was 94.7%, and ranged from 78.57% to 100%.

Discussion

In conducting this study, the researchers sought to better understand factors that may influence access aisle parking violations and to empirically test interventions that may work best to deter these parking violations. The results of this study indicate that the combined signs and pavement markings did not demonstrate a clear effect in deterring access aisle parking violations. This was an interesting finding because focus group participants expressed interest in adopting signs and pavement markings as potential solutions for this problem, which echoes states' initiatives (e.g., Hawaii, Maryland, and South Dakota) to adopt specific access aisle signage. In response to frustrations regarding this issue, other states (e.g., Colorado) have begun to join discussions to adopt similar access aisle signage in their states (Colorado General Assembly, 2014). While subsequent states may choose to adopt signs because of the suggested "best practice," no known study has experimentally evaluated if the placement of signs and pavement markings to deter parking in access aisles is really "best practice," or best guess.

Considering that the cost of each sign is approximately $20, the adoption of signs and pavement markings has the potential to become a very costly expense to both private and public entities who are required to adhere to these increased standards. In addition to the cost of the signs, signposts would need to be installed. If required by state sanctions, the installation of pavement markings would also have additional associated costs. All of these expenses are not to be expressed as a concern if they are effective in increasing community participation for people with disabilities (i.e., increased human rights are priceless), but perhaps are to be seen as a wasted effort in terms of time, money, and enforcement if they are not effective in solving the

original problem they were intended to address. To add to the argument, legislators may be less likely to implement subsequent solutions if original solutions lacking in empirical evaluations failed to address the problem.

It was a serendipitous finding that led the researchers to hypothesize that the function of access aisle encroachments may not be the same as access aisle full violations or the illegal use of accessible parking spaces (i.e., drivers who park in an accessible space without an accessible placard or license). In a qualitative field study conducted by Cope and Allred (1990), common reasons cited by respondents who illegally parked in the accessible space were: 1) could not see (or read) the sign, 2) convenience/in a hurry, and 3) nothing else available. While it was initially hypothesized that the function of the behavior for parking in the access aisle would be the same as illegally parking in the accessible space, these findings imply that the function of access aisle encroachment violations and access aisle full violations may serve different purposes. Due to this hypothesized difference in function, the researchers chose to separate the encroachment and full violations in the visual display of the data.

It is hypothesized that full access aisle violations may serve similar a function to the illegal use of accessible parking spaces (e.g., convenience or lack of available parking), and similar interventions utilized to address illegal parking concerns may lend themselves well to addressing access aisle full violations (e.g., police enforcement). However, these data suggest that full violations are not the primary concern in terms of addressing the usability of access aisles, particularly due to their low rate of occurrence. For example, at Site 1, full violations were only observed four times out of 983 total observed violations (0.41%), and at Site 2, full violations were only observed eight times out of the 137 total observed violations (5.84%). Given the low rate of occurrence for full violations, an intervention targeted to address the

hypothesized function of encroachment violations was prioritized, since the occurrence of encroachment violations was observed to most greatly impact the usability of the access aisle.

It is hypothesized that encroachment violations may function to provide more room to those people with disabilities who need the extra space to safely and conveniently enter and exit their vehicles. This hypothesis was developed through two primary serendipitous findings: 1) The frequency of access aisle violations at Site 2 was low, despite similarities in the setting and frequency of parking behavior, and 2) The “Space 1” accessible parking space at Site 1 was the space with the highest occurrences of access aisle parking violations. To further elaborate, “Space 1” at Site 1 was observed to have an average of 9.64 encroachment violations and an average of 15.07 parking occurrences per 12-hour session in the initial baseline condition. It is presumed that, on average, 63.97% of parking occurrences in “Space 1” would encroach upon the access aisle. The “Driver’s Side” accessible parking space at Site 2, which had a similar positioning to the “Space 1” at Site 1, was observed to have an average of 0.15 encroachment violations and an average of 13.31 parking occurrences per 12-hour session in the initial baseline condition. It is presumed that, on average, only 1.13% of parking occurrences in this space would encroach upon the access aisle. Considering the stark contrast in the number of violations between the similarly positioned accessible parking spaces at Site 1 and 2 (63.97% versus 1.13%), it was hypothesized that the difference in encroachment violations is a difference in function attributed to the environmental impact of the parking layout. Thus, it was hypothesized that an antecedent intervention designed to alter the width available within these accessible parking spaces would also impact the frequency and severity of the respective access aisle parking violations. While it was not feasible to alter the environment at Site 1 to create additional parking space width due to limitations in resources, the researchers did design a method in which

to decrease the additional space designated by the parking layout at Site 2 by creating a temporary barrier.

The data analyzed suggest that if the width of the accessible parking spaces is addressed, this may help to deter both the frequency and severity of access aisle parking violations. The 2010 ADA Standards requires either an eight-foot accessible parking space with an adjacent eight-foot access aisle or an eleven-foot accessible parking space with an adjacent five-foot access aisle for van-accessible spaces, However, the direct observation via video recordings has demonstrated on many occasions that the designated eight-foot parking space width is not always enough for people with disabilities to safely navigate in and out of their vehicles. Upon reviewing video of specific instances of access aisle parking violations at Site 2, researchers observed that many people with disabilities purposely violated the space designated by the access aisle in order to have more room to fully open the vehicle door and navigate the space with a wheelchair, scooter, walker, cane, or crutches.

Discussions gleaned from the focus group indicated that many of the access aisle violators “don’t think about it,” “don’t understand,” or “don’t care.” However, observations indicate that many of the violators are people with disabilities themselves, who actually require the extra space in order to safely navigate the limited space adjacent to curbs or closely parked vehicles. To further elaborate, the required parking space width is often factored to the very edge of the curb. However, this curb space is often uneven and may collect rainwater, leaves, trash, or ice. When measuring the “Space 1” accessible parking space at Site 1, for example, researchers found that the width of the parking space that was an even surface (i.e., accessible terrain in the absence of curb space) measured six-foot five-inches. Considering that the average sports utility vehicle is also this wide, there would be no space to safely get in and out of the vehicle unless

the driver was to park over the access aisle or back into the parking space. However, the video observations suggest that many people do not choose to back into the parking space, and thus chose to park over the access aisle to allow for safe and convenient entrance or exit from their vehicle. Additionally, it is suggested that heavy vehicle and pedestrian traffic may make it difficult to back into a parking space.

Future conversations to address surrounding parking layout solutions will need to be discussed with legislators and people with disabilities. For illustrative purposes, Figure 13 includes photos of exemplary approaches to alternative parking layouts. In The United Kingdom, for example, 1,200 millimeter (i.e., approximately four feet) “bays” (i.e., access aisles) are required to surround all three sides of accessible parking spaces. Thus, vehicles are guaranteed four feet of space adjacent to either the driver’s side or passenger’s side of the vehicle, and are also provided with a clearly marked area for vehicles with rear ramps or lifts. If adjacent to one another, these four-foot access aisles may be combined to equal eight-feet, the width of a van-accessible parking space. If adopted, this proposed layout standardization may accomplish two things: 1) It would make all accessible parking spaces van-accessible, thus adhering to the principles of universal design, and 2) It would have the potential to decrease the number of access aisle parking violations due to the increased area surrounding all sides of the accessible parking space.

Another solution may be to adopt a universal van-accessible parking layout for all accessible parking spaces (i.e., the eleven-foot accessible parking space with the adjacent five-foot access aisle), thereby providing a built-in space for people with disabilities who do not necessarily drive ramp- or lift-equipped vans, but do require additional room to safely navigate in and out of their vehicle. However, further research is needed to examine the frequency and

severity of which people park over the five-foot access aisle when several van-accessible spaces with this layout are adjacent to one another. Future research should examine access aisle violations with the alternative van-accessible layout.

The limitations for this study suggest the need for future studies to further evaluate the effects of varying parking layouts on access aisle parking violations. Future research should examine access aisle parking violations across parking lots, thereby providing additional evidence that the accessible parking layout contributes to the frequency and severity of these access aisle-parking violations. A large limitation of the Site 2 data was a failure to reverse back to the experimental condition after the baseline condition had been reinstated. The researchers planned a return to the experimental condition to show increased experimental control. They arranged a personal meeting with the store manager to return back to the experimental condition for three to four sessions. The store manager, however, emphatically asked the researchers to cease the reinstalling of the barriers due to multiple customer complaints (D. McCoy, personal communication, September 26, 2016). It may be beneficial to employ the same methods used for the Site 2 study at alternative sites, in order to increase the amount of evidence that the width of the parking space itself, and not some other contributing factor, is responsible for deterring access aisle parking violations.

Additional limitations include the failure to obtain a normative comparison of encroachments in non-accessible parking spaces to access aisle encroachments. This data would help to determine if the function of encroachments is specific to people with disabilities. While this study reported anecdotal observations that imply people with disabilities need the extra space designated by the parking layout to get in and out of their vehicles, it would be beneficial to obtain additional qualitative or quantitative data to support these conclusions.

Another limitation was the failure to examine if access aisle parking violations were more or less likely to occur by drivers who parked in the accessible space illegally (i.e., drivers who park in an accessible space without an accessible placard or license). While this data would have been beneficial to determine if violators were more or less likely to have a placard or license, the collection of this data was not feasible due to the video quality of the time-lapse video cameras. Although the use of cameras may be viewed as a potential weakness in this regard, it is important to note that the use of this method to collect data during a 12-hour observation session does contribute to the current accessible parking literature. Previously described interventions found to be effective in deterring illegal parking in accessible spaces have conducted on-site observations through the use of observational probes over the span of two-hours and 15-minutes (Jason & Jung, 1984), one-hour observation sessions (Suarez de Balcazar, Fawcett, & Balcazar, 1988; White, Jones, Ulicny, Powell, & Mathews, 1988), or two-hour observation sessions (Cope & Allred, 1991). The use of the cameras to observe parking over a 12-hour observation session lends itself well to the nature of parking behavior, considering that a single parking space may be occupied or vacant for an entire one- or two-hour observational session. Therefore, despite the cited limitations, the use of cameras may be a preferable observational tool to use in future parking studies as a method to observe parking behavior throughout the day.

While adopting a universal design for all accessible parking spaces may be costly in terms of resources, it is argued that this is not a case of costs, but one of human rights. If people with disabilities are consistently denied access to public services and events due to insufficient and unusable parking spaces, then they will be marginalized in terms of active community participation. Of all the efforts to make the built community environment more accessible for people with disabilities, it would be a shame if community participation had to come to a

screeching halt in the parking lot. Thus, in determining solutions that aim to deter the frequency and severity of access aisle parking violations, the researchers hope to increase the probability that a person with a disability will find a parking space in their community that is not only accessible, but also usable.

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Figure 1
2010 ADA Standards for Van-Accessible Parking Spaces

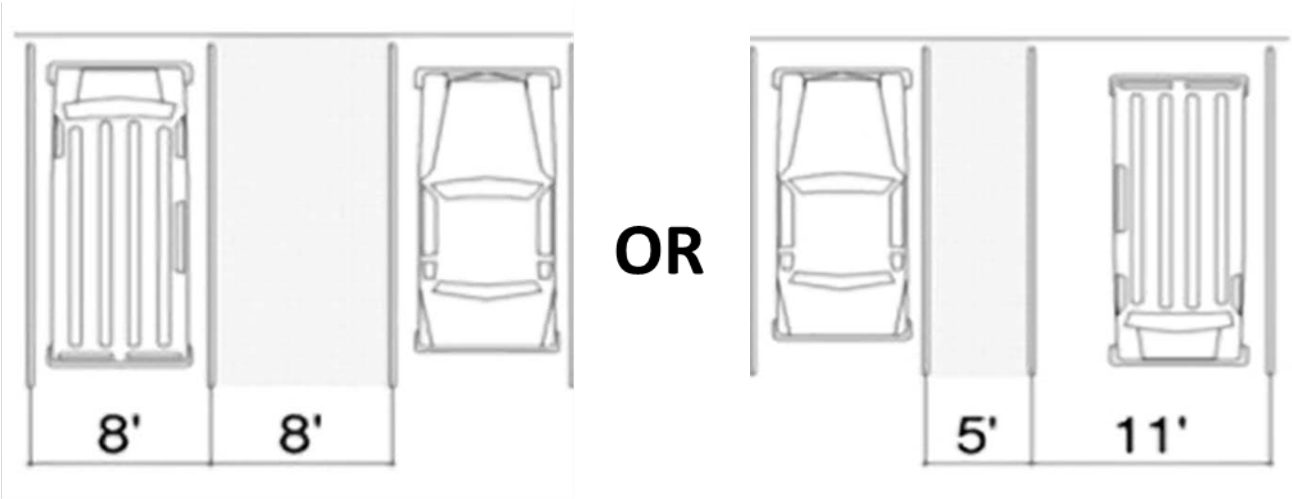

Figure 2
Van-Accessible Parking Space Usability

Usable

Unusable

Figure 3
Site 1 Parking Layout

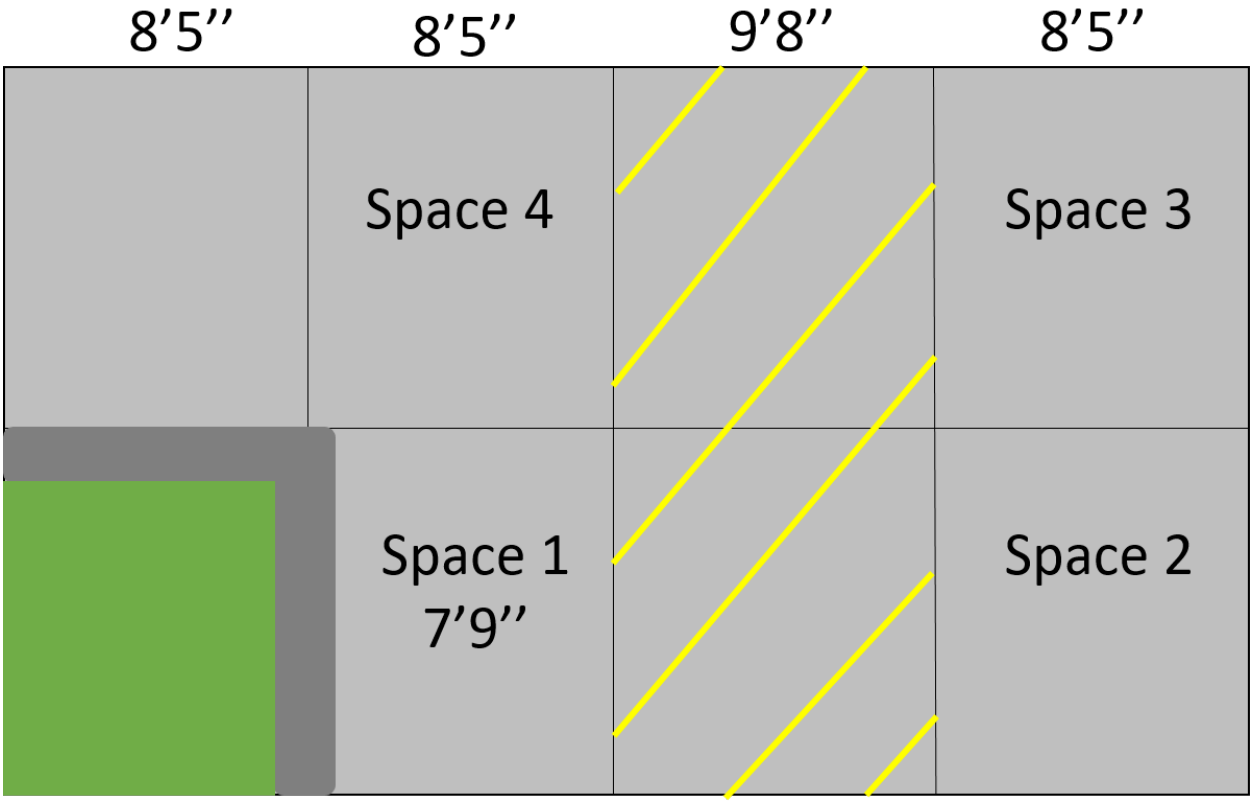

Figure 4
Site 1 First Intervention

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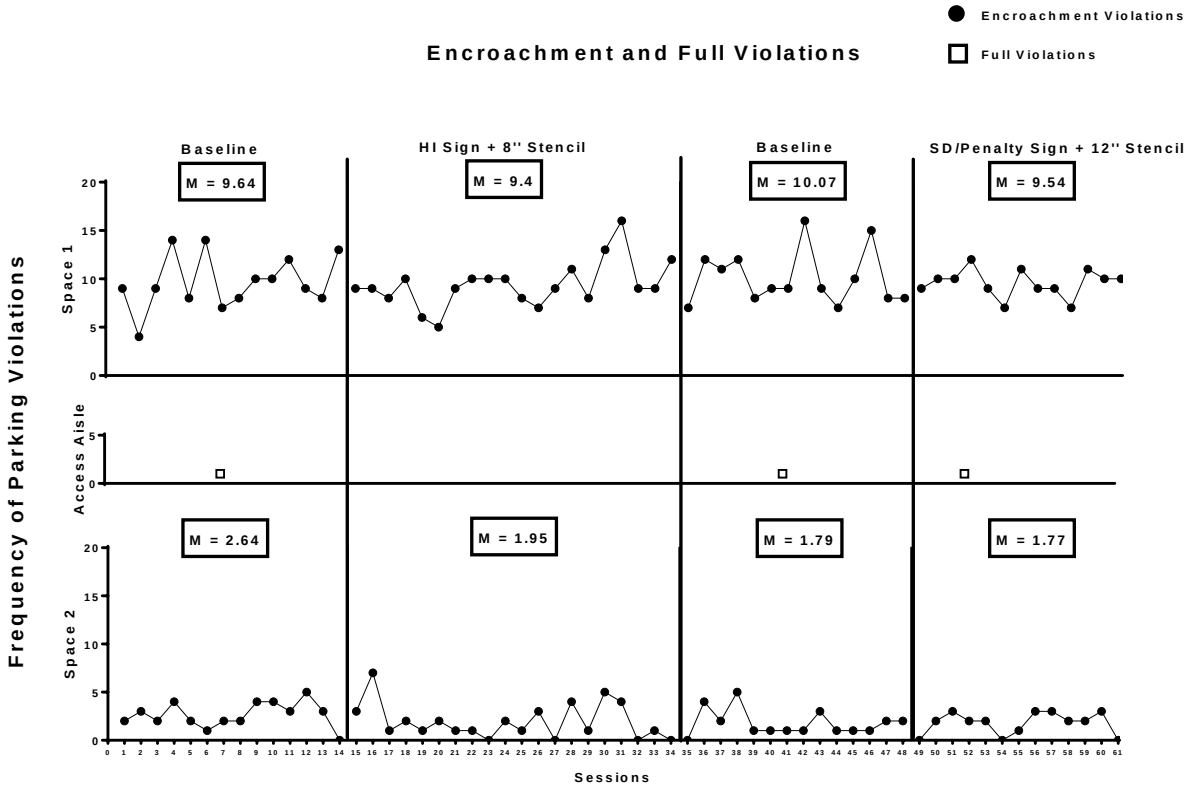
Figure 5
Site 1 Second Intervention

Figure 6
Site 1 Violation Frequency



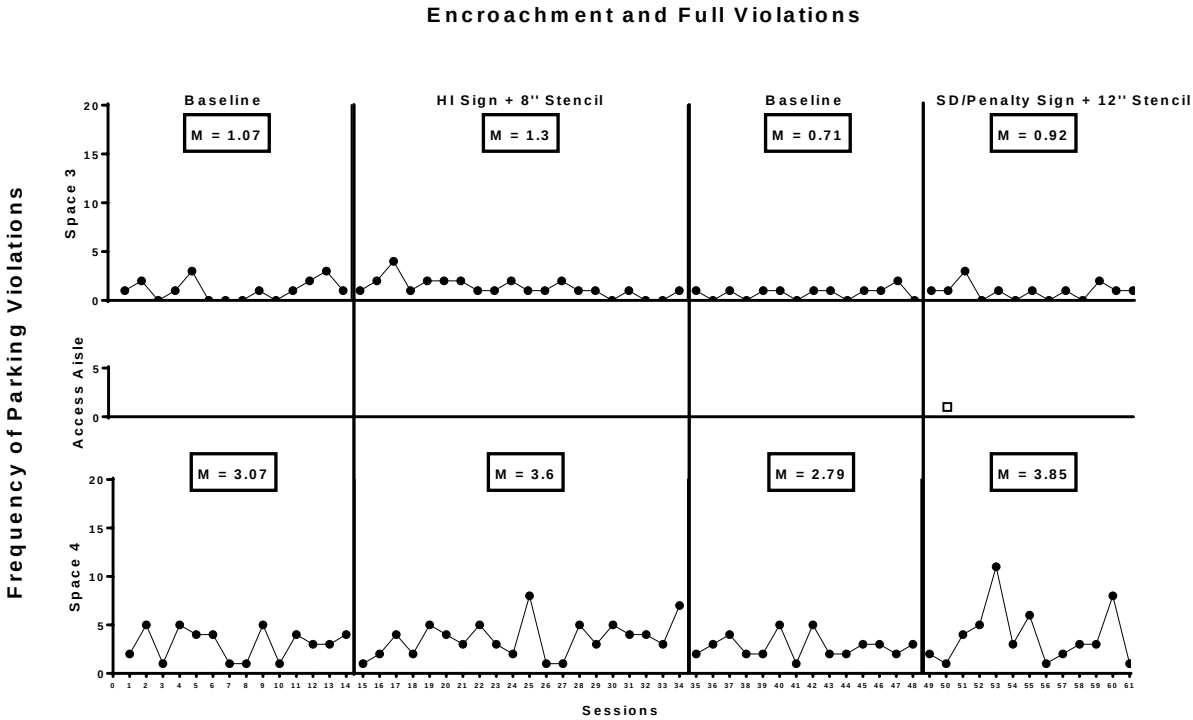


Figure 7
Site 1 Violation Severity

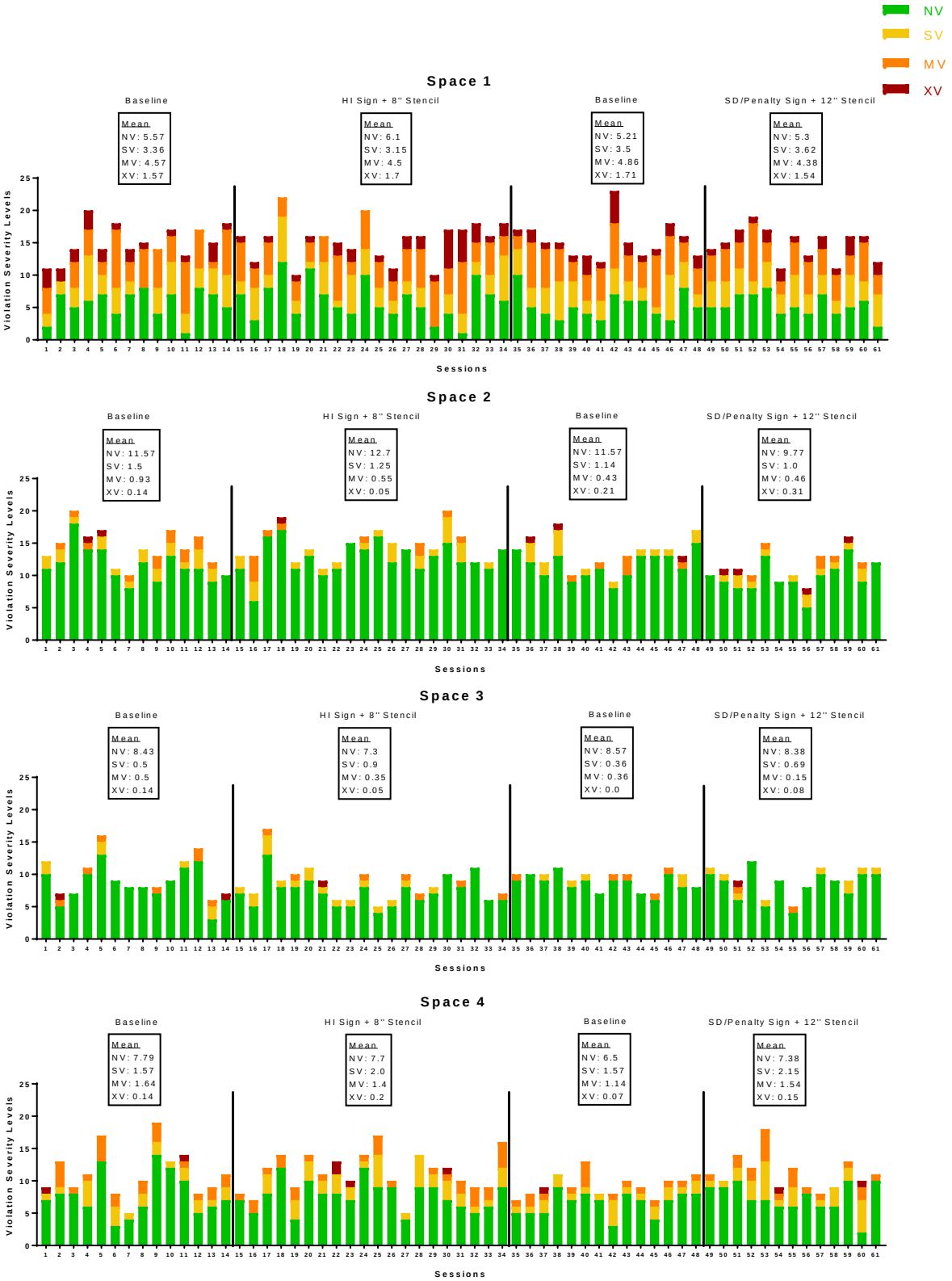


Figure 8
Site 2 Parking Layout

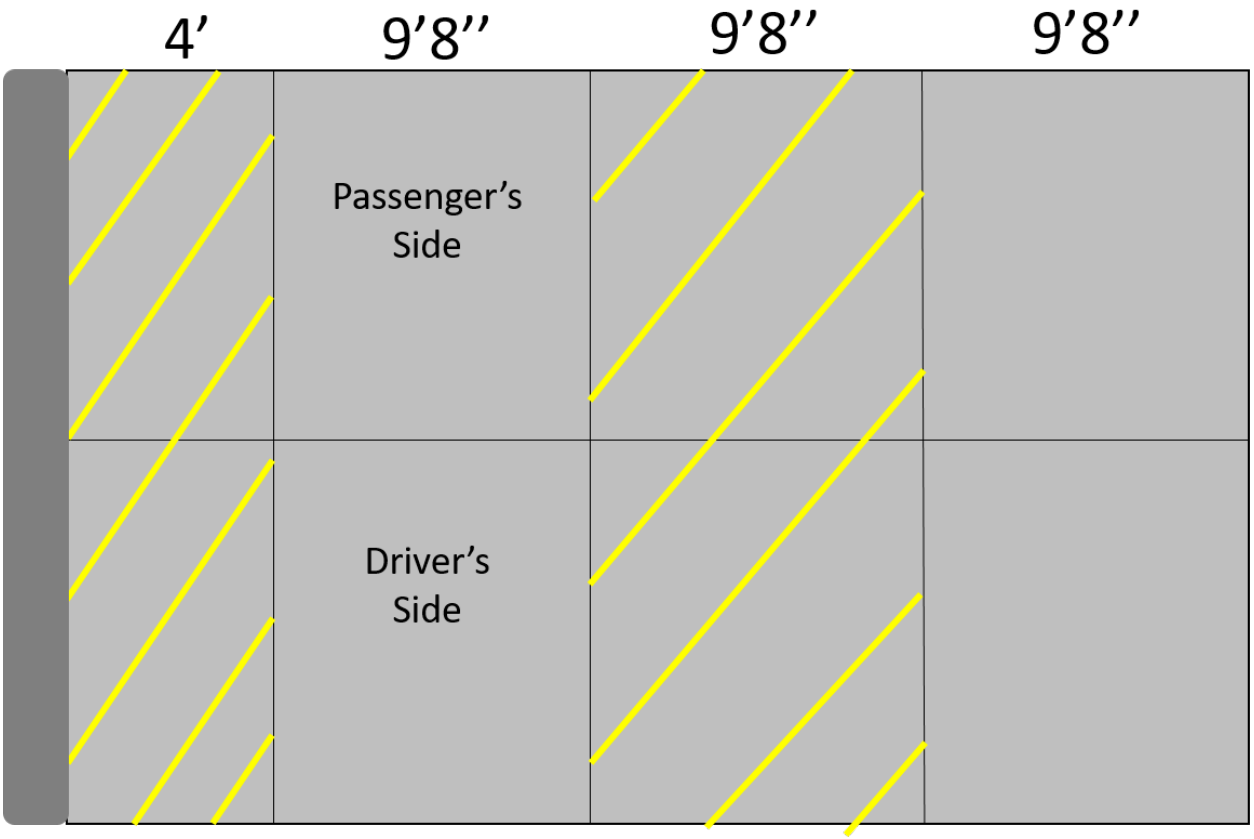
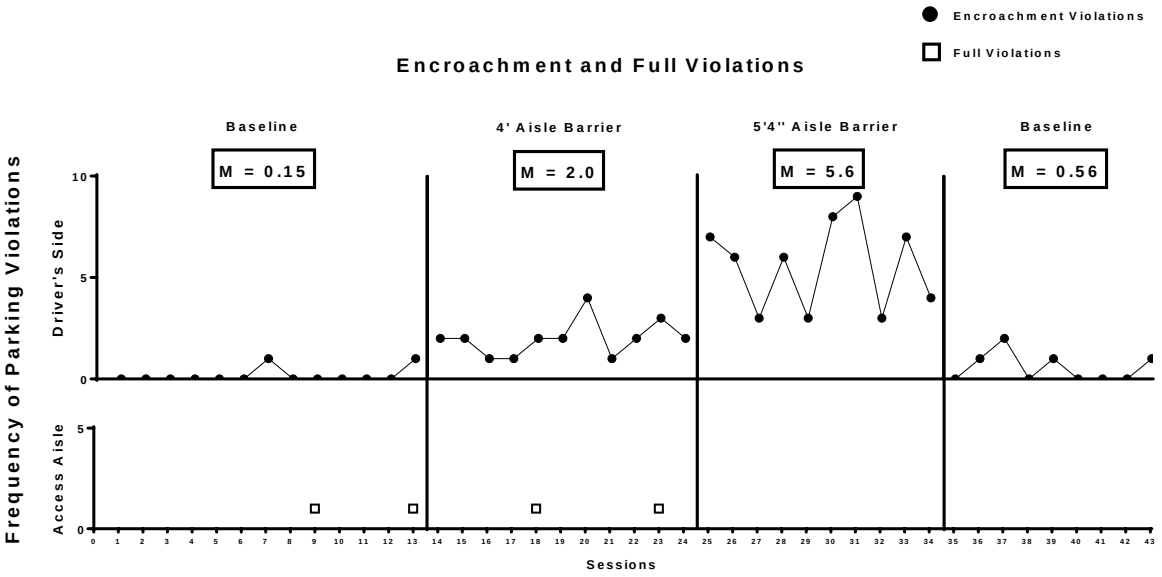


Figure 9
Site 2 First Intervention

Figure 10
Site 2 Second Intervention

Figure 11
Site 2 Violation Frequency



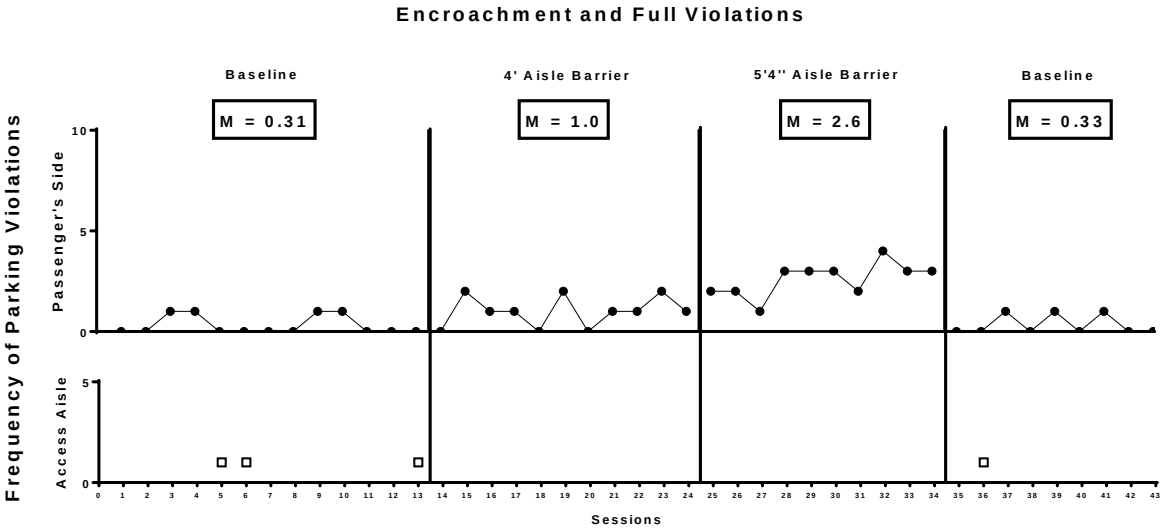


Figure 12
Site 2 Violation Severity

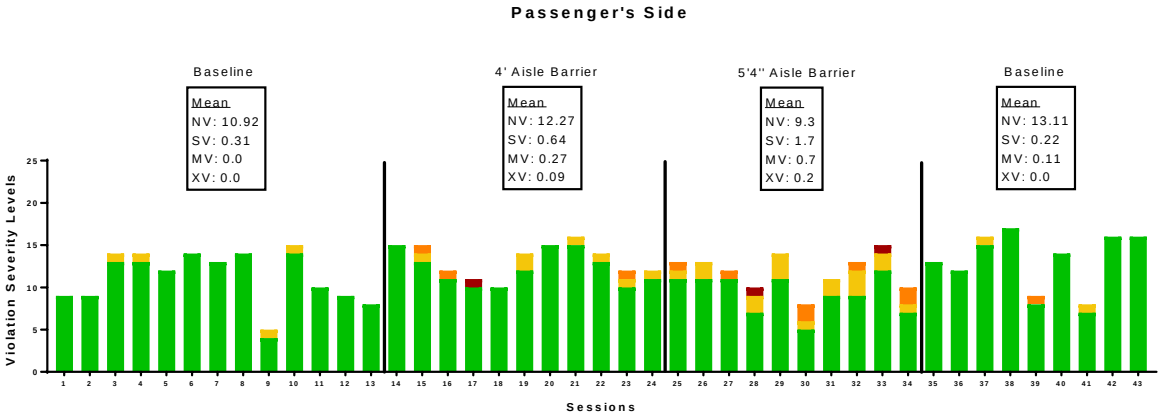


Figure 13
Example Alternative Parking Layouts