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Indirect Effects of School Bus Seat Belt Installation

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16. Abstract The project summarized data from a variety of sources on the indirect effects of seat belts on school buses. This report is a synthesis of the research findings and includes the results of a literature review and program scan. The findings also include anecdotal observations from bus drivers and school district officials obtained from a concurrent NHTSA project titled "Education on Proper Use of Seat Belts on School Buses." Overall, the findings of this project indicate that seat belt use is associated with improved student behavior and reduced bus driver distraction. The findings also show that reported seat belt use is higher when there is a required-use policy in place, and that seat belt use is heavily reliant on the efforts of the bus drivers. It is important to not only train bus drivers in the use and enforcement of seat belts, but to keep them motivated to encourage seat belt use on their buses. While this study offers a view of the indirect benefits of seat belts based on stakeholder experience, a more detailed study focusing on the indirect benefits experienced by a sample of school jurisdictions would better quantify the potential outcomes of school bus seat belts.		
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Executive Summary

Traveling by school bus is the safest mode for transporting pupils to school (National Highway Traffic Safety Administration, 2020). An analysis of school bus crashes over the past 10 years using Fatality Analysis Reporting System (FARS) data found that although total motor-vehicle-related crashes have decreased over the last decade, the same has not been true for school-bus-related crashes (Donoughe & Katz, 2015). When normalizing the data with respect to the percentage of school-bus-related crashes to the total number of crashes nationwide, there is a slight upward trend. Of the fatal school-bus-related crash injuries, 6.2% were school bus occupants. While compartmentalization inside the bus and other safety features outside the bus (such as the color of school buses) have contributed to the strong safety record of school buses, adding seat belts may further reduce the number of injuries and fatalities.

School districts across the Nation are increasingly installing three-point seat belts on their buses to increase the safety of their students. As of November 2019, 8 States have passed legislation requiring seat belt installation on existing or new school buses. The direct benefit of adding seat belts to school buses is to enhance the protection and safety already provided by compartmentalization (Kuppa, 2015), but there may be indirect benefits as well. While some information is known about school bus seat belt use, there is a lack of information on indirect effects of seat belt use on safety due to benefits such as improved child behavior and reduced driver distraction. To explore these types of indirect benefits, NHTSA commissioned this research project in 2018 to collect data from a variety of sources on how seat belts are indirectly affecting safety on school buses. This report is a synthesis of the research findings including the results of a literature review and program scan. The findings in this report also include anecdotal observations from bus drivers and school district officials obtained from a concurrent NHTSA project titled *Education on Proper Use of Seat Belts on School Buses* (Katz et al., 2020).

The literature revealed that there have been some research studies conducted to investigate the impacts of school bus seat belts on capacity as well as use rates, but evaluations of indirect effects on safety (e.g., student behavior and driver distraction) have been minimal. Research in other areas, such as distracted driving and children as a source of distraction, as well as surveys of school transportation representatives (transportation directors and bus drivers) provide additional insight on potential indirect safety effects.

The conclusions of this report focus on the potential indirect benefits of improved student behavior, reduction in bus driver stress and distraction, and increased school bus driver satisfaction and retention. In addition, the impacts on route times, loading times, and capacity are also discussed. Seat belt use is associated with improved student behavior. Reported seat belt use is higher when there is a required-use policy in place, and belt use is heavily reliant on the efforts of bus drivers. To help ensure a successful seat belt program, it is important to not only train bus drivers in the use and enforcement of seat belts, but to keep them motivated to find the best ways to encourage seat belt use on their buses. Assigning specific responsibilities to bus drivers may not be enough to influence belt use, as drivers' motivation, encouragement, and enforcement efforts are likely the strongest determinants of seat belt use. While this study offers an overview of the indirect benefits of seat belts based on a literature review, program scan, and stakeholder experience, a more detailed study focusing on the indirect benefits experienced by a sample of school jurisdictions would better quantify the potential outcomes of school bus seat belt use.

Background

Traveling by school bus is the safest mode for transporting pupils to school (NHTSA, 2020). An analysis of school bus crashes over the past 10 years using Fatality Analysis Reporting System (FARS) data found that although total motor-vehicle-related crashes have decreased over the last decade, the same has not been true for school-bus-related crashes (Donoughe & Katz, 2015). When normalizing the data with respect to the percentage of school-bus-related crashes to the total number of crashes nationwide, there is a slight upward trend. Of the fatal school-bus-related crash injuries, 6.2% were school bus occupants. While compartmentalization inside the bus and other safety features outside the bus such as the color of school buses have contributed to the strong safety record of school buses, adding seat belts may further reduce the number of injuries and fatalities.

School districts across the nation are increasingly installing three-point seat belts on their buses to increase the safety of their students. Often, this increase in seat belt installation is driven by local school bus crashes associated with child passenger injury and, in some instances, fatalities. As of November 2019, eight States have passed legislation requiring seat belt installation on existing or new school buses. The direct benefit of adding seat belts to school buses is to enhance the protection and safety already provided by compartmentalization, but there may be indirect benefits as well. These secondary benefits may include reductions in school bus driver distraction as a function of less visual and auditory stimuli, as well as fewer school bus driver interventions in onboard safety incidents, such as bullying or fighting.

Generally, resistance against installing seat belts on school buses has been based on a variety of reasons. Cost and the potential to reduce the number of children transported by school bus has been the primary resistance. Other reasons include the existing safety features of school buses compared to other vehicles (e.g., taller and heavier vehicles, padded and high seat backs), need for drivers or aides to enforce wearing seat belts, emergency exiting delays, maintenance of seat belts, and other factors.

While some information is known about school bus seat belt use, there is a lack of information on indirect effects of seat belt use on safety due to benefits such as improved child behavior and reduced distraction. Consequently, there is an emerging need to evaluate the comprehensive safety benefits of seat belts on school buses, including both direct and indirect. While the range of possible indirect effects of seat belt use is broad, the most frequently considered benefit is the potential to improve on-board student behavior, thereby reducing distractions for the driver.

The emergence of distracted driving research and campaigns has highlighted the potential safety implications of distracted driving, which may be relevant for drivers of all vehicles, not just passenger vehicles (Strayer & Fisher, 2016). Greene, Brandon, Bailey, and Barber (1981) documented the impact of disruptive student behavior on school bus crashes. In 2007 the American Academy of Pediatrics recognized the benefit of seat belts in reducing school bus driver distraction, while noting it may be challenging for drivers to enforce seat belt use (American Academy of Pediatrics, 2007). School travel research conducted by North Carolina State University's Institute of Transportation Research and Education (ITRE) found that seat belt use leads to a reduction in bus discipline problems, including bullying (Graham & Tsai, 2006; ITRE, 2007).

In addition to decreasing driver distraction via student behavior improvements, it is feasible that the presence of seat belts on school buses may result in improved driver satisfaction and retention as well as increased on-board passenger safety due to reduced student movement. The current research explores these types of indirect benefits and other ancillary effects of seat belts such as an increase in loading and unloading times. The objective of the study was to collect data from a variety of sources on how seat belts are indirectly affecting safety on school buses. This report is a synthesis of the research findings including the results of a literature review and program scan as well as anecdotal observations from bus drivers and school district officials obtained from the NHTSA project by Katz et al. (2020), *Education on Proper Use of Seat Belts on School Buses*.

Method

Identification of Indirect School Travel Safety Factors

The purpose of this task was to identify school bus safety factors and the potential implications and indirect safety benefits of seat belts and other indirect effects of installing seat belts on school buses. The research team used their existing knowledge of and contacts in the school bus safety industry to identify and categorize indirect effects and produce relevant research questions on which to focus the project. These topics and research questions, shown in Table 1, served as the focus for the literature review as well as a guide for identifying key stakeholders and developing key topics and questions for the program scan and interviews with key stakeholders.

Literature Review on Indirect Effects of Seat Belts on School Buses

The primary goal of the literature review was to identify existing research on the indirect safety effects of seat belts on school buses to determine what indirect effects have been noted and what methods have been used, if any, to study the changes in these effects since seat belt installation. The research team used the indirect effects categories and research questions summarized in Table 1 to identify relevant search terms to use for the literature review.

Because of the likelihood that few studies have solely examined the indirect safety effects of seat belts on buses, the research team predicted that much of the useful information uncovered during the literature review would concentrate on broader topics such as seat belts on school buses in general and the effects of visual and auditory distraction on drivers. Therefore, the research team also conducted a more restricted search for general topics, i.e., topics not necessarily or directly related to school buses or seat belt use. The additional topics (e.g., driver distraction, distraction in car with children) that were identified and briefly reviewed are shown in Table 2. Because such findings may not have been directly focused on school buses, it was not the intent of the research team to conduct a full literature review of these general topics, but rather to identify a few relevant and recent research efforts from each topic area that would provide useful background information that may overlap with and/or translate to the indirect effects topics, such as bus driver distraction.

Table 1. Matrix of Safety Factors and Research Questions

Indirect Effects Category	Research Questions	Expected Information Sources
Student Behavior Management	• Has there been a change in student behavior since the installation of the seat belts? • Have there been any changes to the number of students standing while the bus is moving? • Are students more likely to remain in their seats when riding buses with seat belts? • Are there fewer referrals for behavior issues on buses with belts? • Have there been any unexpected behavioral side effects (e.g., students hitting each other with the belts)?	• School District Transportation Supervisors & Drivers • State Transportation Directors • Literature Review
Bus Driver Stress and Distraction	• Have bus drivers' stress levels changed since driving a bus with seat belts? • Have bus drivers' level of distraction changed since driving a bus with seat belts?	• School District Transportation Supervisors & Drivers • Literature Review
Bus Driver Satisfaction & Retention	• Have the seat belts had any effects on the bus drivers' perceived workload? • Has there been a change in bus driver job satisfaction since driving a bus with seat belts? • Has job satisfaction (as an effect of seat belts) had any measurable influence on bus driver retention?	• School District Transportation Supervisors & Drivers • Literature Review
Loading and Unloading Times of Buses	• Have there been any changes to the loading and/or unloading times of the school buses due to the seat belts? • Do the students have trouble getting in or out of the belts (for more than just the first few days)? • Do the seat belts cause any issues with students getting out of the belts during an emergency or evacuation scenario? • Have there been any issues with students, clothing, or backpacks getting stuck in the belts?	• School District Transportation Supervisors & Drivers • State Transportation Directors
Decreased Space Inside Buses	• Have there been any issues regarding decreased space inside of the buses due to the implementation of seats with seat belts?	• School Bus Seat Belt Installers & School District Transportation Supervisors • Literature Review
Effects on Route Times	• Has the amount of time to fasten or unfasten seat belts impacted the amount of time spent at school bus stops.	• School District Transportation Supervisors
Transfer of Effects to Passenger Vehicles	• Does required belt use on school buses influence belt use in passenger vehicles? • Does a lack of seat belts on school buses influence belt use in passenger vehicles?	• Literature Review

Table 2. Literature Review Topics and Example Search Terms

Literature Review Topic Area	Example Search Terms
Primary Literature Review Topics	
General Indirect Effects of Seat Belts on School Buses	• "effects of seat belts on school buses"
Student Behavior Management	• "student behavior and seat belts on buses" • "student behavior" AND "seat belts" • "students hitting each other with seat belts" • "students standing on school buses"
Bus Driver Stress and Distraction	• "bus driver stress" AND "seat belts" • "bus driver frustration and seat belts" • "seat belts on school buses" AND "bus driver responsibility"
Bus Driver Satisfaction and Retention	• "job satisfaction and seat belts on buses" • "bus driver" AND "job satisfaction"
Loading and Unloading Times of Buses	• "loading times and seat belts on buses" • "seat belts on buses causing delays" • "time to fasten school bus seat belts"
Decreased Space Inside Buses	• "decreased interior space in buses with seat belts"
Effects on Route Times	• "effects of seat belts on school bus route times"
Transfer of Effects to Passenger Vehicles	• "seat belt use in buses versus cars" • "students using seat belts in passenger vehicles" • "school bus seat belt use" AND "transfer of effects to passenger vehicles"
General/Support Topics	
Changes in/Effects of Sound Level on Buses	• "sound level on school buses" • "loud buses" OR "noisy buses" • "school bus sound level" AND "driver distraction"
Distracted Driving	• "distracted driving" OR "driver distraction" • "distracted driver peripheral and auditory space"
Distraction in the Car With Children	• "distraction in car with children" • "passenger-related distractions" • "effects of children on driver distraction" • "children distracting drivers"
Children Arriving to School Ready to Learn	• "children arriving to school ready to learn" • "effects of school commute on children" • "school commute" AND "readiness to learn"

Establish Strategy to Locate Material

Prior to beginning the literature review, the research team established a strategy for locating useful material. Sources that were used to search for relevant information included online databases, print sources such as journals, agency websites, and conference material such as papers and presentations.

The research team used Google, Google Scholar, and the Virginia Tech (VT) University Libraries Database as the primary search engines for the literature review. The VT University Libraries Database incorporates 692 databases in the library search engine. Some of the integrated databases include TRID (the TRIS and ITRD databases), PsycINFO, PsycARTICLES, Psychology & Behavioral Sciences Collection, ScienceDirect, Social Sciences & Education Databases, MEDLINE, and PubMed. The research team also identified and conducted a search of 32 State Associations of Pupil Transportation websites, as well as sites from five Canadian provinces, to determine if any links to relevant resources were posted on their websites. Similarly, scans were performed of school bus seat belt manufacturers' websites.

The final list of literature review topics is included in Table 2, along with some example search terms that were used for each topic. Although Table 2 provides a sample of the search terms that were used, the entry of these terms into different databases and search engines may have been modified using different Boolean operators, as appropriate, to conduct a more thorough search. For example, in order to search for resources on bus driver distraction, search terms may have been entered in various ways including "bus driver distraction," "driver distraction," AND "school buses," or "students distracting drivers." Other advanced search methods were applied, where appropriate, such as filtering Google results to only show results from .edu, .gov, or .org domains. Additional search terms and variations of search terms, other than the examples provided in Table 2, were also used.

The research team established a four-step process for identifying, organizing, and reviewing relevant sources for the literature review which is shown in Figure 1.

Scan for and Screen Available Resources

The objective of this literature review stage was to identify potential sources and screen them for relevancy. Sources were filtered out if they were not relevant to any of the established research questions and/or were not necessary in the discussion of the more general topics identified.

The research team developed a literature review database to track and prioritize relevant sources and assist with the literature review synthesis. This resource provided a collaborative platform for researchers to record and share details of each potential source for additional analysis. Sources that appeared to be relevant were entered into the literature review database for further review. In most cases, reviewing a document abstract or executive summary gave the reviewer enough information to determine if the document should be saved for further review. In cases where no abstract or summary was provided, the reviewer conducted a quick scan of the document to determine if it included useful information or cited promising resources.

Each relevant source that was identified in the initial scan was added to the database for further review. Researchers used specific database fields to record the results of their reviews and indicate their recommendation for a more detailed critical review. These fields were then used as a tracking mechanism to know the review history of each source added to the database.

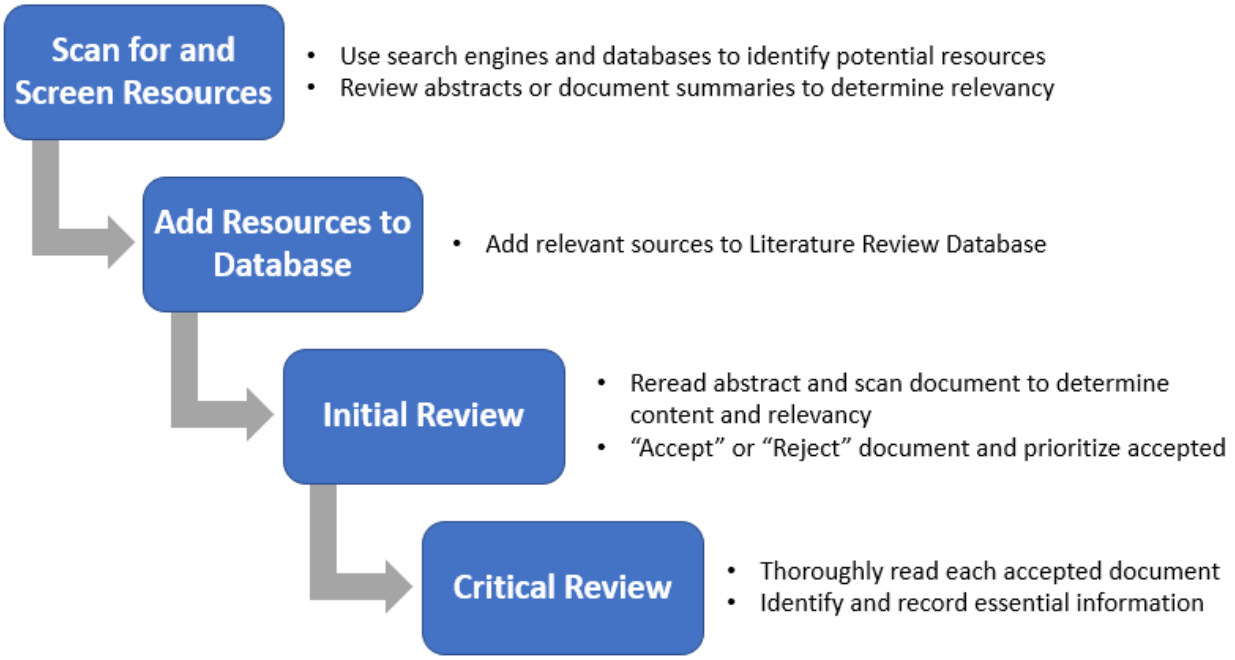

Figure 1. Process for identifying, organizing, and reviewing relevant resources.

Initial and Critical Reviews

Each source was initially reviewed by two team members. A trained reviewer (often the reviewer who entered the document into the database) conducted a scan of the document to determine content and relevance. Sources were assigned one of the following three ratings.

- "Accept-high priority" sources were related to indirect effects of seat belts on school buses.
- "Accept-low priority" sources were not related to the indirect effects of seat belts on school buses, but the content potentially offered other useful information (e.g., other related general topics, other seat belt-related information that might be relevant, or citations of sources that were potentially useful).
- "Rejected" sources did not contain useful information for this effort (e.g., a general discussion of seat belts on buses without data).

The second reviewer briefly scanned each document to ensure that an appropriate determination (to accept or reject) was made. "Rejected" sources did not receive further review.

Accepted sources (high or low priority) received an additional, more thorough and critical review. The critical reviews consisted of the research team performing a thorough reading of each selected document. The purpose of the critical review was to gain a full understanding of literature's content and findings. This involved the reviewer identifying essential information (e.g., research method, results) as well as noting essential information regarding relevance of the document to the project, items of interest, and any notable strengths or weaknesses of a given source.

Although many of the resources added to the literature review database were reviewed, only those that were critical to the understanding of the potential indirect effects of seat belts on school buses were summarized. A summary of the important relevant findings from the literature review is provided in the Results section of this report.

Program Scan and Interviews With Key Stakeholders

The objective of this task was to identify programs with experience and perspective on the potential benefits and considerations of seat belts on school buses.

The research team was concurrently working on the "Education on Proper Use of Seat Belts on School Buses" project (Katz et al., 2020) for NHTSA, which seeks to understand the decisions that States and local agencies use when deciding to implement seat belts on school buses and the funding mechanisms that are used to pay for seat belt installation. This education project helped to inform the current effort by providing stakeholder perspectives on indirect effects of seat belt use. This information was gathered by conducting interviews and discussions with school districts across the country. A bus driver survey was also developed and distributed to gather subjective feedback on the impact of seat belts on student behavior and bus driver distraction. The findings from both the interviews and the bus driver surveys, as they relate to the indirect effects of seat belts, were used for this current project as well.

Interviews/Discussions

The intent of the stakeholder interviews was to gather information regarding the perceived benefits and considerations of seat belts on school buses, and specifically how they relate to indirect effects of seat belts.

As an overlapping program scan had already commenced for the "Education on Proper Use of Seat Belts" project (Katz et al., 2020), efforts were not duplicated. The research team used its network of professional contacts and associations, primarily through existing relationships with the National Association of State Directors of Pupil Transportation and the National Association of Pupil Transportation to identify programs with experience and perspectives that would be useful to the project. Emphasis was placed on gaining participation from States with and without seat belt installation and/or required use policies at the State legislative level. Additionally, the team included districts that have already implemented seat belts, as well as some districts that have not implemented seat belts; this was done to ensure a comprehensive understanding of different barriers and concerns regarding seat belts.

Although the interviews conducted as part of the "Education on Proper Use of Seat Belts" project focused on some topics outside of the scope of this project (e.g., policy and funding), there were many overlapping topics that had the potential of producing information directly relevant to this project such as experiences with stakeholders (including bus driver reactions) and best practices, seat belt compliance (use), effects on student behaviors, and discussion of barriers and lessons learned.

Approval from the Office of Management and Budget was obtained for the "Education on Proper Use of Seat Belts" project and 26 initial interviews were conducted with respondents from 12 States (Florida, California, Indiana, North Carolina, New York, Texas, Arkansas, Maine, North Dakota, New Jersey, Maryland, and Michigan). The median reported fleet size by interview respondents was 112 buses (ranging in size from 11 to 872 buses), and the median number of buses with seat belts was reported to be 66 buses (ranging from 4 to 872 buses).

The breakdown of respondents representing States with and without installation and/or required use policies at the State legislative level is shown in Figure 2. For the purposes of this analysis, an installation requirement mandated that seat belts be installed on either new or existing buses. Policies deemed to have a use requirement indicate that the responsible education entity (school, district, etc.) must enforce the use of seat belts on buses that are equipped with them.

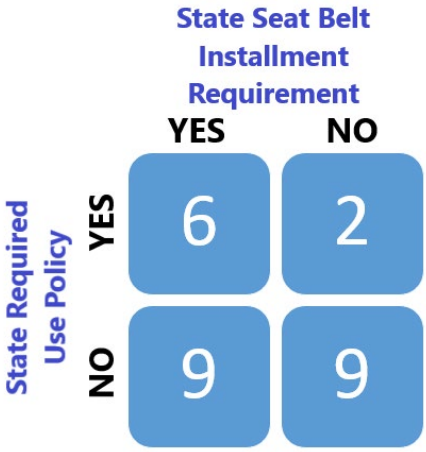

Figure 2. Breakdown of interviewees by State policies

The research team conducted a review of the primary interview findings and identified all interviewees who mentioned any of the indirect effects topics shown in Table 1, with the intent of identifying appropriate contacts for follow-up interviews regarding indirect effects. The 23 initial interviewees mentioned indirect effects of seat belts during their interview. Most of these respondents commented on indirect effects related to student behavior management and/or bus driver stress, reactions, etc. Because these topics were to be included in the bus driver survey, and bus drivers were the most appropriate individuals to elaborate on these topics, those interviewees were not targeted for follow-up interviews.

Of the 23 initial interviewees mentioning indirect effects, 5 mentioned indirect effects topics that were not included in the bus driver survey such as loading and unloading times of buses, route times, and decreased space on buses. These 5 respondents were selected for follow-up discussions to gather detailed information on the indirect effects that they mentioned. The research team reviewed the initial interview notes for these 5 respondents and developed specific questions for each contact based on their previous feedback. The questions were developed to elicit more specific detail regarding the indirect effects that they had already mentioned, as well as to gather information on bus driver satisfaction and retention, as this topic was not included in the initial interviews or the bus driver survey. Three of the 5 identified respondents participated in follow-up discussions with the research team.

Bus Driver Survey

Before conducting the initial interviews for the "Education on Proper Use of Seat Belts" project, interviewees were asked to share a brief, 15-minute, online survey with some of their bus drivers. A link to the online survey was distributed to all districts willing to participate. The research team also shared the link to the survey at the 2019 National Association of State Directors of Pupil Transportation Services Annual Conference and the 2019 National Association for Pupil Transportation Conference. Preliminary survey findings relevant to the indirect effects of seat belts on school buses are provided in the Results section of this report; for a full description of the survey, along with the complete and final survey results, please refer to the *Education on Proper Use of Seat Belts on School Buses* final project report (Katz et al., 2020).

Results

Summary of Literature Review Findings

Research was limited on the indirect effects of seat belts on school buses; however, research on other topics could be related to indirect effects topics. For example, topics such as distracted driving and distraction in passenger vehicles with children can help explain the types of challenges faced by school bus drivers and why it is important to consider the indirect effects (e.g., bus driver distraction, student behavior, route times) that school bus seat belts may have.

Indirect Effects of Seat Belts on School Buses

Lou, Mehta, and Turner (2011) performed an empirical analysis to address factors that affect students' decisions about wearing seat belts on school buses. Of the 11 variables investigated in this study, 8 were found to have significant impacts on seat belt use: age, gender, home county, trip length, time of day, presence/involvement of bus aide, and 2 levels of bus driver involvement. Having bus drivers check the seat belt status of each student prior to starting the vehicle and drivers' encouragement of wearing seat belts both had a positive impact on seat belt use (Lou et al., 2011); however, the authors did not elaborate on the specifics of the positive impact, nor did they specify a quantitative change in seat belt use.

In a similar study, Goldman and Peleg (2010) collected observational data on student, bus driver, and chaperone behaviors and on hazards associated with school buses, bus loading zones, and bus stops in rural communities in Israel. Data were collected over a 4-month period from December 2006 to March 2007. Goldman and Peleg observed that not a single pupil had a seat belt on in 42% of the documented rides despite seat belts being available in 97% of the buses included in the study. They did find that seat belt use was nearly 3 times greater when either buses were equipped with lap-shoulder belts or when a chaperone was present. The researchers also found that primary school students (grades 1 to 6) were 5 times more likely to fasten their seat belts than secondary school pupils (grades 7 to 12). Interestingly, the researchers found the opposite when looking at frequency of unsafe behaviors; although they tended to buckle up more often, primary school students were more likely (46.2%) to engage in unsafe behaviors (such as rowdiness, noisiness, conflicts between pupils, and not remaining seated) than secondary school students (31%). In addition to age, pupil behavior was also found to be dependent on other factors such as time of day (morning bus rides were calmer than afternoon rides) and number of stops on the bus routes; specifically, morning routes were calmer with fewer instances of unsafe behavior (27.2%) than afternoon routes (51.3%) and unsafe behavior was more likely to occur on routes with 5 or more stops (58.3%) than on those with 1 to 4 stops (27.5%). The researchers stated that pupil conduct not only influenced the overall bus environment, but also bus driver concentration; however, there was no indication by the authors that bus driver concentration was measured. The researchers stated that bus drivers "cannot be expected to enforce seat belt use and deal with pupil misconduct while also driving safely." They also summarized that, without enforcement or government regulations, the availability of seat belts is not enough to ensure seat belt use among pupils.

Additional evidence of low school bus seat belt use and absence of improved student behavior when seat belts were available was found in a study performed by the Center for Urban Transportation Research at the University of South Florida (Baltes et al., 1994). Researchers used a nationwide survey to collect information about the operational experiences of school districts operating 20-passenger or larger school buses equipped with seat belts. Baltes et al. found that 90.4% of responding school districts showed no improvement in student behavior due to seat belts. An evaluation of response data also found that more than 77.5% of the responding school districts indicated that students were using the seat belts no more than 10% of the time they are on the school buses and only 6.1% of the districts said that students use belts more than 50% of the time.

The National Institute of Justice funded research that found that seat belts were among the least frequently used behavioral management strategies on school buses (Hendrix et al., 2018). Fifty-seven percent of respondents to a web-based survey reported using this strategy. When evaluating which strategies transportation officials perceived to be effective at reducing misconduct, researchers found that seat belts were among the lowest scores for every misconduct type (e.g., fighting, bullying, use of profanity, substance use, sexual harassment, etc.).

Research conducted in North Carolina employed onboard cameras to examine out-of-seat activities and enforcement levels in buses with and without seat belts (ITRE, 2007). ITRE reported that when elementary students switched from buses without seat belts to buses with seat belts, with enforcement, there was a significant reduction in out-of-seat behaviors. Conversely, when students switched from buses with seat belts to buses without seat belts, there was an insignificant change in passenger behavior. The researchers noted that this may be evidence that passenger behavior is influenced as much by the driver as using the seat belts. It should be noted that this report did not specify how long students were on a particular type of bus, i.e., a bus with seat belts or a bus without seat belts, before switching to the other type of bus.

The ITRE team also conducted an analysis of seat belt policy and impacts for the North Carolina Department of Public Instruction (NCDPI). As part of the study, videos from 2016 to 2018 were analyzed of school bus routes in several different school districts for varying periods of time before and after the installation of three-point seat belts. The findings of this study were outlined in a 2018 internal NCDPI report that showed levels of compliance, measured by the time students remained in their seat compartments, increased after the introduction of seat belts. These results were consistent for both morning and evening routes as well as elementary and middle school routes. The study showed that, in some cases, these benefits declined with time and that the significance of the behavior outcomes associated with the seat belts varied by bus driver. Through both video evidence and interviews with drivers and dispatchers, the ITRE team found that seat belts were more likely to have a positive effect on onboard behaviors when drivers enforced a seat belt policy and/or used the seat belts as a behavioral management tool (e.g., compliant students could choose where to sit). However, when drivers were not trained on enforcement or opted not to enforce use, the seat belts appeared to have negligible effects on behavior.

Smither and Percer (2009) explored the possibility that the lack of seat belts on school buses decreased seat belt use in personal vehicles. Through a review of limited research on the carryover effect, researchers found that the lack of availability of seat belts on school buses had little effect on students' use of seat belts in personal vehicles. The researchers reported that this is largely because children can learn that behavior in one situation can differ from that in another. If children are given specific feedback that school buses are designed to be safe without the use of seat belts, they are less likely to assume that buses and cars are the same and will only apply the seat belt rule to the correct context. Ultimately, parents and mandatory seat belt laws play a significant role in seat belt use.

In the past, decreased capacity to carry students was cited as a reason to not install seat belts. Because lap/shoulder belts have been available for large school buses for more than 15 years, offering better crash protection than lap belts (NHTSA, 1999), research and industry movement focuses on that technology. From 2003 to 2007 school bus seats with lap/shoulder belts offered fixed seating positions, eliminating standard industry practice of using the same 39" school bus seat for three younger students on one route and two older students on another route. This created short- and long-term impacts on capacity and the number of buses needed in a fleet. Several studies, described below, document this impact.

Gurupackiam et al. (2014) examined the potential effects the installation of seat belts on Alabama school buses would have on the fleet capacity and cost. The researchers identified and analyzed four seat configurations for school buses: first, 3 seats on each side of the aisle and 12 rows (3/3-12); second, loss of a row of seats (3/3-11); third, loss of one seat per row (3/2-12) and fourth, loss of both a row and a seat per row (3/2-11). The first configuration (3/3-12) represented the most common seating configuration for buses without seat belts. The researchers concluded that the space required for seat belt hardware may result in the loss of a row of seats and/or the number of students that can be seated per row. Therefore, they studied the three additional seating configurations. The researchers determined the capacity for each configuration and for each school bus using current pupil loads, and concluded that many buses would become overloaded due to seat belt installation, but that it would only be by a few excess pupils. The report indicated that it is likely that the seat belt installation would still require the purchase of additional buses by all school systems. However, transportation supervisors may be able to minimize the amount of new buses necessary by transferring overloads to other buses or by adjusting existing bus routes.

In a separate study, Turner, Lindley, and Brown (2010) conducted a 3-year project to explore the implementation of lap/shoulder belts on newly purchased large school buses. The project investigated the loss of capacity due to seat belts, the rate of seat belt use, attitudes of stakeholders, the cost effectiveness of the belts, and other issues. The project found a seat belt use rate of 61.5% based on 170,000 observations of students in pilot-project buses. Regarding loss of capacity, the report discusses that adding seat belts increases the thickness of seat backs, and that the fixed spacing between belt buckle latches eliminates the option of fitting either three small students or two large students to a seat. The researchers concluded that the thicker seat backs and fixed buckle spacing could cause capacity losses of 5 to 18%, depending on the seating configuration that is used. Turner et al. concluded that despite the slight safety improvements, the net benefits of installing seat belts on buses are negative largely due to the high cost of implementation. Additionally, the installation of seat belts on school buses introduced some new disadvantages. Many bus drivers reported that higher seat backs reduce the

drivers' ability to monitor pupils, making enforcement by the driver nearly impossible; bus drivers were further concerned that they would be held responsible for ensuring the students are wearing the belts.

Demonstrating the rapidly changing landscape, the 2007 ITRE report documents the capacity issue as the biggest impediment to the deployment of lap-shoulder belts on school buses. Just 14 months later, a 2008 report by North Carolina's Child Fatality Task Force documented the advent of flexible seating (North Carolina Child Fatality Task Force, 2008). Flexible seating, which allows the same lap/shoulder belt-equipped seat to be used to three younger students or two older students, has since become the standard. Industry publications (School Bus Fleet, 2015) report that the capacity issue has all but disappeared.

Although much of the research discussed above focuses primarily on capacity concerns, there is limited research on the indirect effects of seat belts in terms of student behavior management and bus driver stress and distraction. Research on the effectiveness of seat belt use in improving student behavior has varied findings (Baltes et al., 1994; Hendrix et al., 2018; ITRE, 2007), with some research showing that student behavior varies based on other factors such as route length and time of day (Goldman & Peleg, 2010). Variables associated with seat belt use such as type of seat belt, student age, number of bus stops, time of day, presence of bus aide, etc. (Goldman & Peleg, 2010; Lou et al., 2011), could be useful considerations for school districts.

Distracted Driving

Although research on the indirect effects of seat belts is limited, there are other topics that, while not directly related to school bus drivers, may lead to a better understanding of potential indirect effects of seat belts and the challenges that bus drivers face. One such topic that has been heavily researched is distracted driving. The use of electronic devices while driving remains an increasing concern, with 11% of crash-involved drivers engaged in phone use (Singh, 2010) and with 14% of all fatal distraction-affected crashes involving cell phones as a distraction (National Center for Statistics and Analysis, 2019). A paper released by the National Safety Council (2012) discusses the impact of engaging in cell phone conversations while driving. The authors discuss the concept of "multitasking," indicating that people do not actually accomplish two tasks simultaneously (and with optimal focus and effectiveness), but rather that the brain is rapidly switching attention between tasks. They further discuss that when people try to perform two cognitively complex tasks, such as driving and talking on a phone, they develop inattention blindness (where important information is not perceived, due to inattention rather than vision deficits). For example, Maples et al. (2008) conducted a study in which participants were asked to respond via button press to visual stimuli that were presented to them both while they were having cell phone conversations and while they were not having cell phone conversations. The results showed significant constriction on visual fields with cell phone use when compared to no cell phone use, suggesting that using a cell phone while driving can decrease the perceptual visual field and make a driver less aware of surroundings. A dual-task study conducted by Strayer and Johnston (2001) examined the effects that a cell phone conversation had on the performance of a simulated driving task. Researchers found that unconstrained conversations using a cell phone, either handheld or hands free, resulted in a twofold increase in the failure to detect simulated traffic signals. Slower reactions to those signals were also recorded.

McEvoy et al. (2005) used phone records and interviews with hospitalized drivers involved in injury crashes in Australia to compare phone activity during the hazard interval (time immediately before their crash) with activity during control intervals (equivalent times participants were driving but not involved in a crash). The results indicated that cell phone use within the 10 minutes before the estimated time of crash was associated with a fourfold increase in the likelihood of crashing. These findings were similar to those found by Redelmeier and Tibshirani (1997), who examined cell phone records of 699 drivers involved in motor vehicle crashes resulting in substantial property damage, but no personal injury. Cell phone records were analyzed for phone calls on the day of the crash and the previous week. The results indicated that the risk of a crash was four times higher when using a cell phone than when not using a cell phone.

A research review by Lee (2014) describes distraction in terms of breakdowns in interruption management and problems of engagement. He discusses that an often-underlying assumption regarding driver distraction is that distraction reflects information overload, and that if drivers are not performing a secondary task, that the driving task receives their full attention. On the contrary, he indicates that it is inappropriate to assume that drivers who are not distracted are fully engaged in driving. He also discusses research that indicates that drivers may be disengaged even in the absence of secondary tasks. For example, a survey of 1,347 licensed drivers in Australia indicated that lack of concentration (i.e., thinking about other things or daydreaming) was the most commonly reported (72%) source of distraction while driving (McEvoy, Stevenson & Woodward, 2006).

Lee (2014) discusses the concept of attention traps (i.e., contingency traps, conditioning traps, and consequence traps) and suggests that the concept of such attention traps provides a useful understanding of what motivates and influences drivers to engage in non-driving activities and/or disengage in driving activities. He provides examples of contingency traps (e.g., drivers failing to attend because hazards and roadway demands are difficult to perceive), conditioning traps (e.g., drivers neglect driving tasks because experience has produced no negative outcomes), and consequence traps (e.g., drivers see driving demands, but choose to neglect them; rewards of other tasks outweigh the expected cost of neglecting the roadway) suggesting that driver experience could influence susceptibility to different traps. For example, contingency traps may pose particular challenges to novice drivers, as they are less likely to perceive hazards than more experienced drivers (Fisher, Pollatsek, & Pradhan, 2006). On the contrary, experienced drivers may be more susceptible to conditioning traps if lack of negative consequences over the years leads to the development of potentially dangerous habits.

Lee (2014) ultimately concludes that this attentional dynamics perspective can be used to compliment the common attentional resources perspective in addressing the problem of distraction. This perspective is potentially relevant to school bus drivers, as their experience (both with driving school buses and with driving buses with seat belts) may influence their perceived ability to enforce belt use while driving, to mitigate student behavior while driving, and/or their perceived distraction and stress levels while driving.

In 2013 Vegega et al. developed a report summarizing a series of studies performed by NHTSA and others on distracted driving. The report not only highlighted what was currently known about distracted driving, but it also identified metrics to determine the nature and scope of the distracted driving problem and discussed methods to enhance distracted driving education and awareness. Based on their review of distracted driving research, Vegega et al. indicated that the majority of driver distraction research has focused on technology-based distraction, such as navigations systems or cell phone use, but they also discuss studies that include non-technology related sources of distraction. For example, a naturalistic study of driver behavior (Stutts et al., 2003) revealed that passenger-related distractions (including babies, children, and adults) were observed more frequently (44%) while driving than cell phone use (34%). According to Ranney (2008), conversing with a passenger was the most frequently recorded internal source of distraction. Interestingly, Horrey and Wickens (2006) conducted a meta-analysis, including 23 different experiments, to examine driving performance costs associated with cell phone use and found that passenger conversations were just as costly to driving performance as were cell phone conversations. Similarly, a 100-car naturalistic driving study, including 12 to 13 months of data collection and observations from 241 drivers, indicated that the most frequent types of inattention for near-crashes and incidents were wireless devices and passenger-related tasks (Dingus et al., 2006). The most frequent secondary tasks contributing to crashes were internal distractions, wireless devices, and passengers. The researchers reported that this finding may indicate that eye glances into the vehicle may reduce peripheral vision of the roadway and thus may lead to more crashes. The study found that 80% of all crashes and 65% of all near-crashes involved drivers looking away from the forward roadway just prior to the conflicts.

Such findings are relevant to school bus drivers because, like holding a conversation in a passenger vehicle (whether with a passenger or on a hands-free phone call), bus drivers may be verbally interacting with students in an effort to manage student behavior, answer questions, etc. Because of the large number of passengers on a school bus, bus drivers face additional challenges related to visual and auditory distractions. For example, a study by Griffin, Huisingh, & McGwin (2014) evaluated distraction among public transit bus drivers and provided findings on the types of driver distractions that occur on large, multi-passenger vehicles. Researchers recorded distractions that occurred during each of 796 individual drives between bus stops within 22 full bus routes. Distractions were considered to be any extraneous factors that took the driver's attention away from the road ahead while the bus was moving. Overall, there was a 39% prevalence of distraction (within the 796 drives between stops) with the most prevalent distractions due to an interaction with a passenger. Distractions were more prevalent when there were more than 20 passengers on the bus.

Research on distracted driving relative to the peripheral visual and auditory space can inform the understanding of school bus drivers and their challenges. In a recent paper, Wolfe, Dobres, Rosenholtz, and Reimer (2017) assessed how drivers acquire information about their operating environment using peripheral vision. After a review of existing research, they found that peripheral vision acquires extensive information essential for driving and that it should be an important consideration in the driver's development of awareness.

Spence (2010) reviewed research conducted on the way in which one's spatial attention or awareness can be pulled without purposeful thought by external stimuli, such as sound or light, in the periphery of current focus; this is referred to as exogenous spatial orienting. This review found that multisensory cues capture participants' spatial attention more effectively than unimodal cues. Lavie (2005) examined the ability to remain focused on goal-relevant stimuli in the presence of potentially interfering distractors. The study found that instructing people to focus their attention on a certain task is not enough to prevent distractor interference. The study also found that both a high perceptual load (which takes full attention and therefore leaves no room for task-irrelevant distractors) and high cognitive-control load are necessary to maintain full attention. This is relevant to school bus drivers, as they have numerous in-vehicle distractions that could detract from their perceptual load.

Research has also been conducted on mechanisms to improve driver attention. In a 2009 study, researchers examined the relative speed with which people can initiate head-orienting responses (turning the head to the left or right from the straight forward head position) following the presentation of spatial warning signals (Ho & Spence, 2009). The study, which consisted of three separate experiments, found that when participants were presented with a variety of placements and types of stimuli (far frontal auditory, vibrotactile at waist, peripheral visual, and close rear auditory), they generally responded much more rapidly to the close rear auditory. This was measured by such things as speed of head-turning movements and braking response times.

Children as a Source of Distraction

There has been some research conducted on the effects of passengers, including children, on bus driver distraction. In 2009, Salmon, Young, and Regan investigated bus driver distraction at a major Australian public transport company and its effect on driver performance. Among many sources of distraction were passenger-related distractions, which included any aspects of managing passengers that can potentially distract bus drivers. This study did not directly measure bus driver distraction, but rather consisted of a collection of data using documentation reviews (e.g., training manuals), a questionnaire, interviews with subject matter experts (e.g., bus driver trainers), focus groups with bus drivers, direct observation of bus operating activities, and an ergonomic assessment of bus cabins. The data obtained informed a hierarchical task analysis and investigation of the nature of bus driver distraction including distraction sources and their effects on driver performance. The analysis identified seven goal-based categories of tasks that bus drivers perform while operating the buses: preparation tasks (e.g., adjusting mirrors), physical vehicle control tasks (e.g., steering the bus), cognitive vehicle control tasks (e.g., monitoring other road users), route/timetabling tasks (e.g., checking route journal), passenger-related tasks (e.g., checking tickets or assisting passengers), communication tasks (e.g., communication with transportation operations center), and personal comfort tasks (e.g., adjusting seat or drinking/eating). Company policy prohibited drivers from performing tasks other than physical and cognitive vehicle control while driving, therefore any other task would be considering "secondary" and should only be performed while the bus was stationary. However, as a significant portion of the company's bus drivers undertake these secondary tasks while driving, the researchers concluded that passenger-related distractions could potentially distract bus drivers while driving and lead to a number of distraction-induced errors, such as braking too late or failing to check surrounding traffic.

More recently, a similar study (Zohar & Lee, 2016) was designed to test a multilevel path model with constructs consisting of safety climate, disruptive student behavior, and safety outcome criteria. These variables were said to have potentially opposing effects on the bus drivers' performance. For example, safety climate might improve driver safety and performance, whereas disruptive student behavior would have the opposite effect. The study began with a preliminary interview of school bus drivers, which indicated that disruptive student behavior was the primary source of bus driver distraction. Video data from 29 buses was used to evaluate the effects of disruptive student behavior (measured in terms of participation in risk-taking practices) on school bus driver performance. The researchers found that disruptive student behavior does increase the incidence of such things as safety shortcuts, violations, and near misses. This is likely exacerbated by the issue of bus drivers often having responsibility for the students' conduct placed on them by organizational policies, which makes this a unique driving distraction for school bus drivers.

Researchers have also investigated the effects of child-related distraction in personal vehicles. From October 2011 to May 2012, Macy, Carter, Bingham, Cunningham, and Freed (2014) conducted a cross-sectional, computerized survey among adult drivers of 1- to 12-year-old children to collect information on unsafe driving behaviors. Of the 570 drivers who completed the survey, 71.2% disclosed child-related distractions. The study also found that parents who reported that their children did not always use age-appropriate restraints or who allowed their children to sit in the front seats were more likely to disclose child-related distractions.

Koppel, Charlton, Kopinathan, and Taranto (2011) used a naturalistic, observational approach to examine whether child vehicle occupants are significant sources of driver distraction. Twelve families participated in a 3-week observational period where each family was discreetly filmed driving an instrumented study vehicle. The results showed that drivers were observed engaging in activities that could potentially distract them during 98% of the trips with 12% of the observed potentially distracting activities involving interactiong with children in the back seat (Koppel et al., 2009). In a similar study (Stutts et al., 2003), researchers mounted video camera units in the vehicles of 70 volunteer drivers to measure exposure to potential distractions and their effects on driving performance. The research found that 20.9% of all participants were distracted by children or babies riding in their vehicles, with babies being more likely to distract drivers than older children. They also examined the effect of vehicle movement on distracted driving behaviors and found that while some behaviors were more likely to occur when the vehicle was stopped (e.g., reading or writing, manipulating vehicle controls, reaching or leaning, etc.), distracting behaviors involving babies and children occurred regardless of whether the vehicle was stopped or moving. Additionally, the researchers found that drivers were more likely to have their eyes directed inside the vehicles when babies or children were present.

Crash data has also been used to obtain more information on the sources of driver distraction. In 2002 researchers encouraged Virginia police officers to report whether distraction was a contributory factor in crashes and if so, to indicate the main source of distraction (Glaze & Ellis, 2003). A total of 2,792 crashes involving driver inattention were reported. The data indicated that distraction caused by passengers or children in the cars was one of the top four (of 35 total) specific types of distraction that were reported, accounting for 9% of the distractions reported. The only specific coded types of inattention that occurred more frequently than this were driver fatigue/asleep (17%), drivers looking at crashes or other roadside incidents (13%) and looking at scenery and landmarks (10%).

Children Arriving to School Ready to Learn

For many youth, school buses are their primary means of commuting. Because several studies have noted how changes to morning commutes may affect adults, the research team explored literature on commuting that may also be relevant to the experiences of student passengers. Chatterjee, Clark, Martin, and Davis (2017) suggest that commute length is related to well-being (e.g., life satisfaction and self-reported heath). Their research indicates that longer commutes are associated with lower job satisfaction and that longer commute times by bus more strongly reduced job satisfaction, as compared to other modes. Although these findings are specific to adults commuting to work, there is research suggesting that longer school bus routes may lead to increased disturbances or unsafe behaviors than shorter bus routes (Goldman & Peleg, 2010).

Ashforth, Kreiner, and Fugate (2000) discuss boundary theory and use commuting as an example of an important transition, both physically and psychologically, between home roles and work roles. They indicate that a commuter may use morning routine to psychologically disengage from the home role and transition into the work role. Kluger (1998) also suggests that while commute length is correlated with commute strain, commute variability is the strongest correlate of strain. While research suggests that morning commutes serve as important time for adults to prepare themselves for work and switch between roles, the same may also be true for children. This is an important consideration regarding the indirect effects of seat belts, as the presence of seat belts may result in a more predictable and less distracted environment.

Summary of Stakeholder Findings

Stakeholder Interviews

In the "Education on Seat Belts on School Buses" project, the research team conducted a series of interviews with school district transportation officials that included follow-up discussions about the indirect effects of seat belt use. Specifically, interviews were conducted with transportation directors, supervisors, or superintendents from 26 school districts in 12 States to discuss their experiences employing seat belts in all or some of their school bus fleets. In follow-up interviews, three of those transportation directors provided additional details about their experiences with the indirect effects of seat belt use. This section summarizes the relevant findings regarding indirect effects of seat belt use obtained both from the initial interviews and the follow-up discussions.

Four of the districts had not implemented seat belts, generally due to concerns about cost, maintenance, capacity, and other issues and are not included in this analysis. The size of the fleets reported by the respondents varied from 8 to 1,350 buses, with a median size of 94 buses. Within these fleets, 10 districts equipped all their buses with seat belts with the number ranging from 2 to 1,087, with a median of 51 buses equipped. All seat belt-equipped buses were new purchases, as opposed to retrofits.

Although some of these respondents had direct experience driving buses with seat belts, especially in smaller districts with an inadequate pool of substitute drivers, the majority of their responses were based on the feedback they received from the drivers they supervised. Although the indirect effects of seat belt use are primarily experienced by the bus drivers themselves, transportation directors and supervisors can serve as a valuable source of information. Because they work with all the bus drivers, they may be better able to identify trends related to the benefits and challenges associated with the school bus environment. They can also serve as key contact points for districts examining the merits of seat belts.

The majority of interview respondents in this sample communicated that seat belts on school buses contributed to a calmer and less distracted environment for school bus drivers. They said that the opinions about seat belts often varied from driver to driver, and that those drivers who invested more time and effort into them (e.g., by establishing and maintaining a consistent policy with their riders) got the most out of them. However, several interviewees also said that some drivers who were initially against seat belts became "believers" after using them.

Compliance

Discussions with transportation leaders highlighted the strong relationship between compliance (i.e., seat belt use) and the indirect benefits of school bus seat belts. The opportunity for experiencing the indirect benefits of seat belts is significantly reduced when student passengers ignore the seat belts and/or are able to do so due to the lack of enforcement policy. Of those districts who spoke about compliance, most said compliance was markedly better for elementary students and younger grades overall. In general, they said seat belt use decreased with age, as compliance was less consistent for middle school students and was minimal with high school students.

The school officials interviewed noted that drivers are generally instructed or recommended to remind students to buckle up as they enter the vehicles, with some districts requiring their drivers to perform visual checks. They also said that few drivers have the time to make sure every passenger is buckled in every time. One respondent said that one fleet of 16-person vehicles transporting special needs students ensures all students are belted before moving, but this is seldom required for most buses. Furthermore, if students are sitting in their seats, it is often difficult to determine from the driver's seat if they are wearing their seat belts, particularly in the rear of the bus. One district noted that students often buckle in but then put the shoulder strap behind their backs.

Many drivers will make extra efforts to check student compliance during the first week or two of the school year, especially when transporting younger (i.e., elementary) students. In addition, some drivers conduct occasional spot checks for compliance throughout the year, which they believe increases the rate of students buckling up in general. While older children are less likely to be compliant, one district that has had seat belts for many years felt that high schoolers' seat belt use rates have grown over the years, noting that this is likely due to the fact that these students have been doing it their whole lives. Therefore, students who buckle up regularly in elementary school may be more likely to buckle up in middle and high school, reinforcing a positive safety habit that may provide benefits well beyond their secondary education.

Overall, levels of compliance are believed to depend primarily on buy-in from the driver. If the driver is untrained or unfamiliar (e.g., a substitute driver) with the seat belts or simply does not want to enforce their use, then the students will have minimal encouragement to buckle up. Alternatively, if the driver feels invested in the use of belts, whether due to their own motivation or because of a district use requirement, then they will do more to encourage compliance (e.g., reminding students, checking on them, and reprimanding them when necessary). This reinforcement can help increase use. Several interviewees related that some drivers initially felt the seat belt policy was burdensome, but they became strong proponents once they saw the benefits of belt use on their own buses. Alternatively, a respondent from a different district said that veteran drivers saw few benefits from seat belts, perhaps because they have other established techniques for maintaining discipline on their routes.

Student Behavior

Almost universally, the districts that participated in interviews reported improvements in behavior on buses with seat belts, particularly when individual drivers encouraged compliance among their passengers. This was especially true for younger grades, as these students were more likely to use the seat belts. Respondents indicated that drivers felt that students sat in their seats more and moved around less on buses equipped with seat belts. This resulted in fewer direct distractions for the drivers and tended to cut down on interactions between students, leading to fewer fights and other infractions. Respondents said that even when students were not wearing the belts, they often did not want to advertise the fact. This was noted to be especially true when such actions lead to an official written-up with a behavioral referral to the school. In these cases, the district transportation officials noted that the indirect benefits of the seat belts were similar regardless of actual use because students moved around and stood up less, causing fewer distractions for the driver. This may also result in improved safety during a crash, as students were more likely to stay within the safety zone offered by compartmentalization.

Respondents said that some drivers reported up to a 50% reduction in the number of violations or referrals compared to buses without seat belts. This was the case even when bus routes with heightened behavioral problems were specifically chosen to use the seat belt-equipped buses. Other respondents indicated that they have seen the number of referrals stay constant with the introduction of belts, as the number of referrals for not wearing seat belts goes up while referrals for other types of violations decrease. While some drivers found it onerous to write up seat belt violations (particularly if they do not feel they get support from administrators at the student's schools), others believe it is easier to report compared to other types of referrals. For example, other types of referrals may require subjective decision-making on the part of the bus driver, whereas someone that is out of a seat is clearly not using a seat belt.

In order to ensure improved behavior, the respondents said that it was important to maintain consistency. They said drivers saw the most success when they were properly trained and had rules that they enforced throughout the year. This included establishing clear guidelines with the passengers and opening up lines of dialogue with their families, when possible. It was also helpful when all drivers, including substitutes and part-time drivers, were trained on all the buses. These school officials said that training was also beneficial for chaperones and coaches and any other adults who assist on field trips or athletic trips.

Delay

The respondents noted few or no instances where the use of seat belts was related to any appreciable delay on bus routes. Most of the school officials shared that their school years begin with training on how to use the seat belts. However, many communicated that on a typical day most drivers did little more than greet student passengers with a "Good morning, don't forget to buckle up" and occasional reminders while in route. Some drivers stopped the bus for an occasional spot-check mid-route, which might increase route time, but could be done only on days without other delays.

One district said it had noticeable delays when it first instituted a mandatory seat belt policy two decades ago. It found that making sure every student was buckled up could delay a bus by up to 15 minutes. Consequently, it decided to not make the drivers police every student, every time. Beyond this case, the only delay problems were due to specific issues associated with the style of the equipment used, such seat belt-equipped buses with overly narrow aisles or use of an older style of seat belt that made buckling difficult, particularly in winter months when students were bundled in layers.

Maintenance

A few districts mentioned the additional time drivers spent to help ensure that the seat belts were in good working order. During pre- and post-inspections, drivers at some districts were asked to check on the seat belt mechanisms and adjust them if necessary. This sometimes involved sliding buckles up after smaller children have used them or making sure they are in the right position. One respondent who used lengthy 2-point belts in a State with harsh winters said that by January the belts tend to become grimy, salty, and hard to bend due to winter weather residue. In this case, drivers had to spend time to keep the belt surfaces clean. They also sometimes needed to work to clean out the interiors of the belts and to physically manipulate the belt material to keep it flexible. However, this district indicated that they will begin phasing in more modern seat belts this year, which they expect to relieve this problem.

Driver Job Satisfaction

Driver attitudes towards seat belts vary widely. Respondents felt that drivers who are "set in their ways" or have their own methods for maintaining discipline prior to the introduction of seat belts may not perceive that there are benefits to investing time into establishing and enforcing a seat belt policy. However, some school officials said they experienced numerous drivers who were initially against the seat belts but quickly became advocates after seeing behavior improve with seat belts.

According to the interviewed respondents, most drivers saw improved behavior on buses with seat belts, which also helped increase their overall job satisfaction. The school officials said that drivers communicated that buses were calmer with seat belts and that they were less distracted and were able to concentrate more on their actual driving duties. Additionally, they noted that the drivers were better able to monitor their students and found that on-board issues did not escalate to the level experienced prior to the introduction of seat belts.

On the other hand, respondents relayed that some drivers said that while they experienced behavioral improvements, the extra work due to enforcement and maintenance of the seat belts was a drawback. Some school officials in districts with required-use (enforcement) policies said a small number of drivers felt that they spent more time disciplining students for not wearing seat belts than they spent previously managing behavior. These issues occurred generally on buses with older students, for whom compliance rates were lower overall.

A couple of districts indicated that their drivers were concerned about liability issues. In the case of a crash, they wanted to know whether they as the driver would be held responsible if a student was injured while not wearing a seat belt. They communicated that it was difficult to be confident that all students were wearing seat belts, particularly towards the back of buses. While some States have clear guidelines about this, many do not and drivers may worry that they will be personally liable in the case of a crash for something they do not have complete control over. At least one district described significant concerns about liability, reporting that bus drivers repeatedly asked for clarification on this issue; unfortunately, while a district may agree that the drivers should not be held responsible if they are doing their jobs in a reasonable matter, they may not feel qualified to declare one way or another on what is essentially a legal issue. If left unresolved, drivers concerned about this issue may be opposed to seat belts even if they experience their benefits.

Although all the school officials interviewed thought that most of their drivers believed that the seat belts made for calmer and more enjoyable driving experiences, none felt they could say with certainty that the belts helped increase job retention. They felt that most drivers were more satisfied with their job experience. However, there are so many issues affecting school bus drivers that it is difficult to disassociate the effect of seat belt use on long-term job satisfaction.

Recommendations

The interview respondents had several recommendations for instituting a successful seat belt program. Key components included achieving buy-in, implementing training, and providing ongoing communication with the community. Ten of the respondents either had or were developing an implementation policy, often simply a variation of "If there are seat belts on the bus, you must wear them."

Gain buy-in of the entire school community including staff, drivers, students, and families.
Successful activities employed to gain buy-in varied. In many cases, merely answering the concerns the community may have with evidence-based answers and exercises helped alleviate concerns. For example, some drivers worried about how seat belts would affect evacuation time in the event of an emergency, but conducting drills helped address these concerns. Similarly, some districts recommend their drivers conduct occasional spot checks of their passengers mid-route. Some drivers may view these spot checks as simply one more task for them, but with proper training can learn to see its long-term benefit.

Several respondents noted that the impetus to purchase buses with seat belts was due to outside legislation, sometimes reacting to a specific event, such as news reports of school bus crashes. The district transportation department was not involved in these discussions leading to these decisions, whether they be at State, local, or school board levels. Whenever possible, it can be beneficial to bring as many stakeholders (parents, administrators, drivers, etc.) to the table as early as possible, although this can often depend upon who is advocating for the issue.

Training is important for a successful school bus program.
Programs that school officials deemed successful included training for all drivers and support staff who might be in seat-belt-equipped vehicles. This training was recommended to include how to use the seat belts and how to establish rules with the riders. Many respondents said that they also developed training protocols and/or materials to teach students on how to properly use the seat belts, which helped reinforce use of the seat belts and improved behavior. These training sessions were often conducted during open houses and would be repeated during the opening

days of the school year, especially for younger grades. The respondents noted that drivers and/or the districts should make sure that any adults riding on the buses (teachers, chaperones, coaches, etc.) are trained to help enforce the policy of the districts or the drivers.

Provide ongoing communication with the community.
Awareness of school bus seat belts takes time to percolate through a district. Several districts worked with local television stations to run programs about the opening of school, including the installation of seat belts. While this helped inform families about the seat belts, it occasionally had the side effect of increasing the number of calls to the district offices. This was particularly true when seat belt installation was done in waves. If only some of the buses have seat belts, then parents of children on other buses may call to ask why their child's bus is not equipped with belts. This meant that any school official who has direct contact with parents or other community members should be trained to discuss this issue. For example, an operator or a superintendent should both be able to explain how seat compartmentalization has been shown to be very effective and that school buses are already the safest method to bring students to school. Ongoing communication is essential for maintaining community buy-in.

Bus Driver Survey

The results gathered for the concurrent "Education on Proper Use of Seat Belts" project included survey responses from 215 bus drivers across 50 districts in 12 States (Arkansas, California, Delaware, Florida, Illinois, Indiana, Minnesota, New Jersey, North Carolina, North Dakota, New York, and Texas), though approximately 71% of the respondents were either from Indiana or New Jersey. The other 10 States each accounted for 0.5 to 5.1% of the respondents. Bus driver experience, based on the total number of years participants have driven school buses, ranged from 0 to 47 years, with a mean of 14 years spent driving school buses. Among all participating drivers, more respondents reported having experience with 3-point lap/shoulder belts (72%) than with 2-point lap belts (28%). When asked how long they have driven buses with seat belts on them, 76% of respondents reported that they have driven buses with seat belts for longer than 6 months.

The following sections provide a summary of the survey findings related to the potential indirect effects of seat belt use on student behavior and bus driver stress, distraction and concentration. The full and final survey results can be found in the *Education on Proper Use of Seat Belts on School Buses* report (Katz et al., 2020).

Seat Belt Use

To understand how the use of seat belts on school buses influences indirect effects such as student behavior and driver distraction, it is important to understand more about seat belt use (i.e., compliance) as well as how belt use is typically and most effectively enforced.

Bus drivers were asked to report, on average, how many students on their buses per trip wear their seat belts (most, some, or none). The results indicated that, regardless of route time (morning, afternoon), younger students were more likely to use their seat belts than older students.

When survey respondents were asked to indicate whether their districts or agencies had school bus seat belt required-use policies – a policy requiring that students use the seat belts – approximately 72% of respondents reported that their school districts did adopt policies that required students to use seat belts if belts were present. Conversely, 15% reported that their school districts had not adopted required use policies, but rather that decisions regarding use are left to each individual driver and/or student choice. Only 8% of respondents did not know whether their agencies had use policies, and the remaining 5% gave some other response (e.g., *"only special needs buses use belts"*). A linear regression was used to estimate seat belt use as a function of a required-use policy (yes, no, don't know). The findings indicated that having a required-use policy was associated with higher reported rates of seat belt use. This was also the case for all combinations of grade levels (elementary, middle, high) and route times (morning, afternoon).

Respondents were also asked, *"As a school bus driver in your district, what are your responsibilities regarding the use of seat belts on the school bus?"* and were instructed to select all responsibilities that applied to them. The most common driver responsibilities were providing daily verbal reminders to students to wear their seat belts (78%) and providing initial instruction on belt use, e.g., at the beginning of the school year (66%). Two responsibilities, conducting walk-throughs before the bus leaves school (53%) and providing periodic instruction or training to the students reminding them how to use the belts (50%) were reported by approximately half of bus drivers. Fewer bus drivers were responsible for enforcing seat belt use via issuing written citations (41%) or via verbal warnings (37%). Linear regressions were performed to determine if the type or number of driving responsibilities assigned to a driver influenced reported seat belt use. There was no significant effect of number of driver responsibilities (count of total responsibilities, ranging from 1 to 6) on reported seat belt use. Similarly, there was no significant effect of type of driver responsibility on reported belt use. This is an interesting finding given that having a required-use policy does influence reported belt use. However, it should be noted that, while neither amount nor type of driver responsibility have a statistically significant effect on reported belt use, it is possible that the way drivers' responsibilities are being carried out may influence belt use. That is to say, two bus drivers may report that it is their responsibility to give daily reminders to students, but one may do a better job of that responsibility than the other (or one may not actually do it at all).

The full findings regarding seat belt use, compliance and enforcement can be found in the Katz et al. report.

Indirect Effects of Seat Belts on Buses

Student Behavior

The survey asked bus drivers to report changes that they have noticed since they started driving a bus with seat belts (changes in student behavior, changes in bus driver distraction, etc.), therefore survey respondents were also asked to report whether they have ever driven buses not equipped with belts; 77% of respondents reported that they have also driven buses without seat belts. The 23% of respondents who had never driven buses without seat belts were not asked to answer any questions regarding changes since driving buses with seat belts. As shown in Table 3, bus drivers largely reported that the behavior of students either improved (60%) or remained the same (35%) after they began driving buses with seat belts; very few (5%) reported that student behavior became worse, with some respondents noting that some students argued with drivers about using the seat belts or became aggravated about having to use them. This suggests that the presence of belts may have a positive influence on student behavior.

Table 3. Reported General Behavior Change of Students Since Drivers Began Driving a Bus With Seat Belts

Since I began driving a bus with seat belts, the behavior of students on my school bus has generally…	Percent of Respondents
Become Much Worse	2%
Become Somewhat Worse	3%
Stayed the Same	35%
Improved Some	29%
Improved a Lot	31%

The research team was further interested in whether belt *use* influences student behavior. To examine this, responses to the question *"Since I began driving a bus with seat belts, the behavior of students on my school bus has generally…"*, the results of which are shown in Table 3, were recoded to numerical values between -2 and +2 with -2 indicating that behavior became much worse, 0 indicating that it stayed the same, and +2 indicating that it improved a lot. A linear regression estimated the change in behavior as a function of reported seat belt use (none, some, most), grade level (elementary, middle, high), timing (morning, afternoon), and all two-way interactions. Survey respondents indicated that behavior was significantly better (mean=1.3) when they also reported that most students wore seat belts compared to when they reported that some (mean=0.79, $p<0.01$) or none (mean=0.39, $p<0.01$) wore their seat belts. Figure 3 depicts this finding, that more seat belt use is associated with a greater improvement in general student behavior on buses.

The bus driver survey questioned respondents about changes in frequency of common safety behaviors. Overall when drivers began driving school buses with seat belts, they indicated that negative behaviors decreased including students standing or out of their seats while the bus was in motion as well as the number of written citations decreased. Nearly one-third of drivers provided additional feedback on these decreased student movements and/or standing activities reporting a reduction in the continual movement of students between seats and up and down in seats or what one driver termed the distracting "popcorn effect." See Figure 4 for additional details. Students hitting each other with their hands or other objects while on buses with seat belts tended to stay the same or decrease. No clear trend emerged regarding changes in student safety in crashes, hard braking, or sharp turns with almost equal numbers of drivers reporting decreases, increases, and no changes in student safety.

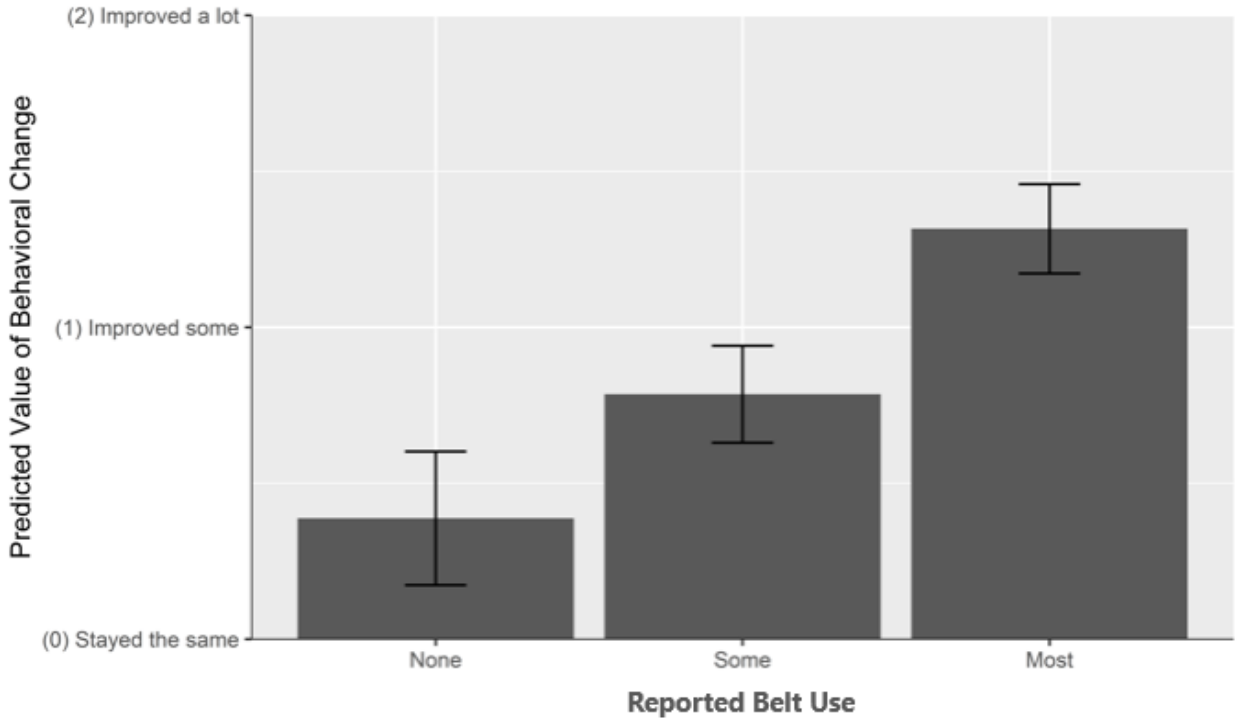

Figure 3. Effect of seat belt use on general student behavior on buses.

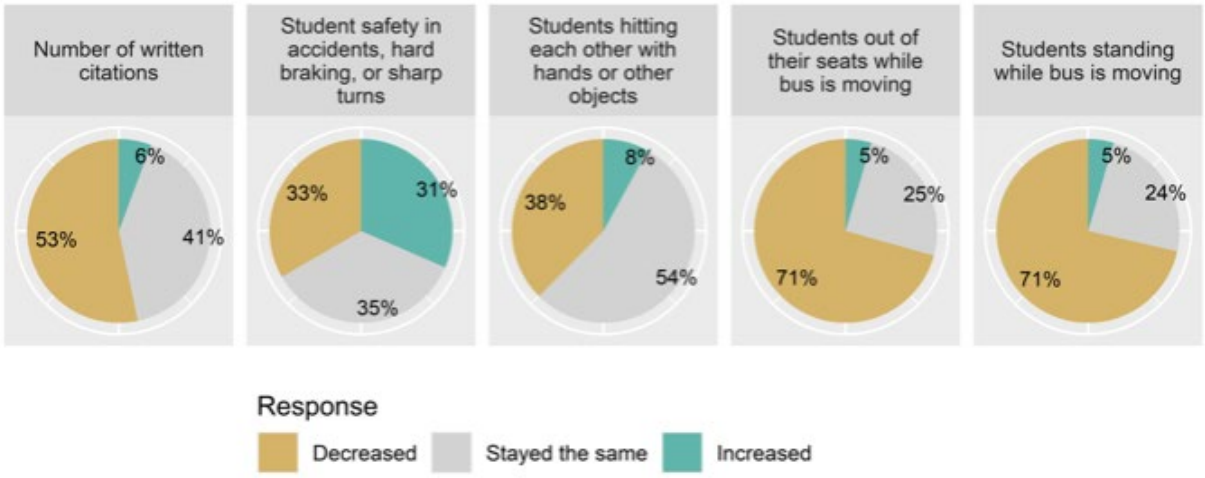

Figure 4. Change in safety behaviors after seat belts were implemented.

Survey respondents also reported other possible problems observed related to seat belts including backpacks getting tangled in the seat belts or to students having trouble getting in or out of the belts. Such issues could contribute to delays and increased loading and/or unloading times. Some bus drivers also reported students hitting each other with the seat belts, however the data indicated that respondents with 2-point lap belts were 4.63 (95% CI: 2.44, 8.96) times more likely than respondents with 3-point lap shoulder belts to observe students hitting each other with the belts.

While the bus driver survey asked respondents to report if they have observed such behaviors, drivers were not asked about the magnitude of each behavior. As such, it was not possible to conclude whether a driver report of such behaviors was associated with a single student or incident or multiple students or incidents.

Bus Driver Stress, Distraction, and Concentration

Changes in reported driver stress levels, distraction levels, and ability to concentrate (while driving and loading/unloading students) were assessed in relation to operating school buses with seat belts. (See Figure 5.) A majority of bus drivers indicated that their ability to concentrate on driving tasks (52%) and to concentrate while students were loading/unloading remained the same. Among drivers who indicated change in ability, there was more likely to be an increase rather than a decrease in ability with 36% noting an increase versus 11% noting a decrease in their ability to concentrate on driving tasks and 24% noting an increase versus 8% noting a decrease in their ability to concentrate while students were loading/unloading. When asked how driving a school bus with seat belts versus without seat belts affects distraction and stress levels, drivers more often reported that distraction and stress levels decreased (46% and 42%, respectively) or remained the same (43% and 43%) with few participants reporting an increase (11% and 15%, respectively).

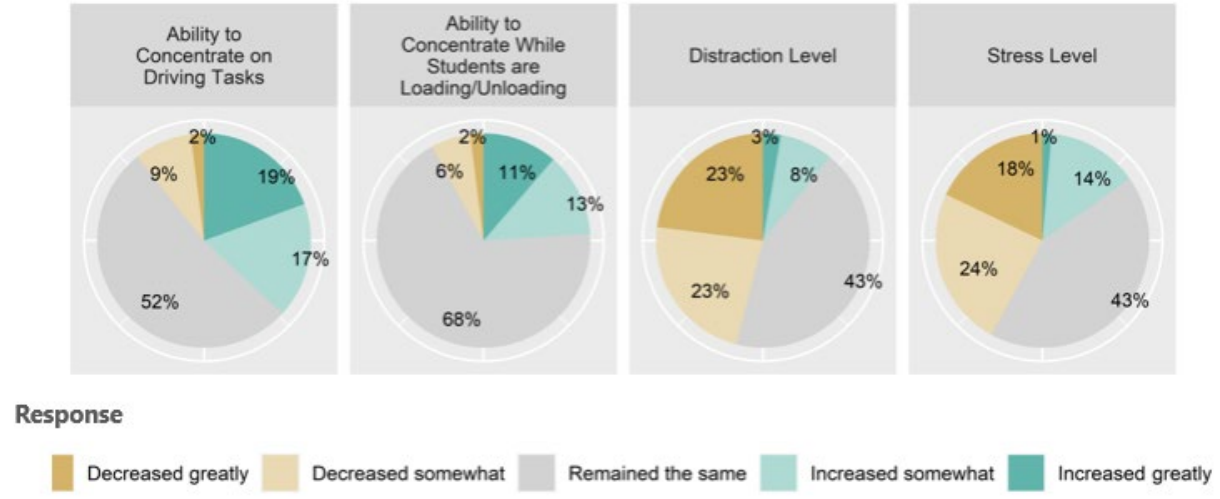

Figure 5. Effects of driving buses with seat belts on bus drivers.

If drivers felt that their stress level had changed, as a follow up, they were asked to explain why. While not all participants responded, responses ranged from increases in stress level because of now having to police and constantly remind students to wear seat belts to decreases in stress level because students were calmer, safer, and/or as a driver they had to spend less time looking in the rearview mirror to see what was going on behind them so they could focus more on driving.

Using scaled responses to the question *"Since I began driving a bus with seat belts, my distraction level has…"* (see Figure 5), the relationship between belt use and bus driver distraction was investigated. Responses were recoded between -2 and 2 (-2 = distraction decreased greatly, -1 = distraction somewhat decreased, 0 = remained the same, +1 = distraction somewhat increased, and +2 = distraction increased greatly). As shown in Figure 6, more reported seat belt use was associated with a greater reported decrease in bus driver distraction. There was a greater decrease in distraction (mean = -0.82) when drivers reported that most students wore seat belts compared to when drivers reported that some (mean = -0.24, $p<0.01$) or none (mean = -0.07, $p<0.05$) of the students wore seat belts.

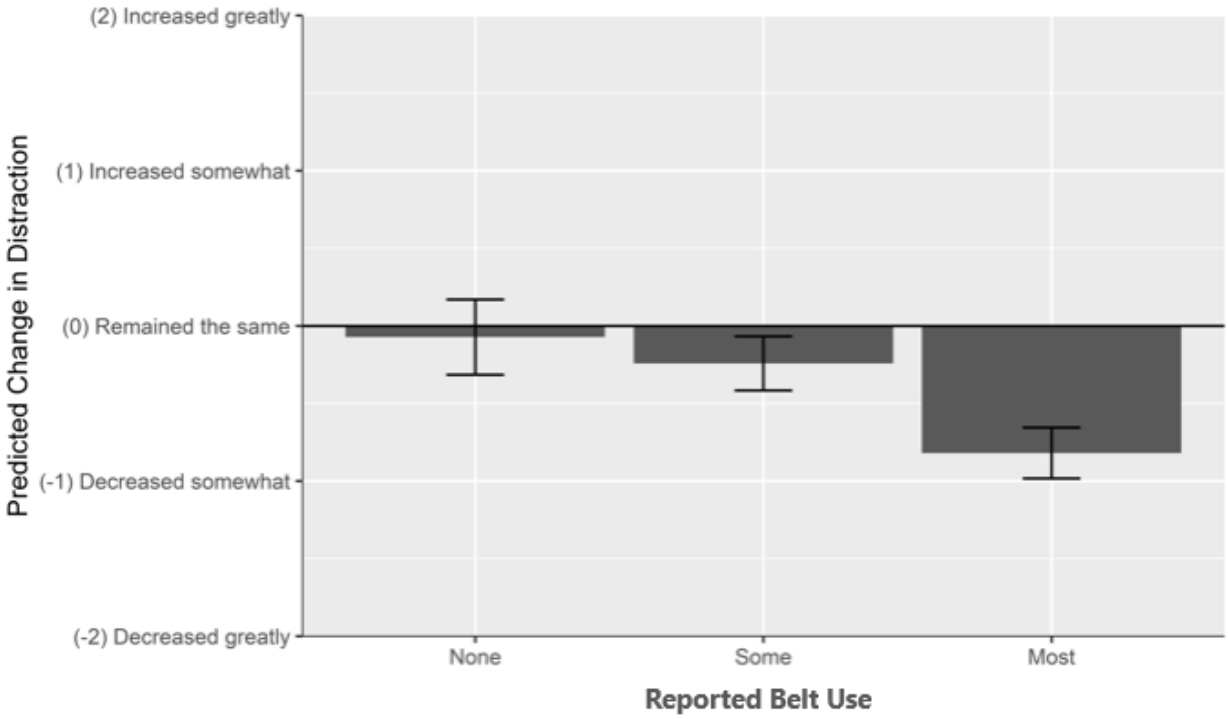

Figure 6. Effect of seat belt use on bus driver distraction.

The influence of driver responsibilities for student seat belt use on bus driver stress was assessed. As noted previously, the six responsibilities included the following.

- Provide daily verbal reminders to students to wear belts
- Provide initial instruction to students on use of belts (beginning of year or when new bus with belts put into service)
- Conduct walk-through with reminders before leaving school in afternoon
- Provide periodic instruction/refresher training to students on use of belts
- Enforce belt use via written citations
- Enforce belt use via verbal warnings

Neither the number of driver responsibilities (1 to 6) nor type of responsibility were significantly associated with driver stress. Although there was no relationship between driver responsibilities and stress, only the type and number of responsibilities mentioned were assessed and not the manner in which these responsibilities were carried out by individual drivers.

Conclusions and Discussion

As evidenced by the literature review, there have been some research studies conducted to investigate the impacts of school bus seat belts on capacity as well as use rates, but discussions of indirect effects on safety have been minimal. Research in other areas, such as distracted driving and children as a source of distraction, provides some additional insight on potential indirect safety effects. While the evidence is largely anecdotal, the research team's work on identifying and analyzing stakeholder responses does provide additional information on potential indirect effects of improved student behavior including a reduction in bus driver stress and distraction and increased school bus driver satisfaction and retention. In addition, the impacts on route times, loading times, and capacity are also discussed. While there are some limitations to the current investigation, this study also generated lessons learned that may provide useful direction for future more comprehensive studies.

Quantifying Seat Belt Use

One common finding from the literature review, stakeholder discussions, and bus driver survey was that younger students are more likely to use their seat belts than are older students. For example, both school transportation officials and bus drivers noted that elementary students used the seat belts more consistently than high school students, regardless of the presence of use policies. This finding may help school districts that are implementing belts prioritize the assignment of buses with belts when resources are limited.

Although there may be other factors that seem to influence compliance, such as belt type (Goldman & Peleg, 2010), stakeholder discussions indicated that levels of compliance often rest primarily upon buy-in from the bus driver. If the bus driver is not motivated to enforce belt use, then students will have minimal encouragement to buckle up. Conversely, if the drivers are invested in encouraging belt use, either personally or due to district requirements, they are more likely to encourage compliance by requiring the students on their buses to wear the seat belts which helps increase seat belt use. These findings were supported by the bus driver survey data which showed that bus driver responsibilities alone were not a significant influencer of reported seat belt use, but that having a required-use policy and/or driver reporting that they require the students on their buses to wear the seat belts lead to higher reported belt use rates.

While the link between having a required-use policy and a driver's individual enforcement of seat belt usages was not examined in this study, these findings suggest that drivers with knowledge of a use policy are more likely to require their students to wear seat belts.

Indirect Effects Encountered

Student Behavior Management

Overall, bus drivers reported that the behavior of students either improved (60%) or remained the same (35%) after they began driving a bus with seat belts, with very few (5%) reporting that student behavior became worse. Discussions with stakeholders also showed, almost unanimously, that drivers experience improvements in behavior on buses equipped with seat belts. Of those drivers surveyed, many felt that students sat in their seats more and moved around less on buses equipped with belts, which ultimately led to less distraction while driving.

The bus driver survey findings also showed a reported decrease in students standing or moving out of their seats while the bus was in motion. Approximately 54% of survey respondents indicated that the number of written citations issued has decreased since driving buses equipped with seat belts, with district stakeholders reporting similar findings that drivers reported up to a 50% reduction in the number of referrals or violations compared to buses without seat belts. This was the case even when bus routes with heightened behavioral problems were prioritized to use the seat belt-equipped buses. Other respondents indicated that they have seen the number of referrals stay constant with the introduction of belts, as the number of referrals associated with lack of seat belt compliance increased while referrals for other types of violations simultaneously decreased.

Some school officials reported that indirect benefits of the seat belts were similar regardless of whether students use the belts properly. They noted that this was primarily because students moved around and stood up less regardless because they knew they were in compartments with belts, which often led to fewer distractions for the driver. However, the bus driver survey results indicated a stronger relationship between belt use and behavior with many drivers reporting that increased seat belt use was associated with greater improvements in overall student behavior while on a bus.

Stakeholders indicated that it was important to maintain consistency to ensure improved student behavior. They said drivers saw the most success when they were properly trained and had rules that they enforced not just during designated times such as the start of a school semester, but throughout the year. This enforcement included establishing clear guidelines with the passengers and opening lines of dialogue with their families, when possible. Training was also helpful for any adults who might be assisting, such as substitute drivers, part-time drivers, chaperones, or coaches.

Bus Driver Stress and Distraction

Research on distraction as a contributory factor in crashes indicates that passengers/children were one of the top four distractions in crashes involving driver inattention (Glaze & Ellis, 2003). Passenger-related distractions can lead to a variety of distraction-induced bus driver errors (Salmon et al., 2009). Furthermore, school bus drivers face an even more unique driving distraction experience, as student misbehavior increases the incidence of safety shortcuts and the level of safety violations (Zohar & Lee, 2016).

The bus driver survey findings indicate that bus drivers' reported ability to concentrate tends to remain the same after drivers began driving buses with seat belts. For those whose reported ability to concentrate did change, the ability to concentrate was more likely to increase than it was to decrease. In addition, bus driver stress and distraction levels were more likely to decrease after driving buses with seat belts, with very few participants reporting that they increased.

Preliminary survey findings also indicate that bus driver distraction decreased with an increase in reported belt use. Additionally, the survey showed there was more of a decrease in bus driver stress for those that reported requiring all their students to wear their belts as compared to drivers who reported not requiring their students to wear their belts.

Several interviewees relayed that some drivers initially felt the seat belt policy was burdensome, but they became strong proponents once they saw the benefits of belt use on their own buses.

Bus Driver Satisfaction and Retention

Many of the school officials that spoke with the research team indicated that most of their bus drivers believed that seat belts led to a calmer and more enjoyable driving experience over all, and some even felt that their drivers were more satisfied with their job experience because of this. However, none felt that they could definitively say whether seat belts (and any indirect benefits to drivers) had any influence on driver retention. This is because there are too many issues influencing school bus drivers to determine if seat belts play a distinct role in retention. Regardless, school officials reported that many bus drivers who were previously opposed to seat belts or were "stuck in their ways" have since become supporters of seat belts due to the indirect benefits that they have seen.

Despite seeing indirect benefits of seat belts, such as improved student behavior and/or less driver stress and distraction, some bus drivers still have concerns. Both the literature (Turner et al., 2010) and interviewees indicated that behavior enforcement is more challenging on buses with higher seat backs, and buses with lap/shoulder seat belts require higher seat backs. It was also noted that the higher seat backs generally made it more challenging to see all the students on the bus. While federal standards were changed in 2008 to require all school bus seat backs (with and without seat belts) to be 4 inches higher than previously mandated, it is unknown whether the issue of student passenger visibility and discipline enforcement is greater for school buses equipped with seat belts.

It is not uncommon for bus drivers to be concerned that they will be held responsible for students not wearing their seat belts (Turner et al., 2010) or, more specifically, to be concerned about liability issues if a crash should occur. Discussions with stakeholders revealed that some drivers are concerned about whether they will be held responsible if a child who was not wearing their seat belt was injured during a crash. Although some States have clear guidelines related to this issue, many States do not have guidelines in place. Thus, many drivers remain concerned about this liability. If left unresolved, this issue may lead some bus drivers to be opposed to seat belts regardless of the direct or indirect benefits they offer.

Effects on Route Times and Loading and Unloading Times of Buses

During the discussions with school officials, very few respondents noted instances where the use of seat belts was related to any noticeable delays on bus routes. Most responded that each school year begins with refresher training on how to use the belts. Additionally, most drivers said they tend to provide morning reminders or verbal reminders en route, which they noted have little effect on route times. Some drivers conduct spot-checks mid-route, which they noted can affect route times. One district did report noticeable delays of up to 15 minutes when it first instituted a mandatory seat belt policy and was making sure that every single student was buckled up. This district consequently decided not to have its drivers monitor every student, every time.

It is possible for occurrences of backpacks to get tangled in the seat belts or for students to have trouble getting in or out of the belts. This could contribute to increased loading and/or unloading times. The bus driver survey asked respondents to report if they have observed such behaviors; however, they were not asked about the magnitude of each behavior, so it was not possible to conclude whether a driver report of such behaviors is associated with a single student or incident or multiple students or incidents.

When discussing effects on route times and delays, one stakeholder mentioned some delay problems due to specific issues associated with the style of equipment used. For example, it was noted that seat belt-equipped buses with overly narrow aisles, or older-style seat belts that were difficult to buckle may cause delays, particularly in winter months when students wore multiple layers of clothing.

Decreased Space Inside Buses

Research on decreased space inside buses was only found regarding reduction in capacity due to seat belts. Most literature draws on data prior to 2007 when seating positions for lap/shoulder belts were fixed, causing a loss of capacity, particularly for elementary school passengers who often sit three-to-a-seat. However, the school bus industry responded to this problem in 2007 by introducing "flexible seating." These new seats allowed the same 39" school bus with lap/shoulder seat belts to accommodate three elementary or two high school students per seat, just as in buses not equipped with belts. This innovation has greatly reduced challenges associated with a loss of capacity on buses with belts.

Limitations and Gaps in Knowledge

To date, there is limited quantitative data regarding the indirect effects of seat belts on school buses. Some literature has examined seating configurations and capacity loss on buses due to seat belts (Turner et al., 2010; Gurupackiam et al., 2014), but this research has limited relevance due to the flexible seating now offered on all new school buses equipped with lap/shoulder belts.

The research team identified a few studies that examined seat belt use rates and/or factors that influence seat belt use (Turner et al., 2010; Goldman & Peleg, 2010; Lou et al., 2010), and even fewer efforts to quantify student behavior relative to seat belt use (Goldman & Peleg, 2010; ITRE, 2007). Additionally, the research team was unable to identify any ongoing attempts to quantitatively measure seat belt use or any indirect effects of seat belts, despite having made abundant contacts with school district transportation supervisors and/or State transportation directors during this project and the concurrent "Education on Proper Use of Seat Belts" project. As such, many of the findings presented in this report provide qualitative data regarding indirect effects.

Another issue to keep in mind is that not only is the technology changing, but legislation and policy are changing. The preliminary survey response pool included heavy participation from various school districts in New Jersey. While New Jersey State law required high back seats and lap belts since 1992, the law was recently changed to require lap/shoulder belts on all new school buses. Driver perceptions based on their experience with lap belts (e.g., when drivers report that children are hitting each other with the belts) may not be as relevant given the increasing preference for installing lap/shoulder belts. Regarding students hitting each other with belts, tripping over belts, and other concerns associated with belt length, it is important to note that the results of this study showed that these outcomes are primarily associated with 2-point belts, which many school districts are phasing out of rotation. For example, data from the bus driver survey indicated that respondents with 2-point lap belts were 4.63 (95% CI: 2.44, 8.96) times more likely than respondents with 3-point lap shoulder belts to observe students hitting each other with the belts. Several of the school district transportation officials interviewed noted that these issues were eliminated with the introduction of 3-point belts.

A limitation of the current investigation and past studies is that no in-depth analysis had been conducted to concretely quantify the indirect benefits of seat belts on school buses. Consequently, a beneficial first step would be a study focused on a sample of school jurisdictions that includes a detailed examination of student behavior using an analysis of documented incident reports or video to help determine impacts before and after seat belt use and installation. In addition, while factors such as driver satisfaction and retention can be influenced by other factors, an analysis of the satisfaction levels and retention rates on routes with and without seat belts would be beneficial.

Lessons Learned

Overall, project findings indicate that seat belt use is associated with improved student behavior. Reported seat belt use is higher when there is a required-use policy in place, and seat belt use is heavily reliant on the efforts of bus drivers. To help ensure a successful seat belt program, it is important to not only train bus drivers in the use and enforcement of seat belts, but to keep them motivated to find the best ways to encourage seat belt use on their buses. Assigning specific responsibilities to bus drivers may not be enough to influence belt use, as drivers' motivation, encouragement, and enforcement efforts are likely the strongest determinants of seat belt use. While this study offers an overview of the indirect benefits of seat belts based on a literature review and stakeholder experience, a more detailed study focusing on the indirect safety benefits experienced by a sample of school jurisdictions would better quantify the potential outcomes of school bus seat belts.

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