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Volume I Final Report

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16. Abstract

With the older adult population of the United States growing at a rapid pace, the National Highway Traffic Safety Administration (NHTSA) is concerned with highway safety issues affecting this age group. NHTSA initiated a three-stage research study in order to gain a better understanding of the factors that contribute to seat belt use or nonuse among people 65 and older. The first stage included a literature review; discussions with experts in the fields of aging, vehicle design, law enforcement, physical mobility and human factors; and analyses of several national databases.

This background research was followed by a series of 15 focus groups with older adults in four States. Participants discussed experiences and difficulties associated with seat belt use. Relevant topics included issues with comfort and convenience, effects of physiological conditions, trip and vehicle characteristics, presence of other passengers, types of media and communication tools to increase belt use among their peers, and a discussion of various seat-belt-related aftermarket devices. These focus groups pointed to a series of common seat-belt-related concerns and complaints among this select population.

The final stage of the project was a human factors field study that provided detailed observation and measurement of seat belt use and acceptability among older occupants targeting comfort, convenience, and usability issues. Fifty-four older adults were exposed to six different seat belt systems and provided ratings regarding comfort, convenience, and likelihood of use. Participants also gave detailed descriptions of their experiences with the different systems, pointing out specific problems with usability and comfort.

Conclusions include information to support the development of strategies to increase seat belt use among older adults and ideas for future related research on this topic.

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EXECUTIVE SUMMARY

The rapid growth of the population 65 and older in the United States over the next 50 years has the National Highway Traffic Safety Administration (NHTSA) concerned with highway safety issues for seniors. NHTSA is interested in preventing crash-related injuries and fatalities within this population. Research has shown that correct use of a seat belt is the most effective means in preventing serious or fatal injury in a motor vehicle crash. In order to better understand the factors that contribute to seat belt use or nonuse among people 65 and older, NHTSA initiated a three-stage research study.

The first stage included a literature review; discussions with experts in the fields of aging, vehicle design, law enforcement, physical mobility and human factors; and analyses of several national databases. This review of information sources pointed to several key concerns that influence seat belt use, nonuse, and misuse among older adults.

The background research was followed by a series of 15 focus groups, held in four States with older adults who travel regularly in private vehicles and who reported part-time or nonuse of seat belts. The focus groups served as a useful tool to explore a variety of the key issues influencing seat belt use and nonuse among the older adult population. The participants discussed experiences and difficulties associated with seat belt use. The topics reviewed included issues with comfort and convenience, effects of physiological conditions, trip and vehicle characteristics, presence of other passengers, types of media and communication tools to increase belt use among their peers, and a discussion of various seat-belt-related aftermarket devices. These focus groups pointed to a series of common seat-belt-related concerns and complaints among this select population and helped to direct the development of the subsequent in-vehicle field study. The focus groups also identified what might be done to increase belt use among older occupants, now and in the future.

The final stage of the project was a human factors field study that provided detailed observation and measurement of seat belt use and acceptability among older occupants. Field data collection was designed to provide the opportunity for a more quantitative approach in gathering information on issues related to comfort and convenience of seat belts for older drivers and passengers. Fifty-four older adults were exposed to six different seat belt systems and provided ratings regarding comfort, convenience, and likelihood of use. Participants also gave detailed descriptions of their experiences with the different systems, pointing out specific problems with usability and comfort. The analysis identified problem areas for countermeasure design as well as the most suitable configurations for target groups of older vehicle occupants.

The conclusions of this study on occupant protection issues among older drivers and passengers include information to support the development of strategies to increase seat belt use among older adults and ideas for future related research on this topic.

I. INTRODUCTION

Over the next several decades the number of older adults in the United States is expected to grow dramatically. By the year 2030, people 65 and older are projected to constitute 71.5 million out of 364 million people or 19.6% of the U.S. population (Older Americans Update, 2006). With many older adults keeping their drivers licenses longer and driving more miles on the roadways, they are at increased risk for involvement in fatal crashes. Unless significant countermeasures are employed, traffic fatalities for older adults are projected to double or triple by the year 2030 (Eberhard et al., 2003).

In the interest of preventing crash-related injuries and fatalities within this population the National Highway Traffic Safety Administration (NHTSA) is identifying approaches to increase seat belt use among older adults. Although older adults are reported to use seat belts more than any other age group, there is still a percentage of older adults who never use seat belts or only use them part-time. Much of what we know about the reasons older adults do not use seat belts is anecdotal, including comfort and convenience, the presence of chronic health conditions such as arthritis, and resistance to seat belt use in general. Other factors attributed to low usage rates are obesity, low socioeconomic status, and race and ethnicity.

Design features of the vehicle, seat, and the seat belt may also influence belt usage by older adults. To illustrate, the source of the shoulder belt portion of the seat belt is most often located on the B-pillar and the buckle is located between the seat and seat back. Finding and using the shoulder belt and buckle can be a challenge for many older adults who are arthritic and have flexibility issues. Adjustable shoulder belts or seat belt extenders might make it easier for these occupants to access and use the seat belt as well as help older adults find a more comfortable fit and alleviate some of the pressure along the chest and waist. Documenting use patterns among older adults according to such design features may help to identify those features that are more user-friendly and are more likely to increase seat belt use among those older adults who would use the belt if some of the physical challenges were addressed.

The overall purpose of this study was to understand what factors contribute to seat belt use and nonuse among adults 65 and older, and identify what can be done to increase seat belt use among older adults, now, and in the future, thereby reducing injuries and fatalities among the older adult population.

II. METHODOLOGY

In order to fully comprehend the dynamics behind the decision to use or not use a seat belt various issues that may influence seat belt use among older adults must be explored. These include factors such as the physical conditions experienced by older adults, design features of the vehicle and seat belt, the weaknesses and strengths of various social marketing strategies, differences in the effectiveness of primary and secondary seat belt laws, and enforcement levels and techniques. To facilitate such an understanding, three different strategies were implemented. The first was a comprehensive review of a variety of information sources on topics related to seat belts and the older adult population. Sources of information included: literature addressing the older adult population and all factors that might affect seat belt use; informal discussions with experts in the field of traffic safety, aging, vehicle design and instrument technology, law enforcement, physical mobility and belt use; and a review of various key databases. The information review was intended to call attention to specific issues affecting seat belt use among older adults as well as reveal gaps in current research.

Following the review and based on its findings, a series of focus groups were conducted. The 15 focus groups were held in four states with older adults who travel regularly in a private vehicle and reported part-time or nonuse of seat belts. Participants represented a range of physical statures, frailties, disabilities, socioeconomic strata, and educational/professional backgrounds. Participants discussed topics relevant to seat belt use and nonuse including: issues of comfort and convenience, physiological conditions, types of trip and vehicle, presence of other passengers, media and communication tools to increase belt use among their peers, and a discussion of various seat-belt-related aftermarket devices. These focus groups pointed to a series of common issues and experiences with seat belts among this population.

In the final stage of the project, a human factors field study was conducted in which 54 older adults were exposed to six different seat belt systems. They provided ratings regarding comfort, convenience, and likelihood of use. Participants also described their experiences with the different systems, pointing out specific problems with usability and comfort. Further details on the methods and findings for each of the three stages of the study are presented in the upcoming sections of this report.

III. SUMMARY OF INFORMATION SOURCES

Information regarding seat belt use by older adults, as well as reasons for nonuse, was compiled from discussions with experts in the field of seat belt use and seniors, literature sources, and various databases. A thorough literature review identified a number of topics that relate to seat belt use among older adults. These included demographic characteristics, anthropometric characteristics, physical limitations, normal belt use and seating practice, risk perception, and comfort and convenience.

Experts in the fields of seat belt use, older drivers, gerontology, occupant restraint design, and traffic safety research identified additional resources and provided descriptive information to explain nonuse among the older adult population. Additionally, databases and survey data sources including the Behavioral Risk Factor Surveillance System (BRFSS), Fatality Analysis Reporting System (FARS), Motor Vehicle Occupant Safety Survey (MVOSS), National Automotive Sampling System- Crashworthiness Data System (NASS CDS), and the Crash Injury Research and Engineering Network (CIREN) were analyzed.

The objective was to synthesize information from a variety of resources, to summarize what is known about seat belt use and identify the most important gaps in the literature. Key findings from the review are summarized below, an in-depth review is provided in Volume II Appendices.

A. Demographic groups among older adults

Seat belt use varies across different demographic groups. Women are more likely to use seat belts than men, and minorities use seat belts less often than white occupants (Glassbrenner, 2005; Lerner et al., 2001). However, while older adults repeatedly have higher usage rates than younger adults, research shows no clear differences in seat belt use across the age cohorts between 65 and 85 years (Kostynuik et al., 2003; MVOSS, 2003; FARS, 2003).

Although numerous studies have examined the relationship between race/ethnicity and seat belt use, differences in seat belt use across various racial and ethnic groups in the older adult population is inconsistent. Using FARS and BRFSS there is some indication that seat belt use is lower among older African-Americans when compared to Whites (Cosby et al., 2003). Studies

suggest that in the African-American community part-time belt use is common (Cordy et al., 2002). Among Hispanics there is conflicting information regarding seat belt use with some studies pointing to lower usage rates among Hispanic older adults and others finding higher seat belt usage rates than White or African-American occupants (Parada et al., 2001; Harper et al., 2000; Sapolsky, 2001; Nelson et al., 1998). Some attribute the differences within the Hispanic community to country of origin, or time living in the United States (Arce et al., 2004; Stiles et al., 1999). In an observational study of Hispanic migrant farm workers in California, Stiles et al. (1999) found that only 37% wore their seat belts.

Socioeconomic status and level of education has been linked to seat belt use rates across all age groups (Cosby et al., 2003; Lerner et al., 2001; Mueller et al., 2004; Shinar et al., 2001; Wells et al., 2002). Generally, higher levels of education and income are related to higher levels of seat belt use. Although studies examining the relationship between education or income and seat belt use do not typically consider age differences, there is no reason to believe that older adults will behave differently from their younger counterparts. This argument is supported by the findings from the MVOSS (2003) and the BRFSS (2002), where older adults with higher levels of education were more likely to report using a seat belt all of the time.

B. Reasons for nonuse of seat belts

Characteristics of seat belt use among older adults are based on a variety of factors including risk perception, road type, trip length, weather, presence of other vehicle occupants, comfort and convenience, and physical conditions. While some of the factors influencing the decision to use or not use a seat belt are similar to those influencing younger adults, others are unique to the older adult population. Older passengers and drivers predate the presence of seat belts in motor vehicles, and therefore have different attitudes regarding the benefits of using seat belts. Since seat belt laws were instituted well after they began traveling in vehicles, seat belts may be viewed as a burden, and many may resent being told what to do.

Evidence on the relationship between risk perception and seat belt use by older adults is conflicted. Some experts contend that older adults are aware of their vulnerability in the event of a crash, and this awareness raises the likelihood they will use seat belts more often than younger adults. Conversely, other experts see no differences between older adults and any other age groups with regard to risk perception and seat belt use.

Type of trip including trip length, weather, and road type are common factors that affect belt use among older adults. Similar to younger adults, many older adults are more likely to use a seat belt on longer trips, in bad weather conditions, and on high-speed roadways because the perceived risk of being involved in a serious crash increases under these conditions. However, according to the National Household Travel Survey, older adults are taking fewer trips, many of their trips are short distance and local, and often they are traveling as passengers (Collia et al., 2003). All these types of trips are often associated with a perceived lower risk of crash involvement, and therefore, a lower use of seat belts.

The presence of passengers, particularly children, can raise the likelihood of seat belt use among older adults. In focus groups, older adults repeatedly mentioned that they will make a point of wearing a seat belt when grandchildren are in the vehicle to set a good example (Academy for Educational Development, 2002). In the 2003 MVOSS 93% of older adults who said they wear their seat belt because they want to set a good example for others also said they

wore their seat belt all the time. In addition, older adults indicate that they will use the seat belt upon the driver's request.

Major factors contributing to nonuse of seat belts among older adults are comfort and convenience. Complaints regarding comfort have been voiced by seniors in a variety of settings including focus groups, meetings with physicians and occupational therapists, and in response to surveys and studies (Balci et al., 2001; Steinfeld et al., 1999). Some of the common issues mentioned by older adults related to comfort and convenience include:

- Difficulty reaching for shoulder belt and pulling across the body;
- Shoulder belt cuts across neck or chokes occupant;
- Seat belt puts pressure on skin and chest;
- Difficulty inserting latch plate in belt buckle;
- Belt buckle and stalk are difficult to locate;
- Release method is confusing;
- Uncomfortable or difficult to use due to occupant girth and height;
- Desire not to wrinkle clothes.

Some of these discomforts may be alleviated by adjusting the seat belt using the height adjuster on the B-pillar available in many newer vehicle models. However, experts have noted that older adults are often unaware of this feature.

Problems with comfort and convenience may be exacerbated by the different types of physical limitations experienced by many older adults. Older adults with disabilities overwhelmingly said they do not like seat belts, finding them to be very uncomfortable and at times even painful (Steinfeld et al., 1999). Older adults who reported poorer health were more likely to report part-time belt use than older adults who indicated that they were in good health (BRFSS, 2002).

Specific physical conditions that may directly influence comfort and seat belt nonuse among older adults include:

- Arthritis, shoulder, and neck pain;
- Osteoporosis;
- Kyphosis;
- Increase in fragility due to aging;
- Presence of a pacemaker;
- Recovery from recent chest or abdominal surgery;
- Obesity; or
- Small stature.

These conditions could lead to misuse and nonuse by making it difficult for older adults to reach for the seat belt, pull it across to the buckle, and insert the latch plate into the buckle.

Misuse is common among older adults causing various belt-related injuries in crashes including lower chest and upper abdominal injuries (Cushman et al., 1990), and certain physiological conditions increase older adults' potential for crash injuries while using a seat belt.

In examining the relationship between body type (measured using body mass index (BMI)) and seat belt use, when compared to average sized older adults, both underweight and overweight older adults were more likely to indicate part-time use (BRFSS, 2002). Obese older adults are even more likely to report part-time and nonuse of seat belts.

Additional issues related to seat belt use among older adults include:

- Sex -- females are more likely to use seat belts than males;
- Marital status -- married older adults are more likely to use a seat belt than single individuals and divorcees;
- Air bag -- the presence of an air bag is positively related to seat belt use;
- Seating position -- passengers are more likely to use a seat belt in the front seat than in the rear positions; and
- Type of vehicle -- occupants of pickup trucks were the least likely to be using a seat belt (BRFSS, 2002; FARS, 2003).

C. Vehicle design

Research indicates that older adults are experiencing a higher rate of fatalities and injuries in motor vehicle crashes per miles traveled than their younger counterparts. Kent and Matsuoka (2005) found that frailty and pre-existing health conditions play a role in crash fatalities in the older adult population. One of the issues related to increased fragility in older adults is their lower level of chest injury tolerance (Zhou et al., 1996), and the risk of fatality from rib fractures increases with age (Wang, 1998). When compared to younger drivers, older belted drivers are more likely to be hospitalized as a result of a crash (Cook et al., 2000).

In spite of the injuries, seat belts still have a significant positive impact on survivability in crashes and help to prevent more severe injuries among the older adult population (Coley et al., 2002). Identifying seat belt designs that may increase comfort and restraint use, and potentially reduce the injury rate is an important goal for the traffic safety community. There are various key design issues that may improve both usability and comfort of vehicle restraint systems, and therefore increase the likelihood that older adults will use seat belts. These design features include belt force limiters, belt pretensioners, dynamic optimization and different sensor systems, integrated seat belt systems, seat belt presenters, and seat belt reminder systems. These systems are either in the development phase or may be found in many of the newer vehicle models. Several manufacturers are working on advances in vehicle design with older adults and baby boomers in mind (Broge, 2001; Greene, 2004; Ehrenman, 2003). These new design features include power swivel chairs, night vision technology, and larger knobs and mirrors.

There are also a couple of promising advanced seat belt systems in the design and testing phase that may be easier to use and potentially provide additional protection for older adults in a crash. Some manufacturers are currently testing a four-point seat belt, with the potential to distribute crash forces across more of the body. Four-point seat belts fit like a pair of

suspenders with a buckle in the front. Another new design includes an inflatable seat belt, designed with sensors similar to those in air bags (Rouhana, 2003).

Finally, there are a variety of aftermarket devices that vary in their design and function. These devices improve ease of reach, pulling or buckling, or improve the fit of the seat belt, and might increase likelihood of use. The following aftermarket devices were mentioned by the experts:

- Shoulder belt pad – provides padding and prevents seat belts from chafing skin and neck;
- Seat cushion – raises the upper body for a better fit for the belt across the shoulder and hips;
- Pivoting seat – raised disk allows for easy twisting to reach for shoulder belt, raises upper body, and results in better fit for lap and shoulder belt;
- Ribbon or plastic loop – permits easier reach for the seat belt and allows occupant to pull the shoulder belt towards the body without twisting of the body;
- Seat belt adjuster – positions the seat belt so it is easier to reach for fastening and so that it is positioned on the shoulder and doesn't chafe the neck; and
- Seat belt extender – extends the buckle so that it is easier to fasten the seat belt.

Original vehicle manufacturers must certify that their seat belt systems conform to requirements specified by Federal Motor Vehicle Safety Standards that are designed to protect vehicle occupants. It is important that no aftermarket device be used that would detract from the injury protection properties contained in those Standards. An aftermarket device should not interfere with any of the following: the lap belt fitting over the hips and not the abdomen, the shoulder belt lying on the chest and over the shoulder, and removal of any slack from the belt.

D. Media and education campaigns

There is no one program specifically targeted at promoting seat belt use among older adults. Rather there are programs and media campaigns such as *Buckle Up America* that are designed for the general public and intended to include older adults as part of the target population, or programs designed to promote safety for older drivers that include brief references to seat belts.

Among the programs developed to target the older adult population is the American Association of Motor Vehicle Administrators (AAMVA) GrandDriver program which included earned media, a speakers bureau, Web site, and toll-free informational telephone line. The GrandDriver brochure focused on the basic rules of driving including the instruction to always use a seat belt as well as descriptions of assistive features in the vehicle including height adjustable seats and seat belt anchors. GrandDriver media kits are now offered to States; however, the exposure and effects of the GrandDriver campaign are unknown.

The CarFit program, a 20-minute assessment of older drivers in their motor vehicles, was developed by the American Society on Aging, AAA, AARP, and the American Occupational Therapy Association in partnership with occupational therapists and other experts in the field of older driver research. The program uses an assessment tool, a checklist, which includes a line item on seat belt use. This line item instructs the assessor to check for misuse and ease of use of the seat belt. Among the material distributed to the older driver is a section under safety procedures that specifically addresses seat belts. CarFit was pilot tested in 10 cities in the

spring of 2005 with more than 300 older drivers. Findings indicated that the program was effective in improving the fit and conditions for older drivers in their vehicles (ASA Web site: www.asaging.org/asav2/carfit/). The CarFit program is now being implemented across the country.

Driver refresher training is another method by which information on seat belts and safe driving is being disseminated to older adults. Driver education is provided via various organizations including AAA and the AARP. Driver refresher training, videos, and material include information on seat belt use. AARP also includes a clip on methods to adjust the seat and belt so that the belt will fit properly. These courses are often connected with reductions in insurance rates and are therefore attended by many older adults.

The Gerontology Institute at the University of Massachusetts recently completed a study on "Promoting Safe Mobility Among Elders by Increasing Awareness of Vehicle Modifications." The project included focus groups, a video demonstration, and surveys. In the video, older drivers model the use of low-cost aftermarket devices to improve safe and comfortable driving. Many of the aftermarket devices mentioned by occupational therapists and driver rehabilitation therapists were included in the video. Those older adults who watched the video indicated that their awareness of adaptive features had increased and some indicated that they purchased one or more of the features described (Van Ranst et al., 2005).

NHTSA, AAA, and other organizations have developed brochures for older adults on safe driving. Much of this material mentions seat belts, although none specifically focus on this issue. Web sites tailored to older adults on safe driving are in place under the management of AOTA, the National Association for Area Agencies on Aging, American Medical Association, AAA, and AARP. Seat belts are featured on these Web sites, including admonitions to use belts, but these sources do not provide detailed guidance on how to improve the comfort or fit of a seat belt. Information specifically tailored to occupant restraint use among older adults is not available.

IV. FOCUS GROUPS

The focus group effort had two general objectives. First, it served as a useful qualitative method to explore a variety of key issues that influence seat belt use and nonuse among older adults. The group discussions provided a better understanding of what behaviors, attitudes, and physical limitations contribute to nonuse of seat belts among adults 65 and older. Second, it helped to direct the development of the subsequent in-vehicle study, and identified what might be done to increase belt use among older occupants, now and in the future.

A. Site selection

A total of 15 focus groups were conducted in four sites located across the country. One site was local to the Westat home offices in Rockville, Maryland. The remaining three sites were selected using Census data to identify States with larger numbers and percentages of older adults in their populations. States were also selected to represent different regions of the country, which allowed for the capture of responses that might vary by region. The four sites were:

- Miami, Florida - The State with the largest percentage of older adult residents (16.8%), an active senior community, and a warmer climate.

- Cedar Rapids, Iowa - The State has one of the highest percentages of older adults (14.7%), is located in the central region of the country, and has many seniors who remain in place upon retirement, often in rural communities.
- Boston, Massachusetts - Traditionally, one of the “older” States (13.3% of the population is over 65), many seniors live independently, and Massachusetts experiences extreme winters.
- Rockville, Maryland – Relative to the other 3 States, this State has a smaller percentage of older adults (11.4%), with 37% of seniors living alone. This State was selected in accordance with the contract which required a series of focus groups to be conducted local to Westat home offices.

In Maryland, Westat executed all necessary preparatory and logistic activities to conduct the focus groups. Focus group facilities were engaged in each of the remaining States to recruit and host the four focus groups. Project staff acted as the moderators at all focus groups.

B. Participant sample

Each of the focus groups had between 8 and 12 participants. Participants were recruited through advertisements in local newspapers and flyers posted in facilities frequented by older adults (senior retirement communities, senior centers, and community centers). Some recruiting was conducted on site at various community centers and senior living facilities. All advertising material referred to a discussion on “transportation issues for seniors (age 65+) traveling in a personal vehicle at least once a week.” When potential participants called in response to the advertisements or flyers, they were given a brief screening that collected information on age, sex, race, driving practices, health issues, and seat belt use.

All participants were older adults who drive or ride in a passenger vehicle on a regular basis at least once a week. Participants admitted to at least part-time belt use in response to a question regarding how often they use a seat belt or a query regarding the last time they did not use a seat belt.

In order to encourage thorough and detailed discussions of several topics that might contribute to nonuse by older adults, participants from the general senior population were recruited for some focus groups while other focus groups targeted participants of a specific age range, race, or physical limitations (arthritis, bursitis, osteoporosis, recent chest/abdominal surgeries, or other dexterity issues). Identifying participants for the various groups was based on research indicating that age, race, and physical limitations may all be correlated with seat belt use among older adults (Cordy et al., 2002; Balci et al., 2001; Steinfeld et al., 1999). The 15 focus groups were divided into two age groups, participants 65 to 79 (9 groups) and participants 80 and older (6 groups). Specific demographic groups included *Impaired Groups*, with individuals who have physical limitations that interfere or affect their daily living activities, *African-American Groups* and *Hispanic Groups*. The physical and demographic breakdown of the 15 focus groups is provided in Table 1.

Table 1: Physical and Demographic Characteristics Of the 15 Focus Groups		
	Age	
	65-79 Years Old	80+ Years Old
Unimpaired	3 Groups	2 Groups
Impaired	2 Groups	2 Groups
Hispanic	2 Groups	1 Group
African-American	2 Groups	1 Group

C. Procedures

The focus groups followed a structured question path (see Appendix A) led by a moderator. Each focus group was 1 ½ to 2 hours long and was audio-taped for review and analysis. The introduction indicated NHTSA sponsorship and presented the topic of older adults and seat belts. The moderator emphasized the need to discuss, in a non-judgmental way, their honest opinions and what they actually do with regard to using seat belts, rather than what they consider ideal or socially acceptable behavior.

The discussion began with an "ice breaker" question. Participants were asked to introduce themselves and respond to the question, "Can you tell me what comes to mind when you hear the words 'seat belt'?" The ice breaker gave everyone in the room a chance to introduce themselves and directed the attention of the group to the topic at hand. The moderator then proceeded to guide participants through a range of topics related to seat belt use. At the end of the focus group meeting participants were reimbursed for their time.

D. Topics

The focus group topics included issues related to seat belt use and nonuse discovered as being important to older adults during the literature review and discussions with experts. Each topic was introduced as a series of questions by the moderator.

The major focus group topics were:

- Comfort – seat belt features that are comfortable or uncomfortable;
- Convenience – difficulties reaching, buckling, and unbuckling;
- Physiological conditions – physical conditions that make seat belt use difficult or uncomfortable to use;
- Decision-making process – primary reasons participants choose to use or not to use a seat belt;
- Ideas for increasing comfort and convenience – discussion on better seat belt designs;
- Experiences with others and seat belts – riding with others including adults, seniors, and children; and
- Countermeasure proposals – review of various countermeasures including use of media outlets and other types of grassroots efforts.

E. Presentation of aftermarket devices

The final minutes of each session were devoted to a presentation of various aftermarket devices. The devices presented in the focus groups were identified in the literature review stage of this project, and included shoulder belt pad, seat cushion, pivoting seat, ribbon or plastic loop, seat belt adjuster, and seat belt extender. The moderator began the discussion on the aftermarket devices by clarifying that these products are not endorsed by NHTSA and that these devices are of interest because they may be used to increase comfort and usability of seat belts.

These devices were selected for demonstration because they are either currently used by older adults or were recommended by occupational therapists or driver rehabilitation experts as devices that may improve comfort and ease of use of seat belts (Van Ranst et al., 2005). All of the devices, with the exception of the seat belt extender, which must be obtained directly from the vehicle manufacturer, are sold in a variety of catalogs and automobile equipment stores.

F. Key findings

Several major themes emerged during the focus group discussions. The major themes were specific broad concerns that stood out based on commonality among the focus groups, the intensity of the discussion, the diversity of the described behavior, or significance of the issue. This section highlights the key findings and opinions voiced by the participants.

Participants had mixed opinions in response to the “ice breaker” regarding what comes to mind when the term seat belt is mentioned. While many of the individuals initially spoke of safety and protection, others were more negative in responding to the question, using words such as “restrained,” “constricted,” “nuisance,” “uncomfortable,” “harness,” “policemen,” or “ticket.” Some statements were more severe, including:

> *It’s an infringement on my privacy* (MD 80+ Unimpaired Group).
>
> *Feels like I’m being decapitated* (IA 65-79 Impaired Group).

Comfort

In general, most participants spoke of the discomfort associated with twisting and turning to reach for and buckle the seat belt. Others described numbness or a pain in their extremities that they related with sitting immobile with the seat belt secured.

A number of smaller-statured women complained about the shoulder belt chafing, choking, or rubbing across their necks. The pressure on the neck proved to be extremely uncomfortable and even painful for some women. One woman described an allergic reaction to the material in the seat belt causing chafing along her neck. Some of the participants sought ways to remedy the discomfort by using seat belt covers, clothing pins or adjustors to hold the shoulder portion of the belt away from their neck, or cushions to boost themselves up so the shoulder portion of the belt may fit better.

Heavier participants mentioned problems using the seat belt as well as discomfort or tightness felt around the waist once secured. Some participants noted that seat belts are not long enough for larger people and are often uncomfortable and tight when secured. In addition, some of the older model vehicles have seat belts that tighten as you ride (automatic locking retractors). This

increases the tightness which adds to the discomfort. Some of the heavier participants were embarrassed about their experiences, while others were more open to discussing their difficulties with using the seat belt. Participants also described providing rides to overweight older adults who have difficulty with seat belts due to their girth.

The effects of weather were brought up in some of the focus groups. In Florida there was discussion about the seat belt material chafing the skin in the heat. On the other hand, participants in Maryland, Iowa, and Massachusetts talked about the difficulty and discomfort associated with using a seat belt while wearing bulky winter coats.

While some of the participants chose not to use their seat belts at all, a number of individuals spoke of various techniques used to alleviate pain and discomfort. These techniques included holding the shoulder belt away from the body, loosening the straps, moving the shoulder belt portion behind the upper body, securing the seat belt behind them and then sitting on it, as well as using various assistive devices including covers, pillows, and cushions.

Convenience

Most participants mentioned a variety of challenges associated with reaching, pulling, buckling, and unbuckling the seat belt. A number of participants had difficulty reaching back for the shoulder belt. They complained about shoulder pain or difficulty twisting when reaching for the shoulder belt. Often, participants complained about the belt locking up midway through the buckling motion, and needing to start over which is very frustrating for them. In some cases the seat belt twists while being pulled and will not fasten, requiring them to start over with the entire process.

Many participants mentioned problems inserting the latch into the buckle portion of the seat belt. They noted difficulty finding the buckle as well as inserting the latch. For some participants unbuckling is problematic because the buckle is difficult to locate, and once they locate the buckle, it is difficult to release the latch from the buckle. These difficulties may result in an individual giving up on using the seat belt entirely or requesting assistance from other occupants which may be awkward and embarrassing.

> *Terrible, I finally have to ask somebody to do it* (unbuckle seat belt). *It's embarrassing, awfully embarrassing* (MA 80+ Impaired Group).

Unfamiliar vehicles pose additional challenges. The source of the shoulder belt, the location of the buckle, and release mechanism in the buckle all vary across vehicle types. When in an unfamiliar vehicle, older adults identify more trouble with locating and putting on a seat belt. Many participants felt that the seat belt system should be standardized across all vehicles so, for example, the release mechanism for the buckle is in the same location in all vehicles.

One participant in Iowa was a habitual user of para-transit transportation. She repeatedly mentioned that the seat belts in para-transit vans are often difficult to access and use although they are required. She finds it embarrassing when the para-transit access driver needs to provide assistance.

Most of the participants do not use their seat belts in the rear seat. They felt seat belts in the rear passenger seats are both harder to find and more difficult to buckle. In many vehicles the buckle is recessed back between the seat and the seat back which makes it difficult to find and use.

Physiological conditions

Older participants mentioned a number of physical conditions that either make it difficult for them to use the seat belt or prevent them from using the belt entirely:

- Arthritis, shoulder, or neck pain - These conditions make it difficult to twist, reach, pull, and buckle the seat belt. A number of the participants had full range of motion with only one arm which affects their ability to buckle up in either the driver or passenger side. In some cases the participants require assistance to buckle up. That is, on days when their arthritis or bursitis is "acting up" they cannot successfully buckle themselves, and need assistance from another passenger. Alternatively, some provide assistance to other seniors who have these conditions and need help buckling up.
- Recent surgery - A few participants had surgery in recent years or provided rides to seniors post-surgery and were able to describe the difficulties with belt use for this population. Surgeries that adversely affect seat belt use include shoulder, open heart, breast, and hip replacement surgeries. People who have recently had surgery near the chest experience pain and discomfort from the shoulder belt pressing on the chest. Others had surgery on their shoulders which limits their range of motion and impairs their ability to reach for shoulder belts. Finally, some participants stated that hip replacement made twisting to reach for the shoulder belt and buckle uncomfortable. Some participants found methods to alleviate discomfort including using the lap belt only, a cushion between the shoulder belt and chest, or loosening the shoulder belt by holding it away from their chest.

  When (husband) had this heart surgery, he had great difficulty with that tightness across his chest (MD 80+ Unimpaired Group).
- Pacemakers - A few participants have a pacemaker or provide rides to seniors with pacemakers. These individuals complained the shoulder belt pressing on the area of the chest with the pacemaker causes additional discomfort.
- Asthma - There were a few participants who noted that the tightness of the shoulder belt causes shortness of breath or asthma attacks.

Across the various focus groups a number of participants mentioned that doctors can provide patients with a note to show to law enforcement in the event they are pulled over for not using a seat belt. The note simply states that for medical reasons the occupant cannot use a seat belt. A number of participants have received such a note in the past or knew of friends and acquaintances who had one.

Decision-making process

Participants mentioned a number of reasons for increased belt use in recent years including personal experiences in crashes or of family members in crashes, mandatory seat belt laws, increased enforcement, receiving a citation, and reminders from friends and family. Additional factors that increase seat belt use are driving on high-speed roads, in heavy traffic, or in inclement weather.

Individuals mentioned a variety of reasons for not using a seat belt including the wish to be carefree, inherent laziness, stubbornness, the inconvenience of buckling and unbuckling every

time they need to get into and out of the vehicle, and not having to use seat belts when they were younger.

Because it is not their habit to put on their belts immediately, participants often said they simply forget to use their seat belts at the start of trips. When reminded by other passengers, drivers, or the seat belt reminder system they will put on their belt. These participants were more likely to advocate for various reminders in the vehicle including buzzers (belt reminder systems) and automatic seat belts.

Participants were least likely to use a seat belt when on short trips, or when riding along familiar, local, or low-speed roads. A short trip ranged from simply driving from one end of a shopping center parking lot to the other or as long as several miles within their communities. Many of the participants in the Iowa focus groups believed driving on rural roads or in the fields is less risky and thus they are less likely to use a seat belt. In addition, participants mention that they will not use a seat belt within the confines of their retirement communities or within a gated community. They believe State seat belt laws do not apply within the walls of the community, and also feel that they are at less risk of having a severe crash because the speed limits in the development are often 20 mph or below and there are many stop signs. Conversely, some of the participants noted that on long trips the seat belt becomes uncomfortable, and they will attempt to adjust, loosen, or simply remove the seat belt.

In Massachusetts, a secondary seat belt law State, there was some discussion regarding the fact that lack of a mandatory law decreases their likelihood of using a seat belt. In fact they interpreted the secondary law as allowing a person to choose whether or not to use a seat belt. Participants were quick to note that they are much more careful about using a seat belt while driving through Connecticut (a primary seat belt law State).

> *I don't think it should have been optional because I think if you have a law it shouldn't be you can wear it if you want to* (MA 65-79 African-American Group).

Most participants agreed that in towns with strict enforcement policies or during seat belt enforcement campaigns they are more likely to buckle up. Many of the participants believe that seat belts are not needed in the back seat, because it is safer. In fact a number of individuals mentioned that, unlike in the front seat where you can be injured by an air bag or the windshield, in the rear seat the front seat will cushion you in the event of a crash.

While some participants indicate that seat belts provide safety "most of the time," in each of the four States, focus group participants mentioned a fear of being trapped in their belts in the event of a crash. Many felt that they would not be able to release the seat belt and might be trapped in the vehicle. In Florida this apprehension is directly related to the canals that run along the roadways and the participants there all expressed a strong fear of being trapped in the vehicle and drowning. Other participants mentioned that often an individual is knocked unconscious, and therefore, may not be able to extricate himself. Some participants suggested that seat belts automatically retract after a crash or after the engine is turned off.

Many of the participants did not like to use seat belts when they were wearing nice clothing. On these occasions they are more apt to hold the shoulder belt away from their bodies or not use them at all in order to prevent wrinkling. Participants cited church and other activities when they have on fancy dresses, beading, corsages, or jewelry. In one group Hispanic men complained about how seat belts wrinkle their guayaberas (linen shirts).

Ideas for increasing comfort and convenience

Most participants advocated for the use of softer, more comfortable fabric for the seat belt design. Many believed that a softer material would resolve many of the comfort issues such as rubbing against the neck and clavicle.

Many thought better adjustments for the shoulder belt and seat would also assist in increasing comfort. Participants believed that having better adjustments for the shoulder belt and seat would allow them to achieve a customized and comfortable fit. The participants talked about new designs including automatic seat belts, and suspender-style seat belts. They had mixed opinions about these designs. While some felt these designs would help them to use the belt and increase comfort, others felt it would not increase their likelihood of use and would even be more cumbersome. Ignition interlocks were seen by some as a foolproof method to get people to use their seat belts; other participants thought this method would be invasive or dangerous. Some participants were familiar with automatic seat belts; however several considered them startling or unpleasant. Finally, a number of participants claimed that comfort was not the main issue, belt use is more a matter of habit and until it becomes a habit there is always a chance that a person will not use a seat belt.

Experiences with others and seat belts

Participants were quick to note they are more likely to use a seat belt as passengers. Some individuals will use a seat belt when asked to by the driver either because they were “reminded” or out of respect for the driver’s wishes. Others are more likely to use one because they do not trust the driver’s abilities.

Interestingly, when participants learned that the driver of the vehicle is responsible for the passenger’s belt use, all said they would be more careful about using seat belts. Participants did not want to be responsible for drivers being cited for seat belt violations. In addition, many said they were more likely to buckle up in the presence of grandchildren or children so as to serve as role models. Participants noted that children are very quick to remind them to buckle up and are much more used to seat belts.

The younger set of focus group participants (age 65-79 years) discussed providing rides to seniors older than themselves. When providing rides to others, participants often encounter physical limitations that affect the older passengers’ seat belt use. Arthritis, obesity, post-surgery, as well as various other impairments and ailments often impede older adults’ ability to easily use their seat belts. Many of the participants found themselves having to assist their older relatives and friends.

> *I’m older but I have older friends and it’s difficult for them to even get into the car. So you’ve got to help them in and then you buckle them up…. I don’t think they could have put the seat belt on themselves* (MA 65-79 African-American Group).

Perceived effectiveness of countermeasure proposals

During the course of the focus group participants were asked for suggestions on how to communicate the importance of using seat belts to the older adult population. As members of AARP, many read the organization’s magazines and newsletters, and believed the magazines and letters to be good venues for communicating with the older adult population. Many of the

older participants felt that national campaigns are targeted at younger adults and therefore they ignore their message. In order to get the attention of older adults, they believed a campaign needs to focus on their generation and also suggested a more grassroots approach. Other venues mentioned include insurance companies' newsletters, senior center programs, health fairs, and various social events. Participants also recommended monetary incentives such as lower insurance premiums.

When trying to convey the message, participants overwhelmingly voiced interest in real-life images and stories of people who were in a crash and survived because they were restrained or died as a result of being unrestrained, rather than just using statistics. However, some did agree that numbers of fatalities or crashes may be included alongside the personal anecdotes. The importance of using large-size text was mentioned. Television and radio, specifically local news shows, are viewed by participants as the most effective. In the case of Hispanic participants they recommended using Latino channels.

Most of the participants would be interested in attending a CarFit type event, where drivers are reintroduced to their vehicles and their different features. However, some said that it would not be a good idea to compare the CarFit event to child-seat-fitting stations.

Presentation of aftermarket devices

The presentation of various aftermarket devices to increase comfort and usability of seat belts received extremely positive feedback. A number of participants wanted to know where they could purchase these items and if they are considered "safe." Participants said that not only were these devices likely to increase their comfort but they believed they would be more inclined to use their seat belts. Many of the smaller-stature participants who complained about the seat belt chafing at the neck were interested in the seat belt pad or seat belt adjuster. The shoulder pad was made of felt or sheepskin and wraps around the shoulder belt and minimizes chafing, while the adjuster moves the shoulder belt away from the neck.

A few heavy-set participants expressed an interest in the seat belt extender, assuming that it would minimize the tightness around the waist line and enable them to find the buckle more easily.

A number of the participants already own and use some of these devices. A few of the participants created their own shoulder belt pad, ordered extenders from their dealerships, or use seat cushions. The participants noted that they learned about the devices from friends or family members, and in some cases their children purchased devices for them. Those devices which raised the most interest included the shoulder belt pad, the plastic loop, and the seat belt extender. All three were incorporated into the field data collection study that followed the focus groups.

During the course of the focus groups many participants repeatedly came back to discomfort as a major reason for not using seat belts or using them incorrectly. Many participants attempted to maneuver the belt (hold the belt away from body, place shoulder belt behind upper body) or introduce devices (seat belt covers, clothes pins, cushions) that would address some of the sources of discomfort. With that in mind Westat designed a field data collection effort that specifically investigated various types of seat belt systems and their effect on seat belt use on the older adult population.

V. FIELD DATA COLLECTION

The field data collection was designed to provide a more quantitative approach in gathering information on issues related to comfort and convenience of seat belts for older drivers and passengers. The procedures and design of the in-vehicle study were based on the results of the literature review, discussions with experts, evaluation of existing data sources, and the focus groups. The in-vehicle study allowed for careful examination of older occupants operating seat belts in various vehicle-seat configurations. A controlled experimental approach was applied, in which specific variables of interest were selected for evaluation.

The primary objective was to examine the relationship between seat belt system characteristics and user characteristics in determining comfort and convenience, and relating these factors to the likelihood of seat belt use. The participants provided ratings on the comfort and usability of various seat belt configurations, and responded to open-ended questions addressing specific seat belt configurations and features (see Appendix B for the Field Data Collection form).

A. Selection of seat belt systems

The study consisted of six seat belt systems selected to provide a diversity of belt configurations, seat types, seat adjustability, and vehicle types. The three test vehicles varied in size. Features of the systems in the vehicles selected for this study are described below:

- Compact vehicle – In the particular model used, the shoulder belt descends from the B-pillar. The shoulder belt has an adjuster on the B-pillar. The seat belt buckle stalk extends from the seat in proximity to a relatively small center console. The latch plate was able to slide along the lap and shoulder belt. The vehicle had manual seat adjustments and a smaller cabin.
- Mid-size vehicle – In this particular model the shoulder belt descends from the B-pillar; in this two-door design the B-pillar is substantially further back than in a four-door design. The seat belt buckle stalk is recessed in the seat alongside a large console that descends to the floor of the vehicle. The latch plate was able to slide along the lap and shoulder belt. The vehicle had both manual and automatic seat adjustments.
- Full-size vehicle – In the model used the shoulder belt originates from the retractors attached to the front passenger seats. The seat belt buckle stalk protrudes from the seat in proximity to a medium-sized center console. The latch plate was sewn directly onto the straps of the lap and shoulder belt, making it stationary on the belt and requiring a very specific angle in order to be able to insert the plate in the buckle. Automatic adjustments and integrated seat belts with retractors attached to the driver and right-front passenger seats.

Participants experienced a total of six seat belt systems. Each test vehicle was experienced twice, once with the original belt system and once with a modified belt that included one of three aftermarket devices (seat belt extender, plastic loop, or shoulder pad). These devices generated considerable interest among the focus group participants. Each aftermarket device was paired with one of the three vehicle systems. The six seat belt systems were as follows:

- Compact
- Compact/Seat Belt Extender

- Mid-Size
- Mid-Size/Plastic Loop
- Full-Size
- Full-Size/Shoulder Pad

Each aftermarket device was paired with the one base system for which it was likely to be most effective in increasing comfort and usability of the seat belt system. The plastic loop was paired with the two-door mid-size vehicle to facilitate reaching for the seat belt. The shoulder pad was paired with the integrated seat belt system in the full-size vehicle to reduce chafing to the neck. The seat belt extender was paired with the compact vehicle to assist with buckling, especially in the case of the rear seat. The devices were not rotated among the different systems due to the limited number of data collection trials possible in the time frame of the study. Even with the limited number of trials, the in-vehicle task typically took between 90 minutes and 120 minutes to complete, and the length raised serious concerns regarding participant fatigue. Although this design may have resulted in a possible confounding effect of the vehicle base seat belt system on the utility of a particular aftermarket device, the findings may suggest that for some older adults, improving comfort and usability of the various seat belt systems might increase the likelihood that they will use them.

B. Participant sample

All of the participants were recruited in the greater Washington, DC, area. Recruitment efforts targeted nonusers and part-time users who traveled in a personal vehicle at least once a week. A total of 54 test subjects participated in the study. Based on information gathered from literature review as well as findings from the focus groups, selected subgroups of older adults with various physical limitations were targeted for inclusion in the field study. The most common limitations cited by older adults were arthritis, flexibility issues, bursitis, osteoporosis, recent chest or abdominal surgery, pacemakers, weight, and stature. Participant characteristics were identified using a screener, similar to that used in recruiting for the focus groups.

C. Design and procedure

The study used a three-factor experimental design with one between-subjects factor (participant group) and two within-subject factors (seat belt system, seating location). Data were collected for two seat locations, driver and front seat passenger, for all six systems. Data were collected for two systems in the rear left seating position in one of the vehicles (compact). All of the test vehicles had the same type of rear-seat belt system, the shoulder belt was integrated into the seat back (as opposed to a pillar on the side of the vehicle) and the buckle deeply recessed between the seat and the seat back. Given that many older adults have difficulty maneuvering into and out of the back seat and in order to keep the session to a reasonable length, data for the rear seating position were collected in only one vehicle.

Passenger data were collected for all participants, driver data were only collected for those participants who were active drivers. Therefore, each participant who was an active driver had 14 data collection trials and each non-driver (n=1) had 8 data collection trials. The order in which participants encountered the various seat belt systems was randomized and counterbalanced to preclude any effects of sequence.

Data collection took place at the Westat home office in Rockville, MD in a covered parking garage. All vehicles remained stationary during the study. Occupants completed a series of tasks simulating the typical range of driver and passenger actions and body positions. A moving vehicle study was not conducted due to concerns regarding the safety of the participants as well as their comfort and convenience. Having participants drive the vehicles would have added time to an already lengthy data collection session and asking older participants to drive unfamiliar cars presented a number of safety concerns. In addition, many of the complaints regarding seat belts involve use and comfort, and may be experienced while a vehicle is stationary.

Each test vehicle was outfitted with a video recorder and multiple video cameras to capture user behavior in all tested seating positions. The video captured the series of movements involved in reaching, pulling, and buckling the seat belt. The video recordings allowed for more detailed analysis following the completion of real-time observations.

Each session began with the experimenter providing a brief introduction of the study, after which each participant was required to sign a consent form. Once the experimenter described the study and pointed out the video cameras, participants were directed to the first of the six systems.

For each vehicle, the driver and passenger seats were initially adjusted to the most rearward and lowest positions and the seat backs to the most forward positions. The experimenter briefly described all of the available seat (and steering column for driver seat) adjustment options, and then asked the participant to adjust the seat to his or her preferred position. Once the seat was adjusted, the participant was asked to buckle, adjust, and unbuckle the seat belt two times. No instruction on how to use the seat belt was provided, unless the participant was unable to use the belt without assistance. The initial attempt to use the seat belt system helped to familiarize the participant with the system as well as reveal whether the mechanism was intuitive and easily mastered. The initial trial also made typical errors more evident. After two trials the participants were more familiar with the mechanism, so that their ratings of comfort and convenience reflected a more typical user. Following the second operation of the seat belt the experimenter measured the horizontal and vertical distance of the participant's shoulder to the D-ring on the B-pillar and the fore/aft distance of the vehicle seat.

The experimenter then requested that the participant go through some of the typical actions one might complete as a driver, front-seat passenger, or rear-seat passenger in accordance with the seating position. These actions included:

- Driver - Assume a driving position with hands on the steering wheel and foot on the gas pedal; turn the steering wheel in each direction; simulate backing up from a parking space; check mirrors; move the steering wheel as if changing lanes; adjust heating control; pick up cup from a cup holder; speak to a passenger in the rear.
- Front Passenger - Speak with the driver; reach down to pick up a package; turn to speak with a rear passenger; adjust heating control; pick up cup from a cup holder.
- Rear Passenger - Turn to speak with a neighbor; reach down to pick up a package; lean forward to hand something to a front seat occupant.

During the next phase of data collection, participants responded to a series of ratings and open-ended questions concerning the comfort and usability of the seat belt system. After the participants completed ratings and responded to open-ended questions regarding comfort and convenience for each of the six systems, they were asked to indicate the system they liked the

most and the least. The participants were also asked which components of the various systems they liked or disliked. Finally, they were asked to compare the systems, to the configuration in their own vehicle (or the vehicle in which they travel most often).

Once the participants experienced all six seat belt systems, they completed a brief form that inquired about their general state of health, awareness of any chronic health conditions, use of assistive devices in vehicles, frequency of travel in a personal vehicle, and seat belt use habits. Then anthropometric measurements were taken for each participant including height, arm length, leg length, and weight. Once the data collection was complete, participants were asked to sign a consent form permitting use of footage from the video recordings in presentations and reimbursed for their participation.

D. Major themes

For each exposure to a specific seat belt system, objective measures and subjective judgments were collected. Together, these data described how the participant used the seat belt system, what problems were encountered, and how acceptable the system was to the user. All these measures were self-reported. In order to ascertain their opinions regarding the system while they were currently experiencing it and to avoid confusion between the systems, these ratings and questions were asked of each participant following a trial in each of the seating positions.

Rating scales

The rating scales addressed comfort and usability of a particular system in a given seating position. The scale ranged from 1 through 10. Participants were instructed to consider all of the tasks they performed while wearing the seat belt prior to making any ratings. The ratings included:

- Comfort;
- Ease of reaching;
- Ease of buckling;
- Ease of unbuckling; and
- Likelihood of belt use.

For comfort ratings, a “1” corresponded to “extremely comfortable” and a “10” corresponded to “almost impossible to find a comfortable fit.” For usability ratings, a “1” corresponded to “almost effortless” and a “10” corresponded to “almost impossible for me to do.”

Finally, during each trial, participants were asked to rate their likelihood of using the seat belt system when sitting in a given seating position. A “1” corresponded to “I would wear the seat belt every time” and a “10” corresponded to “I would never wear the seat belt.”

Open-ended questions

The open-ended questions inquired about specific difficulties encountered and the relative comforts and discomforts of each system. In addition, after the second seat belt system was experienced in a particular vehicle, participants were asked if either system (i.e., base system or modified system with aftermarket device) was more comfortable and/or easier to use.

E. Data reduction

Once data collection was complete for all 54 participants, the video recordings for each participant were reviewed in detail. Experimenters evaluated footage to capture details not immediately evident during the initial data collection.

The experimenters timed each participant completing the task of operating the seat belt. For each of the two attempts, timing began when the participant reached for the shoulder belt and ended when the latch was secured in the buckle.

Footage of the participant's second attempt to fasten the seat belt and the tasks performed while wearing the seat belt were reviewed for the following information:

- Type of reach for the shoulder belt - overhand, underhand, or crossing over the torso;
- One-handed or two-handed buckling; and
- Obvious difficulties – belt lock-up; need to shift or lift body; cutting or tightness on neck, waist, or chest.

F. Database and analysis

Data from the in-vehicle study were entered into an Excel database. The files were set up with a unique ID number for each participant. The database included elements from the participant screeners and post-survey, in-vehicle study data elements, anthropometric measurements, and observations from data reduction.

Analytic methods included simple modeling (e.g., logistic regression). However, given that the sample size was only 54, significant relationships between the dependent and independent variables were not common. When the relationship between the dependent and the independent variable was statistically significant it is cited in the report, otherwise relationships are presented as trends that might be of interest with regard to future study on a larger scale. Findings for each target group were compared and contrasted, allowing outcomes to be related to user characteristics, and also to determine the generality of belt feature effects across target groups of interest. The analysis identified problem areas for countermeasure design as well as the most suitable configurations for target groups of older vehicle occupants.

G. Key findings

The following sections outline participant characteristics and their ratings for comfort and usability of the base and aftermarket systems as well as the increased likelihood of seat belt use they reported for the six systems.

Participants

A total of 19 males and 35 females participated in the field study. They ranged from 65 to 89 years old. Among the 35 females, the average age, height, and weight were 75 years (65-87 years), 63.3 inches (53-68 inches), and 160 lbs (101-268 lbs), respectively. Among the 19 males, the average age, height, and weight were 79 years (66-89 years), 68.1 inches (63-72 inches), and 181 lbs (129-245 lbs), respectively. All participants traveled in personal vehicles at

least once a week; many served as drivers and provided rides for their spouses and friends (see Table C1).

When asked about their general health, 89% of the males felt their health was between good and excellent, and 94% of the women believed their health was between good and excellent. Only 5% of males and 6% of females rated their general health as fair or poor. However, when asked if they had any disabilities or health problems that can make seat belt use more difficult or uncomfortable, 50% of females and 42% of males identified problems with arthritis. Participants also suffered from general stiffness and shoulder problems. Approximately 30% of males reported multiple disabilities or limitations. Table 2 lists the disabilities and limitations as well as the percentages of individuals who identified each as a problem that might affect their seat belt use.

Table 2: Percentage of participants who reported physical disabilities and limitations that affect seat belt use

	Male	Female
Arthritis	42%	50%
Stiffness	16%	18%
Shoulder Problems	16%	3%
Weight Issues	11%	0*
Hand Dexterity	5%	3%
Chronic Pain	5%	3%
Recent Chest Surgery	5%	0%
Height Issues	0*	9%
Pacemaker	0*	6%

* None reported by participants.

Some of the participants reported part-time seat belt use in the driver, front passenger, and rear passenger seats. Among the males, 32% and 47% reported part-time use in the driver and front passenger seating position, respectively. Among the females, 50% and 30% reported part-time use in the driver and front passenger seating position, respectively. In reference to the rear passenger seat, 74% of males and 74% of females reported part-time use. Eleven percent of males and 9% of females indicated that they never used a seat belt in the rear seating position. The percentages of participants reporting part-time use by the various seating positions are shown in Appendix C Table C2 and Graph C1.

Participants' ratings for base seat belt systems

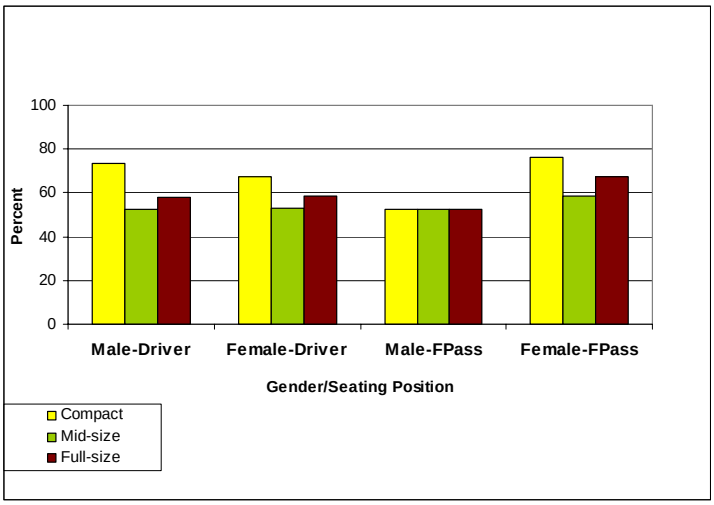
A comparison of the three base seat belt systems in the two front seating positions shows that, overall, the system in the compact vehicle was rated the most comfortable, easiest to reach with regard to the shoulder belt, and easiest to buckle by the older participants. The system in the compact vehicle was often followed by the system in the full-size vehicle in the ratings for most of the seating positions while the system in the mid-size vehicle received the lowest ratings in most of the seating positions. The percentages of participants who gave positive ratings for comfort, ease of reach, buckling, and unbuckling by seating position are shown in Appendix C Graph C2 through Graph C5. Using the rating scale of 1 through 10, a positive rating was

defined as a rating of 1 through 3. This definition was applied throughout the report when referring to a “positive rating” unless otherwise noted.

Participants cited a number of difficulties with operating the base seat belt system in the two-door mid-size vehicle. Overwhelmingly, participants said the location of the shoulder belt was inconvenient. The majority of participants had difficulty locating and reaching for the shoulder belt that was affixed to the B-pillar. Because the center console in between the two front seats was large and rigid, most participants had difficulty finding and seeing the buckle that was recessed between the seat back and seat cushion.

Due to the fact that the seat belt system in the full-size vehicle is integrated into the seat back, many participants had difficulty finding the shoulder belt and needed to twist around to locate it, and then twist again to insert the latch into the buckle. As with the system in the mid-size vehicle, participants had difficulty finding and seeing the buckle in the full-size vehicle, and felt that the area around the buckle was too narrow. In addition, the design of the latch plate in the full-size vehicle requires positioning it at a very specific angle to the buckle so that it will catch. Many older participants had difficulty finding this angle and voiced frustration. Unlike the systems in the full-size and mid-size vehicles, the compact seat belt system received few complaints; most were about the seat and had nothing to do with the belt system.

There were statistically significant differences ($p = .03$) in how participants rated their likelihood of using the three base seat belt systems. When asked how likely they would be to wear each type of seat belt, both males and females were most likely to say they would wear the belt in the compact vehicle on every trip. They were least likely to believe they would wear the belt in the mid-size vehicle on every trip. Graph 1 shows the reported likelihood of “all the time” belt use for each base seat belt system by sex and seating position.



Graph 1: Percentage of participants reporting “all of the time” belt use for the base system by sex and seating position

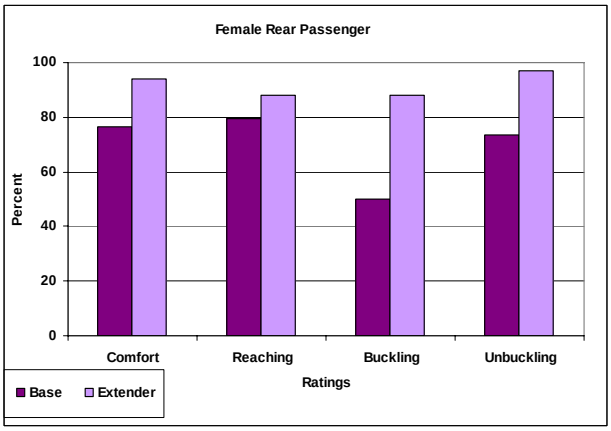
Participants only experienced the rear seating position seat belt system in the compact vehicle. Interestingly, the ratings for comfort and usability for the system in the rear seat of the compact vehicle were lower than those for the front passenger seat for both males and females. These differences were not statistically significant. Graphs C6 and C7 in Appendix C compare ratings given to the two passenger seating positions in the compact vehicle.

As mentioned earlier, the design of the rear seat belt system included an integrated shoulder belt and the buckle that was deeply recessed between the seat and the seat back. As with the system in the full-size vehicle, many participants had difficulty finding the shoulder belt and needed to twist around to locate it, and then again to insert the latch into the buckle. Participants had difficulty locating the buckle in the rear seating position, and felt that the seating area was too narrow, resulting in them sitting on the buckle. Several participants had difficulty with belt lock up when trying to operate the system, or after the belt was on and they tried to reach for something.

Comparison between base system and system with aftermarket device

Participants experienced each test vehicle twice, once with the original belt system and once with a modified belt that included one of three aftermarket devices (seat belt extender, plastic loop, and shoulder pad). One aftermarket device was introduced to the base system of each vehicle. As participants experienced each vehicle they rated both systems independently for comfort and usability. Once they had experienced both the base system and the modified system, participants were asked if either of the two systems was more comfortable and/or easier to use.

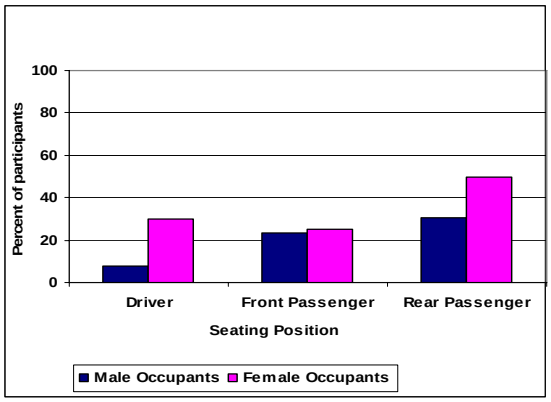
The seat belt extender was added to the base system in the compact vehicle. There was not much difference in the independent ratings for comfort and usability between the compact and compact/extender conditions in the driver and front passenger seating positions, as shown by Graphs C8 to C11 in Appendix C. In the rear seating position, there was a noticeable increase in both the comfort and buckling ratings for both males and females when using the extender. However this increase in ratings was not statistically significant. Graphs 2 and 3 show the percentage of participants who gave positive ratings for the rear passenger seat in the compact and compact/extender conditions.



Graph 2 and Graph 3: Percentage of participants who gave positive ratings for the rear passenger seat in the compact and compact/extender conditions

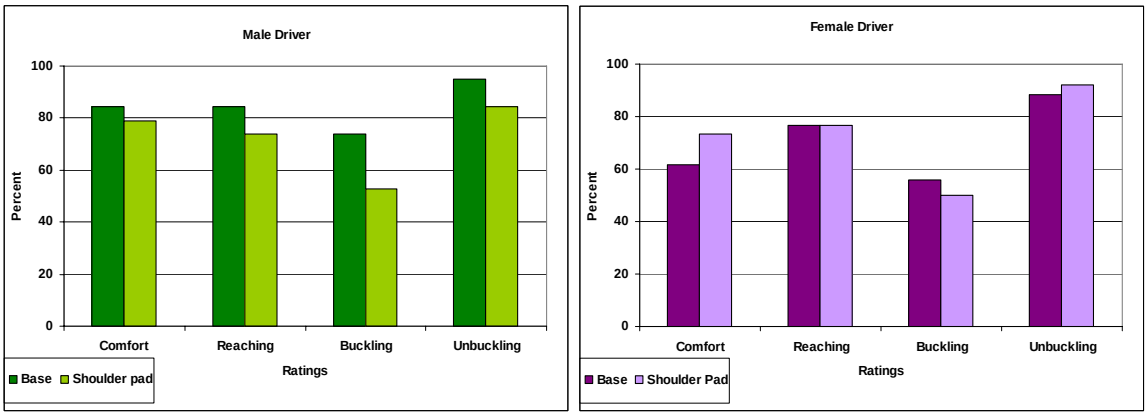
Once the participants experienced both belt systems in the compact vehicle they were asked to compare the base and aftermarket systems and indicate whether either system was more comfortable or easier to use. When comparing the two systems in the compact vehicle, 13 males and 20 females said the presence of the extender improved both the comfort and usability of the seat belt. A proportion of these 33 participants also said the presence of the

extender would increase their likelihood of using this belt system. This was most apparent in the rear passenger position. Among participants who believed the extender improved seat belt comfort and usability, Graph 4 shows the percentage who said they would use their seat belt more often if an extender was added.



Graph 4 Percentage of participants who said that they would use their seat belt more often with extender added to the seat belt system in the compact size vehicle (N=33)

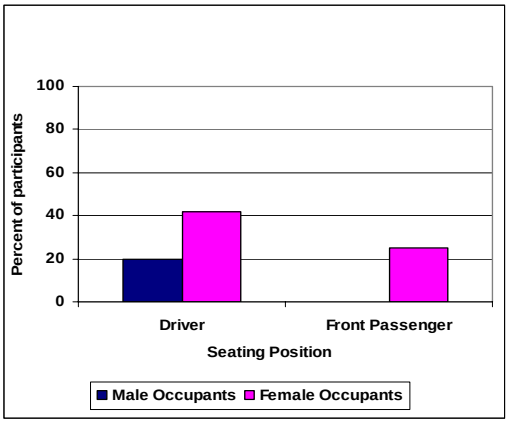
The shoulder pad was added to the system in the full-size vehicle. When rating comfort independently for each of the two systems, some female participants rated the shoulder pad system higher than the base system in the driver position. Participants' ratings for usability did not improve in the shoulder pad condition. Graphs 5 and 6 show the percentage of participants who gave positive ratings for comfort and usability in the full-size and full-size/shoulder pad conditions in the driver position. Graphs C12 and C13 in Appendix C show the percentage of participants who gave positive ratings for the front passenger seat in the full-size and full-size/shoulder pad conditions.



Graphs 5 and 6: Percentage of participants who gave positive ratings for comfort and usability in the full-size and full-size/shoulder pad conditions in the driver position

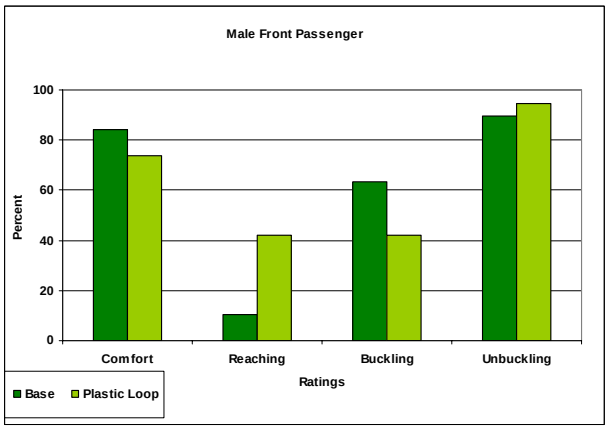
Once the participants experienced both belt systems in the full-size vehicle they were asked to compare the base and aftermarket systems and indicate if either system was more comfortable and/or easier to use. Among the 5 male and 12 female participants who said the shoulder pad made the seat belt more comfortable and easier to use in the full-size vehicle, there were

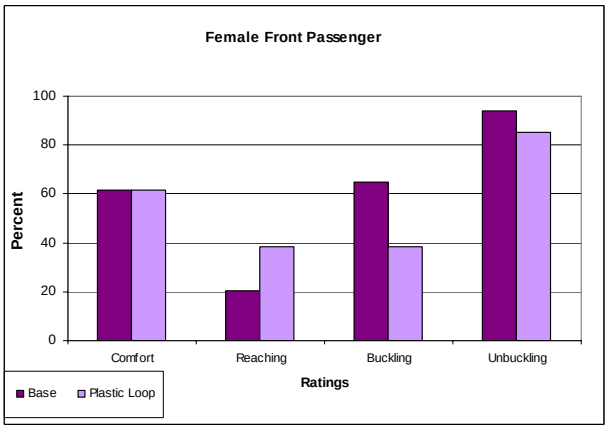
participants who said they would be more likely to use the seat belt system if a shoulder pad was part of the system. Although some participants felt the aftermarket device added comfort, it got in the way when they were trying to operate the system. Others simply mentioned that it was too thick and did not add any comfort. Graph 7 shows the percentages of the 17 participants in the two seating positions who said they would use their seat belt more often with this system.



Graph 7: Percentage who said they would use their seat belt more often with shoulder pad added to the system in the full-size vehicle (N=17)

The plastic loop was added to the system in the mid-size vehicle. It was found to be helpful for many of the participants in locating, reaching for, and pulling the shoulder belt towards them. However, the plastic loop got in the way when participants tried to buckle or complete other maneuvers. This pattern is most evident in the front passenger position for both female and male participants and is presented in Graphs 8 and 9 below.





Graphs 8 and 9: Percentage of participants who gave positive ratings for comfort and usability in the mid-size and mid-size/plastic loop conditions in the front passenger position

Graphs C14 and C15 in Appendix C show the percentage of participants who gave positive ratings for the driver seating position in the mid-size and mid-size/plastic loop conditions.

Of the participants who felt that the plastic loop system in the mid-size vehicle improved usability, none felt that it would increase their likelihood of using the seat belt. The benefit of being able to reach the shoulder belt was outweighed by the difficulties experienced once they

had the belt in hand and tried to buckle it. The plastic loop often got caught along the shoulder belt and made it difficult for them to maneuver the latch into the buckle. In addition, the plastic loop would often end up sitting across the participant's chest once they were buckled in and many participants found this uncomfortable.

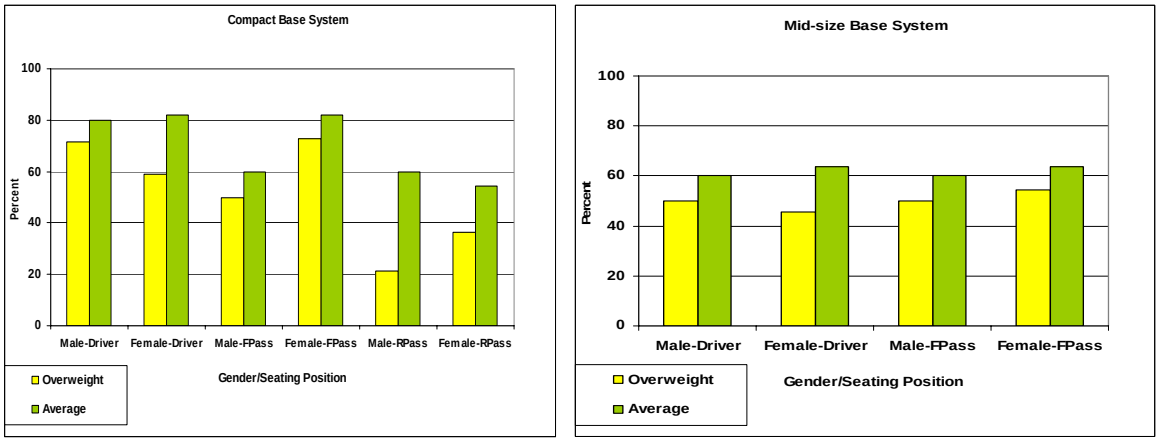
Special physical and health considerations

Based on findings from the literature review and information gathered during the 15 focus groups, two target populations among older adults were singled out for additional analyses: individuals who were identified as overweight and those considered to be smaller stature.

Overweight participants

Using the Body Mass Index (BMI) a subgroup of overweight participants was identified. The Centers for Disease Control and Prevention (CDC) identify the BMI index as a reliable indicator of body fatness, and it is a common screening tool for identifying possible weight problems in the adult population (www.cdc.gov/nccdphp/dnpa/bmi/). BMI is calculated using weight and height measurements. Of the 54 participants, 14 males and 22 females were identified as overweight.

When compared to average-weight participants, overweight participants were less likely to say they would use their seat belt in both the compact and mid-size base systems in all seating positions. This finding, however, was not statistically significant. Overweight participants complained about the shoulder belt cutting across their neck and being too tight across their chest, not being able to find the buckle, and needing to twist to find the shoulder belt and buckle. Graphs 10 (compact vehicle) and 11 (mid-size vehicle) show the percentage of participants in each weight category (overweight and average) who said they would use their seat belt 100% of the time in the various seating positions.



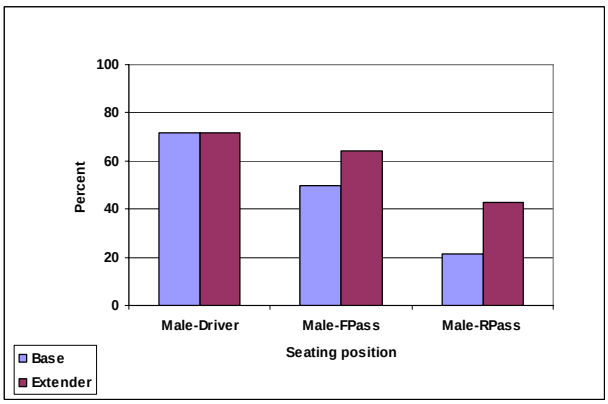
Graph 10 and 11: Percentage of average and overweight participants who said they would use their belt all of the time by sex and seating position in the compact and mid-size base systems

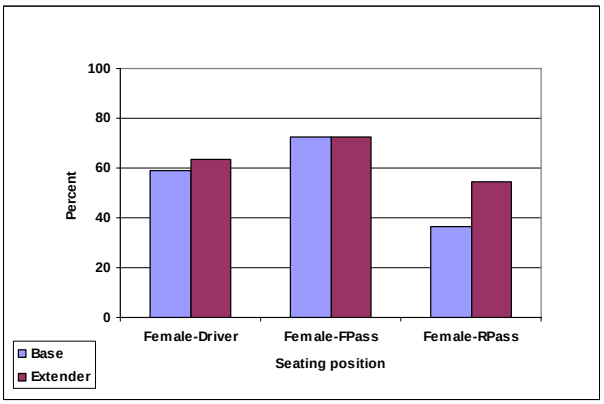
However, in the full-size base system the data were not so clear. In the driver position, overweight participants were more likely to report that they would wear the belt, while in the front passenger seating position the percentage of overweight individuals willing to wear the seat belt 100% of the time was lower. Graph 12 shows the percentage of participants in each

weight category (average and overweight) who said they would use their seat belt 100% of the time in the various seating positions in the full-size base system.

Graph 12: Percentage of average weight and overweight participants who said that they would use their belt all of the time by sex and seating position in the full-size base system

Introducing the aftermarket devices to the three seat belt systems had no major effect on anticipated belt use by the overweight participants with the exception of the rear seating position of the compact vehicle. Both overweight males and females reported increased likelihood of seat belt use when the extender was added to the base seat belt system in the rear seat of the compact vehicle. Graphs 13 and 14 show the percentage of overweight participants who said they would use their seat belt 100% of the time in the compact vehicle with, and without, the extender.





Graph 13 and 14: Percentage of overweight participants who said they would use their belt all of the time by sex in the compact base and the compact/ extender conditions

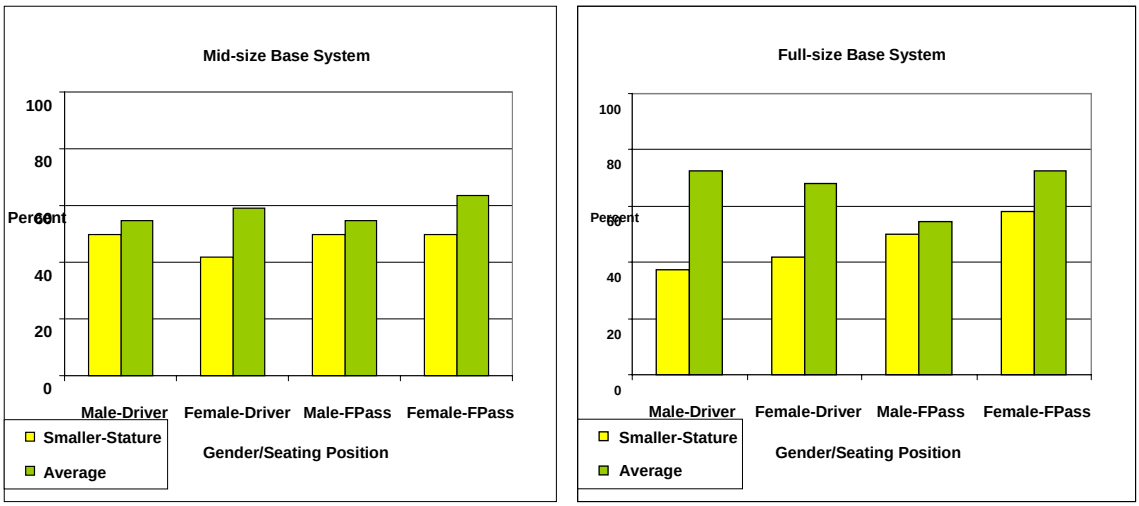
The addition of the plastic loop and the shoulder pad in the mid-size and full-size vehicles did not influence the likelihood of seat belt use for overweight participants (See Graphs C16, C17, C18 and C19 in Appendix C). One possible reason for the increased likelihood of seat belt use in the compact/extender condition could be that this aftermarket device addressed complaints overweight participants had about the seat belt including the shoulder and lap belt being too

tight across the chest and lap, not being able to find the buckle, and needing to twist to find the buckle. Conversely, the plastic loop and shoulder pad might not have resolved specific problems overweight participants had in using the seat belt.

Smaller-stature participants

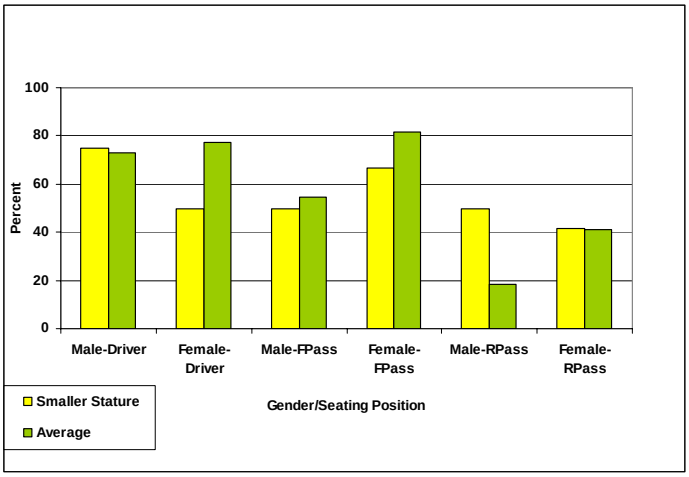
Using CDC data for the average height of older adults 65 and older, a subgroup of smaller-stature participants was identified. According to CDC data the average height for older adult males and females is 68 and 64 inches, respectively (McDowell, 2005). Twenty participants (12 female and 8 male) who were under the average height for their sex were classified as smaller-stature. When compared to average-height participants, smaller-stature participants were less likely to use their seat belt all of the time. This difference was statistically significant (p=.003).

In both the mid-size and full-size base systems smaller-stature participants complained about the shoulder belt cutting across their necks, not being able to find or reach the shoulder belt, and needing to twist to find the shoulder belt. Graphs 15 and 16 show the percentage of smaller-stature and average-height participants who indicated that they would use their seat belt 100% of the time in the various seating positions in both the mid-size and full-size base vehicles.



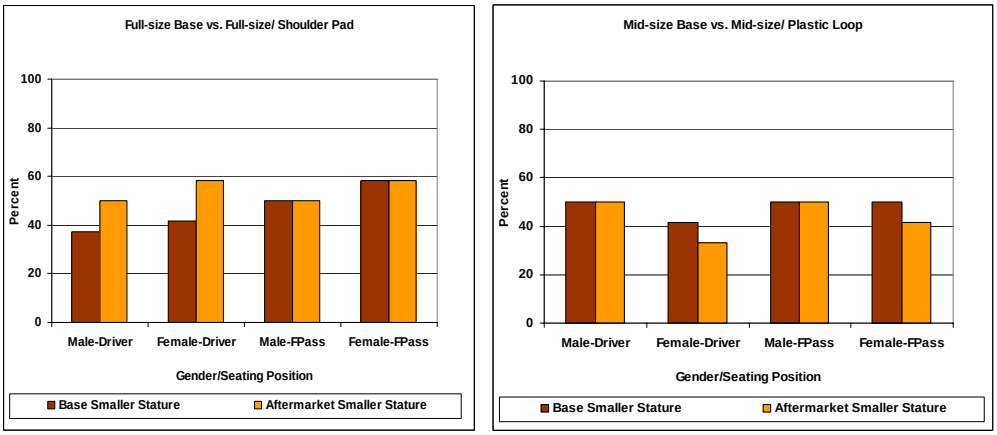
Graph 15 and 16: Percentage of average and smaller-stature participants who said they would use their belt all of the time by sex and seating position in the mid-size and full-size base systems

However, in the compact base system the data were not so clear. Smaller-stature women in both the driver and front seating positions were less likely to report they would use their seat belt 100% of the time. On the other hand, there appeared to be no differences between average-height males and smaller-stature males in the two front seating positions. In the rear passenger position, average-height males were less likely to anticipate using their seat belt 100% of the time. For some of the taller male participants getting into the rear seat of a compact vehicle limited their mobility, and sitting comfortably was difficult due to the length of their legs. These difficulties may have colored their ratings for this seating position.



Graph 17: Percentage of average and smaller-stature participants who said they would use their belt "all of the time" by sex and seating position in the compact base system

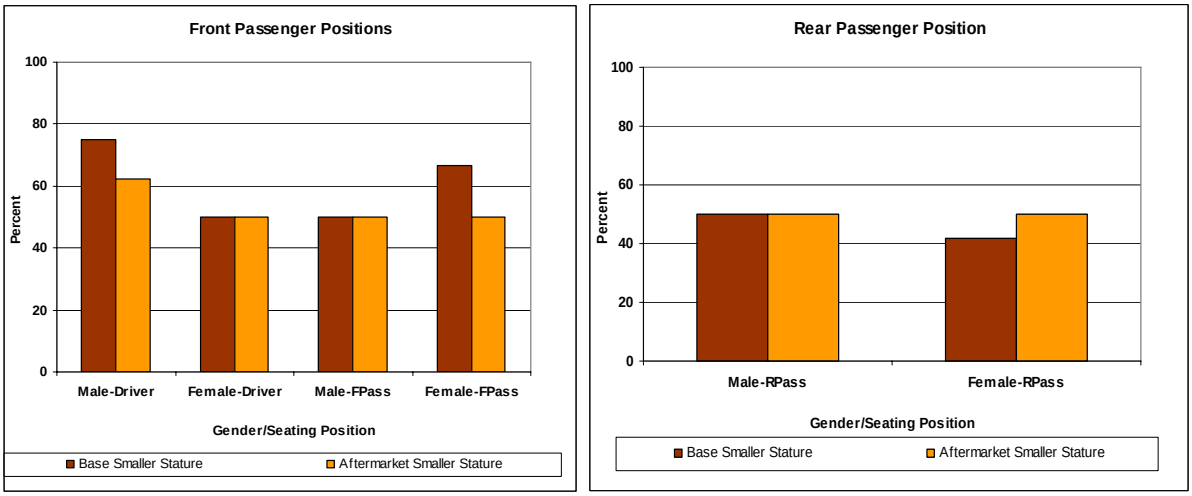
Smaller-stature participants reacted differently to the introduction of the three aftermarket devices. In the driver position of the full-size vehicle, both smaller-stature males and females reported increased likelihood of seat belt use when the shoulder pad was added to the system. However, the shoulder pad produced no change in anticipated seat belt use in the front passenger position. When the plastic loop was introduced to the seat belt system in the mid-size vehicle, smaller-stature females were less likely to say they would use the seat belt. Smaller-stature males were not influenced by the addition of the plastic loop in the mid-size vehicle. Graphs 18 (full-size vehicle) and 19 (mid-size vehicle) show the percentage of smaller-stature participants who said they would use their seat belt 100% of the time with and without the aftermarket device.



Graph 18 and 19: Percentage of smaller-stature participants who said they would use their belt "all of the time" by sex and seating position in the full-size and mid-size base and aftermarket systems

For smaller-stature participants, introducing the extender to the front two seating positions of the compact vehicle generated mixed results. When the extender was introduced to the driver seating position, smaller-stature males seemed less likely to anticipate 100% future use of the seat belt, and there was no influence on use in the front passenger seating position. The

reverse was true for smaller-stature females. In the front passenger seating position they seemed less likely to expect 100% future use of the seat belt with the extender, and there was no influence on use in the driver position. Introducing the extender in the rear passenger seating position had little or no influence on anticipated seat belt use for either smaller-stature males or females (see Graphs 20 and 21).



Graph 20 and 21: Percentage of smaller-stature participants who said they would use their belt all of the time by sex and seating position in the compact base and aftermarket system

The only aftermarket device that seemed to positively influence the likelihood of seat belt use among smaller-stature participants was the shoulder pad in the full-size driver position. It might be due to the fact that among smaller-stature participants one of the major complaints about the belt systems was chafing along the neck and clavicle. While the plastic loop in the mid-size vehicle might have helped them to locate and reach the shoulder portion, the difficulties they had manipulating the belt once they reached it may have outweighed the benefits for many participants.

VI. KEY FINDINGS AND RECOMMENDATIONS

Although belt use is already very high among the older adult population, a large proportion of older adults continue to be involved in fatal crashes. There are a number of methods that may be used to increase seat belt use among older adults. In consulting with experts and examining existing data and literature, key research gaps and recommendations for future studies have been identified. The issues that need to be addressed and examined in detail include: improved vehicle designs that will result in higher rates of seat belt use by allowing for more-comfortable access and fit and by providing better protection to this fragile population in the case of a motor vehicle crash, as well as communications programs developed and tailored to older age groups and subgroups. In addition, research that will examine seat belt use patterns of older adults or target populations within the older adult community is needed to forecast future scenarios and develop additional programs.

With regard to media campaigns, there are many well established large-scale public information and education campaigns focused on increasing restraint use. However, few are targeted at the older adult population. *Buckle Up America, Click It or Ticket,* and *Over the Limit. Under Arrest.*are all national campaigns to increase safety along the roadways in an effort to save lives and prevent injuries. While many older adults are aware of these programs, they do not believe the campaigns are specifically targeting them. Many disregard the message, believing these campaigns are only for younger adults and teens.

During the focus groups older adults repeatedly referred to a fear of being trapped by the seat belt in the event of a crash. Many believed that the belt will lock up during a crash and they will not be able to extricate themselves from the vehicle. Others believed the rear seating position in the vehicle was safe "because the back of the front seats will act as a cushion during a crash" and they therefore did not need to buckle up. Any educational program must focus on overcoming these beliefs.

Educating older adults on the benefits of seat belt use might simply mean adjustments in who is targeted and how the information is distributed. To illustrate, *Buckle Up America* has involved numerous organizations and individuals that deal on a daily basis with the older adult community, such as health professionals, hospitals, police, and fire and rescue teams. *Buckle Up America* could include a campaign specifically targeted at the older adult community using these professionals to communicate the seat belt message. Based on discussions during the focus groups, many older adults responded positively to a grassroots approach of disseminating information. Venues such as senior center programs, health fairs, and various social events were thought to be particularly effective; locations that provide older adults an opportunity to socialize with their peers and provide local representatives an opportunity to disseminate the information on a smaller scale.

While the literature regarding the effect of race/ethnicity on seat belt use presents conflicted findings, it is evident that each community may react differently to campaign efforts to increase seat belt use (Arce et al., 2004; Parada et al., 2001; Harper et al., 2000; Sapolsky, 2001; Nelson et al., 1998; Stiles et al.,1999). Any attempt to increase belt use in the different racial and ethnic communities must consider the different customs and perceptions within that community. Concerns regarding law enforcement are very evident in both the Hispanic and African-American communities. If law enforcement is used in conjunction with a well planned educational message regarding the benefits of seat belt use, it may result in higher belt usage. If the information campaign is not well thought out, some groups might feel they were targeted because of their race/ethnicity. Campaigns are most effective when they consider the concerns, customs, priorities, and values of the target community.

Nonuse or part-time belt use among older adults can fall into two categories: those who do not use seat belts for behavioral or attitudinal reasons and those who do not use seat belts because of physical challenges or limitations that prevent them from doing so comfortably. Barriers including difficulty reaching around for the belt or inserting the latch plate into the buckle may be due to simple limitations in mobility associated with aging, or to more serious limitations due to severe arthritis.

Prior to this project, there were no specific studies examining the relationship between seat belts, seating characteristics, and user characteristics in determining comfort and convenience,

and in turn relating this to the likelihood of belt use for older adults. By selecting a sample of senior drivers and passengers to operate seat belts in a variety of vehicles and in different seating positions in each vehicle, this project was able to relate seat belt features and seat configuration to measures of performance, comfort, convenience, and likelihood of belt use. This project also identified problem areas for countermeasure design indicated as most suitable for the older adult population.

The limited evidence available from the current study suggests comfort and convenience is related to greater reported likelihood of seat belt use among the older adult population. A comparison of the three vehicle seat belt systems showed that, overall, the compact vehicle was rated the most comfortable, easiest to reach with regard to the shoulder belt, and easiest to buckle by the older adults. The compact vehicle was often followed by the full-size vehicle in ratings for comfort and usability while the mid-size vehicle received the lowest ratings in most seating positions. The 2-door mid-size vehicle consistently received the lowest ratings because the B-pillar was located farther back, making the shoulder belt difficult to find and reach for a large number of older adults. In addition, the buckle was recessed in between the seat cushion and the center console, making the buckle difficult for most participants to find and use. Not surprisingly, when asked how likely it was that they would use one of the three base systems, older adults were more likely to say they would use the compact system “all of the time” in most seating positions.

Introducing aftermarket devices intended to improve comfort and usability seemed somewhat effective in increasing the likelihood of belt use among the older adults. That is, among those older adults who felt that the addition of the aftermarket device increased comfort and usability of the system, some felt it would also increase their likelihood of seat belt use in that particular vehicle. Of the three aftermarket devices, the seat belt extender in the compact vehicle received the most positive feedback. While many older adults understood the purpose of the shoulder pad and the plastic loop, and found them helpful in finding a comfortable fit or locating the shoulder belt, their true benefit might have been masked by difficulties older adults had operating the seat belt with the devices attached. If these two aftermarket devices were integrated into the seat belt design, and therefore stationary on the belt, older adults might have had a different experience. Alternatively, introducing each aftermarket device to different types of seat belt systems might have resulted in different conclusions regarding effectiveness in improving comfort and usability. In order to make strong conclusions regarding the characteristics and design features necessary to increase seat belt use among the older population, a more-in-depth analysis using a larger sample of older adults is necessary, as well as a more random design where participants experience each aftermarket device in each vehicle.

As with any population, different subgroups within the older adult population have different requirements with regard to comfort and convenience. Older adults who were overweight were less likely than their average-weight counterparts to report that they would use the seat belt. These individuals often complained of difficulty finding the shoulder belt and buckling, a tightness across the chest and waist, and belt lock-up. For these individuals the only aftermarket device that offered some relief and increased likelihood of using the belt was the seat belt extender in the rear seating position. This seating position was often the most uncomfortable for overweight older adults because the source of the shoulder belt was integrated into the seat back, requiring them to twist. In addition, the seat was narrow and the buckle was deeply

recessed in between the seatback and seat. Smaller-stature adults were less likely to use their seat belt in both the mid-size and full-size base systems in all seating positions. They complained about the shoulder belt cutting across their necks in the full-size vehicle, not being able to find or reach the shoulder belt, and needing to twist to find the shoulder belt in the mid-size vehicle. Adding a shoulder pad to the full-size base system did increase the number of older adults who felt that they would use their seat belt. In both the overweight and smaller-stature groups, the addition of an aftermarket device that addressed specific complaints resulted in some increase in reported likelihood of using seat belts in the vehicle.

While strong conclusions regarding the different systems and their effect on older adults' seat belt use are limited due to the small sample size in the current study, the findings suggest that improving the comfort and convenience of seat belt systems might increase the likelihood that they will use them. Throughout the study, older adults defined convenience as a shoulder belt and buckle that are easily located and reached with little twisting of the torso, a shoulder belt that does not retract or lock up while in operation, and a buckle that you can hold with one hand while inserting the latch. Once buckled, comfort is defined as a seat belt that is not snug or tight along the chest, neck, or abdomen, and has flexibility. When these conditions were satisfied older adults were more likely to report that they would use the seat belt. However, in order to make strong recommendations regarding the specific characteristics and design features necessary for older adults to easily operate and wear a seat belt, more in-depth analyses using a larger sample of older adults are necessary. A larger sample will allow for significance testing among the various systems and older adult populations, and permit more definitive conclusions regarding the different systems and their effects on older adults' belt use. Such a study might also include a more-random design where participants experience each aftermarket device in each vehicle, so that a more-thorough examination of the effects of the different design systems on belt use among older adults can be completed.

Findings from the current study suggest that changing one feature on a seat belt can make it more user friendly for the older adult population. It might be interesting to examine the effects of introducing multiple devices to the base system. Will introducing the plastic loop and the belt extender simultaneously to the base system increase the positive effect for older adults? Given that the seat belt system in the compact model was the most popular in the current study, receiving the highest ratings for comfort and convenience, it might be interesting to take a more-thorough look at the features and design of the belt system in the compact vehicle model. Will introducing the different aftermarket devices, such as the plastic loop and extender, compound the positive effects of comfort and convenience and further increase the likelihood of use among older adults?

Finally, an examination of the different subgroups of the older adult population suggests benefits to designing a seat belt that can be customized to address the different needs of vehicle occupants. Manufacturers may consider incorporating a retractable extender into the buckle portion of the seat belt so occupants can pull it into view when buckling and unbuckling. While older adults objected to automatic seat belt systems, it might be helpful to design a belt that would present the shoulder belt to the occupant who would then pull it forward to buckle. For older adults, both of these concepts would address two major usability concerns and implementing them might increase their likelihood of using seat belts on a regular basis.

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Appendix A
Focus Group Question Path

FOCUS GROUP QUESTION PATH

1. Review Purpose, Objective, and Scope of the Focus Group

- Introduce moderator/staff and indicate NHTSA sponsorship
- General topic has to do with transportation patterns and the comfort and usability of seat belts.

What we are especially interested in today is why older adults choose not to use seat belts when traveling in passenger vehicles. You have been selected to participate in this focus group because you stated that there are times you do not use your seat belt. We would like to understand the reasons why this nonuse occurs and use the information we gather today to develop strategies or design changes that might increase seat belt use. There are no "right" or "wrong" answers. We are here to learn from you. We want to know the types of situations and thought processes that drive your decision not to wear seat belts or only use them on occasion. We won't be judging your responses, nor will we share any information you provide with any licensing authority. In fact, your name and any other identifying information will not be shared in any report of our findings. Our objective is just to gain some insights about why people don't wear seat belts, and if there is anything that can be done to increase the likelihood of their wearing one. As we go through the session, I will guide us along various topics, but you will be the experts doing the talking.

2. Clarify Focus Group Procedures and Etiquette

- Round table discussion, encourage cross talk among group, not to/from moderator
- Moderator guides discussion, topics
- Give everyone opportunity to speak
- Looking for range of perspectives, not consensus; need <u>your</u> view
- Inform of being audiotaped for offline analysis; participation is voluntary
- Please do not hold any side conversations with your neighbor during the focus group. It may be picked up on the audiotape.
- Refreshments, rest rooms, breaks, payment

3. Self Introductions and Ice Breaker

Go around to each person in turn.

- Can you tell me what comes to mind when you hear the word "Seat belt"?

  Why does _____ come to mind?

If Hesitation from Group:

- Is there a word or image that comes to mind when you hear the word "Seat belt"?
- What is the purpose of a seat belt?
- Do you think that wearing a seat belt improves safety or do you think it really won't make a difference? If not, why?

4. Focus Group Topics

Detailed exploration of problems, group-specific focus;

A. Comfort

- Does anyone here have difficulty with finding a comfortable fit when using a seat belt?
- What about the seat belt or its design makes it difficult to find a comfortable fit?
- What comfort issues have ever caused you not to wear a seat belt when traveling in a vehicle?

How about these problems?

- Shoulder belt cuts across neck and chokes occupant
- Seat belt puts pressure on skin and chest
- Uncomfortable or difficult to use due to girth or height
- Desire not to wrinkle clothing
- Problems with maneuvering medical devices
- Other issues related to comfort that I may not have mentioned

B. Convenience

- Do you find buckling or unbuckling a seat belt to be difficult in any way?
- What kinds of situations make using a seat belt difficult?

Probe for these types of responses:

- Difficulty reaching for shoulder belt and pulling across body
- Difficulty inserting latch plate in belt buckle
- Belt buckle and stalk is difficult to locate
- Release method is confusing
- Passive shoulder system can be startling
- Other issues related to comfort that I may not have mentioned

C. Physiological Conditions

- Does anyone here have physical conditions that make using a seat belt difficult?

- Arthritis of Cervical Spine and hands
- Joint deformity
- Osteoporosis
- Kyphosis
- Lack of Flexibility
- Presence of a Pacemaker
- Recovery from Recent Surgery
- Weight and Height Issues

- How does *the condition* make it difficult to use and secure a seat belt?

D. Decision-making Process

- What are your primary reasons for wearing and not wearing a seat belt?
- Has your frequency of seat belt use changed over time? How did it change? What caused the change?
- What are the times or situations that might influence your wearing or not wearing a seat belt?

Read List of Bullets

- Length of Trip
- Type of Trip
- Time of Day
- Weather Conditions
- Who is Driving
- Difference between Driver and Passenger
- Presence of Other Passengers
- Presence of Children in Vehicle

E. Increasing Comfort and Convenience

- Is there anything you can think of that might increase the comfort of the seat belt?
- How about anything that would increase the likelihood of your wearing the seat belt?

F. Perceived Effectiveness of Countermeasure Proposals

- If you had to develop a public information campaign directed at older adults, and the goal of the program was to increase seat belt use by seniors, what would you do?
- What type of information would you include?
- What do you think would be the most effective way to disseminate the information?

    - Include as part of Introduction to Vehicle from Dealership when Purchasing
    - Include within driver refresher training
    - Public events to address older drivers "fit" in their motor vehicle
    - Media Campaigns utilizing radio, television, print media
    - Dissemination of Brochures via AARP, AAA
    - Websites

- Do you feel that there are additional methods that would increase the likelihood of seat belt use among older adults in addition to public information campaigns?
    - How would you feel about the use of interlock devices to enforce belt use, including ignition and gear shift locks?
    - What is your opinion regarding increased Law Enforcement campaigns?

G. Experiences with Others and Seat Belts

- Does anyone here regularly provide rides to other older adults? *(If yes, continue)*
- Do the older adult passengers tend to wear seat belts? If not, why not?
- Do you ever assist any of your older adult passengers to put on their seat belt? *(If yes, continue)*
- Do you ever experience difficulties helping them put on their seat belts? If so, what are those difficulties?

H. Presentation of Alternative Seat Belt Designs, Vehicle Design Features, and Aftermarket Devices

Aftermarket Devices

There are a number of aftermarket products that you can use to increase comfort and usability of seat belts. I would like to discuss some of these products with you. These devices are not endorsed by NHTSA. [Bring in photos/video/devices]

- Are you familiar with any of these devices?

    - Seat Belt Pad of Sheep Skin Cover
    - Seat Cushion
    - Pivoting Seat
    - Ribbon or Plastic Loop
    - Seat Belt Adjuster
    - Seat Belt Extender

- Have you used any of them? If so, has the device made it easier to use the seat belt?
- Do you think using one of these devices would make seat belts more comfortable or easier to use?

5. Closing Remarks

Thank you for your time. What we have heard and learned about today will help the NHTSA in promoting appropriate and effective programs to increase seat belt use among older adults.

- Instruct participants as to how they will be reimbursed for their time.

Appendix B
Field Data Collection Material

OLDER OCCUPANT PROTECTION: DATA COLLECTION FORM

General Instructions

Our objective is just **to gain some insights** about how people use their seat belts and what they find comfortable or uncomfortable about different seat belt designs. I am going to ask you to sit in several different cars, with several different kinds of seat belts. You will be sitting in several seat locations in each car: driver seat, front passenger seat, and rear passenger seat.

In each seat location, I will have you adjust the seat and operate the seat belt a couple of times. After you have the seat and the belt adjusted I will take a few measurements of your seating adjustments. Then, I will ask you to go through a few actions that simulate the sorts of things you might do as a driver or a passenger. For example, turn the steering wheel or adjust the climate control. Next, I will have you give us your opinions about how easy and comfortable the seat belt was to use. Some of these opinions will be in the form of ratings on a 1-to-10 scale. Other questions will directly ask you to identify what you did or did not like about the seat belt system. I will explain the questions in more detail for you later. Finally, I will take some measurements of your height, arm length, leg length, torso, etc.

We will also be making a video recording while you do all this. There are cameras mounted in each car. The cameras will provide us with a visual record of your actions and will also provide a record of what you say. These video recordings will be used only for making measurements and recording your answers to the questions we ask. We will not share any identifying information you provide with any licensing authority, nor will any identifying images of you be included in any reports without your expressed permission. So, if you do not sign the second image consent form I will give you at the end of the session be assured that we will not use any images in any reports or presentations.

As we go through the session, I will guide you through the various tasks, but I would like you to feel free to express any opinions you might have, identify any difficulties you might have working the seat belt systems or aspects about each system that you might like as we are working through the session.

Before we start I would like to ask you about the vehicle you drove here today.
Are there any things about the seat and belt in your vehicle that make it particularly uncomfortable or difficult to use?

Do you have any questions before we go to the first car?

Vehicle Form

Subject Number: _____
Date: _____

Vehicle Type: Full-size Mid-size Compact

Aftermarket Device: None Shoulder Pad Plastic Loop

Seat Belt Extender

Driver Seat Ratings

Direct participant to driver seat:

First I would like you to adjust the seat and steering wheel to get them where you are most comfortable for driving. Remember, I would like you to adjust all the vehicles features into the positions that would be most comfortable for you to drive **this vehicle.**

Seat Adjustments

In this car, the seat has these adjustments:
[indicate controls for forward position, back angle, seat height, etc.]

The steering wheel has these adjustments.
[indicate options for steering wheel angle, extension]

Now go ahead and adjust the seat and steering wheel into the positions you would like them to be in if you were going to drive this vehicle.

Using the Seat Belt System

1ST Trial

Now I would like you to buckle yourself in.
[when done:]

The seat belt attachment can be adjusted up or down. If you would like to adjust this, go ahead and do that now.
[make D-ring adjustment. Also any adjustment related to aftermarket device. When done:]

Now unbuckle the seat belt.
[be sure belt retracts all the way]

2nd Trial

Now please buckle the belt again and leave it on.

Good. I have to make a few measurements now that you have the seat and belt adjusted.

- Distance from shoulder to D-Ring/B-pillar
  - Horizontal Measure _____
  - Vertical Measure _____

- Seat position fore/aft _____

Now, I would like you to go through some of the actions you might make when you are actually driving.

- First, assume the position you take while you are driving down the road (Hands on the steering wheel, foot on the gas pedal) and hold that for a little while. (hold for 10 seconds)
- Now turn the steering wheel as though you were making a right turn.
- Turn on the turn indicator for a left turn.
- Check your driver side mirror to see if the left lane is clear.
- Now turn the steering wheel as though you were changing lanes to the left.
- Look over your shoulder as if you were backing up.
- Adjust the heat control so that the temperature is comfortable for you.
- Pick up the cup from the cup holder.
- Turn to face someone in the rear passenger seat.

Good. Now unbuckle your seat belt.

Vehicle Form / Driver

Ratings for Comfort and Usability

Now, I would like you to make some ratings.

1. Considering all of the tasks I had you do while you were wearing this seat belt, if you were driving this car, how comfortable would you find driving in this seat and with this seat belt on?

   1= it was extremely comfortable. I could easily wear this seat belt and drive
   10= it was almost impossible to find a comfortable fit.

   1 2 3 4 5 6 7 8 9 10

2. How easy or difficult was it to reach for the shoulder belt portion of the seat belt? Rate the ease of reaching from 1 to 10, where

   1= the act of reaching for the shoulder belt was almost effortless
   10= the act of reaching for the shoulder belt almost impossible for me to do

   1 2 3 4 5 6 7 8 9 10

3. How easy or difficult was it to operate the buckle of the seat belt? Rate the ease of buckling from 1 to 10, where

   1= the act of buckling this seat belt was almost effortless
   10= the act of buckling this seat belt was almost impossible for me to do

   1 2 3 4 5 6 7 8 9 10

4. How easy or difficult was it to unbuckle the seat belt?

   1= the act of unbuckling this seat belt was almost effortless
   10= the act of unbuckling this seat belt was almost impossible for me to do

   1 2 3 4 5 6 7 8 9 10

5. Tell me about any specific problems you had adjusting the seat belt or buckling or unbuckling it. *If you notice someone having problems with a specific aspect of buckling and unbuckling and they do not mention it at this point, prompt.*

6. Were there any things about this seat and belt that made it more comfortable or easy to use?

7. Were there any things about this seat **and** belt that made you particularly uncomfortable? *If you notice someone having problems with a specific aspect of buckling and unbuckling and they do not mention it at this point, prompt.*

8. If you had this type of seat belt in your car, how likely do you think you would be to wear the seat belt?

   1= I would wear the seat belt every time I drove the car, no matter what the trip
   10 = I would never wear the seat belt, no matter what the trip

   1 2 3 4 5 6 7 8 9 10

****

[Note: Only ask once participant has been in the same vehicle twice (with and without the aftermarket device)]

9. You have been in this vehicle with two different seat belt systems (with and without an added aftermarket device). Can you tell me if either of these systems was more comfortable and/or easier to use? Why?

Vehicle Form

Front passenger seat ratings

Direct participant to front passenger seat:

First I would like you to adjust the seat to where you are most comfortable sitting in this car. Remember, I would like you to adjust all the vehicle's features into positions that would make you the most comfortable as a passenger in **this vehicle**.

Seat Adjustments

In this car, the seat has these adjustments:
[indicate controls for forward position, back angle, seat height, etc.]

Now go ahead and adjust the way you would like it.

Using the Seat Belt System

1st Trial

Now sit in the seat and buckle your seat belt.

[when done:]

The seat belt attachment can be adjusted up or down. If you would like to adjust this, go ahead and do that now.

[make D-ring adjustment. Also any adjustment related to aftermarket device. When done:]

Now unbuckle the seat belt.

[be sure belt retracts all the way]

2nd Trial

Now please buckle the belt again.

Good. I have to make a few measurements now that you have the seat and belt adjusted.

- Distance from shoulder to D-Ring/B-pillar
  - Horizontal Measure _____
  - Vertical Measure _____
- Seat position fore/aft _____

Now I would like you to go through some of the actions you might take when you are actually riding as a passenger.

- Turn as though you were talking to someone in the driver's seat.

- Reach down as though you were picking up some object, such as a handbag or package, off the floor.
- Turn as though you were talking to someone in the rear seat.
- Adjust the heat control so that the temperature so that it is comfortable for you.
- Pick up the cup from the cup holder.

Good. Now unbuckle your seat belt.

Vehicle Form / Front Passenger

Ratings for Comfort and Usability

I would like you to make some ratings.

1. Considering all of the tasks I had you do while you were wearing this seat belt, if you were riding in this car, how comfortable would you find riding in this seat and with this seat belt on?

   1= it was extremely comfortable. I could easily wear this seat belt and ride
   10= it was almost impossible to find a comfortable fit.

   1 2 3 4 5 6 7 8 9 10

2. How easy or difficult was it to reach for the shoulder belt portion of the seat belt? Rate the ease of reaching from 1 to 10, where

   1= the act of reaching for the shoulder belt was almost effortless
   10= the act of reaching for the shoulder belt almost impossible for me to do

   1 2 3 4 5 6 7 8 9 10

3. How easy or difficult was it to operate the buckle of the seat belt? Rate the ease of buckling from 1 to 10, where

   1= the act of buckling this seat belt was almost effortless
   10= the act of buckling this seat belt was almost impossible for me to do

   1 2 3 4 5 6 7 8 9 10

4. How easy or difficult was it to unbuckle the seat belt?

   1= the act of unbuckling this seat belt was almost effortless
   10= the act of unbuckling this seat belt was almost impossible for me to do

   1 2 3 4 5 6 7 8 9 10

5. Tell me about any specific problems you had adjusting the seat belt or buckling or unbuckling it. *If you notice someone having problems with a specific aspect of buckling and unbuckling and they do not mention it at this point, prompt.*

6. Were there any things about this seat and belt that made it more comfortable or easy to use?

7. Were there any things about this seat **and** belt that made you particularly uncomfortable? *If you notice someone having problems with a specific aspect of buckling and unbuckling and they do not mention it at this point, prompt.*

8. If a car that you sometimes ride in as a passenger had this type of seat belt, how likely do you think you would be to wear the seat belt?

   1= I would wear the seat belt every time I rode in the car, no matter what the trip
   10 = I would never wear the seat belt, no matter what the trip

   1 2 3 4 5 6 7 8 9 10

****

[Note: Only ask once participant has been in the same vehicle twice (with and without the aftermarket device)]

9. You have been in this vehicle with two different seat belt systems (with and without an added aftermarket device). Can you tell me if either of these systems was more comfortable and/or easier to use? Why?

Rear passenger seat ratings

[Note: skip the rear passenger seat in all vehicles except the compact and compact extender systems]

Direct participant to right rear passenger seat

Using the Seat Belt System

1st Trial

Now sit in the seat and buckle your seat belt.
[when done:]

Now unbuckle the seat belt.
[be sure belt retracts all the way]

2nd Trial

Now please buckle the belt again.

Good. I have to make a few measurements now that you have the [seat and] belt adjusted.

- Distance from shoulder to D-Ring/B-pillar
  - Horizontal Measure _____
  - Vertical Measure _____

- Seat position fore/aft _____

Now, I would like you to go through some of the actions you might take when you are actually riding as a passenger.

- Turn as though you were talking to someone in the seat next to you.
- Reach down as though you were picking up some object, such as a handbag or package, off the floor.
- Lean forward as though you were handing something to someone in the front passenger seat.

Good. Now unbuckle your seat belt.

Vehicle Form / Rear Passenger

Ratings for Comfort and Usability

I would like you to make some ratings.

1. Considering all of the tasks I had you do while you were wearing this seat belt, if you were riding this car, how comfortable would you find sitting in this seat and with this seat belt on?

   1= it was extremely comfortable. I could easily wear this seat belt and ride
   10= it was almost impossible to find a comfortable fit.

   1 2 3 4 5 6 7 8 9 10

2. How easy or difficult was it to reach for the shoulder belt portion of the seat belt? Rate the ease of reaching from 1 to 10, where

   1= the act of reaching for the shoulder belt was almost effortless
   10= the act of reaching for the shoulder belt almost impossible for me to do

   1 2 3 4 5 6 7 8 9 10

3. How easy or difficult was it to operate the buckle of the seat belt? Rate the ease of buckling from 1 to 10, where

   1= the act of buckling this seat belt was almost effortless
   10= the act of buckling this seat belt was almost impossible for me to do

   1 2 3 4 5 6 7 8 9 10

4. How easy or difficult was it to unbuckle the seat belt?

   1= the act of unbuckling this seat belt was almost effortless
   10= the act of unbuckling this seat belt was almost impossible for me to do

   1 2 3 4 5 6 7 8 9 10

5. Tell me about any specific problems you had adjusting the seat belt or buckling or unbuckling it. *If you notice someone having problems with a specific aspect of buckling and unbuckling and they do not mention it at this point, prompt.*

6. Were there any things about this seat and belt that made it more comfortable or easy to use?

7. Were there any things about this seat **and** belt that made you particularly uncomfortable? *If you notice someone having problems with a specific aspect of buckling and unbuckling and they do not mention it at this point, prompt.*

8. If a car that you sometimes ride in as a passenger had this type of seat belt, how likely do you think you would be to wear the seat belt?

   1= I would wear the seat belt every time I rode in the car, no matter what the trip
   10 = I would never wear the seat belt, no matter what the trip

   1 2 3 4 5 6 7 8 9 10

****

[Note: Only ask once participant has been in the same vehicle twice (with and without the aftermarket device)]

9. You have been in this vehicle with two different seat belt systems (with and without an added aftermarket device). Can you tell me if either of these systems was more comfortable and/or easier to use? Why?

Post-Trials Information

Now that you have experienced all of the different systems we have for you today I would like you to think about the different systems.

1. Was there anything that you really liked about any of the seat belt systems that you used?

2. Was there anything that you really disliked about any of the seat belt systems that you used?

3. Can you tell me which vehicle's seat belt you like the **most**? And why?

4. Can you tell me which vehicle's seat belt you like the **least**? And why?

5. How do these seat belt systems compare with the one in your own vehicle? Do you think the system in your vehicle is more comfortable or easier to use? Why?

6. Did any of the assistive devices (shoulder pad, extender, or loop) help you when putting on the seat belt, or allow you to find a more comfortable fit?

There are just a few more items of information I need. Please answer the questions on this form. This information will be very helpful to us in interpreting the information we have gathered here today.

Subject Number: _____
Date:_____

Post Trial

Please answer the questions on this form. This information will be very helpful to us in interpreting the findings.

Age: _____ Sex: Male Female

Date of Birth: _____

1. Would you say your health in general is

    a. Excellent
    b. Very good
    c. Good
    d. Fair
    e. Poor
    f. Don't know

2. Do you have any disabilities or health problems that can make seat belt use more difficult or uncomfortable? Please circle all that apply.

    a. Arthritis
    b. Stiffness or lack of mobility in neck or torso
    c. Shoulder problems [Specify] _____
    d. Back trouble [Specify]_____
    e. Chronic pain [Specify]_____
    f. Trouble with hand dexterity
    g. Height issues
    h. Weight issues
    i. Pacemaker
    j. Mastectomy
    k. After effects of a stroke
    l. Recent chest surgery or other upper body surgery
    m. Broken bones [Specify] _____
    n. Other [Specifiy] _____
    o. None

3. In any vehicles that you frequently drive or ride in as a passenger, do you use any of the following? Please circle all that apply.

    a. Seat cushions
    b. Pedal extenders
    c. Seat belt extenders
    d. Seat belt pad
    e. Other things that attach to the seat belt [Specify]_____
    f. Other assistive devices [Specifiy]_____
    g. I do not use any devices

4. How frequently do you drive a car?

    a. Almost every day
    b. 2 or 3 days per week
    c. Once a week
    d. Less than once a week

5. How frequently do you ride as a passenger in a car?

    a. Almost every day
    b. 2 or 3 days per week
    c. Once a week
    d. Less than once a week

6. As a driver, how often do you drive **unbelted**? [Considering all the trips you make, even short trips]

    a. All of the time
    b. Most of the time
    c. Some of the time
    d. Rarely
    e. Never

7. As a passenger in the **front seat**, how often do you ride **unbelted**? [Considering all the trips you make, even short trips]

    a. All of the time
    b. Most of the time
    c. Some of the time
    d. Rarely
    e. Never

8. As a passenger in the **rear seat**, how often do you ride **unbelted**? [Considering all the trips you make, even short trips]

   a. All of the time
   b. Most of the time
   c. Some of the time
   d. Rarely
   e. Never

9. Explain what conditions determine when you are likely to go unbelted on some trip.

_____

_____

_____

_____

STOP HERE

Hand these forms back to the experimenter.

ANTHROPOMETRIC MEASUREMENTS

I have one last thing I need to do. I would like to take a few measurements of your arm length, leg length, torso length, overall height and weight. This information will assist us in interpreting the data once we have completed the data collection process. It will help us to determine what body types or characteristics contribute to the assessment of comfort and ease of usability for the different seat belt systems we have presented today.

Height:_____ Arm Length: _____

Torso Length_____ Leg Length:_____

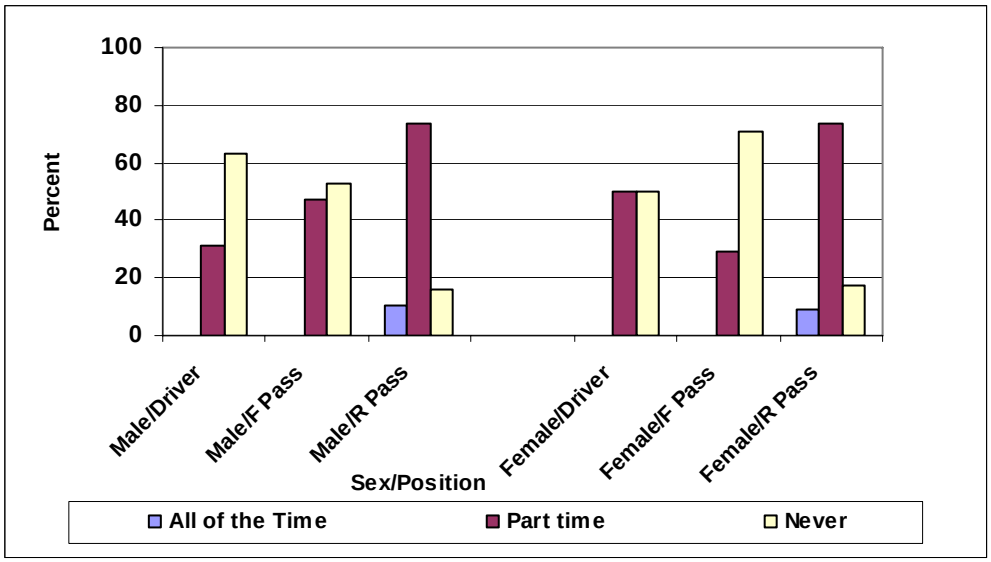
Weight: _____ **OR** Self-Reported Weight_____

If a participant refuses to step on the scale ask them if they would mind giving an estimate of their weight. If they agree and provide a response please indicate the weight measure is Self-Reported

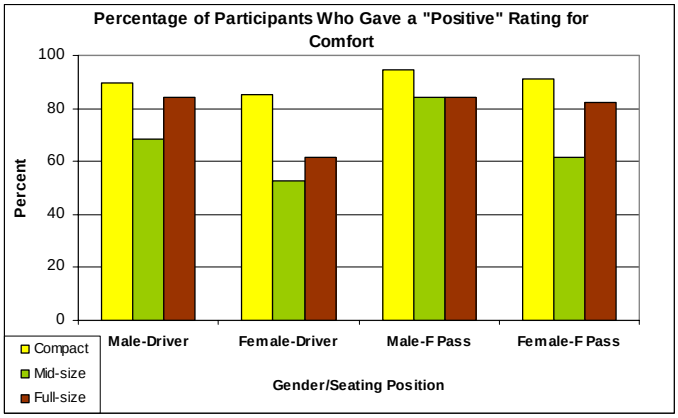
Appendix C
Tables and Graphs
From In-Vehicle Field Study

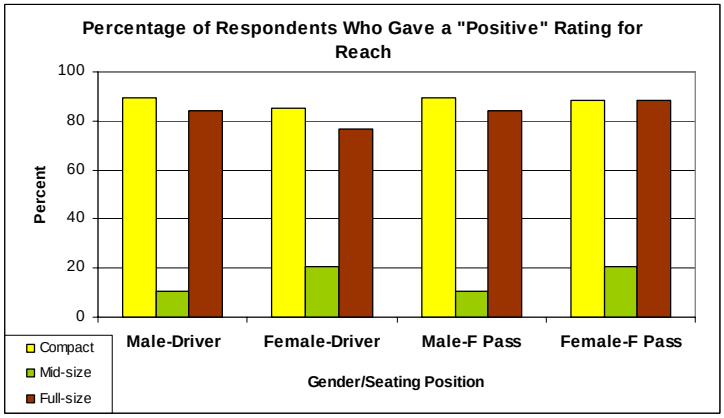
Table C1: Percentage of Participants Reporting Traveling in a Vehicle at least Once a Week		
	Male	**Female**
Driver	89	91
Passenger	74	56

Table C2. Percentage of participants reporting traveling unbelted by sex and seating position						
	Male/ Driver	Male/ FPass	Male/ RPass	Female/ Driver	Female/ FPass	Female/ RPass
Unbelted All of the Time	0.00%	0.00%	10.53%	0.00%	0.00%	8.82%
Unbelted Part-time	31.58%	47.36%	73.68%	50.00%	29.41%	73.53%
Never Unbelted	63.16%	52.63%	15.79%	50.00%	70.59%	17.65%

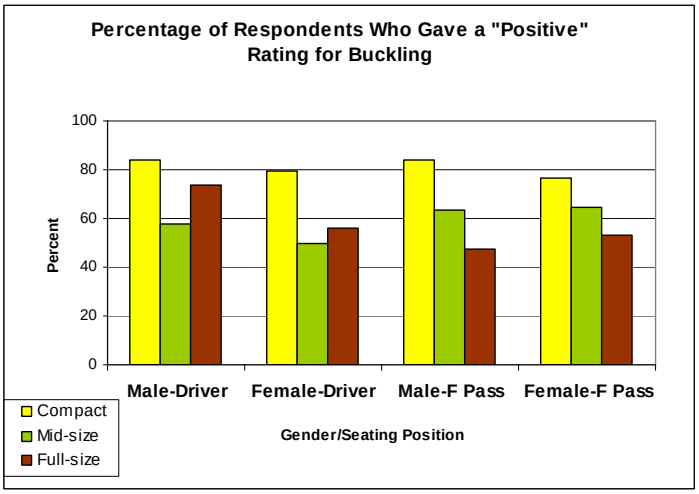


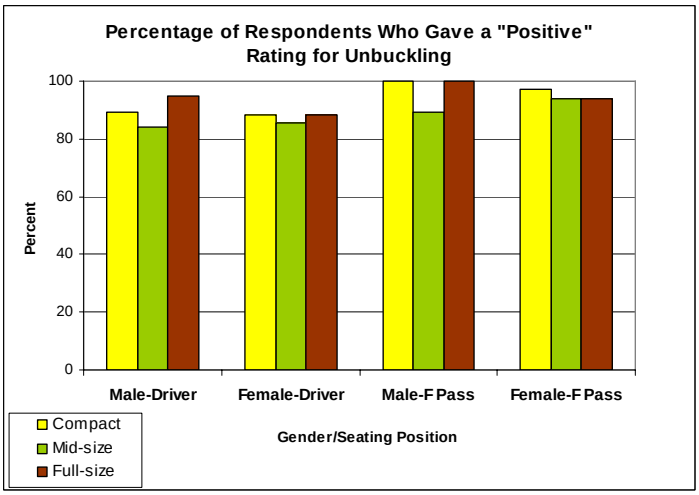
Graph C1 Percentage of participants reporting traveling unbelted by sex and seating position



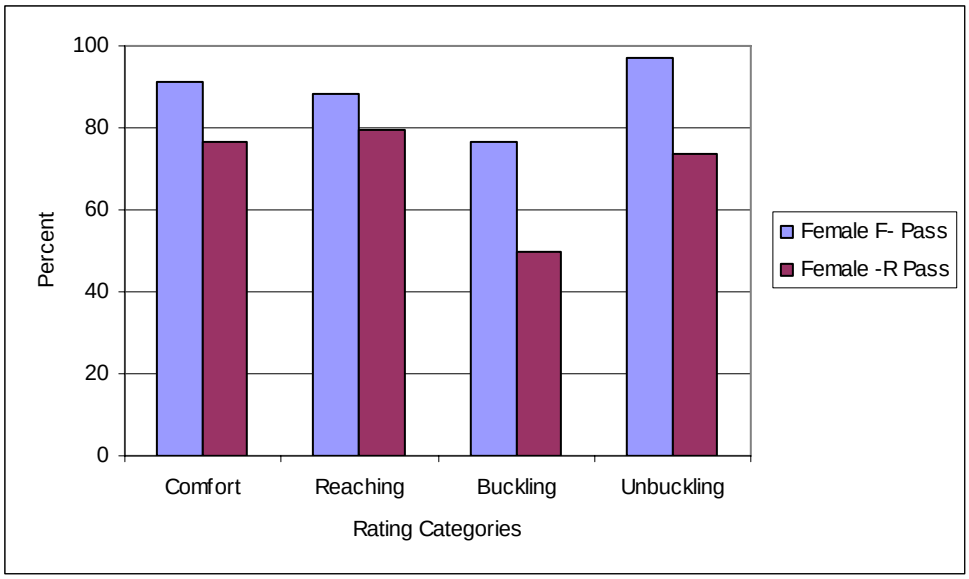


Graphs C2 and C3: Percentage of participants who gave a positive rating (rating of 1-3) for comfort and easy reach.

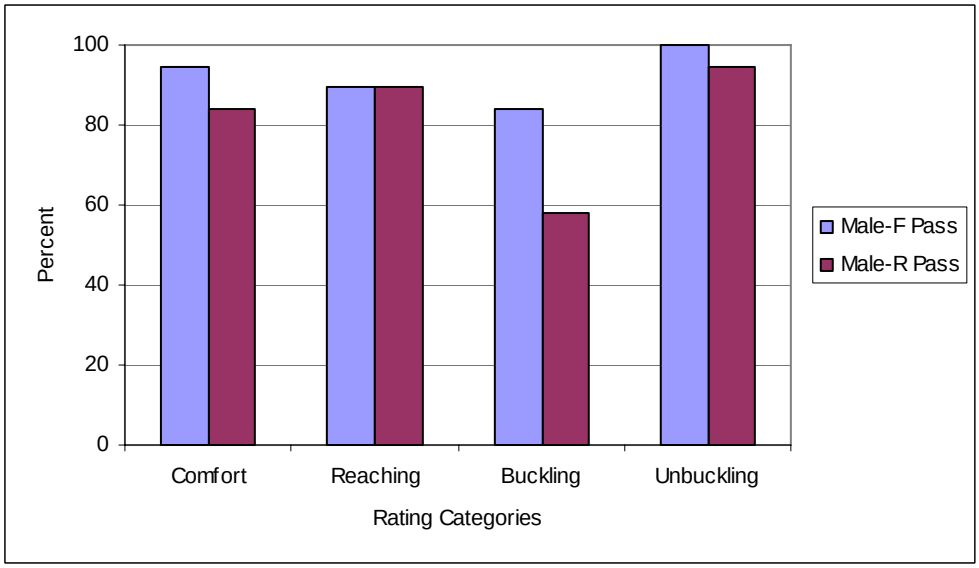




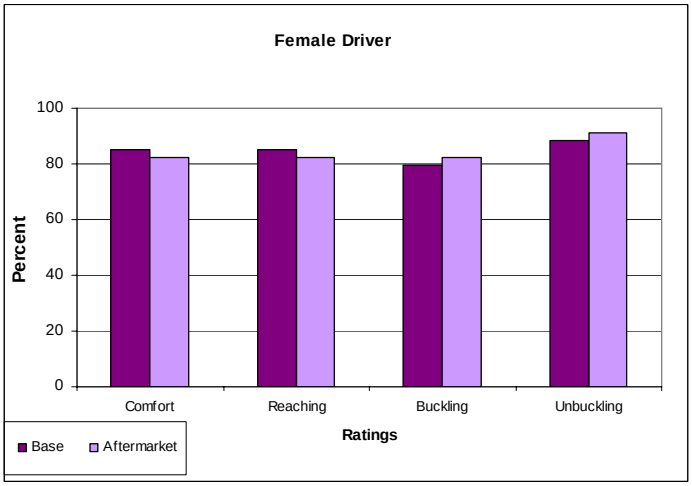
Graphs C4 and C5: Percentage of participants who gave a positive rating (rating of 1-3) for buckling and unbuckling



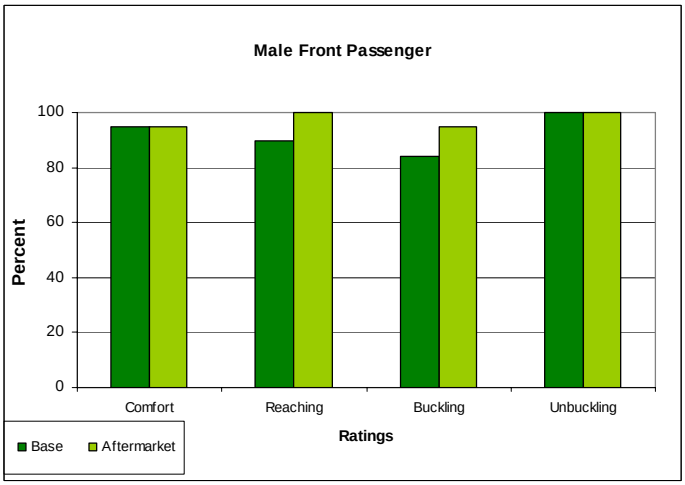
Graphs C6: Percentage of female participants who gave a positive rating (rating of 1-3) for comfort and usability in the front and rear seating positions of the compact vehicle

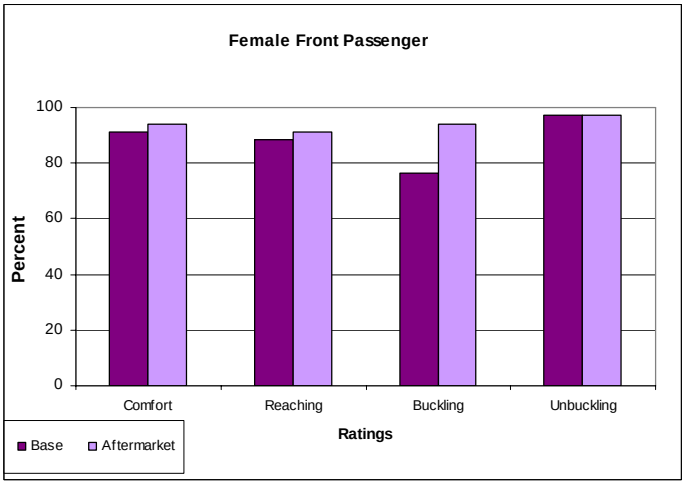


Graphs C7: Percentage of male participants who gave a positive rating (rating of 1-3) for comfort and usability in the front and rear seating positions of the compact vehicle

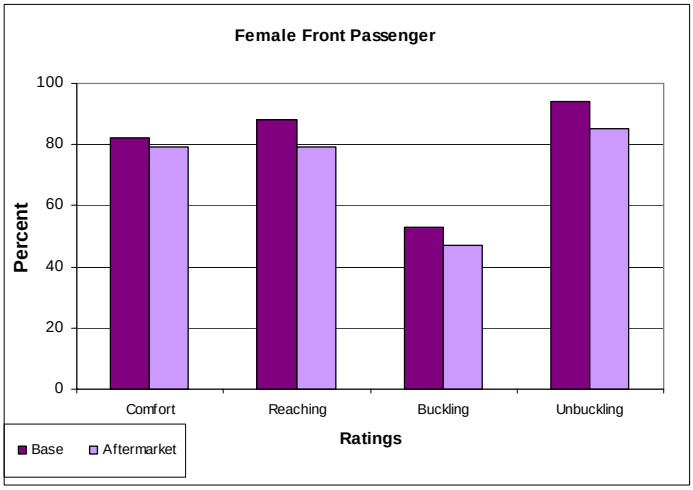


C8 and C9. Percentage of participants who gave positive ratings (rating of 1-3) for comfort and usability for the compact and compact/extender in the driver position

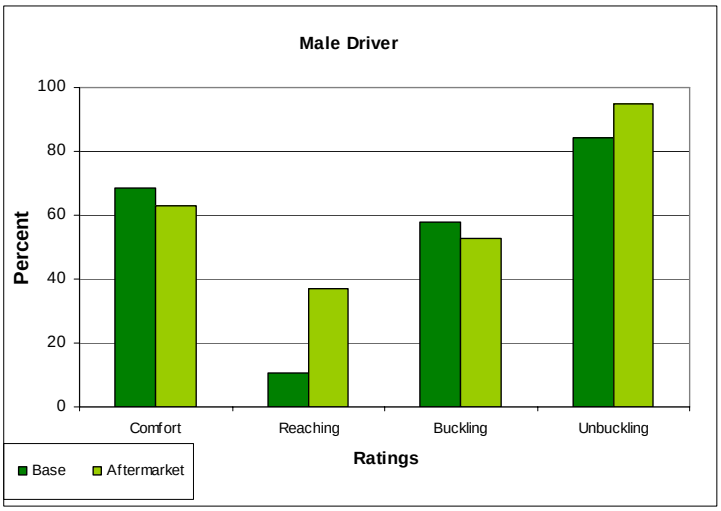


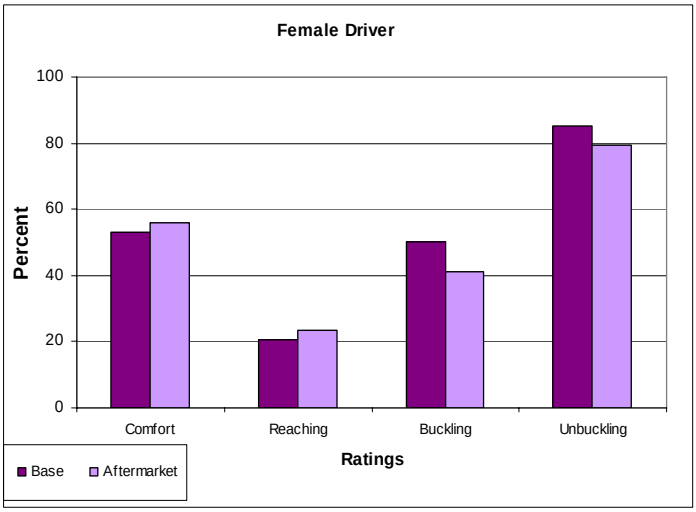


C10 and C11. Percentage of participants who gave positive ratings (rating of 1-3) for comfort and usability for the compact and compact/extender in the front passenger position

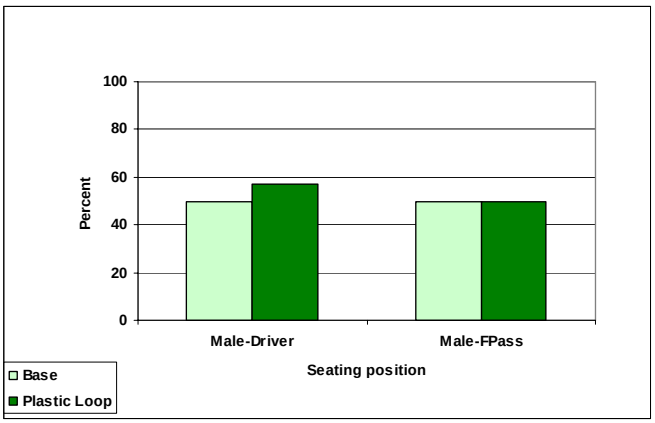


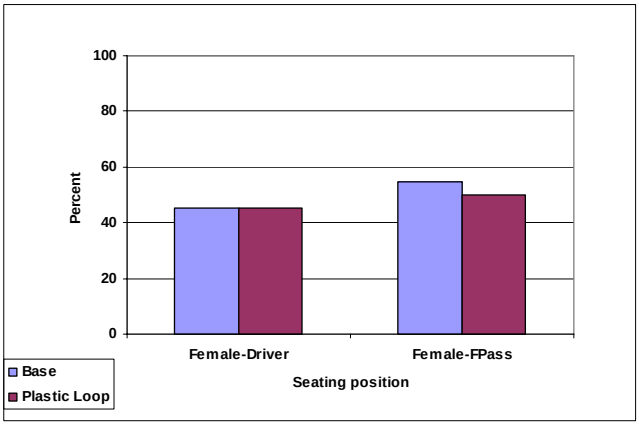
C12 and C13. Percentage of participants who gave positive ratings (rating of 1-3) for comfort and usability in the full-size and full-size/shoulder pad conditions in the front passenger position



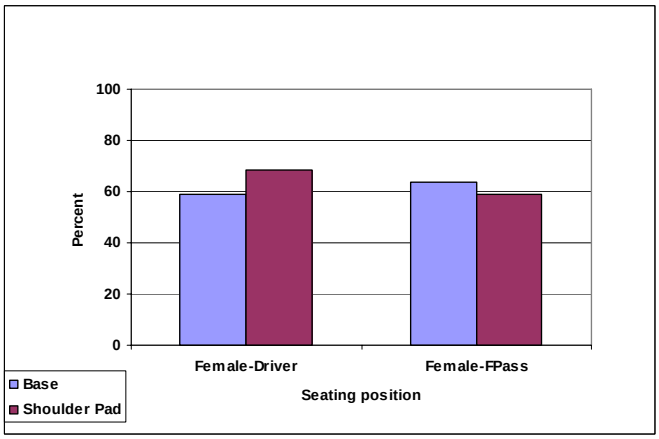


C14 and C15. Percentage of participants who gave positive ratings (rating of 1-3) for comfort and usability in the mid-size and mid-size/plastic loop conditions in the driver position





C16 and C17. Percentage of overweight participants who said they would use the seat belt “all of the time” by sex in the mid-size and mid-size/plastic loop conditions



C18 and C19. Percentage of overweight participants who said they would use the seat belt “all of the time” by sex in the full-size and full-size/shoulder pad conditions

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