STABILITY IN DRIVERS’ SPEED CHOICE

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ABSTRACT

Speed data that are used in psychological studies may be obtained from self-reports or from measurements in traffic. Although self-reported data may not give a correct picture of the speed a driver actually would choose on the road they are used for practical reasons. In addition, self-reports are often used in modelling of driver behaviour. When speed data are obtained in traffic usually a single speed measure from each driver is used in analyses. Both of these methods do not take into account the variability in individual drivers’ speed in real traffic. Questions may arise as to whether an obtained speed measure is typical of a driver’s normal speed. In the present paper an attempt is made to show how stable drivers are in their choice of speed.

Repeated speed measurements were obtained to examine drivers’ consistency in speed choice. Drivers were observed at two locations along a route or for two days at the same location. Single carriageway roads were used with posted speed limits of 70 km/h and 90 km/h. Results showed correlation coefficients between repeated speed measures from .49 to .81 for free-flowing vehicles. Higher consistency between measures was found where segments of the road were homogenous. Consistency in relation to speed limit varied as a function of roads and direction of travel. From 4 to 41% of the drivers observed legal speeds at both sites and between 43 and 100% travelled over the speed limits at both sites. The results are discussed in terms of using self-reported speed in driver surveys and modelling of driver behaviour.

INTRODUCTION

Speed choice is one of the most studied driver behaviours. One reason may be because speed is strongly related to accident risk. A consensus has evolved among traffic researchers that high speed is a major problem in traffic (e.g. Fieldes & Lee, 1993). Factors such as age (Quimby, Maycock, Palmer & Buttriss, 1999; Solomon, 1964), risk of apprehension (Armour, 1984; Østvik, 1989; Rothengatter, 1982; Shinar & McKnight, 1985) and attitudes (Åberg, 1998; Parker, Manstead, Stradling, Reason & Baxter, 1992) have been reported to influence speed choice. These factors might also interact with each other and are used in attempts to model driver behaviour (Åberg, 2001; Parker & Manstead, 1996).
Measures of speed may be obtained in various ways, e.g. objective speed on passing vehicles in traffic, or by self-reported data. Models of driver behaviour are often based on self-reports. Although such data may give a general level of drivers' speed rather than an exact figure for a given situation it is agreed among researchers that the use of self-reports may be justified. The relation between actual and reported speed has given moderately high correlations (Corbett, 2001). The method is to measure drivers’ speed in the traffic stream and then to stop the drivers and interview them about speed related issues (e.g. Åberg, Larsen, Glad & Beilinson, 1997; de Ward & Rooijers, 1994; Haglund & Åberg, 2000; Parker, 1997; West, French, Kemp & Elander, 1993).

For practical reasons speed is often measured on a single occasion and this measure is used as a criterion of the driver’s normal speed choice. The underlying assumption is that the measured speed reflects the driver’s cognitive, social, attitudinal and motivational characteristics (Quimby, et al., 1999). Little attention, however, has been devoted to the question whether drivers are consistent in their choice of speed.

In attempts to model driver behaviour often a single measure of driving speed is used and the question arises as to whether that speed measure is representative of the driver’s speed behaviour. If we, for instance, in a questionnaire ask about a driver's normal speed on a certain road or for a certain speed limit we do not know how well it reflects actual speed on the road.

The road layout and roadside environment in urban areas is significantly different from that in rural areas and the two environments may affect drivers’ speed choice in different ways. In urban settings drivers encounter more intersections, pedestrians, parked cars, buses, and so on. On highways driving may be monotonous because of fewer intersections and long stretches with similar surroundings. In an early study Ogawa, Fisher and Oppenlander (1962) investigated speed behaviour of individual drivers during one journey along a road with various speed limits. Speeds were measured at rural and urban sites. They found higher consistency in speed choice among rural sites. No consistency was found between urban sites or between rural and urban sites. That is, a fast driver on highway was not necessarily a fast driver in urban settings, and vice versa.

In the present study an attempt is made to demonstrate drivers’ stability in speed behaviour. Individual drivers were observed on different occasions at the same site or at different sites along a road during the same trip. Observation sites were selected where it was possible to compare (a) speed at different locations with the same speed limit, (b) speed at different locations with varying speed limits, and (c) speed at one location on different days.

**METHOD**

**Roads**

Speeds were measured on highways with speed limits of 70 or 90 km/h at the measurement sites. Repeated speed measures were obtained for individual vehicles, either at two sites along the same road, so comparisons could be made between the sites to determine how drivers varied their speed during one journey, or at one site for several days to compare drivers’ speed on different journeys.

In one comparison (A) the speed limit was 90 km/h at both sites. The distance between measurement sites was approximately 7 km (about a 4 min 40 s drive between sites). The road layout was the same along the study route and the speed limit was the same along the
road segment. In both driving directions from the measurement sites the speed limit was 90 km/h for several kilometres of road. Visibility along the road section was good.

A second pair of measurements (comparison B) was obtained in which the speed limit was 70 km/h at one site and 90 km/h at another site. Drivers thus encountered the two speed limits in different order depending on direction of travel. Distance between measurement sites was about 4.5 km (about a 3 min 20 s drive).

A third comparison (C) was made where the speed was limited to 70 km/h at both sites. Between measurement sites a 0.7 km road segment with speed limit 50 km/h was located. Distance between measurement sites was about 3.5 km (about a 3 min 15 s drive). For traffic in eastbound direction the first speed measure was obtained about 0.5 km before the speed limit was lowered to 50 km/h. The second speed measure was obtained 2.3 km after the 50 km/h section.

In a forth comparison (D) speed measures were obtained for several days to observe drivers who repeatedly were passing the site. If drivers were observed on more than two days, only the first two observations were used in the analyses. The speed limit was 70 km/h.

**Speed measurements**

Speeds were measured by the use of video cameras. Each camera was unobtrusively placed inside a car parked on a minor road intersecting the target road. Distance from the camera car to the target road was about 100-200 m. By using video technique vehicles that turned onto or off the target road, or vehicles passing other vehicles could easily be detected and excluded from the analyses.

Speeds were later calculated by vehicles’ passing time between two white poles placed about 200 m apart beside the road. The distance was measured on the roadway to the nearest 0.1 m. This arrangement made it possible to measure speed within approximately 0.5 km/h. Traffic was observed for two to three days on comparisons A to C and for four days on comparison D. Recording sessions lasted for about two hours in the morning and all recordings were made in good weather conditions.

**Drivers**

To identify drivers on the video tapes and to assure that it was the same vehicle that was observed at both sites vehicle and driver characteristics such as license number, driver’s sex and estimated age were recorded. This was done by two observers, one at each site, sitting in cars parked at the roadside.

In all, about 2500 vehicles were observed. The total number of vehicles observed more than once was 809. The number of free-flowing vehicles (at least 6 s time gap to another vehicle) on two occasions and used in the analyses was 580. One driver whose characteristics matched on both occasions was omitted from analyses because of extremely slow speeds on both occasions. For drivers to be included in comparison D (same site for several days) they had to be observed twice, the vehicles had to be moving in the same direction on both occasions and the recorded driver characteristics had to match on both occasions. For vehicles observed along the same road it was assumed it was the same driver as normal driving times between sites did not allow for a change of drivers.
RESULTS

In general, a high percentage of drivers exceeded the posted speed limits and differences in law-abidingness were found for sites and directions. For comparison B (first measurement site) about 96% of the drivers in eastbound direction exceeded the speed limit 70 km/h. The best result was found for westbound traffic in comparison C (second measurement site) where 55% of the drivers exceeded the speed limit. For comparison D (70 km/h) all drivers included in the analyses were travelling faster than the speed limit.

Speed measures taken on two occasions for individual drivers show differences in stability between different roads. Correlations for free-flowing vehicles are shown in Table 1. Correlations are shown for different directions of travel. As shown in the table, correlations vary between .49 and .81. Mean correlation over comparisons is .71 for free-flowing vehicles. If all vehicles that were observed twice are included, the mean correlation is slightly lowered to .68. For comparison D the number of observations was too small for separating direction of travel.

Table 1. Correlation coefficients for repeated observations at two sites along the target road (Comparisons A – C) and for two occasions at the same site (Comparison D).

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Direction</th>
<th>r</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>East</td>
<td>.81</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>West</td>
<td>.78</td>
<td>97</td>
</tr>
<tr>
<td>B</td>
<td>East</td>
<td>.75</td>
<td>92</td>
</tr>
<tr>
<td></td>
<td>West</td>
<td>.67</td>
<td>83</td>
</tr>
<tr>
<td>C</td>
<td>East</td>
<td>.70</td>
<td>89</td>
</tr>
<tr>
<td></td>
<td>West</td>
<td>.49</td>
<td>107</td>
</tr>
<tr>
<td>D</td>
<td>East+West</td>
<td>.70</td>
<td>37</td>
</tr>
</tbody>
</table>

All correlations are significant at p<.001.

Percentages of drivers keeping to the speed limit at one or both sites, or one or both occasions for comparison D, are shown in Table 2. For comparison A the speed limit was 90 km/h at both sites and for several kilometres before the sites. For comparison B two speed limits were in force, 70 and 90 km/h. This means that drivers travelling in the eastbound direction first passed the 70 km/h speed limit and then 90 km/h. Consequently, drivers travelling in westbound direction came into a lower speed limit after driving at a higher speed limit.

Table 2. Percentage of drivers who travelled below or above the speed limit at two sites.

<table>
<thead>
<tr>
<th>Direction</th>
<th>Comparison</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>E</td>
<td>W</td>
<td>E</td>
<td>W</td>
<td>E+W</td>
</tr>
<tr>
<td></td>
<td>(75)</td>
<td>(97)</td>
<td>(83)</td>
<td>(89)</td>
<td>(107)</td>
</tr>
<tr>
<td>Legal at two sites</td>
<td>41</td>
<td>25</td>
<td>4</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>Speeding at one site</td>
<td>16</td>
<td>19</td>
<td>42</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>Speeding at two sites</td>
<td>43</td>
<td>56</td>
<td>53</td>
<td>70</td>
<td>64</td>
</tr>
</tbody>
</table>
For comparison A, in both directions, over 80% of the drivers were consistent in speed choice in relation to the speed limit. For comparison B and in the westbound direction for comparison C lower percentages of drivers were consistent in speed choice. For comparison D all drivers were speeding on both occasions.

Large differences can be found for drivers who consistently observe the speed limit as a function of road, from 4% for comparison B to over 40% for comparison A. In addition, differences can be found for direction of travel. For comparison B, very few drivers kept the speed limit on the 70 km/h section which may explain the fact that few drivers were consistent in keeping the speed limit at both sites on that road.

**DISCUSSION**

In the present study rural roads were selected. The reason for this was practical considerations. For instance, it should be possible to make unobtrusive observations of the traffic and the number of connecting roads between measurement sites should be limited. In addition, heavy traffic may limit the amount of free-flowing vehicles. Consequently, rural roads were studied because traffic and road environment were considered more homogenous. Therefore some caution is necessary in generalising the results to roads in general.

The results show a relatively high consistency in speed choice for individual drivers. Mean correlation of repeated speed measures for free-flowing vehicles observed twice was .71. It was found that a high percentage of drivers exceeded the posted speed limits, indeed a common phenomenon (e.g. Fildes & Lee, 1993; Østvik & Elvik, 1991). For comparison B, in which the drivers passed two speed limits, only 4-5% of the drivers regularly travelled within the posted speed limit. When travelling from a higher to a lower speed limit an effect of speed adaptation can be expected to occur (Casey & Lund, 1987). The effect is that the driver underestimates the speed of his or her car when slowing down. However, it was also found that drivers travelling in the opposite direction on that road, that is, going from a lower to a higher speed limit, were observed driving well over the 70 km/h speed limit. In westbound direction for comparison C, the correlation coefficient was somewhat lower than for the other comparisons. In addition, speed variance was reduced in this condition. A curve following the measurement site might have had an effect on speed choice and speed variance in this case. Drivers might also have reacted to the observation vehicles close to the road, for instance, believing that they were police vehicles. If the road had previously been enforced by the police it might in such a case have had an effect on drivers’ speed. However, no data on enforcement activities were available for the roads in the study.

The results of the present study were obtained on rural roads where the road environment can be assumed to be more homogenous than in urban areas (Fildes & Lee, 1993). It can be assumed that it is easier for a driver to keep a more uniform speed on a rural road as compared with urban roads. Such a conclusion can be based on the results reported by Ogawa et al. (1962). They found correlations of the same magnitude as in the present study, and they found no consistency in driving speed between urban and rural sites or between the different urban sites. One difference between urban and rural roads is the flow of the traffic. In urban areas drivers may have to adjust speed to traffic signals, pedestrians, and are hindered by slower vehicles much more often than on highways. Therefore, higher correlations can be expected on highways than in urban traffic. Even if all speed measurements in the present study were made on highway traffic road layout varied between comparisons. For instance, in comparison A the same speed limit (90 km/h) was in force before and at the measurement sites. For comparisons B and C, road layout changed.
along the roads and accordingly speed limits changed. Therefore, when drivers have to adjust speed according to speed limits, road width and visibility, speed may vary more along a route.

Although the results in the present study showed a regularity in drivers’ speed choice there was also a variation in speed between sites. This variation restricts the correlation coefficient which could be seen as a limit for relations between self-reported speed and observed speed. Compared with correlations of .70 for repeated observed speed measures, a correlation of .58 between self-reported and observed speed for highway traffic (Haglund & Åberg, 2000) seems as a reasonably good estimate of the relation between intentions and actual behaviour. Åberg et al. (1997) reported a correlation of .40 for urban traffic which also can be regarded as reasonable considering the more complex traffic environment.

When modelling driver behaviour a natural step is to use some measure of speed behaviour. The present results suggest that drivers’ consistency in speed choice is related to road layout. This may have important implications when results from questionnaires are coupled with speed measurements obtained on the road. It is therefore important to choose measurement sites with care.
REFERENCES


