VEHICLE SPEEDS IN SCHOOL ZONES

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ABSTRACT

The present study was conducted to answer two questions: do drivers slow down for children in school zones, and what factors affect vehicle speeds in school zones during times of school zone activity. The posted speed limit in school zones is 20 MPH, and there are various types of signs in use at different schools that inform drivers of the school zone speed limit. The study was designed to examine the effect of different types of school zone speed limit signs and the effect of different speed limits on the roads approaching the schools. Vehicle speed data were obtained using pneumatic-tube speed measurement devices that were placed in the road in front of 40 elementary schools. The speed data were analyzed for the 30-minute critical time periods before the start of the school day and after the close of school.

The findings showed that, overall, a substantial percentage of vehicles were traveling at high speeds through school zones during the critical time periods; about 12% exceeded 35 MPH. Schools situated on roads with 25 MPH approach

speed limits were associated with slower vehicle speeds; less than 5 percent exceeded 35 MPH, and the type of school zone sign had no effect on speeds. School zones with faster approach speed limits (30-40 MPH) were associated with higher speeds. Up to 30 percent of the vehicles exceeded 35 MPH during the critical time periods at the start and end of the school day. However, “flashing light” school zone signs were effective in slowing vehicles; average speeds were 5-7 MPH slower, and less than 4% exceeded 35 MPH.

The conclusions and recommendations were:

(1) A significant proportion of vehicles travel at high speeds through school zones during times when children are likely to be in proximity to the road. Enhanced enforcement of traffic laws in school zones would seem to be clearly warranted by the study findings.

(2) Excessive speeds occurred predominately at schools with faster approach speed limits. The siting of new school construction on roads with higher speed limits should be discouraged.

(3) School zone speed limit signs with flashing lights were effective in slowing vehicles. Obviously, there are higher costs associated with installation and maintenance of such signs. Nevertheless, replacement of existing signs with flashing light signs should be considered for schools located on roads with higher speed limits.

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INTRODUCTION

The School Zone Safety Act was passed by the 1996 Washington Legislature and directed the Washington Traffic Safety Commission (WTSC) to develop and implement programs to improve safety in school zones. In response to the School Zone Safety Act the WTSC initiated a study to measure vehicle speeds in school zones. The study was designed to answer two questions: do drivers slow down for children in school zones, and what factors affect vehicle speeds in school zones during times of school zone activity. The posted speed limit in school zones is 20 MPH.

The data from an initial sample of 17 schools showed that just before the start of school almost half of the vehicles were measured at under 25 MPH. However, more than 25 percent of the vehicles were exceeding 30 MPH, and almost 9 percent were traveling at more than 15 MPH over the posted speed limit of 20 MPH. In the time period coinciding with school dismissal, about 50 percent of the vehicle speeds were under 25 MPH. Again, more than a quarter exceeded 30 MPH, and almost 10 percent were measured at 35 MPH or faster.

The schools were grouped in various categories and analyzed for differences in vehicle speeds. City population, average daily traffic, and the percent of students

who rode school buses did not affect speed compliance. However, there appeared to be marked differences in vehicle speeds at schools with various types of school zone speed limit signs, especially when the posted speed limit approaching the school was 35 MPH.

These preliminary findings suggested that a substantial number of vehicles were travelling through school zones at excessive speeds and posed a risk to students walking to and from school. The data also suggested that the type of speed limit sign and approach speed limit may be important factors. To examine more precisely the effects of these two variables, another 23 schools were added to the initial sample of 17 schools. These additional schools were selected so that the final sample would provide a cross-section of the different types of signs and approach speed limits found at elementary schools in Washington State.

METHOD

Sample.

There were 40 schools in the study sample, and all were elementary (K-6) schools. Most were located in smaller to mid-size cities in Washington. Larger cities in the sample included Tacoma and Spokane, but there were no Seattle schools in the sample. The schools comprise a convenience sample; i.e., the schools were in cities that a Washington State Department of Transportation employee would travel to during his normal work schedule. The schools were selected to provide a mix of the various types of school zone signs and approach speed limits found in Washington State.

There were four types of school zone speed limit signs among the 40 schools:

1. Signs indicating specific times of the day for the 20 MPH speed limit (“time of day” signs), for example, “Speed limit 20 MPH, 7:30 AM to 4:30 PM”. Signs with no indication of specific times, i.e., the 20 MPH limit is in effect for all hours of the day, were also included in this category.
2. Signs with yellow lights on the sign post that indicated the 20 MPH limit was in effect when the lights were flashing, (“flashing light” signs).
3. Signs indicating the 20 MPH limit was in effect when children are present (“when present” signs).
4. Signs which indicated that the 20 MPH limit was in effect when orange flags were attached to the sign post (“when flagged” signs).

These sign types were categorized into groups by the posted speed limit approaching the schools: approach speed of 25 MPH and approach speed of 35 MPH (30 MPH and 40 MPH speed limits were counted with the 35 MPH group).

There would have been eight groups in the study, but no schools were found with “flashing light” signs and 25 MPH approach speeds. Also, only two schools were found with “time of day” signs and 35 MPH approach speeds; they were excluded from the data analysis of signs and approach speed limits. The final sample consisted of 38 schools categorized into six groups. These groups were:

- 25 MPH approach speed and:
    a) “time of day” signs (N=8),
    b) “when present” signs (N=8),
    c) “when flagged” signs (N=5).

- 35 MPH approach speed and:
    a) “flashing light” signs (N=6),
    b) “when present” signs (N=5),
    c) “when flagged” signs (N=6).

Procedure.

Vehicle speed data were obtained using pneumatic-tube speed measurement devices. Two tubes were placed in the road several feet apart and were attached to an automatic recording device that calculated the speed of each vehicle passing over the tubes. The devices also recorded the time of day that vehicles passed over the tubes. Speeds were recorded in 5 MPH intervals, and time of day was recorded in 15-minute intervals. These 5 MPH intervals were the maximum precision of measurement of the speed recording device. Before activating the device, the installer used a radar gun to check accuracy, and calibration was done, if necessary. The installer was a Washington Department of Transportation (DOT) employee with prior experience in collecting vehicle speed data.

The speed measuring devices were placed inside the 20 MPH speed zones in front of each school, and the tubes spanned one lane in one direction of travel. Data collection took place during a one to five day period while school was in session. The installer also recorded information about the speed limit approaching the school zone and the type of school zone sign. After collection of the speed data was completed, the schools were contacted to determine their time schedules for the beginning and end of school on the specific days that the speed data were

collected. Early dismissal and late start days as well as school closure days were noted and accounted for in the data analysis.

Data Analysis.

The data for each school were summed across all days that the speed measurement device was in operation and entered onto a spreadsheet. Rows displayed a 24 hour day in 15 minute intervals and columns displayed vehicle speeds (in intervals ranging from 0-5 MPH to 56-60 MPH and 61+ MPH). Each cell in the spreadsheet showed the number of vehicles counted in the particular speed and time interval.

Time of day on the spreadsheets was matched with the different start and end times for each school. Two “zero points” were set for each school to coincide with the start and the end of the school day. The zero point in the morning was the 15 minute interval beginning at or just after the time school started. The zero point in the afternoon was the 15 minute interval ending at or just before the time school was dismissed. These zero points provided common time reference points for schools with different time schedules.

Data for two critical time periods were extracted from the spreadsheets for each school. These time periods were the ½ hour before the school-start zero point and the ½ hour following the school-dismissal zero point. The zero points and critical time periods were adjusted to account for days with late starts or early dismissal, and days coinciding with school closures were excluded from the analysis.

Two dependent measures were used in the data analysis: mean (average) vehicle speed and the percent of vehicles exceeding certain speeds. Because the precision of measurement of the speed recording device was only 5 MPH intervals, the mean was calculated using the formula for grouped frequency distribution data. The midpoint of each speed interval (e.g., 22.5 for the 20-25 MPH interval) was multiplied by the number of vehicles in the interval, the products summed and then divided by the total number of vehicles.

RESULTS

Vehicle speed data for all schools combined.

Figures 1 and 2 show overall average speeds for all 40 of the schools in the study. Average speed slowed from over 35 MPH in the morning hours (Figure 1) to about 25 MPH just before the start of school. Speeds returned to about 30 MPH for the rest of the morning. Figure 2 displays average speeds for the afternoon hours. Average speeds of about 30 MPH dropped to under 25 MPH during the time when students were leaving school, and then returned to between 30 and 35 MPH about an hour later.

The critical time periods of 30 minutes before the start of school in the morning and 30 minutes after school dismissal in the afternoon were analyzed in detail. During these times children are actively using school crosswalks, and the speed limit in school zones is 20 MPH.

Figure 3 shows the percentage of vehicles travelling at various speeds during the 30-minute critical morning period. (Given that the precision of speed measurement for the present data was 5 MPH intervals, we defined compliance with the school

zone speed limit as 25 MPH or less.) Most vehicles were measured at 25 MPH or under. However, a substantial percentage of vehicles (45 percent) exceeded 25 MPH, 12 percent of the vehicles exceeded 35 MPH, and 4 percent were travelling at 41 + MPH.

Figure 4 shows the percentage of vehicles travelling at various speeds during the afternoon critical time period. The distribution of vehicle speed was nearly identical to that found in the morning speed data; 47 percent exceeded 25 MPH, 13 percent of the vehicles exceeded 35 MPH, and 5 percent exceeded 40 MPH.

Effects of school zone speed limit signs and approach speed limits.

To compare the effectiveness of different types of school zone speed limit signs, the schools (N=38) were grouped by type of sign and posted speed limit approaching the school zone. The data for both the morning and afternoon 30-minute critical time periods were combined, and the dependent variables examined were average speed and the percentage of vehicles exceeding 35 MPH. These data were analyzed using one-way ANOVAs with post-hoc tests of between group differences (Student-Newman-Keuls test).

There was an overall significant difference between the six groups of schools in average speed, $F(5,32)=5.73$. When the posted speed limit approaching the schools was 25 MPH, vehicles were in substantial compliance with the 20 MPH school zone limit, regardless of the type of sign. As shown in Figure 5, average speeds ranged from 21 to 24 MPH for the “time of day”, “when children are present”, and “when flagged” signs. None of these differences were statistically significant. However, when the approach speed limit was 35 MPH, vehicles were

measured at significantly higher average speeds with “when children are present” signs (30.3 MPH) and “when flagged” signs (28.3 MPH). In contrast, “flashing light” signs were associated with significantly slower average speeds of 22.5 MPH. Schools with “flashing light” signs had vehicle speeds that were not significantly different than schools with 25 MPH approach speed limits.

Data for the percent of vehicles exceeding 35 MPH are summarized in Figure 6 and show a pattern that is similar to the average speed data. The overall between group difference was significant, $F(5,32)=7.50$. Few vehicles (less than 5 percent) were measured at high speeds when the approach limit was 25 MPH, and there was no significant difference between the “time of day”, “when present”, and “when flagged” signs. However, a substantial and significantly greater percentage of vehicles were travelling at high speeds in school zones with 35 MPH approach limits and “when children are present” signs (30 percent) and “when flagged” signs (23 percent). In spite of higher approach speed limits, schools with “flashing light” signs had significantly fewer vehicles travelling in excess of 35 MPH (3 percent). This percentage was not significantly different than the schools with 25 MPH approach speed limits.

DISCUSSION

Even though about half of the vehicles in the study were in compliance with the 20 MPH speed limit in school zones, a major finding of this study was that many vehicles were measured at speeds greater than 35 MPH. About 12-13 percent exceeded the school zone speed limit by 15 MPH or more,

and 4-5 percent were travelling at 40+ MPH. Vehicles travelling at these speeds pose a substantial risk of injury to children who are in proximity to traffic while going to or leaving school.

The above percentages represent an aggregate of all schools in the study. When the data were analyzed by the type of school zone sign and speed limit approaching the school, a different pattern of results emerged. Schools situated on roads with slower approach speed limits were associated with much slower vehicle speeds; less than 5 percent exceeded 35 MPH. In addition, the type of school zone sign had no effect on vehicle speeds when the approach speed limit was 25 MPH. These schools were located predominately in residential neighborhoods and on non-arterial streets.

School zones with faster approach speed limits were associated with substantially higher speeds during the ½ hour critical time periods just before and just after school hours. However, “flashing light” school zone signs were effective in slowing vehicles. The average speed at schools with “flashing light” signs was about 5-7 MPH slower than at schools with “when children are present” and “when flagged” signs. A 5 MPH decrease in vehicle impact speed can mean the difference between a minor/moderate injury vs. a major/fatal injury to a pedestrian. Using data gathered by the Interdisciplinary Working Group for Accident Mechanics (1986), Anderson et al (1997) estimated that the probability of a

pedestrian fatality rose from about 10 percent to about 60 percent, a six-fold increase, when vehicle impact speed increased from 23 mph to 28 mph.

Limitations of the study.

Whether the findings can be generalized to all schools in Washington and in other States is uncertain because the schools included in the study were a convenience sample and may not be completely representative of the entire population of schools. An important omission is that no Seattle schools were included. However, the sample can be considered a rough cross-section of schools in small, medium, and larger cities. It is unlikely that the sample was systematically biased in that the selection of schools was quasi-random within the constraints of the travel itinerary of the DOT employee who collected the data.

It is possible that the findings of this study could be confounded with other factors that were not identified during data collection. Potential confounding variables include changes in pavement textures in the approaches to the school zones, other warning markers such as road bumps or rumble strips, or the presence of law enforcement in the school zones.

The speed data reported in this study are from the 30 minute time periods

just before the start and after the end of school. We assume that students were in proximity to the road and the school zone during these times, but we could not independently verify this. The 30 minute periods were selected based on discussions with school administrative personnel to identify school start and end times.

Conclusions and Recommendations.

- A significant proportion of vehicles were measured at excessive speeds through school zones during times when children are likely to be in proximity to the road. Enhanced enforcement of traffic laws in school zones would seem to be clearly warranted by the findings of this study.

- Excessive speeds occurred predominately at schools with faster approach speed limits, while slower approach speed limits were associated with better speed compliance in school zones. The siting of new school construction on roads with higher speed limits should be discouraged.

- School zone speed limit signs with flashing lights were effective in slowing vehicles. Obviously, there are higher costs associated with installation and maintenance of such signs. Nevertheless, replacement of existing signs with flashing light signs should be considered for schools located on roads with higher approach speed limits.

Anderson, R.W.G., McLean, A.J., Farmer, M.J.B., Lee, B.H., & Brooks, C.G. (1997). Vehicle travel speeds and the incidence of fatal pedestrian crashes. *Accident Analysis and Prevention 29* (5), 667-674.

Interdisciplinary Working Group for Accident Mechanics (University of Zurich and Swiss Federal Institute of Technology ETH). (1986). *The car-pedestrian collision: injury reduction, accident reconstruction, mathematical and experimental stimulation: head injuries in two wheeler collisions.* Zurich: The Group.