TRUCKER PRECEPTIONS AND OPINIONS OF LANE RESTRICTION AND DIFFERENTIAL SPEED LIMIT POLICIES ON FREEWAYS

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ABSTRACT

To improve traffic operation and safety, several states have implemented truck lane restriction and differential speed limit policies on freeways. The State of Louisiana introduced such restrictions on an 18-mile elevated four-lane rural segment of Interstate 10 (I-10) in response to an 11-vehicle crash in September 2003. The new control policies, implemented in 2005, have restricted trucks to the right lane only and reduce their speed limit to 55 mph. At the same time the speed limit for passenger cars was also reduced from 70 mph to 60 mph. This paper highlights the findings of a survey to assess truck drivers' perceptions and opinions of these restrictive policies. Another objective of the survey was to solicit ideas and input for other potential strategies that could be useful to the drivers. Overall, the results showed that the truckers were not in favor of the restrictions and they did not perceive that a significant safety benefits were being gained from restrictions. In fact, it was apparent that they felt it was safer to have uniform and higher speed limits and freedom to select a travel lane.

KEYWORDS

Truck Lane Restriction, Differential Speed Limit, Elevated Freeways, Safety, Opinion Survey.

INTRODUCTION

To improve the operation and safety of traffic on freeway segments, several states have implemented special policies that restrict trucks to specific lanes and impose lower speed limits on them. Examples of these control policies can now be found in Texas, Tennessee, and Virginia. The State of Louisiana introduced such restrictions on an 18-mile elevated four-lane segment of Interstate 10 (I-10) in response to an 11-vehicle crash in September 2003. The segment is located in a rural region of south Louisiana, between Baton Rouge and Lafayette. This study location is also unique in that it is elevated above the flood plain of the Atchafalaya Basin for its entire length and thus has relatively narrow shoulders and no entrance or exit ramps along the segment. The 2003 crash resulted in five fatalities and was caused by a truck failing to notice stationary traffic ahead. Due in large part to this incident, new policies were implemented in 2005 to restrict trucks to the right lane only and reduce their speed limit to 55 miles per hour (mph). At the same time the speed limit for passenger cars was also reduced from 70 mph to 60 mph. To evaluate the effectiveness of the restriction policies, a research study was initiated by Louisiana Department of Transportation and Development (LADOTD). Among the objectives of this study was to obtain feedback from truck drivers and trucking companies on their assessment of the new policies. This was accomplished using a mail-in opinion survey. The results of the survey are presented in this paper.

BACKGROUND

Over the past several decades numerous studies have been conducted to measure the safety and operational effectiveness of traffic restriction policies on freeways, including truck lane restrictions and differential speed limits. These studies have shown mixed findings in terms of impact. While some have shown positive results, others have shown negative or no impact at all. The following paragraphs of this section briefly summarize the main findings from some of the more recent informative studies.

Truck Lane Restriction

Lane restriction strategies are used to limit trucks to a certain lane or lanes, with the goal of minimizing the interaction between trucks and other types of vehicles to improve safety on certain sections of freeways. Researchers have used field data and/or simulated data to measure effect of such measures on the overall traffic operation and safety. For instance, Zavoina et al. (*1*) conducted a study to evaluate the effect of prohibiting trucks from traveling in the left lane on a three-lane section on I-20 near Fort Worth, Texas. The study concluded that the directional distribution of trucks changed significantly due to the imposed restriction. Also, the authors found no significant impacts on the directional distribution of cars, speed of either cars or trucks, or time headways between vehicles. Another study by Cate et al. (*2*) addressed the impact of a lane restriction on large trucks on Tennessee's highways and recommended that truck lane restrictions be used on freeways with at least three lanes in each direction. However, the study also specifically advised against restricting trucks to a single lane. A nationwide survey was conducted by the Texas Transportation Institute (TTI) (*3*) on the

current state of practice in managing lanes. According to the TTI survey results, lane restrictions have been implemented in 26 states; 14 to improve highway operations and 8 to improve safety.

Borchardt (*4*) collected traffic data throughout 36-week period of truck restriction over a six mile long freeway segment for demonstration before-and-after study in Houston. The results showed that restriction reduced traffic accidents by 68 percent without any changes in freeway operations, travel time, frequency of lane changes, or traffic patterns. Kuhn et al. (*5*) compared the advantages and disadvantages of implementing truck lane restrictions in Texas, and concluded that although maximizing efficiency and success of designated lanes was a difficult and complex process, designated lanes were believed to be the best approach for moving traffic more efficiently and improving safety on highways that were frequently used by 18-wheelers. Zeitz (*6*) examined the safety benefit of truck lane restrictions implemented for one year on I-85 in South Carolina. The results showed that with targeted enforcement applied for lane restriction and aggressive driving violations, truck-related accident rates decreased by 78 percent.

Several studies using simulation have also been conducted to examine the operation and safety impact of truck lane restriction. In a study conducted by Mussa and Price (*7*), CORSIM was used to simulate the traffic operations on I-75 with a median lane restriction for trucks. The results revealed that the policy of restricting trucks from the median-lane provided a safer and more efficient operation, and therefore, should be kept in place. Models have also been developed by Gan and Jo (*8*) to assess strategies for truck lane restrictions that would offer the most efficient operations on highways. They concluded that, in general, when sections with restricted lanes are not under heavy weaving and lane changing conditions, truck lane restriction policies appeared to be beneficial in terms of traffic operation. By contrast, a study by Fontaine (*9*) on lane restrictions along I-95 demonstrated an increase in crash rates, and thus negative safety implications.

Differential Speed Limits (DSL)

Differential speed limits have been applied to establish lower speed limits for trucks while maintaining higher speeds for passenger vehicles. In the past, DSL's have also been used in combination with lane restriction policies. This section summarizes several studies that were conducted to evaluate the safety benefits of DSL. Wilmot and Khanal (*10*) documented the effect of speed limits on vehicle speed and safety on roadways and concluded that there was no proof of a positive impact of differential speed limits on highway safety. A report, by Garber et al. (*11*), compared the safety effects of differential speed limits on rural interstate highways against those with uniform speed limits. In this work it was found that changing from a uniform speed limit to a differential speed limit or vice versa had no impact on the mean speed and speed variance of vehicles on highways. In another study, Garber (*12*) used a modified empirical Bayes framework to evaluate the crash frequency changes for the four policy

groups: maintenance of a uniform limit, maintenance of a differential limit, a change from a uniform to a differential limit, and a change from a differential to a uniform limit. The aggregate results of this work showed no consistent safety effects of differential speed limit as opposed to uniform speed limit. Monsere et al. (*13*) evaluated the effects of a proposed maximum speed limit change to 65 mph for trucks and 70 mph for passenger vehicles on Oregon's Interstate highways. The study examined the influences of speed change on motor-vehicle accidents, enforcement, health, economy, and the environment. The results indicated negative effect on all but travel time and some economic development benefits.

Interestingly, the literature also showed that none of the past studies have explicitly considered the perception of truckers or the trucking industry representatives to these types of lane restriction and differential speed limit policies. Driver perceptions and opinions are important and should be considered in the implementation of such restrictive policies. Additionally, it was felt that feedback provided by people who actually experience driving under the policies would be quite useful to generate new ideas and assess how these policies are viewed. The lack of and need for such information was viewed as a significant gap by the researchers and the LADOTD and gave motivation for this work. To this end, a survey questionnaire was developed for distribution to truckers using this segment to meet the following objectives:

- to gather information on the travel experience of the drivers and their frequency of travel on that section, as well as the type of truck they operate;
- to measure the truck drivers' awareness of the restriction policies in effect;
- to poll the driver's opinion on the safety impact of the policies;
- to determine the effectiveness of warning signs and law enforcement along the section; and
- to identify other possible strategies proposed by drivers to improve safety and operations.

STUDY SECTION AND DATA COLLECTION

The study was conducted on the 18-mile elevated section of I-10 in Louisiana between milepost 135 (near Ramah) and milepost 117 (near Henderson) as shown in Figure 1. This segment of roadway is somewhat unique in that it is elevated above grade for its entire length. Although its typical cross-section features a 12 foot right should and a six foot left shoulder, it has also been constructed with a narrower than usual cross-section in some areas that incorporate four foot shoulders on both sides of the road as shown in the photograph of Figure 2. The fact that this segment also spans the Atchafalaya Basin floodplain also means that there are no interchanges or other entrance or exit ramps along its extent.

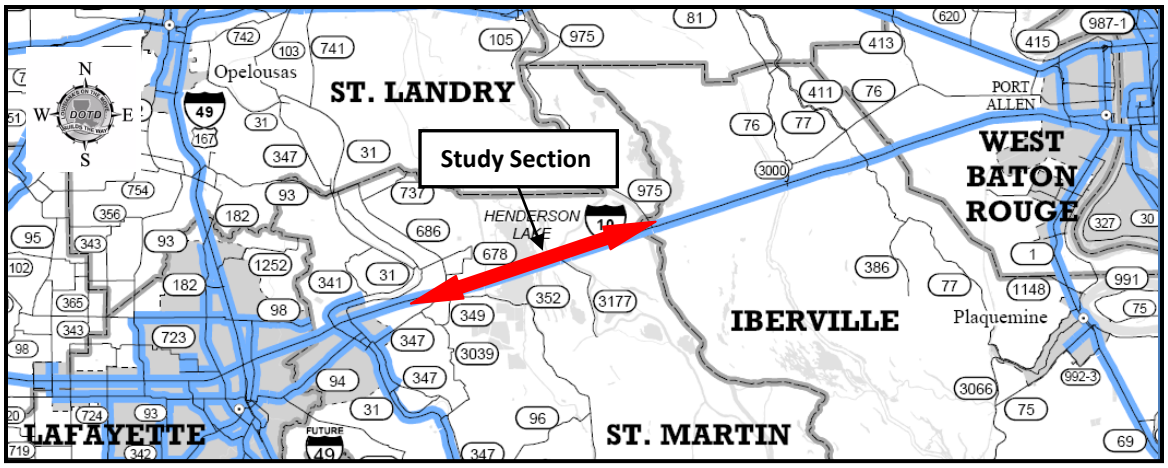

Figure 1: Map of the study section of I-10 in Louisiana

Figure 2: Cross-section view of the study section

Along this section, trucks have been restricted to the right lane with a speed limit of 55 mph, while other types of vehicles have a speed limit of 60 mph. The sample group that was targeted for the survey consisted of truck drivers who were employees of trucking companies and who have driven over the study section at least once since the implementation of the lane restriction and 55/60 mph differential speed limit policies in 2003. The survey was mailed out to a total of 485 trucking companies, out of which 159

responses were received. The questionnaire was composed of eight parts, including: (1) general information on the truck driver; (2) travel frequency over the study area; (3) driver's awareness of the restriction policies; (4) driver's perception of the safety impact of the restriction policies; (5) driver's opinion about the warning signs and level of enforcement on the study section; (6) information on lane changing behavior; (7) driver's proposed strategies for possible improvements; (8) additional comments. Figure 3 and Figure 4 show a detailed snapshot of the questionnaire.

PART 1: GENERAL INFORMATION

1. How many years did you work as a truck driver?

☐ Less than 1 ☐ 1 to 5 ☐ 6 to 10 ☐ 11 to 15 ☐ 16 to 20 ☐ More than 20

2. What is the type of vehicle you are currently operating?

☐ Tractor Semitrailer ☐ Straight Truck ☐ Other:

PART 2: ATCHAFALAYA SWAMP FREEWAY

3. Since September 2003, how many times have you traveled on the Atchafalaya section of Interstate 10?
Note: This elevated roadway is located between Lafayette and Baton Rouge. Going eastbound, it starts near Henderson and ends near Ramah. Please see attached map.

PART 3: POLICY

4. Are you aware of the different speed limits for trucks and cars (55 mph for trucks and 60 mph for cars) at this location?

☐ Yes ☐ No

5. Are you aware of the policy that is restricting trucks to the right lane at this location?

☐ Yes ☐ No

PART 4: SAFETY

6. Do you think the current speed limits might improve the safety at this location?

☐ Yes ☐ No ☐ Do Not Know

If yes, to what degree? ☐ Significantly ☐ Average ☐ Not Significantly

7. Do you think the current policy that is restricting trucks to the right lane might improve the safety?

☐ Yes ☐ No ☐ Do Not Know

If yes, to what degree? ☐ Significantly ☐ Average ☐ Not Significantly

PART 5: WARNING AND ENFORCEMENT

8. Do you believe that there is sufficient warning about the speed limits and the lane restriction at this location?

☐ Yes ☐ No

9. Do you believe that the legibility of the warning signs is adequate?

☐ Yes ☐ No

10. Have you ever received citation for violation of the speed limit at this location since September 2003

☐ Yes ☐ No If yes, how many times? _____

11. Have you ever received citation for violation of the lane restriction at this location since September 2003?

☐ Yes ☐ No If yes, how many times? _____

Figure 3: Survey Questionnaire Parts 1 to 5

PART 6: LANE CHANGING

12. What are the two primary reasons you might need to change lanes when driving this road segment?

PART 7: FUTURE STRATEGIES

13. Which of the actions below do you think should be taken by the Louisiana Department of Transportation and Development? (Multiple answers allowed)

Strategies Relating to Speed

☐ 1. Keep the 55 mph speed limit for trucks in force
☐ 2. Keep the 60 mph speed limit for cars in force
☐ 3. Keep the lane restriction in force
☐ 4. Change the speed limit for trucks to_____mph
☐ 5. Change the speed limit for cars to _____mph
☐ 6. Set different speed limits for left and right lanes:____mph for left lane, _____mph for right lane
☐ 7. Reduce the speed limit for all vehicles during the peak hours
☐ 8. Place a mechanism on the section that detects an incident and warns the drivers before they approach the scene
☐ 9. Place a mechanism that informs a driver of his/her cruising speed versus the posted speed limit
☐ 10. Double the fines for speed and lane violations

Lane Restriction Strategies

☐ 11. Restrict trucks to the left lane and allow them to change lanes at exits
☐ 12. Restrict cars to the left lane and allow them to change lanes at exits
☐ 13. Restrict cars to the right lane
☐ 14. Restrict a truck to the lane that it was in at the beginning of the section
☐ 15. Restrict a car to the lane that it was in at the beginning of the section
☐ 16. Do not implement any kind of restriction for trucks
☐ 17. Separate left lane from the right lane using barriers

Roadway Lighting Strategies

☐ 18. Improve the lighting along the section

Enforcement Strategies

☐ 19. Increase the number of law enforcement patrols

Other Strategies (Please Specify)

☐

14. How would this strategy benefit to the traffic safety and operations on this segment, the trucking industry, and the roadway pavement?

PART 8: ADDITIONAL INFORMATION

15. What else would you like to mention about the lane restriction and speed limit policy for trucks at this location?

Figure 4: Survey Questionnaire Parts 6 to 8

DESCRIPTIVE ANALYSIS OF SURVEY RESPONSES

The following sections provide a general overview of the survey findings. This descriptive analysis characterizes the aggregate perceptions and interpretations of truck driver opinions based on their direct responses to the questions. Where appropriate, some of the responses have been presented in a disaggregated manner and evaluated in greater detail based on various conditional groupings of responses to identify and evaluate violators based on certain levels of experience, understanding, and patterns of behavior. In the following section these responses are then analyzed more quantitatively using statistical procedure to assess the consistency and relationship of certain responses to various driver characteristics, such as driving experience.

Driver and Vehicle Characteristics

The first set of questions were posed to assess the level of experience of the truck drivers using the segment of freeway under analysis, the types of trucks they operated, and the number of times they traveled on the section. These issues were assumed to be important since a driver's familiarity with the speed and lane restrictions was thought to be a function of the frequency of their trips through the segment and their general experience in operating large trucks in areas with similar types of controls. The survey results suggested a very experienced pool of respondent drivers. Of the drivers responding to the question, 63 percent reported having more than 10 years driving experience with nearly a third (32 percent) reporting 20 or more years of experience. Although 23 percent reported 5 or fewer years of driving experience, only 1 percent reported driving one year or less. In terms of the type of truck configuration driven by the operators in the survey, 81 percent of respondents reported driving a tractor semi-trailer configuration; making it by far the most common type of truck in the survey. Of the remaining 19 percent, 16 percent reported driving a single unit "straight" truck and only 3 percent reported driving other configurations.

The frequency of passage over study section is shown in the histogram of Figure 5. Although a fairly wide distribution of passage rates was reported by the respondents, it can be seen that the majority of the drivers had driven through the test section 100 or more times during the five years of the restriction policies. Specifically, 54 percent of respondents reported driving more than 100 times, with 22 percent driving the segment more than 200 times or about once a week. Only 24 percent reported driving through the segment 25 or fewer times, or an average of about once every two or three months, since the policy change.

Awareness of Operating Policy

Next, two questions were posed to gauge the level of awareness of the differential speed limits and the lanes restriction. These were included to assess the level to which speed and lane-use violations may have been related to a lack of understanding on the part of truck drivers. Based on the responses it was quite clear that the drivers involved in the survey were well aware of both controls. 96 percent of those that responded to the question reported being aware of the differential speed limits for cars and trucks and 95 percent indicated that they were aware of the truck lane restriction. These results clearly suggest that the information about the controls is being effectively communicated and understood by those to whom it is targeted. These results were also somewhat surprising to the researchers since the surveys were likely filled out by many drivers who also indicated that they only drove through this section two or three times a year.

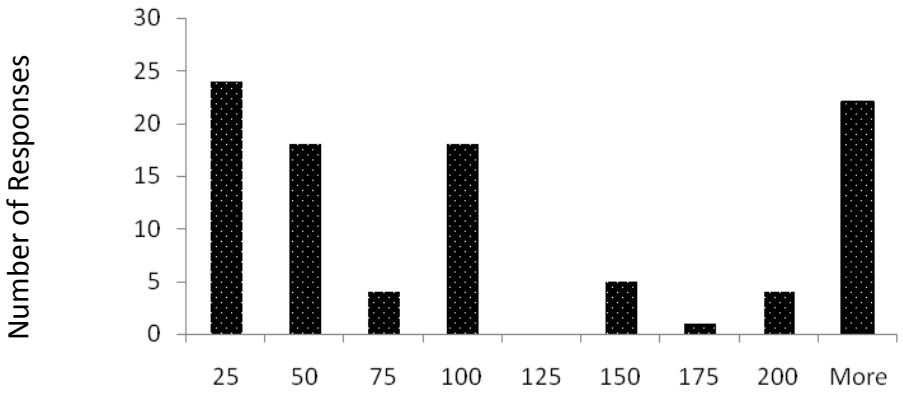

Figure 5: Travel Frequency over the Study Section

To further explore the issues of communication and understanding, two additional questions were posed to evaluate the truck drivers' perceptions of the control configuration that exists along the route. The first question centered specifically on the sufficiency of the advanced warning provided by the signing in the area. Based on the survey, it was determined that 83 percent of respondents found that the communication of advanced warning information about the speed and truck lane restrictions was adequate at this location. Similarly, 85 percent of the respondents also found the warning signs to be adequately legible. Coupled with the results from the previous set of questions, these findings clearly suggest that pre-signalization information was being both effectively communicated and clearly understood by the truckers in the survey.

Perceived Safety Benefits

Although the intent and measured outcome of the differential speed limits and truck restriction was to enhance safety for drivers along the elevated freeway segment, its perceived effect among drivers was thought to vary. This was assumed to be based on the level of satisfaction or dissatisfaction of drivers who were confined to the right lane as well as not being able to drive as fast as the adjacent passenger vehicles. Not surprisingly, the survey revealed that the respondents had a generally negative opinion of the current policies.

The majority of the respondents (57 percent) expressed the opinion that the existing deferential speed limit policies actually worked to diminish safety in the area in turn. The most common areas of driver complaint were that the reduced speed policy for trucks resulted in long queues of trucks in the right lane which, in turn, lead to reductions in advanced sight distance and difficulties when merging onto the freeway. Another complaint among drivers was that the lower speeds resulted in reductions in levels of driver alertness and an increased potential to fall asleep at the wheel.

Only 32 percent of the survey respondents thought that the speed policies had clearly perceived benefits. The remaining 11 percent did not know or had not formed an opinion. Interestingly, of the drivers who thought they did have a positive impact, 40 percent of them felt the effects were "somewhat beneficial" or "very beneficial." 60 percent of those with positive perceptions of the policies thought that the degree of safety impact was only "average." Overall, these findings suggest that the majority of truckers perceive the safety benefits of the speed limit to be less than significant.

Based on the above findings, the driver perceptions were next disaggregated by experience and the type of truck driven to assess perceptions based on more lengthy exposures to various driving and control conditions and the sizes of their vehicles. This cross-classification revealed that positive perceptions of the safety benefits of the control policies were highest among drivers with five years or less experience and the among drivers of single unit straight trucks. Figure 6 shows the survey results for drivers at different levels of experience who thought that the current differential speed limit policy improved traffic safety. Figure 7 shows the results for the same driver experience groups who thought that the lane restriction policy improved safety conditions. Not surprisingly, these respondents also supported the combined application of truck lane restriction and differential speed limit.

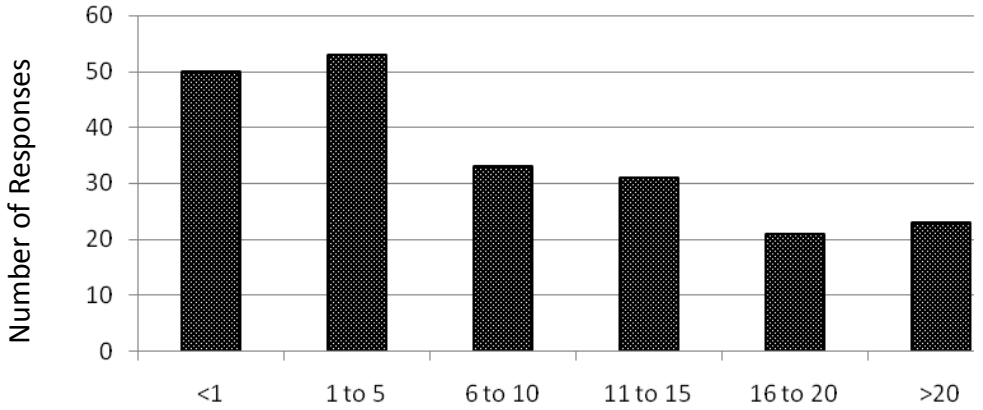

Figure 6: Perceived Differential Speed Limit Safety Improvement Based on Driver Experience

Next, the perceived safety impact resulting from the lane restriction was evaluated. Again, it was not surprising to find that the perceived safety benefits of the lane restriction among truckers closely mirrored the opinions expressed on the differential speed limit. This time 58 percent of the respondents reported that they perceived the existing lane restriction policies to reduce the level of safety in this location. Of the remainder, 34 percent of respondents thought that the speed limits improved safety and 8 percent thought it had no effect or did not know. Also similarly were the degrees to which those who thought it did have a positive impact. 44 percent of them felt the effects were "somewhat beneficial" or "very beneficial," while the remaining 13 percent

of those with positive perceptions of the policies thought that the degree of safety impact was “average.”

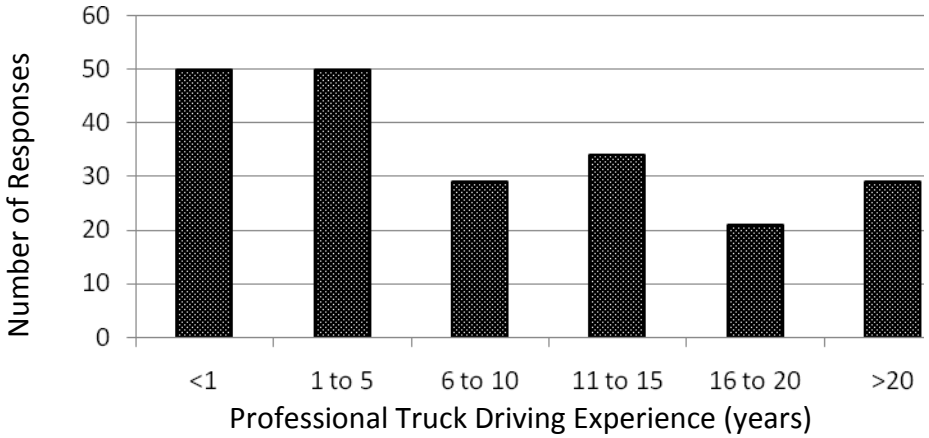

Figure 7: Perceived Lane Restriction Safety Improvement Based on Driver Experience

When these findings are correlated with those of the previous questions, they clearly suggest that the majority of truckers feel the perceived safety benefits of theses lane restrictions are not particularly significant. The responses also appear to suggest that truck drivers that differential speed limits and truck lane restriction are best when implemented together (78 percent of those that believed differential speed limit was beneficial safety-wise, also thought the truck lane restriction improved safety). However, nearly 25 percent of the respondents believed that both measures lead to significant safety benefits.

Violations and Enforcement

The next set of questions focused on the effects of enforcement within the study corridor, an area often of interest among truckers. The first of them sought to identify the percentage of respondents who reported (or admitted to) receiving a citation for a speeding violation within the study segment. Of the 159 respondents, only two (about 1 percent) reported receiving a speeding citation since the policy change in September 2003. Of these, both reported receiving two citations. Next, a similar question was posed to determine how many respondents reported receiving a citation for a lane restriction violation since the policy change in September 2003. Once again, only two of the 159 reported receiving citations. These findings clearly suggest that only a very small portion of truckers have ever received a citation within the study area.

Lane Changing

To assess operational conditions along segment, truckers in the survey were asked about their reasons for changing lanes. The range of responses that were given is summarized in Figure 8. Two most common reasons among truck drivers that given for making a lane change were to avoid and/or give additional leeway for roadside incidents such as stalled vehicles and emergency response/police vehicles on the shoulder and to pass vehicles that were traveling below the speed limit in the right lane. The percentage

of the total respondents that stated these reasons were 45 percent and 35 percent, respectively. Other reasons given included to avoid construction zones, permit access for merging vehicles, and to avoid various other hazards and crashes. One also cited the need to fight boredom. These results were consistent across drivers of all experience levels. These results suggests that drivers primarily feel the need to change lanes for safety reasons and that such lane changing behaviors are not strongly correlated with driving experience.

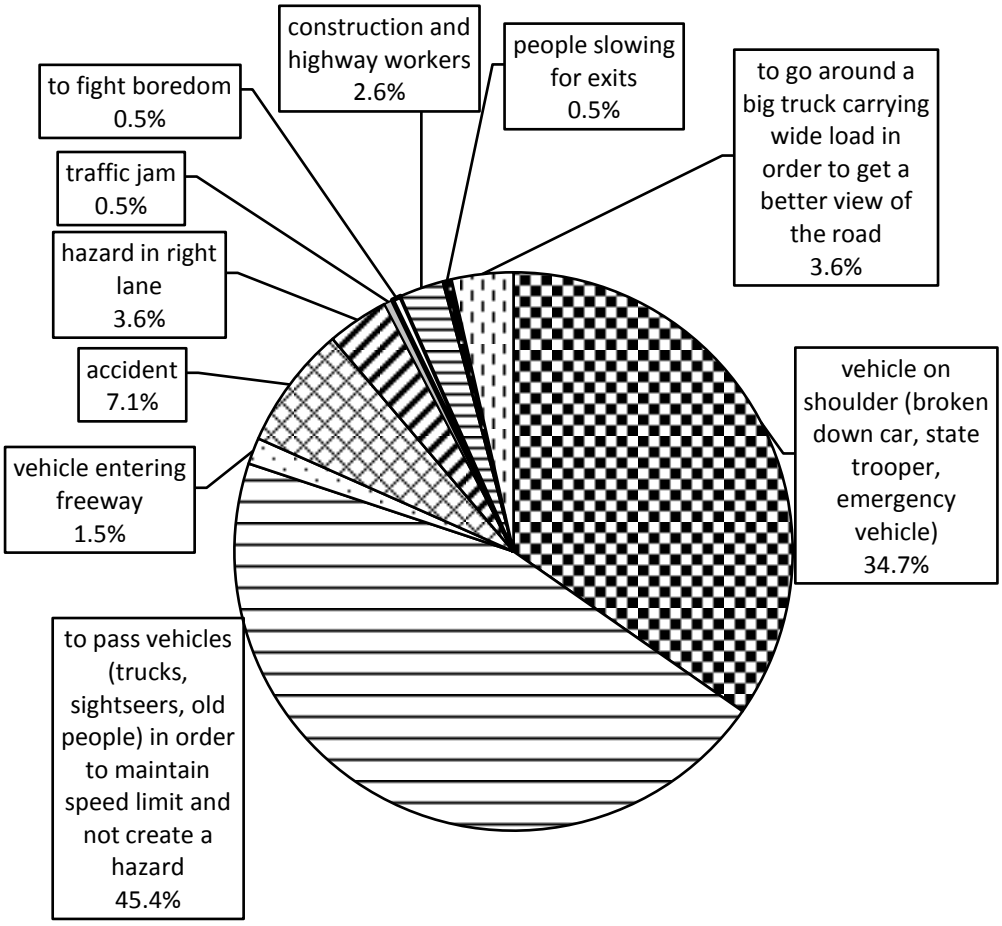

Figure 8: Drivers' Reasons for Lane Changing

Strategy Changes

The next group of questions was used to assess the opinions of the truck drivers on the speed and lane use control strategies from the perspective of what they would do if they were in the position to implement policy. Similar to an earlier question, drivers were also permitted to indicate preferences to maintain or modify the controls as well as to enhance related conditions such as by adding lighting and additional enforcement. An opportunity was also provided to allow the drivers to suggest their own ideas. To provide additional insight, the survey also respondents to describe how they thought

such strategies would improve operations specifically and benefit the trucking industry, in general.

Speed Limits

In terms of the speed limits, it was not surprising to find that only 85 percent of the respondents did not favor maintaining the current 55 mph truck and 60 mph car speed limits, while the remaining 15 percent did. In the following question respondents were then asked more explicitly about restrictions that were based on the type of vehicle, specifically passenger vehicles versus trucks. As expected, 67 percent of truckers favored increasing the truck speed limit and only 45 percent of them favored lowering the speed limit for cars. These findings are also consistent with those of earlier questions which showed that the respondents were not happy with the current truck speed limit.

In terms of lane-specific *s*peed limits, 87 percent of the respondents did not favor differential speed limits for the right and left lanes. Of those who did, 27 percent favored a 70 mph speed limit for the left lane, 32 percent favored 65 mph, 36 percent favored 60 mph. Somewhat inexplicably, one favored a decrease to 40 mph. Of the pro-differential speed respondents, 32 percent favored a 65 mph speed limit for the right lane, 50 percent favored 60 mph, and 18 percent favored 55 mph. These findings clearly suggest that the respondents favored consistent speed limits. Although, for those favoring right and left lane speed limits, the preferred option appeared to be 65 mph for the left lane and 60 mph for the right lane. When asked about peak-hour *s*peed limits specifically, 89 percent of the respondents did not favor varying speed limits for the peak and no-peak periods, making the responses consistent with the earlier preference for consistent speed limits.

Warnings and Violations

To assist truck drivers in monitoring their speed and to maintain conformity to the speed limits, opinions were also solicited with regard to the implementation of incident and speed detection and warning devices and increasing fines for violators. Of the responses received, 54 percent of the truckers were in favor of devices that could be used to facilitate incident detection and warning. However, 75 percent of the respondents did not favor speed detection systems that informed drivers of their current speed. These findings would suggest that truck drivers are open to receiving additional information about traffic conditions such as occurrence of incidents ahead, but they did not consider that speed monitoring systems added to increased levels of safety. Not surprisingly, 89 percent of the respondents were not also in favor of increasing the speed and lane violation fines.

Lane Restrictions

When opinions were solicited on the lane restriction policy, the surveys responses tended to follow the established preference for fewer, rather than more, restrictions. As was expected, only 21 percent of the respondents favored maintaining the current

truck lane restriction. Making it was clear that the respondents also did not favor policies that restricted their ability to move freely. When asked more specifically about separate restrictions for trucks *and* cars, the respondents overwhelming showed they were opposed to both; at a level of 89 percent for trucks and 92 percent for cars. The respondents were also quite clear in not preferring any right-lane restriction for cars (96 percent) along the segment and/or restricting lane position to the lane in which the vehicle entered the segment (i.e., no lane changing at all); both for trucks (94 percent) and for cars (97 percent). In what was the only inconsistency in the responses, respondents were split nearly evenly (58 to 42 percent) when asked if no restrictions on trucks should be imposed.

Physical Modifications and Enforcement

The final area of input on strategies was on the use of physical modifications like barrier separation and lighting and increased patrols by law enforcement. Although half of the respondents were in favor of enhancements to night lighting along the section (presently this segment has no illumination), they were strongly to any physical separation using barriers. The survey results also showed that the respondents were split nearly evenly (51 to 49 percent) and overwhelmingly opposed (96 to 4 percent) in not preferring any barriers to separate right and left lane traffic streams. An increased law enforcement presence was also opposed by 73 percent of the truck drivers.

Other Suggested Strategies

24 of the 159 respondents also took the opportunity to use Question 14 to suggest other strategies that they felt would provide benefits to traffic safety and efficiency along the study segment. These responses were grouped into six categories similar that followed the groupings used above. In the area of lane restrictions, four of the respondents suggested permitting trucks to pass slower trucks and get move immediately back into the right lane, one respondent offered a strategy of dedicating the right lane to commercial vehicles and the left lane to the non-commercial vehicles, and one other suggested the implementation of lane restrictions but only between 10 PM and 6 AM when traffic volumes were lower. From the standpoint of speed limits, two respondents suggested implementing a uniform speed limit with one of them further suggesting the uniform limit be set as 65 mph for all traffic in both lanes.

Most of the suggestions were related to law enforcement. They were also quite diverse in terms of their creativity and suggested punitive severity. Among them were suggestions to:

- Increase police enforcement coverage during heavy or inclement weather;
- Issue warnings to gravel truck drivers about their apparent low level of compliance;
- Utilize “undercover” police to catch the violators;
- Revoke licenses and impose jail time as punishments for speeders;
- Install more crossovers between the two elevated spans to allow police officers to watch for violators;

- Have police officers ride in trucks during their training to observe the traffic on the segment; and
- Install enforcement cameras on the bridge.

Among the design-related suggestions were ideas to widen the existing shoulders, repave the entire section, placing of white stripes to enhance road visibility in rainy weather, and cut grooves could help reduce the potential for hydroplaning on wet pavement. Others suggested providing more emergency assistance to drivers and opening up the crossovers between the two spans (they are normally blocked by movable concrete barriers) to park broken down vehicles. Lastly two of the respondents suggested placing more advanced warning signs to alert drivers to the restrictions.

CHI-SQUARE TEST OF INDEPENDENCE OF RESPONSES

In evaluating the general findings of the survey responses it was also recognized that some of the responses to individual survey questions might be related to the answers given to other questions. To find out whether dependent relationships existed between the responses, chi-square tests were performed to investigate the independence of responses to selected pairs of questions. The pairings developed for analysis were grouped into the cases described below:

Case 1. Drivers who expressed support for the 55 mph truck speed limit and their frequency of travel over the segment;

Case 2. Drivers who expressed support for the 55/60 mph differential speed limit and their frequency of travel over the segment;

Case 3. Drivers who expressed support for the lane restriction and their frequency of travel over the segment;

Case 4. Drivers who expressed support for the 55/60 mph differential speed limit and also expressed an opinion on the impact of 55/60 mph differential speed limit on traffic safety;

Case 5. Drivers who expressed support for the lane restriction and expressed an opinion of the impact of lane restriction on traffic safety;

Case 6. Drivers who expressed an opinion on the impact of lane restriction on traffic safety and also expressed support for the 55/60 mph differential speed limit;

Case 7. Type of truck driven and expressed support for the 55/60 mph differential speed limit;

Case 8. Driver experience and opinions on the impact of lane restriction on traffic safety;

Case 9. Driver experience and opinions on the impact of 55/60 mph differential speed limit on traffic safety.

The null hypothesis for each of the nine cases was that the response to question A was statistically independent of the response to question B. The test statistic of chi-square test for a two-way contingency table was computed using the following equation:

$$\chi^2 = \sum_{\forall i,j} \frac{(O_{ij} - E_{ij})^2}{E_{ij}} \quad (1)$$

Where: O_{ij} = the observed count for the cell in the i^{th} row and the $j^{\text{th}} j^{th}$ column; and E_{ij} =the expected count for the cell in the i^{th} row and the $j^{\text{th}} j^{th}$ column when the null hypothesis was true. The expected count of a cell was estimated as the product of the corresponding marginal totals divided by the total count.

$$E_{ij} = \frac{T_i T_j}{N} \quad (2)$$

Where:
E_{ij} = the expected number of responses for the cell in the i^{th} row and the $j^{\text{th}} j^{th}$ column;
T_i = the number of responses in the i^{th} row;
T_j = the number of responses in the $j^{\text{th}} j^{th}$ column;
N = the total number of responses.

The p-value of the chi-square test was used to determine if the responses to two questions were independent at significance level of 0.05. In addition, the cell chi-square value (χ_{ij}^2) showed the contribution of each cell to the total chi-square and was used to specify the source of significant association if the p-value was less than 0.05.

$$\chi_{ij}^2 = \frac{(E_{ij} - O_{ij})^2}{E_{ij}} \quad (3)$$

Tables 1 through 3 show the results of the chi-square tests of independence for all nine cases. The travel frequency responses were grouped into two categories: (1) those who traveled less than 100 times; and (2) those who traveled more than 100 times. The results of the tests are summarized in the following summaries:

Case 1: The test results were statistically insignificant (P>=0.05) which implies that the responses to both questions were independent. That is, the travel frequency over the study section did not impact the truckers' opinions on whether to keep the 55 mph speed limit or not.

Case 2: The test results were statistically insignificant (P>=0.05) which implies that the responses to both questions were independent. That is, the travel frequency over the study section did not impact the truckers' opinions on whether to keep the truck lane restriction or not.

Case 3: The test results were statistically insignificant (P>=0.05) which implies that the responses to both questions were independent. That is, the travel frequency over the study section did not impact the truckers' opinions on whether to keep the differential speed limit of 55/60 mph or not.

Case 4: The test results were statistically significant (P<0.05) which implies that the responses to both questions were not independent. That is, those who recommended keeping the differential speed limit on the section also believed that differential speed limit would improve safety.

Case 5: The test results were statistically significant (P<0.05) which implies that the responses to both questions were not independent. That is, those who recommended keeping the lane restriction on the section also believed that lane restriction would improve safety.

Case 6: The test results were statistically significant (P<0.05) which implies that the responses to both questions were not independent. That is, those who recommended keeping the differential speed limit on the section also believed that lane restriction would improve safety.

Case 7: The test results were statistically significant (P<0.05) which implies that the responses to both questions were not independent. That is, those who drove relatively smaller trucks also believed that the differential speed limit improved safety.

Case 8: The test results were statistically insignificant (P>=0.05) which implies that the responses to both questions were independent. That is, the driving experience did not impact the truckers' opinions on safety benefits of lane restriction.

Case 9: The test results were statistically significant (P<0.05) which implies that the responses to both questions were not independent. That is, the driving experience may have an impact on the trucker's opinions of whether the differential speed limit improves safety or not. The largest χ_{ij}^2 values were observed for driving experience less than 5 years and more than 15 years.

Table 1: Results for Chi-Square Test of Independence (Cases 1 to 3)

Case 1			Question A: Keep 55 mph speed limit?		p-value
			Yes	No	
Question B: Frequency of Tracel	>100	Frequency	8	42	0.07
		Expected	11.86	38.14	
		χ_{ij}^2	1.254	0.390	
	<100	Frequency	15	3	
		Expected	11.14	35.86	
		χ_{ij}^2	1.334	0.415	
Case 2			Question A: Keep lane restriction?		p-value
			Yes	No	
Question B: Frequency of Tracel	>100	Frequency	9	41	0.37
		Expected	10.83	39.18	
		χ_{ij}^2	0.308	0.085	
	<100	Frequency	12	35	
		Expected	10.18	36.83	
		χ_{ij}^2	0.327	0.09	
Case 3			Question A: Keep 55/60 mph differential speed limit?		p-value
			Yes	No	
Question B: Frequency of Tracel	>100	Frequency	3	47	0.05
		Expected	6.19	43.81	
		χ_{ij}^2	1.64	0.23	
	<100	Frequency	9	38	
		Expected	5.81	41.19	
		χ_{ij}^2	1.75	0.25	

Table 2: Results for Chi-Square Test of Independence (Cases 4 to 6)

Case 4			Question A: Keep 55/60 mph differential speed limit?		p-value
			Yes	No	
Question B: 55/60 improves safety?	Yes	Frequency	18	31	
		Expected	7.15	41.85	
		χ_{ij}^2	16.45	2.81	<0.0001
	No	Frequency	2	86	
		Expected	12.85	75.15	
		χ_{ij}^2	9.16	1.57	
Case 5			Question A: Keep lane restriction?		p-value
			Yes	No	
Question B: Lane restriction improves safety?	Yes	Frequency	28	24	
		Expected	11.43	40.57	
		χ_{ij}^2	24.01	6.77	<0.0001
	No	Frequency	3	86	
		Expected	19.57	69.43	
		χ_{ij}^2	14.03	3.95	
Case 6			Question A: Keep 55/60 mph differential speed limit?		p-value
			Yes	No	
Question B: Lane restriction improves safety?	Yes	Frequency	20	32	
		Expected	8.11	43.89	
		χ_{ij}^2	17.41	3.22	<0.0001
	No	Frequency	2	87	
		Expected	13.89	75.11	
		χ_{ij}^2	10.18	1.89	

Table 3: Results for Chi-Square Test of Independence (Cases 7 to 9)

Case 7			Question A: 55/60 differential speed limit improves safety?		p-value
			Yes	No	
Question B: Truck Type	Small truck	Frequency	15	7	<0.0001
		Expected	7.92	14.08	
		χ_{ij}^2	6.33	3.56	
	18-wheeler	Frequency	30	73	
		Expected	37.08	65.92	
		χ_{ij}^2	1.35	0.76	
Case 8			Question A: Lane restriction improves safety?		p-value
			Yes	No	
Question B: Driving Experience	<5 yrs	Frequency	17	13	0.08
		Expected	11.22	18.78	
		χ_{ij}^2	2.97	1.78	
	6-10 yrs	Frequency	6	12	
		Expected	6.73	11.27	
		χ_{ij}^2	0.08	0.05	
	11-15 yrs	Frequency	12	20	
		Expected	11.97	20.03	
		χ_{ij}^2	<0.0001	<0.0001	
	>15 yrs	Frequency	17	42	
		Expected	22.07	36.93	
		χ_{ij}^2	1.17	0.70	
Case 9			Question A: 55/60 differential speed limit improves safety?		p-value
			Yes	No	
Question B: Driving Experience	<5 yrs	Frequency	17	12	0.02
		Expected	10.53	18.47	
		χ_{ij}^2	3.98	2.27	
	6-10 yrs	Frequency	7	11	
		Expected	6.53	11.47	
		χ_{ij}^2	0.03	0.02	
	11-15 yrs	Frequency	11	20	
		Expected	11.25	19.75	
		χ_{ij}^2	0.01	0.003	
	>15 yrs	Frequency	14	43	
		Expected	20.69	36.31	
		χ_{ij}^2	2.16	1.23	

CONCLUSION

This paper highlights the primary findings of a survey to assess truck drivers' perceptions and opinions to recent lane and speed control policies that have been instituted on an elevated Interstate freeway section in Louisiana. In addition to driver opinions, the survey was also used to evaluate whether truck drivers felt the existing communication and warnings modes were helpful and effective or not and to determine whether they thought that level of enforcement was adequate over this segment of roadway. The final objective of the survey was to seek input and ideas for other potential strategies that could be useful to the drivers in their driving task.

The study yielded many expected and some not-so expected results. Overall, it was obvious that the truckers were not in favor of the restrictions imposed on their driving. It was also clear that they did not perceive a significant safety benefit was being experienced from the restrictions; rather they tended to view them as an inconvenience to their driving task. In fact, it was apparent that they felt it would be safer to have more uniform speed and vehicle lane distributions on the study segment. This was an interesting finding since it has been recognized by traffic researchers and practitioners that uniformity of speed promotes both safety and efficiency on freeways. Among the most useful findings, particularly from a design and control standpoint, was that the vast majority of drivers were well-aware of the restrictions along this segment and did not feel an overwhelming need add more features like incident warnings, current speed displays, or even night time illumination. In fact, given the drivers similarly strong opinions opposing higher degrees of enforcement, it could also be concluded that despite perceptions to the contrary, truckers do not feel that they are a threat to traffic safety and would prefer to be left alone to do their jobs.

In addition to these findings, the exercise of collecting this type of basic information was also unique in Louisiana as this type of data had never been collected previously in the State. It is also unique in the US in that there are no other examples of surveys that have specifically examined trucker views and opinions on the impact of lane and speed restrictions specifically on elevated freeway segments. Although their results were not be discussed here in detail, the findings documented in this paper are also currently being cross-compared against actual rates of driver compliance to the control policies and before-and-after effects of traffic crashes along the segment. These results should be available with the next year/

In terms of transferability, it is difficult to know if the findings presented here would be also be seen in other locations since there are no similar opinion-based survey studies of trucker attitudes and perceptions of lane restrictions and differential speed controls. However, there is also no evidence to suggest that the results would vary in different parts of the country; for both elevated and grade-separated facilities. Based on this, it is thought that these findings can be used by other transportation agencies who may be considering similar such policies. It is also suggested that future potential users of such strategies review the results of the upcoming studies of safety and compliance in this section.

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