Professional drivers as road users in the urban environment

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ABSTRACT

Few international studies have so far been conducted in terms of professional drivers' speed compliance in urban areas, and even fewer on professional drivers' compliance with rights of way at pedestrian crossings.

The project began with a literature review to identify existing knowledge on the role of professional drivers in traffic. The municipalities of Luleå, Piteå, Kalix and Älvsbyn in Sweden were contacted for information about the project and for cooperation in the selection of study sites. Speed measurements with a handheld laser were conducted in the urban environment with the focus on commercial vehicles such as buses, trucks, freight services, taxis and service vehicles. In parallel with the speed measurements, video recording was conducted for observational studies of yielding behaviour at pedestrian crossings in the urban environment, with the focus on commercial vehicles.

Professional drivers as a group are not clearly distinguished from other drivers regarding compliance with speed limits and, when they differed from other drivers, it was in a negative way. Bus drivers and taxi drivers drove faster than other drivers at sites with maximum speed limit of 30 km/h, and the tendency was that taxi drivers also drove faster on roads with maximum speed limit of 50 km/h.

Professional drivers are much like other drivers. This averages that it is common that the relevant rules not are followed, two to three out of ten drivers do not give priority to pedestrians at marked pedestrian crossings. This also applies to professional drivers.

Key words: traffic safety, urban traffic, professional drivers, pedestrians, bicyclists.

INTRODUCTION

Road users maintaining the correct speed is vital to good traffic safety and security as part of the transport system. Vehicle drivers yielding to pedestrians at pedestrian crossings are important to good safety and security, and access in towns or built-up areas. The Swedish Road Administration and local municipalities invest in measures to maintain speeds in built-up areas where vehicular traffic is mixed with pedestrians and bicyclists, particularly near schools where special consideration is given to children's and young people's traffic environment. Professional drivers are an important road user category even in urban environments. There are good opportunities for professional drivers to be or provide good examples for other road users.

Those who are professional drivers have traffic as their working environment and working environment legislation shall be complied with in a working environment. Driving as part of a person's employment is also a working environment issue. The employer bears the responsibility for minimising risks of ill-health and accidents in Sweden. This also applies to the working environment that is made up of traffic (see the Swedish Road Administration' website, 2007). This applies whether or not the employee drives a company vehicle, whether business travel makes use of a private car or whether a cycle is used. Other categories need to be considered in additional to professional drivers. These may include home help services, health care provided in the home, security staff, tradesmen and sales employees and many others. During procurement, consideration should be given to employees' working environments and working hours. The employer is however responsible for such issues. In recent years, the Work Environment Authority has received signals that working environment problems have increased significantly. Work shifts have become longer and the opportunities for taking breaks have decreased.

A significant volume of commercial traffic has the state, local municipalities or county councils as employers. Commerce that is operated in the enterprises referred to above shall provide good quality and the safety of citizens. Furthermore, it shall provide good examples for other road users. This shall include wearing a seat belt, complying with traffic regulations and adapting speed to road conditions. Drivers shall also be rested and free from the effects of alcohol and drugs.

The following issues have been studied in this project.

- How do professional drivers drive in relation to the maximum permitted speed limits?
- How well do professional drivers comply with the obligation to give way to pedestrians at pedestrian crossings?

METHOD

The project commenced with a literature study in order to map current knowledge of the professional driver's role in traffic. Municipalities were contacted for information concerning the project and for collaboration with a selection of study sites. Speed measurements using hand-held laser meters in built-up areas were conducted with the stress on commercial traffic such as buses, goods traffic, taxis and service vehicles. Video filming for observational studies of compliance with rights of way in built up areas at pedestrian crossings was conducted. This was also directed at commercial traffic.

Literature studies

Searching in January 2008 in the Compendex database (*Compendex Web was an interdisciplinary bibliographic database of engineering and technology research literature, nowadays called Scopus.*) for the years 1969-2008 using the search word *driver* produced 35328 hits. To enhance the level of detail, the search was combined with the key words *driver* and *professional*. This produced 803 hits. The combination of *driver, professional* and *speed* produced 87 hits. The combination of *on-the-job* and *driver* produced 15 hits.

After a search in January 2008 in the PsycINFO database (PsycINFO *provides systematic coverage of the psychological literature and associated subject areas*) from 1887-2008 on *driver* and *professional* produced 21 hits. The search words *on-the-job* and *driver* produced 3 hits.

Searching in January 2008 in the TRAX database provided by VTI, (The Road and Transport Research Institute) on the word *professional driver* produced 26 hits, of which 4 dealt with professional drivers' compliance with speed limits. None of them dealt with professional drivers' compliance with giving way at pedestrian crossings.

Contact with municipalities

Field measurements were conducted at four places in Sweden - Luleå, Piteå, Kalix and Älvsbyn. The places were chosen because of their proximity to Luleå University of Technology and because they represented different sizes of municipality. Three of the places; Luleå, Piteå and Kalix are located on the coast while Älvsbyn is located inland. Otherwise the working conditions are considered similar in the different places.

Persons who work within technical management in three municipal offices (Luleå, Piteå and Kalix) were initially contacted by phone. Contact was not established with persons concerned at Älvsbyn municipality despite repeated attempts via email and phone. Persons were informed verbally about the project and were asked whether the municipality would like to be included in the project. The respective municipalities were asked for comments on the choice of sites that were studied, flow data, speed data and information on which transport companies were used by the municipalities. Staff at the three municipalities were positive about the project. In some cases there was a different person who responded to questions concerning procurement of transport services. The same information was then sent to the respective municipality by email. The same material and questionnaires were sent to Älvsbyn municipality without a response being received.

Vehicle flows

The values for vehicle flows (*ÅDT - Annual average daily traffic*) at the study sites were accessed from the Subscription portal on the Internet. Measurements were carried out by Vägverket Konsult. The values were rounded up by 1.5% per annum up to the 2007 level since the measurements had previously been carried out earlier than 2007.

Speeds

During May, June and September 2007, vehicle speeds were measured using hand-held laser meters at the study sites and at different times on weekdays. The laser measurements were carried out when free-moving vehicles were traveling across pedestrian crossings. Measurements were conducted using ProLaser III hand-held lasers. The instrument registers the actual speed without any safety deduction. The speeds were measured only for free-moving vehicles. The term "free-moving vehicles" refers to vehicles that are unaffected by other traffic such as other vehicles or unprotected road users. The speeds of vehicles where the driver has adapted his driving as a consequence of vehicles in front, turning vehicles or pedestrians or cyclists traveling along or crossing the road, were not recorded. Average speeds are used to describe and compare the different road user's speed. The 90 percentile is used as a measure to describe the range of speed for different road user groups, and the percentile is also compared with the maximum speed limit as a description of speeding.

Traffic patterns

The stretches that were studied and pedestrian crossings were video filmed. The input data from video filming was coded and compiled manually in Excel. The coding of the material from the sites was stratified so that, for some of the material, all meetings between vehicles and unprotected road users at pedestrian crossings were coded irrespective of the type of vehicle. In the case of the other part of the material, all the occasions were coded when commercial vehicles met unprotected road users at pedestrian crossings.

Table 1. Coded parameters.

Site data	**For vehicles**
Place	Direction from which the vehicle came
Site	Entry /departure at the crossing
Maximum permitted speed	Commercial vehicle or not
Number of lanes	Type of vehicle
School or not	Traffic situation, vehicle stops/slows down or not
Date	Number of vehicles in sequence that meet the unprotected road user
Time of day	Vehicles from another direction stop/slow down or not
For unprotected road user	**Miscellaneous**
Type of unprotected road user that the vehicle driver meets	Conflict or not
Number of unprotected road users	Comments

Vehicles classified as not being commercial vehicles are private cars without markings or decals to indicate that the vehicle is some type of company vehicle. This is the commonest type of vehicle on our streets and roads.

The following types of vehicle are classifies as commercial vehicles: *Van, courier, truck and bus.* Most of these types of vehicle are marked or have decals which indicate some type of haulage company, transport company, travel company or builder/contractor. However, vehicles of the types referred to above that do not have decals are also classified as commercial vehicles. *Taxis*, i.e. private cars that have signs for and display decals in order to be taxis. Furthermore, *company cars*, i.e. private cars with decals or other marking for some type of business, service or contractor companies, as well as municipal or public activities have been classified as commercial vehicle. That type of vehicle is probably driven by a person that is not a professional driver. However, part of the person's job is evidently driving a vehicle. This is the reason why this type of vehicle is included in the study. Taxis have been coded with the supplementary information to differentiate taxi cars from other private cars.

It is the occasions when an unprotected road user has crossed the road at or adjacent to a pedestrian crossing that have been studied. The occasions when an unprotected road user has crossed the road at or a bit away from a pedestrian crossing have not been studied. The parameters that have been coded for the vehicles in the study are described in Table 1.

All video filming was conducted during daylight, bare ground conditions and fine weather. The stretches were video filmed over at least two days during the hours of 7.30 – 9.00 and three concurrent hours between 13.00 and 17.00 hrs. These are times when children and young people are on their way to and from school and when adults drive to and from work. These time intervals are often the hours for maximum vehicle traffic.

A Hi8 camera was used at each site in order to film the actual pedestrian crossings or intersections. Cameras were placed on posts or building facades 3-5 metres above the ground in such a manner that they would not attract attention and result in a change in road user behaviour.

COMMERCIAL TRAFFIC IN BUILT UP AREAS

Of the international publications that resulted in hits during database searching, only a few concerned a professional driver's compliance with the speed limit or regulations. Of the few publications that were found to deal with a professional driver's working environment or traffic safety, most dealt with tiredness and (the lack of) road safety.

The only international source that can be linked to this study considered different factors' impact on a professional drivers' safe way of driving (Caird och Kline, 2004). 330 professional drivers were queried via questionnaires to which 190 responded and 153 of these persons' accident statistics were linked to the questionnaire responses. Factors that were positive in terms of the drivers' safe way of driving or safety were support from the driver's own organisation and the facilities for planning a journey before departure. The lack of planning and tiredness has a negative effect on the way of driving, i.e. increased risk of an accident.

Three of the Swedish studies on compliance with speed restrictions were compiled by NTF (*Nationalföreningen för Trafiksäkerhetens Främjande - The National Society for Road Safety*) of which the latest study was published in 2003 (Cronvall, 2003). Speed measurements were recorded in the study on approximately 30 companies' vehicles in service as taxis, buses, haulage vehicles, couriers and services during the Spring and Autumn of 2003. The companies were informed of the results after each measurement. Measurements were taken at around 15 sites in Stockholm's inner suburbs. Measurements were taken on stretches with a maximum permitted speed of 30 km/h and 50 km/h where the traffic environment is not regulated in terms of speed. All the companies in the study had an average speed that was higher than that permitted on stretches with a maximum speed of 30 km/h and 50 km/h. Of the total number of vehicles that were measured, 25% complied with the current speed regulations. Taxis had an average speed on 30 km/h stretches of 38 km/h, buses 35 km/h, haulage vehicles 36 km/h and courier/services of 37 km/h. On 50 km/h stretches, taxis had an average speed of 60 km/h, buses 55 km/h, haulage vehicles 58 km/h and couriers/services 58 km/h. In the case of SL buses, 8 out of 10 drove too fast on stretches with maximum permitted speeds of 30 km/h and 50 km/h.

During the Spring and Autumn of 2007, the Swedish Road Administration measured the speed of commercial traffic, trucks, buses and taxis on rural roads (Swedish Road Administration website, 2008a). In total, 28,000 observations were made on stretches of road with maximum permitted speeds of 50 km/h, 70 km/h and 90 km/h. The measurements were recorded in collaboration with Sveriges Åkeriföretag (*Haulage Companies Sweden*), Bussbranschens Riksförbund *(Swedish Bus and Coach Federation)* and Svenska Taxiförbundet (*Swedish Association of Taxi Owners*). The study detected deterioration in speed compliance in the Autumn by comparison with the Spring. Three out of four taxis drove too fast where the maximum permitted speed was 50 km/h while of the trucks that were observed, two-thirds exceeded the limit. On roads with a maximum permitted speed of 90 km/h, just over half of all buses and slightly more taxis drove faster than the signposted speed.

Few studies have therefore been carried out to date in Sweden and worldwide with regard to professional drivers' compliance with speed regulations in built-up areas and even fewer with regard to professional drivers' compliance with regulations that give right of way at pedestrian crossings.

SITE DESCRIPTIONS

The following are brief descriptions of the study places and the sites that were studied. Data on places were accessed from Statistics Sweden (SCB), 2007.

Site description - Luleå
Luleå is a municipality in the county of Norrbotten and has approximately 73,000 inhabitants. Five sites in central Luleå were included in the study. The sites were mostly in the central part of the town where there is a high flow of unprotected road users, and also even further out where there are still high vehicle flows but fewer unprotected road users. The studied streets were: Kungsgatan, Lulsundsgatan (30 km/h), Prästgatan Rådstugatan, Backgatan (30 km/h).

Figure 1. Two pedestrian crossings on Kungsgatan, viewed towards north.

Figure 2. Lulsundsgatan, viewed towards west.

Figure 3. Skeppsbrogatan, viewed towards south.

Figure 4. Rådstugatan, viewed towards north.

Figure 5. Backgatan, viewed towards north.

Site descriptions - Älvsbyn

The municipality of Älvsbyn is approximately 65 kilometres west of Luleå. Älvsbyn has approximately 8.500 inhabitants of which the built-up area has around 5,000. Five sites were studied in this municipality, all of which are in the central parts. The studied streets were: Östermalmsleden, Parkgatan (30 km/h), Medborgargatan and Nyvägen.

Figure 6. Crossing between Östermalmsleden /Storgatan, viewed towards south.

Figure 7. Parkgatan, viewed towards east.

Figure 8. Medborgargatan, viewed towards north.

Figure 9. South pedestrian crossing to the left, view to the south. North pedestrian crossing to the right, view to the north.

Site description - Piteå

The municipality of Piteå lies 55 km south of Luleå near the coast. Piteå is both a commercial and industrial town. A number of paper mills dominate the vista of Piteå that has approximately 41,000 inhabitants. Four sites are included in the Piteå study. The studied streets were: Bryggargatan, Västergatan, Olof Palmes gata (30 km/h), and Svartuddsvägen.

Figure 10. Pedestrian crossing at Bryggargatan, viewed towards north.

Figure 11. Intersection between Västergatan /Storgatan, viewed towards south.

Figure 12. Olof Palmes gata, viewed towards north.

Figure 13. Svartuddsvaägen, viewed towards south.

Site description - Kalix

The municipality of Kalix lies along the Norrbotten coast approximately 75 km north of Luleå next to route E4 and has a population of approximately 17,300. Three sites along Centrumvägen (all 50 km/h) in central Kalix were included in the study.

Figure 14. Centrumvägen at Postgatan, view towards west.

Figure 15. Centrumvägen at Nygatan, view towards west.

DESCRIPTION OF DATA

Vehicle speeds

Vehicle speeds were measured for a total of 4833 vehicles of which 1065 were commercial vehicles.

Yielding behaviour

A total of approximately 200 hours of filmed material was collected. The yielding behaviour for a total of 1871 vehicle drivers was studied in a total of 141 hours of filmed material. See Table 2. In about a third of the material, 39 h, only professional drivers' yielding behaviour was studied. All film material from the sites with the greatest permitted speed of 30 km/h was coded.

Table 2. Number of observations according to type of vehicle and maximum permitted speed.

Maximum permitted speed		Private car	Truck	Van	Bus	Others	Total
30 km/h	Non-professional	162				3	165
	Professional	15	9	28	5	1	58
Total		177	9	28	5	4	223
50 km/h	Non-professional	1176				3	1179
	Professional	97	41	276	42	12	468
Total		1273	41	276	42	15	1647
Total for the study		**1448**	**52**	**305**	**47**	**19**	**1871**

Vehicle flows

Table 3. Flows at sites studied.

place	Speed limit	Site	Data year	Flow. Annual average daily traffic	Flow, adjusted up to 2007
Luleå	50	Kungsgatan	2007	4857	4857
	30	Lulsundsvägen	2007	3775	3775
	50	Prästgatan	2005	5785	5960
	50	Rådstugatan	2007	10398	10398
	30	Backgatan	2005	7404	7630
Älvsbyn	50	Östermalmsleden	N/A	Flow lower than Nyvägen	
	30	Parkgatan	N/A	Local traffic – low flow	
	50	Medborgargatan	N/A	Higher than Parkgatan but lower than Nyvägen	
	50	Nyvägen	2000	3500	3900
Piteå	50	Bryggargatan	2006	6000	6090
	50	Västergatan	2006	4400	4470
	30	Olof Palmes gata	2006	3500	3550
	50	Svartuddsvägen	N/A		
Kalix	50	Centrumvägen V	1995	5220	6300
	50	Centrumvägen M	N/A	Higher than Centrumvägen V	
	50	Centrumvägen Ö	N/A	Higher than Centrumvägen V	

The table above provides a summary of the vehicle flows at the study sites. The flow data from the sites have been adjusted upwards by 1.5% per annum up to 2007.

RESULTS

Speed per vehicle type and maximum permitted speed

Table 4 shows the vehicles speed per maximum permitted speed divided according to different types of vehicle and driver. At sites with a maximum permitted speed of 30 km/h, the average speed for all 989 vehicles was just over 27 km/h, [27.4 +/- 0.56] (confidence interval 95% for average value gives a confidence interval of +/- 1.96*0.29), and the 90-percentile was 39 km/h. There was no difference in average speed for private car drivers and professional drivers in total.

Bus drivers were the professional group that drove the fastest at sites with the maximum permitted speed of 30 km/h with an average speed of 34.6 km/h [34.6 +/- 2.47] and a 90 percentile of 41 km/h, significantly faster than the average value for all road users [27.4 +/- 0.57].

Taxi drivers were the professional group that drove the next fastest at sites with the maximum permitted speed of 30 km/h with an average speed of 30.0 km/h [30.0 +/- 4.91] and a 90 percentile of 43 km/h. This was not significantly faster than the average value for all road users.

Table 4. Vehicle drivers' speed at pedestrian crossings divided according to vehicle type and maximum permitted speed.

			n	Average (km/h)	90-perc	STDP (km/h)	STDP Average (km/h)
30 km/h	Private cars	Non-professional	804	27.4	39.0	9.22	0.33
		Professional (incl. taxis)	106	28.2	41.0	9.41	0.91
		total	910	27.5	39.0	9.24	0.31
	All vehicles	Non-professional	804	27.4	39.0	9.21	0.32
		Professional	185	27.4	39.6	9.24	0.68
		total	989	27.4	39.0	9.22	0.29
	Taxi		15	30.0	43.0	9.70	2.50
	Trucks		23	22.3	32.8	7.23	1.51
	Bus		16	34.6	41.0	5.05	1.26
	Van		39	25.3	37.6	8.78	1.41
50 km/h	Private cars	Non-professional	3024	36.8	49.0	10.01	0.18
		Professional (incl. taxis)	489	37.2	50.0	9.99	0.45
		total	3513	36.8	50.0		0.00
	All vehicles	Non-professional	3057	36.7	49.0	10.01	0.18
		Professional	783	36.3	49.0	10.07	0.36
		total	3840	36.7	49.0	10.02	0.16
	Taxi		70	38.7	51.1	9.88	1.18
	Trucks		120	36.4	48.1	9.26	0.85
	Bus		59	32.1	44.2	11.70	1.52
	Van		76	33.9	47.5	9.58	1.10

Drivers who drove trucks or vans drove significantly slower [22.3 +/- 2.96] than the average for all drivers. All traffic groups drove faster than the maximum permitted speed since the 90 percentile was always greater than the maximum permitted speed of 30 km/h.

At sites where the maximum permitted speed was 50 km/h, the average speed for all 3840 vehicles was just over 36 km/h, [36.7 +/- 0.32] and the 90-percentile was 39 km/h. There was no difference in the average speed of private car drivers and professional drivers in total. Taxi drivers constituted the professional group that drove the fastest at sites with a maximum permitted speed of 50 km/h with an average speed of 38.7 km/h, and the 90 percentile was 51 km/h. This means that somewhat more than 10% of taxi drivers drove faster than the maximum permitted speed.

Speed per place and maximum permitted speed

Table 5 shows the vehicles' speeds irrespective of type of vehicle per place and maximum permitted speed with or without traffic-calming measures divided according to different types of driver. There was no difference in average speed between sites with a maximum permitted speed of 50 km/h at the different sites with the exception of Kalix where the average speed was significantly faster [45.3 +/- 0.35] km/h compared with the other sites where the average speed was slower than 40 km/h.

The table also shows that there was no significant difference between sites with a maximum permitted speed of 30 km/h and 50 km/h if the sites do not have traffic-calming measures to reduce vehicle speeds. The average speeds were between 35-40 km/h irrespective of the site (with the exception of Kalix) if without traffic-calming measures and if, the site has traffic-calming-measures in the form of raised pedestrian crossings, the average speed was between 20-27 km/h, irrespective of the maximum permitted speed.

Table 6 shows *the private car drivers*' speeds per place and maximum permitted speed with or without traffic-calming measures divided according to different types of driver. The professional driver group's average speed was not significantly different from the private car driver group at any of the sites and places. But the trend is that the taxi driver group drives faster than private car drivers or other professional drivers who drive private cars.

Table 5. Vehicle driver's speed at a pedestrian crossing divided according to place, traffic-calming measures at the site and maximum permitted speed (PC = pedestrian crossing).

Place	Speed limit, km/h	Traffic-calming measures	Road user	n	Average (km/h)	STDP (km/h)	STDP Ave. (km/h)
Kalix	**50**	None	All professional	172	45.4	5.54	0.42
			Non-professional	738	45.3	5.58	0.21
			Total	910	45.3	5.57	0.18
Luleå	**30**	None	All professional	57	35.2	5.86	0.78
			Non-professional	166	37.5	7.18	0.56
			Total	223	36.9	6.94	0.46
		Raised PC	All professional	67	20.0	5.04	0.62
			Non-professional	260	20.2	5.49	0.34
			Total	327	20.1	5.40	0.30
	50	None	All professional	232	35.6	7.81	0.51
			Non-professional	763	37.3	8.34	0.30
			Total	995	36.9	8.25	0.26
Piteå	**30**	Raised PC	All professional	49	25.5	5.47	0.78
			Non-professional	306	26.2	6.47	0.37
			Total	355	26.1	6.35	0.34
	50	None	All professional	155	30.2	5.52	0.44
			Non-professional	574	31.1	5.85	0.24
			Total	729	30.9	5.79	0.21
		Raised PC	All professional	58	20.5	5.46	0.72
			Non-professional	297	23.4	5.64	0.33
			Total	355	22.9	5.71	0.30
Älvsbyn	**30**	None	All professional	12	40.2	10.62	3.07
			Non-professional	73	35.4	6.94	0.81
			Total	85	36.0	7.75	0.84
	50	None	All professional	166	39.2	10.32	0.80
			Non-professional	688	37.5	10.43	0.40
			Total	854	37.9	10.43	0.36
Total	**30**	None	All professional	69	36.1	7.18	0.91
			Non-professional	239	36.8	7.18	1.69
			Total	308	36.7	7.18	0.41
		Raised PC	All professional	116	22.3	5.90	0.56
			Non-professional	566	23.4	6.75	1.07
			Total	682	23.2	6.63	0.25
	50	None	All professional	725	37.6	9.25	0.35
			Non-professional	2763	38.2	9.28	0.67
			Total	3488	38.1	9.28	0.16
		Raised PC	All professional	58	20.5	5.46	0.64
			Non-professional	297	23.4	5.64	1.40
			Total	355	22.9	5.71	0.30

Table 6. Private vehicle drivers' speed at a pedestrian crossing divided according to place, traffic-calming measures at the site and maximum permitted speed (PC = pedestrian crossing).

Place	Speed limit, km/h	Traffic-calming measures	Road user	n	Average (km/h)	STDP (km/h)	STDP Ave. (km/h)
Kalix	**50**	None	Professional private car used for business	113	45.4	5.84	0.55
			Of which taxis	10	50	8.63	2.72
			Non-prof. PC	738	45.3	5.58	0.21
			Total	851	45.3	5.61	0.19
Luleå	**30**	None	Professional private car used for business	25	36.0	6.38	1.28
			Of which taxis	5	42.8	4.66	2.05
			Non-prof. PC	166	37.5	7.18	0.56
			Total	191	37.3	7.10	0.51
		Raised PC	Professional private car used for business	37	21.6	5.42	0.89
			Of which taxis	2	23.5	-	-
			Non-prof. PC	260	20.2	5.49	0.34
			Total	297	20.3	5.50	0.32
	50	None	Professional private car used for business	145	36.7	8.04	0.67
			Of which taxis	23	41.4	5.89	1.23
			Non-prof. PC	762	37.3	8.34	0.30
			Total	907	37.2	8.29	0.28
Piteå	**30**	Raised PC	Professional private car used for business	34	26.1	5.38	0.92
			Of which taxis	7	24.6	1.76	0.76
			Non-prof. PC	305	26.2	6.48	0.37
			Total	339	26.2	6.38	0.35
	50	None	Professional private car used for business	106	30.6	6.00	0.58
			Of which taxis	16	30.0	5.04	1.26
			Non-prof. PC	571	31.1	5.83	0.24
			Total	677	31.0	5.86	0.23
		Raised PC	Professional private car used for business	37	22.6	4.66	0.77
			Of which taxis	6	23.67	4.07	1.67
			Non-prof. PC	296	23.4	5.65	0.33
			Total	333	23.3	5.56	0.30
Älvsbyn	**30**	None	Professional private car used for business	10	41.7	11.01	3.48
			Of which taxis	0	-	-	-
			Non-prof. PC	73	35.4	6.94	0.81
			Total	83	36.1	7.82	0.86
	50	None	Professional private car used for business	119	40.5	10.18	0.93
			Of which taxis	10	43.5	7.5	2.38
			Non-prof. PC	688	37.5	10.43	0.40
			Total	807	38.0	10.45	0.37

Giving way behaviour according to vehicle type

73% of all 1048 observed private car drivers gave way to pedestrians who wanted to cross a road at a pedestrian crossing, see Table 7. 72% of all 446 observed professional drivers gave way to pedestrians who wanted to cross a road at a pedestrian crossing. Taxi drivers were the group who were most inclined to give way to pedestrians, 78% of them, and truck drivers were the least inclined to give way, 69% of them gave way. There was no significant difference between private car drivers and any of the professional driver groups, neither was this the case between any of the professional driver groups.

Table 7 also shows vehicle drivers' inclination to stop, i.e. remaining stationary or almost stationary when giving way, or if they slow down but continue to creep forward while the pedestrian is crossing. Of all the drivers, almost two-thirds, 64% stopped when they gave way. 63% of private car drivers stopped when they gave way. Taxi drivers and drivers of other vehicles (such as tractors) were the group who were most inclined to give way to pedestrians by stopping; 75% did so.

Truck drivers were the least inclined to give way by stopping. 45% gave way by stopping. The differences between taxi drivers, private car drivers as professional drivers, van drivers, compared with truck drivers as a group was statistically significant ($p<0.02$). There was also a significant difference between private car drivers and truck drivers in their inclination to give way by stopping the vehicle ($p<0.05$).

Table 7. Proportion (%) of vehicle drivers who gave way to pedestrians.

	Number of observations	Proportion who gave way	Of those who gave way, by stopping	by slowing down
Private car drivers				
Private cars	1048	*73*	*63*	*37*
Professional drivers				
All private cars	89	*75*	*70*	*30*
Of which taxis	41	*78*	*75*	*25*
Trucks	42	*69*	*45*	*55*
Vans, couriers	270	*72*	*64*	*36*
Buses	33	*76*	*60*	*40*
Other vehicles	12	*67*	*75*	*25*
All professional drivers	446	*72*	*64*	*36*

The regulation governing a vehicle driver's obligation to give way at a pedestrian crossing applies only to pedestrians. Vehicle drivers need not therefore give way to cyclists. However, 47% of all private car drivers observed gave way to cyclists who wished to cross a road at a pedestrian crossing, see Table 8. The difference compared with private car driver's inclination to give way to pedestrians was statistically significant. 42% of all 81 professional drivers observed gave way to cyclists who wanted to cross the road at a pedestrian crossing. The difference between a professional driver's inclination to give way to pedestrians was also statistically significant.

Professional drivers who drove a private car were the group of professional drivers who were most inclined to give way to cyclists, 57% of them. 50% of taxi drivers gave way to cyclists. Bus drivers were the least inclined to give way. 21% of them gave way to cyclists. There was no significant difference between private car drivers and professional drivers in their inclination to give way.

Table 8. Proportion (%) of vehicle drivers who gave way to cyclists.

	Number of observations	Proportion who gave way	Of those who gave way, by stopping	by slowing down
Private car drivers				
Private cars	296	*47*	*64*	*36*
Professional drivers				
All private cars	23	*57*	*46*	*54*
Of which taxis	12	*50*	*17*	*83*
Trucks	8	*38*	*100*	*0*
Vans, couriers	35	*40*	*57*	*43*
Buses	14	*21*	*67*	*33*
Other vehicles	1	*100*	*0*	*100*
All professional drivers	81	*42*	*56*	*44*

Of all professional drivers, more than half, 56%, stopped when they gave way. 64% of private car drivers stopped when they gave way. The difference was not significant.

Giving way behaviour per vehicle type and maximum permitted speed

Of the total of 42 professional drivers who met a pedestrian who intended crossing the road at a pedestrian crossing on stretches with a maximum permitted speed of 30 km/h, 62% gave way to pedestrians, see Table 9. Of the 113 private car drivers who met a pedestrian who intended crossing the road at a pedestrian crossing on a stretch with a maximum permitted speed of 30 km/h, 64% gave way to a pedestrian. There was no significant difference between the two groups. There were too few observation of professional drivers on roads with a maximum speed of 30 km/h for further analysis per professional group.

Of the total of 404 professional drivers who met a pedestrian who intended crossing the road at a pedestrian crossing at a stretch where the maximum permitted speed was 50 km/h, 74% gave way to the pedestrian.

Of the 935 private car drivers who met a pedestrian who intended crossing the road at a pedestrian crossing at a stretch where the maximum permitted speed was 50 km/h, 74% gave way to the pedestrian. Consequently there were 12 percentage points more professional drivers who gave way at a site with a maximum permitted speed of 50 km/h than at a site with a maximum permitted speed of 30 km/h. However, the difference was not statistically significant. The difference in giving way between private car drivers at sites with the maximum permitted speed of 30 km/h or 50 km/h was significant ($p<0.02$).

On stretches with a maximum permitted speed of 50 km/h, it was the taxi driver group who more often gave way, 79% of the total of 34 observed taxi drivers. Truck drivers were the group that gave way least often, 68% of the total of 38 drivers. There was no significant difference between private cars marked as professional vehicles or “normal” private cars in their inclination to give way neither on roads with a maximum permitted speed of 30 km/h and 50 km/h. Neither was there any significant difference between different types of professional vehicles on stretches with a maximum permitted speed of 50 km/h.

Table 9. Number of observations and proportion (%) of professional drivers who gave way to pedestrians at a pedestrian crossing per maximum permitted speed.

		Number of observations	Proportion who gave way
30 km/h	**Private car drivers**		
	Private cars	113	*64*
	Professional drivers		
	All private cars	11	*64*
	Of which taxis	7	*71*
	Trucks	4	*75*
	Vans, couriers	23	*61*
	Buses	3	*67*
	Other vehicles	1	*0*
	All professional	42	*62*
50 km/h	**Private car drivers**		
	Private cars	935	*74*
	Professional drivers		
	All private cars	78	*77*
	Of which taxis	34	*79*
	Trucks	38	*68*
	Vans, couriers	247	*73*
	Buses	30	*77*
	Other vehicles	11	*73*
	All professional	404	*74*

Table 10. Number of observations and proportion (%) of vehicle drivers who gave way to cyclists at a pedestrian crossing per maximum permitted speed.

		Number of observations	Proportion who gave way
30 km/h	**Private car drivers**		
	Private cars	52	*46*
	Professional drivers		
	All professional	16	*56*
50 km/h	**Private car drivers**		
	Private cars	244	*47*
	Professional drivers		
	All private cars	19	*53*
	Of which taxis	11	*45*
	Trucks	3	*33*
	Vans, couriers	30	*37*
	Buses	12	*17*
	Other vehicles	1	*100*
	All professional	65	*38*

Both private car drivers and professional drivers gave way even to cyclists who wanted to cross the road at a pedestrian crossing but this was significantly less common as has already been stated. Table 10 shows that 56% of all professional drivers gave way to cyclists on roads with a maximum speed of 30 km/h and 38% of all professional drivers on roads with a maximum speed of 50 km/h. The values were not significantly different from each other.

Giving way at sites with schools

At all sites with a maximum permitted speed of 30 km/h there was a school in the vicinity and it has already been determined that it was less common for vehicle drivers to give way to pedestrians. At sites where the maximum permitted speed was 50 km/h, the trend was that private car drivers and professional drivers more often gave way at sites where there was a school in the vicinity. However, the differences were not statistically significant for any of the groups. The presence of a school did not play any significant role in the drivers' inclination to give way to pedestrians. See Table 11.

Table 11. Number of observations and proportion (%) of professional drivers who gave way to pedestrians at pedestrian crossings in the vicinity of a school.

			Number of observations	Proportion who gave way
30 km/h	School	Private car drivers	113	*64*
		Professional drivers	42	*62*
50 km/h	No school	Private car drivers	775	*73*
		Professional drivers	378	*73*
	School	Private car drivers	165	*78*
		Professional drivers	26	*77*

Giving way depending on the flow of unprotected road users

The number of meetings between vehicle drivers and unprotected road users was used in this study as a measure of flow of unprotected road users, i.e. the number of meetings per hour indirectly indicates the flow of unprotected road users. See Table 12. There was a significant difference in the private car drivers' and professional drivers' inclination to give way to pedestrians depending on the number of meetings between vehicles and unprotected road users. It was in the range of 11-30 meetings per hour when 79% of private car drivers gave way and 67% of professional drivers gave way ($p<0.05$).

Table 12. Number of observations and proportion (%) of vehicle drivers who gave way to pedestrians at a pedestrian crossing according to pedestrian crossing meetings per hour.

		Number of observations	Proportion who gave way
Fewer than 10 per hour	Private car drivers	135	*63*
	Professional drivers	44	*64*
	Total	179	*63*
11-30 per hour	Private car drivers	333	*79*
	Professional drivers	63	*67*
	Total	396	*77*
31-50 per hour	Private car drivers	399	*70*
	Professional drivers	171	*75*
	Total	570	*72*
More than 51/h	Private car drivers	186	*74*
	Professional drivers	168	*74*
	Total	354	*74*

There was a significant difference for vehicle drivers in total (<0.05) and private car drivers' inclination to give way depending on the flow of unprotected road users ($p<0.01$) but not for professional drivers. This was in the interval of fewer than 10 meetings per hour when it was least likely for vehicle drivers to give way to pedestrians. All the roads with a maximum permitted speed of 30 km/h that are included in the study had a low pedestrian crossing flow, i.e. fewer than 10 meetings between vehicles and unprotected road users per hour.

Giving way according to vehicle flow

Vehicle flow measured in ÅDT had a certain significance for vehicle drivers' inclination to give way to pedestrians at pedestrian crossings. All vehicle drivers in total gave way significantly more often if the vehicle flow was lower (fewer than ÅDT 5000). 74% compared with 63% ($p<0.001$). See Table 13. There were significantly more private car drivers who more often gave way if the vehicle flow was low, 74% compared with 6% ($p<0.001$). The trend was the same for professional drivers. 75% gave way during a lower vehicle flow compared with 69% at a high vehicle flow. However, the difference was not significant. There was no significant difference between professional drivers and private car drivers with regard to giving way in relation to vehicle flow.

Table 13. Number of observations and proportion (%) of vehicle drivers who gave way to pedestrians at a pedestrian crossing according to vehicle flow.

		Number of observations	**Proportion who gave way**
< 5,000 vehicles	Private car drivers	388	*74*
	Professional drivers	258	*75*
	Total	646	*74*
>5,000 vehicles	Private car drivers	317	*61*
	Professional drivers	119	*69*
	Total	436	*63*

Giving way depending on other vehicles

There was no significant difference between the inclination of private car drivers and professional drivers to give way if another vehicle driver from the opposite direction had given way or not, or if there was no vehicle approaching from the other direction.

Table 14. Number of observations and proportion (%) of vehicle drivers who gave way to pedestrians at a pedestrian crossing according to whether there was another vehicle in the vicinity.

		Number of observations	Proportion who gave way
Another vehicle does not give way	Private car drivers	59	*59*
	Professional drivers	19	*53*
	Total	78	*58*
Another vehicle gives way	Private car drivers	195	*85*
	Professional drivers	63	*87*
	Total	258	*86*
No other vehicle	Private car drivers	799	*71*
	Professional drivers	364	*71*
	Total	1163	*71*

There was however a significant difference both for private car drivers and professional drivers with regard to the inclination to give way if another vehicle driver from the opposite direction had given way. 87% of professional drivers gave way if another driver had given way compared with 53% if another vehicle driver had not given way (p<0.01). In the case of private car drivers, the distribution was 85% compared with 59% (p<0.001).

CONCLUSION AND DISCUSSION

This study shows the results of vehicle drivers' compliance with speed limits and regulations measured and observed in the field. Vehicle drivers' speeds were studied when the vehicles were at a pedestrian crossing, i.e. a theoretical site for collisions with unprotected road users such as pedestrians or cyclists. Chapter 3, Section 15 of the Highway Code states that drivers shall maintain a sufficiently slow speed based on conditions at places such as pedestrian crossings or other sites where pedestrians cross the road. The regulation is reasonable since a vehicle's speed is decisive for the outcome of a collision between a vehicle and a pedestrian according to the crash injury principle. The proportion of vehicle drivers who drive at speeds higher than are permitted is used in this context as a means of describing vehicle drivers' compliance with speed limits.

The professional drivers group made up of bus drivers and taxi drivers demonstrated negative behaviour at sites with a maximum permitted speed of 30 km/h. There was no significant difference in average speed of private car drivers and professional drivers in total. However, at sites with a maximum permitted speed of 30 km/h, bus drivers made up the professional group that drove the fastest, a 90 percentile of 41 km/h. This is significantly faster than the average for all road users. Taxi drivers were the professional group that drove the next fastest at sites with the maximum permitted speed of 30 km/h, a 90 percentile of 43 km/h, not significantly faster than the average value for all road users.

All traffic groups drove faster than the maximum permitted speed since the 90 percentile was always above the maximum permitted speed of 30 km/h. There was no significant difference between sites with a maximum permitted speed of 30 km/h and 50 km/h if the sites did not have traffic-calming measures to reduce vehicle speeds. The average speeds were between 35-40 km/h irrespective of the site (with the exception of Kalix) if there were no traffic-calming measures and if the site has traffic-calming measures in the form of raised pedestrian crossings, the average speed was between 20-27 km/h, irrespective the maximum permitted speed.

From this it is possible to conclude that a maximum permitted speed of 30 km/h makes no clear difference for any driver group, not even professional drivers, if the site does not have traffic-calming measures to reduce vehicle speeds.

All the sites with a maximum permitted speed of 50 km/h that were studied had average speeds at pedestrian crossings that were clearly lower than the maximum permitted speed. This can be considered unusual on the whole. All the sites were clearly of a built-up nature. Some of them were part of the municipal network while some were in a local network. However, all were part of a building structure that was more or less detailed with relatively short links and a certain flow of vehicles and unprotected road users that did not encourage higher speeds, at least not during the times of day, morning and afternoon, that were studied.

Taxi drivers constituted the professional group that drove the fastest at sites with a maximum permitted speed of 50 km/h, and with a 90 percentile of 51 km/h. This averages that somewhat more than 10% of taxi drivers drove faster than the maximum permitted speed.

Professional drivers as a group were not clearly different from other vehicle drivers with regard to speed. And when they did differ from other drivers, the difference was negative. Bus drivers and taxi drivers drove faster than others at sites with a maximum permitted speed of 30 km/h. There was a tendency for taxi drivers to drive fastest on roads with a maximum permitted speed of 50 km/h.

Of all vehicle drivers, more than 70% gave way to pedestrians who intended crossing the road at an unguarded pedestrian crossing irrespective of the maximum permitted speed. There was no significant difference between private car drivers and any of the professional driver groups, neither was this the case between any of the professional driver groups.

Taxi drivers were the group that was most inclined to give way to pedestrians, 78% of them, and truck drivers were the least inclined to give way, 69% of them gave way. This means that two to three out of ten vehicle drivers did not give way to pedestrians who intended crossing the road. There was no clear difference between professional drivers and other road users. There was a tendency for taxi drivers to appear positive and for drivers of heavy vehicles to appear negative. The latter is negative from a crash injury aspect since the severity of personal injury is often increased as a consequence of a collision between a pedestrian and a heavy vehicle. When divided according to maximum permitted speed, it was more common for pedestrians to be given precedence on roads with a maximum permitted speed of 50 km/h rather than 30 km/h. This applied to professional drivers as well as private car drivers.

All the roads with a maximum permitted speed of 30 km/h had a low flow of pedestrians and cyclists. The tendency was that pedestrians were not always given the same degree of precedence. The fact that fewer pedestrians were given precedence can therefore be a factor of the low flow of pedestrians rather than the maximum permitted speed.

From the above study it can be seen, though the sample sizes differs the result is clear, that professional drivers drive in much the same way as other vehicle drivers in terms of compliance with regulations governing speed and giving precedence at pedestrian crossings. This averages that it is common that current traffic regulations are not complied with. This also applies to professional drivers. This is something that the industry and the authorities are well aware of since these bodies have compiled check lists and programmes designed to get professional drivers to comply with current traffic regulations. However, the effect of these programmes is not known.

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