Driver Speed Behavior on U.S. Streets and Highways

Samuel C. Tignor, Ph.D., and Davey Warren

Introduction

During the past five years, the Federal Highway Administration has sponsored a number of studies to establish a better understanding of travel speeds and speed limits on various types of roads. The study of the speed zoning problem was prompted in part by concern about widespread violations and the seemingly arbitrary level of many posted speeds.

Speed limits are intended to inform drivers of the maximum reasonable and safe travel speed. However, there is little agreement on what constitutes a safe speed. In a nationwide survey of current speed zoning practices, all states and most of the 44 localities reported using the 85th-percentile speed as the basic factor in setting speed limits. However, the posted speed is often set up to 10 mph lower than the prevailing speed based on a subjective consideration of other factors such as roadside development. The relative subjectivity of the speed zoning process points to the need to re-examine the criteria and procedures used in setting speed limits.

Properly established speed limits foster voluntary compliance and separate the occasional high-risk driver from the vast majority of drivers. On the other hand, speed limits which are set artificially low tend to be ignored and misallocate resources, apprehending and prosecuting motorists driving at safe speeds. Over time this could lead to a loss of respect for all speed limits and create the impression that traffic law enforcement and the judicial system are unfair. The same public when emotionally aroused demand and often get reduced speed limits by believing the lower limit will slow down traffic and reduce accidents.

Even though a great deal has been written and said about speed limits, there is almost no scientific research on the precise effects on the number of accidents of altering speed limits. Most traffic officials agree we should be working to improve our knowledge of the effects of speed limits and to develop criteria that are objective and scientifically sound.

This paper presents some preliminary results of our research on speed limits, speeds, and accident risk. The final results are not expected until early next year.

Data Collection

The basic data for the analysis described here consists of speeds from two separate studies. In one study, data were collected to determine speed characteristics and the reasonableness of speed limits on low and moderate speed roads in urban, small-urban, and rural built-up areas. Speeds were measured for a 24-hour period on 52 roads and streets in four states; Delaware, North Carolina, Colorado, and Arizona. The measurements were made with the IRD 1040 traffic statistics recorder connected to a pair of loop mats in each lane. The equipment stores the arrival time, lane, speed, and length of each vehicle. The sites were randomly selected from the Highway Performance Monitoring System using a stratified clustered sampling procedure to represent different road types and speed laws. Accident data were obtained for a three-year period and the relation between accident risk and travel speed in urban areas was determined using the estimated travel speed before the crash.

A second study is taking advantage of routine speed zoning changes made by the States to determine on a scientific basis the effects of altering speed limits on travel speed, accidents, and injury consequences. Speeds and headways were measured for a 24-hour period at 102 sites in 23 states before and one year after the change took place. The measurements were made using the Sarasoto VC1900 traffic classifier connected to a pair of portable loop mats in each lane. The data were collected in the free-flow mode which classified the speeds in 1-mph bins from 1 to 128. A four-second headway was used to define free vehicles. Data were simultaneously collected at another 102 sites on similar roads without any change in speed limit to control for time trends. The sites represent a full range of speed limits and road types including a few 65-mph freeways.

Supplemental measurements were made at some of the sites to investigate any spillover effects on surrounding roads.

Preliminary Results

Driver compliance with speed limits is poor. On average, 7 out of 10 motorists exceeded the posted speed in urban areas. Compliance ranged from 3 to 99 percent. Compliance tended to be worse on low-speed roads, better on roads with prima facie limits, or where the speed limit was based on an engineering study. Better does not mean good compliance; less than 10 percent on the sites had more than 50-percent obedience with the posted speed.

On many streets and highways the speed limit is set 8 to 12 mph below the prevailing 85th-percentile speed. The extreme case was a prevailing speed of 51 mph in a 30-mph zone. Truck speeds were consistently 3 mph slower than car speeds in urban areas. The factors that had the most influence on speeds were number of access points and commercial development.

The accident involvement rates on streets and highways in urban areas was highest for the slowest 5 percent of traffic, lowest for traffic in the 30-to-95-percentile range and increased for the fastest 5 percent of traffic. The relative involvement rate is a measure of the chance of being involved in an accident, and is a ratio of the percent of accidents in a given speed range to the percent of travel in the same speed range.

For each accident that occurred at a site, the speed of each vehicle involved in the accident was assigned to the appropriate percentile speed category for that site. All such data from each site were then combined and the relative risk computed. The risk curve for roads in built-up areas is consistent with the work of Solomon, Cirillo, and West, and Dunn which showed that the risk of involvement in accidents is minimum near the average speed of traffic and increases dramatically for vehicles traveling much slower or faster than average. The rate at which drivers experience overtakings follows a similar U-shaped relationship and provides a theoretical explanation for the shape of the speed-risk curve.

Many current speed limits coincide with 30-percentile speed, which is near the lower bound of safe travel speed. Speed limits should be set in the 70-to-90-percentile range or roughly 5 to 10 mph above the average speed to correctly reflect maximum safe speed. Speed limits are set in multiples of 5 mph; the 70-to-90-percentile range will almost always include a 5-mph multiple. Allowing a 5-mph tolerance, enforcement would then be targeted at drivers who are clearly at risk. If speed limits were raised to more realistic levels, would drivers automatically drive 5 to 10 mph over the new speed limit as is commonly believed? The answer is no. Raising the speed by various amounts up to 15 mph has little or no effect on speeds over a broad range of road types and speed levels.

Conversely, lowering the speed limit will not slow down traffic. Although speed increases of 3 mph and decreases of 3 mph were observed at individual sites, the expected change in speed is less than 1 mph, which is normal variation. In addition, there is no evidence in our studies that raising the speed limit to 65 on rural interstate freeways led to an increase in speeds off the freeway.

Conclusions

It would be premature to draw any firm conclusions since the research is still underway. However, the findings to date suggest that, on the average, current speed limits are set too low to be accepted as reasonable by the vast majority of drivers. Only about 1 in 10 speed zones has better than 50-percent compliance. The posted speeds make technical violators out of motorists driving at reasonable and safe speeds.

For the traffic law system to minimize accident risk, then speed limits need to be properly set to define maximum safe speed. Our studies show that most speed zones are posted 8 to 12 mph below the prevailing travel speed and 15 mph or more below the maximum safe speed. Increasing speed limits to more realistic levels will not result in higher speeds but would increase voluntary compliance and target enforcement at the occasional violator and high-risk driver.

One way for restoring the informational value of speed limits requires that we do a better job of engineering speed limits. Hopefully, the results of this research will provide engineers with the knowledge and tools needed to set maximum safe speed limits that are defensible and accepted by the public and the courts.

Tignor is the chief of the Traffic Safety Research Division of the Federal Highway Administration in McLean, Virginia. Warren is a Highway Research Engineer at the same facility. *Charts and graphs are not reprinted.* *Reprinted by permission of the Institute of Transportation Engineers, 525 School St., S.W., Suite 410, Washington, DC. Originally published in ITE 1990 Compendium of Technical Papers.*