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Keywords: exhaust emissions, fuel consumption, street types, driving behaviour, driver characteristics

Abstract:

Driving pattern, i.e. the speed profiles of vehicles, was studied in connection with variables in the driver-car-environment system. Data were collected using five measuring cars that were driven by 29 randomly chosen families for two weeks each. The cars were equipped with data-logging devices that enabled studies of the speed and acceleration patterns of the vehicles as well as engine speed and gear changing. For connection to external conditions co-ordinates for positions were registered with global positioning system (GPS) receivers. The GPS co-ordinates were matched to a digitised map to which detailed street parameters, such as street function, speed limit, width, and traffic flow had been attributed. A descriptive analysis of driving patterns on 21 street types was accomplished. A large set of driving pattern measures including speed, acceleration, power use, engine speed, and gear changing behaviour are reported for different street types. Further, a cause effect model for the variation of driving patterns was estimated. The model included effects of driver characteristics, car performance and street environment as well as some important interactions between variables. The model was found to predict the variation of speed with acceptable explanatory power. For other driving pattern measures significant effects were estimated for street type as well as driver variables. However, the explanatory power was low; the reasons for this are discussed, and bases for new model structures are outlined.

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1 Introduction

Driving patterns have been extensively studied since the 1970s because of their important influence on fuel consumption and emissions (Watson 1978). The aim has been to describe real traffic driving patterns, to investigate differences between different driving conditions and to create typical driving cycles. At the start studies were performed using the chase-car technique, and several hours of speed-data were collected in different urban areas (Scott Research Laboratories 1971; Khatib et al. 1986; Lyons et al. 1989; Kent et al. 1978). However, the chase-car method has been shown to have several disadvantages, such as being time consuming, having accuracy problems, risk of getting a biased sample, and ethical reasons (Ericsson 1996). The accuracy of the chase-car method can be improved by the use of a forward-looking laser range finder mounted in the front grill of the chasing car (Austin et al. 1993; Grant 1998). In other studies data have been collected by using instrumented private cars that have been driven by their ordinary drivers (André et al. 1995; Defries et al. 1992). These studies have the advantage of using ordinary cars and drivers, and the data collected have been extensively used to gain overall knowledge of driving behaviour and to make bases for new driving cycles. However, these studies offer no possibilities for analysis on the street level since the data do not have any geographical connection. Wolf et al. (1999) studied the possibility of using global positioning system (GPS) to collect position data in connection with travelling behaviour and driving pattern data. They emphasise that GPS receivers must cover the street segment without too much missing data and that recorded data must be matchable to the corresponding street segments. Wolf et al. address the problems with mismatch of GPS data, which was a problematic issue in the present study as well.

This study aimed to present driving pattern data for a detailed street net and, further, to examine the possibilities of estimating a model for the variation of driving patterns as a function of external conditions. Five cars of different sizes and performance levels were equipped with data logs for registration of speed and engine parameters and GPS receivers for location to street net. The cars were used in daily driving by 30[1] families for two weeks. The GPS data were matched to a digitised map to which street and traffic attributes had been attached. Thus, driving patterns could be divided into parts with the same overall circumstances in terms of driver, car, street type and traffic flow conditions. Measures of a large set of driving pattern parameters is presented for 21 street types defined by the street function, the type of area, the speed limit and the number of lanes. The parameters include speed and acceleration measures, measures of power demand, engine speed and gear changing. Further the values of 16 driving pattern ***factors*** that in an earlier study, Ericsson (2000b) have been found to represent independent dimensions of driving patterns are presented for each street type.

A cause effect model of driving patterns and external conditions has been formulated earlier (figure 1; Ericsson 2000a). In the present study various dimensions of driving patterns are studied in connection with some of the factors in figure 1. A model was formulated to test the relation between driving patterns and: (1) street characteristics in terms of street function, type of area, speed limit, number of lanes, and distance between passed intersections; (2) traffic flow conditions in terms of vehicles per lane and hour; (3) weather conditions in terms of snow or no snow; (4) different drivers in general, as well as differences between driver ages and gender; and (5) the way cars that have different performances (effect/mass) are handled by their drivers. The model could sufficiently explain speed variables. For other variables, significant effects were

[1] The measuring equipment failed for one period so data from 29 families remained

estimated but the explanatory power was low. Preliminary tests indicate that the later variables could be estimated with higher explanatory power if the model was modified and some new independent variables were added.

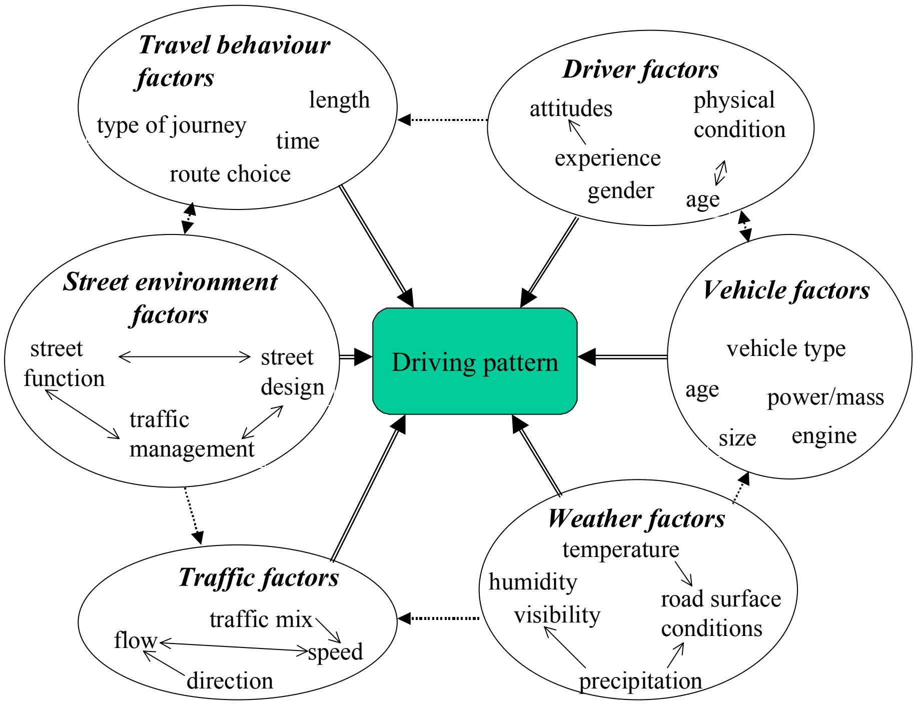


Figure 1 Cause effect model of variability in driving patterns Ericsson (2000).

The report is divided into three main parts. The first part ***Data collection and characterisation of data*** contain 1) the design of the observational study, 2) a description of the procedure to locate driving patterns to the street net and 3) the characterisation of driving patterns variables and background variables. The second part ***Driving patterns on different street types a descriptive analysis*** deals with the descriptive part of the analysis methodologies and results. The third parts ***The relation between driving conditions and driving patterns*** deals with the 1) design of a prediction model for driving patterns, 2) the problems with the complicity of such model and utilised strategies for interpretation and 3) the results that were reached concerning effects of different types of explanatory variables on driving patterns. Further research is discussed in a separate section as well as the general conclusions of the investigation.

2 Data collection and characterisation of data

2.1 Data collection

The design of the study was observational and the purpose was to get a sample of ordinary driving behaviour in an average Swedish town. Five cars were instrumented with a data acquisition system that measured the vehicle speed, a set of engine parameters and location via GPS; for further details see Johansson et al. (1999a) and Johansson et al. (1999b). 500 car owners from the city of Västerås was randomly chosen from the national vehicle register and asked whether they were willing to participate in the study. About 40% answered yes and among those the final 30 participants were randomly[2] chosen. The sample was weighted to match the overall occurrence of cars of different sizes and performances in Västerås according to the original sample of 500 cars. The five measuring cars were chosen for being among the most-sold car models in Sweden in respective vehicle class during the first half of 1998. The cars were: a Volvo 940, a Ford Mondeo, a VW Golf, a Toyota Corolla and a VW Polo. Each car owner got to borrow a measuring car similar to their own car in terms of size and performance to use it in their daily driving for two weeks each. The subjects either lived, worked or studied within the developed area of Västerås, and they usually drove their car to work/school every day. The length of measuring period of two weeks each was chosen to ensure that the families became accustomed to the car and the measuring situation and consequently drove as usual. Evans (1991) found that the skill of driving a car is highly automated; i.e., the force that is used to press the accelerator or the brake pedal is decided by highly automated behavioural patterns. For one measuring period the measuring equipment failed and thus data for 1 of 30 subjects was lost. An inquiry among the chosen families showed that approximately 45 drivers, of different ages and gender, drove the cars. Altogether, driving patterns representing 2550 journeys and 18,945 km of driving were collected. The data was collected in October-December 1998.

The study was completed in co-operation between Swedish National Road Administration and the Department of Technology and Society, Lund Institute of Technology, Lund University. Rototest AB, a Swedish consultant company, constructed and installed the measuring equipment and was also hired to deal with practical tasks in connection with shifts of subject families.

The parameters that were logged in the cars are listed in table 1. Vehicle speed, engine speed, ambient temperature and location were logged in all cars. Two of the cars, the VW Golf and the Ford Mondeo, had advanced equipment that registered more engine parameters than the other equipment. The additional parameters were to be used in projects dealing with mechanistic emission models.

The choice of city was based on a set of initially established criteria: The city should represent an average-sized Swedish city and be big enough to include different types of streets and environments. To be representative, the city should not be too hilly and it should be located somewhere in the middle of Sweden for practical reasons. It was important for the analysis that a digitised map was available and that the local authorities had data concerning traffic statistics as well as structured information about the different streets. The choice fell on Västerås; an average-sized Swedish city with 125,000 inhabitants. Västerås fulfilled most of the criteria, and traffic flow data and street characteristics had been adapted as attributes to the digitised map.

[2] Except for the fact that the distribution of car sizes and performances according to the initial 500 person sample was kept constant.

Table 1 Recorded parameters in the data-logging system of the measuring cars.

Parameter	Unit	Measuring frequency
Wheel rotation[1)3)]	No pulses induced by wheel rotation	10 Hz
Engine speed[1)]	Rpm[4)]	10 Hz
Ambient Temperature[1)]	°C	1 Hz
Position[1)]	Position co-ordinates	2 Hz
Use of breaks[1)]	Break lights on/of	10 Hz
Fuel use[2)]	ml/s	10 Hz
Engine inlet air temperature[2)]	°C	1 Hz
Engine water temperature[2)]	°C	1 Hz
Exhaust temperature in front of catalyst[2)]	°C	1 Hz
Exhaust temperature after catalyst[2)]	°C	1 Hz
Oxygen contents in exhaust[2)]	Volt (Lambda sensor)	10 Hz
Throttle angle[2)]	Volt	10 Hz
Mass air flow sensor[2)]	Volt	10 Hz

[1)] Parameters that were registered in all five cars.
[2)] Parameters that were registered in two of the cars, the VW Golf and the Ford Mondeo.
[3)] Wheel rotation was base for vehicle speed via wheel circumference.
[4)] Rotations per minute

2.2 Matching of driving patterns to the street network

To match GPS points to a road net on a digitised map, a high degree of accuracy of the position data is needed. However, there are several reasons for inaccuracies to occur. The co-ordinates generated by the GPS are not exact; even a differential GPS gives deviation from the right position. Differential GPS is a method to decide the position more exact and have been used to correct for the military satellite signal degradation that was in use until May 2000. Further, in urban areas, especially with street canyons between high buildings and other obstacles, the satellite signals may be prevented from reaching the ground and the GPS receivers. Another reason for a mismatch is that the streets might be incorrectly digitised. If using a street centreline map for representing the street net, the actual street-width induces several metres of error. Thus, to match measured GPS points to the street net, a certain amount of data processing and correction is needed. Wolf et al. (1999) concluded that route choice accuracy is a function of GPS accuracy and future systems require a unit capable of data post-processing to correct the signal and compensate for military signal degradation. This problem may be less serious in further studies since the military degradation of satellite signals now is removed. However, other reasons for mismatch might still cause some problems.

The GPS receivers that were used in the present study were able to employ land-based signals from the Coast Guard, and the co-ordinates could thus be differentially compensated. Rototest AB tested the equipment in Stockholm, 113 km from Västerås, with acceptable results. However, at the end of the study, the staff discovered that the differential signal had not reached Västerås. Thus, the collected data was in reality not differentially compensated and had an error that varied between approximately 0 and 150 metres. Examples of the mismatch are shown in figure 2.

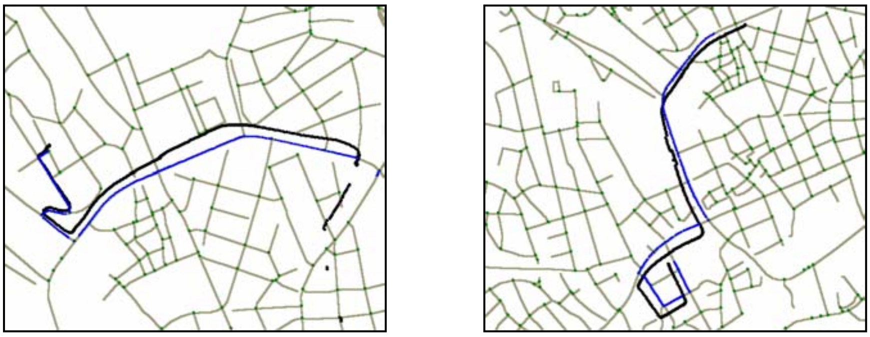


Figure 2 Examples of mismatch between uncorrected GPS data and street net.

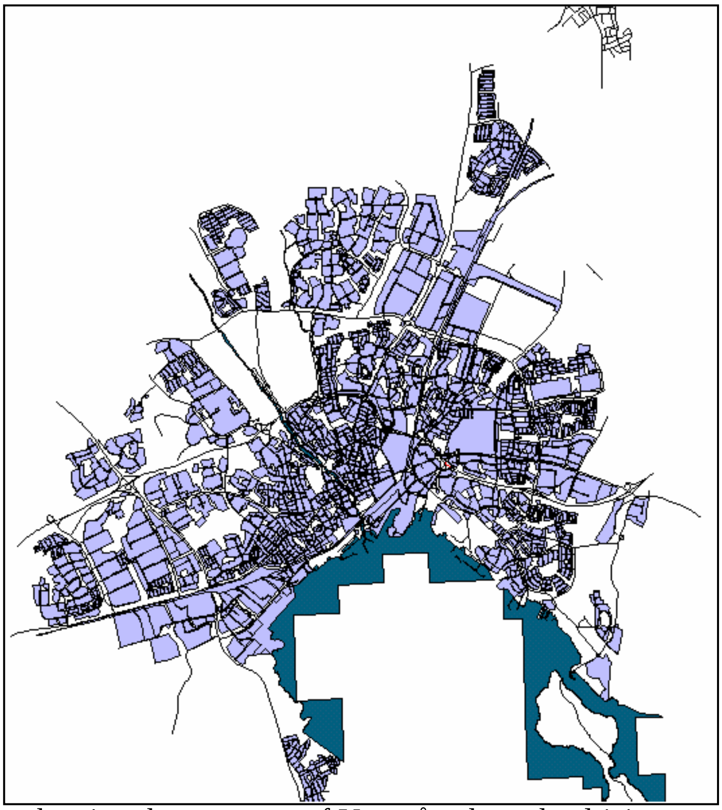


Figure 3 Map showing the street net of Västerås where the driving patterns of this study were collected. Data were collected in smaller suburbs around the city, as well.

A map-matching procedure was developed by visiting Professor Henrik Edwards and experts from GIS[3] Centre at Lund University, especially Dr. Petter Pilesjö. The method should locate logged driving patterns to the correct street and provide each driving pattern with attributes of that particular street. The issue was problematic, and the development of a map-matching method took several months. The principles that were used will be reported in a forthcoming paper.

The map-matching method attributed to each driving pattern codes for different street attributes. The attributes used are listed in table 2. With use of these attributes, driving patterns were divided into subsections, i.e. cases, with the same outer conditions. Thus, the driving patterns were cut every time any attribute (in the column Groups) according to table 2 changed. The division of the driving pattern resulted in 19 230 cases with their corresponding external conditions. While correcting driving patterns to the street net, the number of passed intersections

[3] Geographical Information Systems

was counted. Furthermore, the intersection was divided on signalised intersections, roundabouts and other intersections. Likewise, the direction of turning at each intersection was coded and summarised for each driving pattern. The cases were also attributed with codes for driver characteristics and type of car. In the present study was not all registered background data employed in the analysis.

Table 2 Codes for the street, traffic, car and driver characteristics that were attributed to each driving pattern. For further analysis the driving patterns were sectioned based on the 12 grouping variables.

Grouping variable	Groups
Street function	1) Pass through road 2) Radial arterial 3) Collector street 4) Local street
Street type	1) Motorway (4 lanes flyover intersections, i.e., freeway) 2) Road with > 3 lanes, with a central reserve 3) Street >10 metres with no central reserve 4) Street <10 metres, two lanes
Type of environment	1) Residential 2) Industrial 3) Other
Location in city	1) Central 2) Semi central 3) Periphery
Street width	3–25 metres
Speed limit (km/h)	1) 30 2) 50 3) 70 4) 90
Traffic flow	ADT (Average daily traffic flow)
Percentage heavy vehicles	0–40 %
Vehicle size	1) Large, >1340 kg 2) Medium, 1050 to 1340 kg 3) Small, <1050 kg
Vehicle mass/effect (performance)	1) Great, >0,07 2) Medium, 0,06 < K < 0,066 3) Small, < 0,059
Driver category age	1) 18–25 2) 25–35 3) 36–59 4) 59
Driver category, gender	1) Female driver (female driver ≥75% of measuring period) 2) Male driver (male driver ≥75% of measuring period) 3) “Mixed” (female/male drivers ≈ 50% each)

The accuracy of the map-matching procedure was checked by looking at the result for thirty randomly chosen driving patterns. The corrected and uncorrected co-ordinates were taken into the GIS software ArcView. The assessment was done through ocular examination and using the measure tool in ArcView. It was found that 93 % of all cases had been located to the right street, this corresponded to about 96% of the total length of the corrected cases. Sometimes the map-matching procedure excluded parts of the driving patterns, mainly if the conditions induced an extra risk of mismatch. If including the thus excluded parts 92% of the total driven length within the developed area had been matched to the correct street, 4% were cut and thus excluded and 4% was matched to the wrong street. This accuracy was judged to be sufficient for the study. Yet the sample of driving patterns on each street type was checked for outliers which were occasionally excluded. Only driving patterns within developed areas (according to figure 3) are included in the study.

2.3 Measures to characterise the driving patterns

Each case, i.e. driving pattern in a certain street environment, was initially described using 62 driving pattern parameters. Forty-four parameters described speed, acceleration and deceleration patterns, oscillation of the speed curve and surrogate variables for power demand, e.g., shares in different intervals of $v \cdot a$[4]. In addition, 18 parameters described engine speed and gear-changing behaviour. The parameters are described in detail in Ericsson (2000b). In the same study the 62 parameters were reduced to 16 independent ***factors*** with use of factorial analysis. The ***factors***, described in table 3, represent independent dimensions that vary over urban driving patterns.

Emission factors of HC, NOx and CO2 and fuel-consumption factors were calculated for a subset of 5217 driving patterns. The driving patterns that were used for emission modelling all originated from the Volvo 940 and the VW Golf. The Volvo and the Golf were chosen for the emissions and fuel consumption calculations because one mechanistic emission model was available for each of those two cars. One model, Veto, had been validated for a Volvo 940[5], Hammarström (1999), another model had been developed in 1999 by Rototest AB for the same VW Golf that was used in the study.

The relation between the 16 driving pattern ***factors*** and emission factors of HC, NO_x and CO_2 and fuel consumption/10 km was investigated using linear regression analysis in Ericsson (2000b). Nine driving-pattern factors were found to have significant and large effects on emissions and/or fuel consumption (table 4).

[4] ***v*** = speed and ***a*** = acceleration

[5] Except for the fact that the Volvo 940 in the Västerås study had a turbo engine.

Table 3 Independent ***factors*** describing the variation in driving patterns of urban driving (Ericsson, 2000b). (RPA is defined in section 3.2.2)

Factor	Termed	Interpretation	Typical parameter
1	Deceleration factor	Amount of deceleration. Increase with many and heavy decelerations, decrease with few and light.	Average deceleration
2	Factor for accelerations with strong power demand	Amount of acceleration with very high power demand. Increase with a lot of high power demand accelerations and decrease when sequences of high power demand are rare.	RPA
3	Stop factor	Describe the occurrence and duration of stop in the driving pattern.	% of time speed <2 km/h
4	Speed oscillation factor	Amount of oscillation of the speed curve. Increases with a lot of oscillation of the speed curve, and it decreases if the speed curve has only few or no oscillations.	Frequency of local max/min values of the speed curve per 100 s.
5	Factor for acceleration with moderate power demand	Amount of acceleration with power demand corresponding to $v \cdot a$ is 3–10 m^2/s^3. The factor decreases if acceleration is undertaken with either higher or lower power demand than 3–10 m^2/s^3.	% of time when $v \cdot a$ is 3–6 m^2/s^3
6	Extreme acceleration factor	Occurrence of very high acceleration levels. Those extreme accelerations can be, but is not necessarily connected to high power demand. Whether they do depends on at what speed the acceleration is undertaken.	% of time at acceleration over 2.5 m/s^2
7	Factor for even speed 15–30	Percentage of time in speed 15–30 km/h and when engine speed is <1500 rpm	% of time at speed 15–30
8	Factor for speed 90–110	Driving at speed 90–110 km/h at gear 5	% of time at speed 90–110
9	Factor for speed 70–90	Driving at speed 70–90 km/h at moderate engine speed at gear 5 or high engine speed at gear 4	% of time at speed 70–90
10	Factor for speed 50–70	Driving at speed 50–70 km/h at gear 4	% of time at speed 50–70
11	Factor for late gear changing from gear 2 and 3	Late gear changing from gear 2 and 3 when accelerating	% of time engine speed is 2500–3500 rpm at gear 3
12	Factor for engine speed >3500	Shares of time at very high engine speed	% of time engine speed >3500 rpm
13	Factor for speed >110	Speed >110 km/h and engine speed >3500 rpm, when at gear 5	% of time speed >110 km/h
14	Factor for moderate engine speeds at gear 2 and 3.	Changing the speed at gear 2 and 3 without speeding the engine over 2500 rpm.	% of time at engine speed 1500–2500 at gear 2
15	Factor for low engine speed at gear 4	Factor for driving at engine speed <1500 rpm at gear 4	% at engine speed <1500 rpm at gear 4
16	Factor for low engine speed at gear 5	Factor for driving at engine speed <1500 rpm at gear 5	% at engine speed <1500 rpm at gear 5

Table 4 Driving pattern factors with significant effect on emissions and fuel use. Dark background mark when the effect is supported by both emission models used[6]. The number of pluses and minuses represent effect size (+ means standardised B is approximately 0.1, ++ means standardised B is approximately 0.2, etc.) (Ericsson, 2000b).

Driving pattern factor	**Fuel**	**CO_2**	**HC**	**NO_x**
Deceleration factor	–	–		
Factor for accelerations with strong power demand	++++	++++	+++	++++
Stop factor	+++++	+++++		
Speed oscillation factor	++	++		
Factor for acceleration with moderate power demand	++	++		
Extreme acceleration factor	++	++	+++++	++++
Factor for even speed <30				–
Factor for speed 90–110				
Factor for speed 70–90	–	–		
Factor for speed 50–70	– –	– –		
Factor for late gear changing from gear 2 and 3	+	+	++	+++
Factor for engine speed >3500			++	++
Factor for speed > 110				
Factor for moderate engine speeds at gear 2 and 3	– –	– –		–
Factor for low engine speed at gear 4	–	–		–
Factor for low engine speed at gear 5	–	–		–

6 Veto for the Volvo 940 and the Rototest model for the VW Golf

3 Driving patterns on different street types a descriptive analysis

3.1 Methodology

One of the aims of the study was to describe the driving pattern over the street net. A descriptive analysis was performed for 21 urban street types. The street types in the descriptive part of the analysis were formed by four conditions: the type of area, the street function, the speed limit and the number of lanes. In the analysis a set of driving pattern parameters as well as the 16 driving pattern ***factors***[7], according to table 3, was used to describe driving patterns at the different street environments.
Initially the collected data were described by reporting number of cases and average length and duration of the driving patterns on each street type. Further was the number of passed intersections per km on each street type reported. Intersections are divided on total number of intersections, number of signalised intersections respective roundabouts. The variation over those variables is reported as 5 and 95 percentiles.

When describing a phenomenon through mean values and measures of variations it is important to reflect on which mean to use. The parameters and ***factors*** that according to section 2.3 are used to describe the driving patterns are all constructed to describe individual driving patterns irrespective of their length and duration. When describing the overall speed, acceleration/deceleration and the power used on a certain street type the differences in length and duration ought to be accounted for. Otherwise, short driving patterns (which might have deviant driving pattern properties) would get the same weight that long ones. Thus, for each street type average driving pattern parameters were calculated based on the total length driven and/or on the total time spent at that particular street type, i.e. as ratios between totals. For example, average speed on a certain street type was calculated as the total length driven (including all cases) divided by the total time spent on that particular street type. The reported mean values are accompanied by a measure of variation or accuracy. For those estimates that are computed as ratios between sample totals, $\sum y / \sum x$, the standard error has been estimated as:

$$\sqrt{\frac{n\left(Var(y) + \left(\frac{\sum x}{\sum y}\right)^2 Var(x) - \frac{2Cov(x,y)\sum x}{\sum y}\right)}{\left(\sum x\right)^2}}$$

as suggested by Cochran(1977).

For some measures it was not possible (or complicated) to calculate the average as ratios between sample totals. This was the case for 1) the percentage of time spent at different engine speeds when in different gears and 2) for the 16 independent driving pattern ***factors***. For those parameters respective ***factors*** the average over cases are reported together with the corresponding standard error of the mean.

[7] As reported in table 3 and in Ericsson (2000b)

3.2 Driving patterns on different street types - Results

3.2.1 The distribution of the driving patterns over the street network

The first step of the analysis was to estimate the number of driving patterns on different street types, their average length and duration and also how frequently intersections had appeared in driving on different street types. These background variables are reported in table 5. Generally, the length of the driving patterns was different for different street types, with the shortest average length for streets in CBD and the longest for freeways. This implies that street attributes varied more frequently at CBD than at freeways. Further the total production of vehicle km was highest on arterial streets with four lanes, especially freeways. This fact should be kept in mind when discussing overall effects on emissions and fuel use in urban driving. Driving in the CBD might induce higher levels of emissions per kilometre but the total production of vehicle km on those streets, according to this study, was much less than the total distance driven on the urban arterial roads, especially the freeways.

The number of passed intersections for different street types indicate that the geometrical design is rather different for different types of streets, which would affect the driving conditions. Highest intersection density appeared at CBD and lowest on the freeway. The amount of passed signalled intersections and roundabouts differ between street types as well. Main streets in CBD and in residential areas had high density of signalised intersections. The largest density of roundabouts was found on main streets in industrial areas and on arterial streets with two lanes and speed limit 70 km/h. The traffic control system in terms of number of signalised intersections and roundabouts is likely to differ from city to city. The presented data should foremost be seen as a description of the data sample of the present study.

The number of cases differs a lot between street types, a fact that mirrors the route choices of the drivers. Unfortunately, the low frequency of driving patterns on streets with speed limit of 30 km/h forced us to exclude those street types from the further analysis.

3.2.2 Driving pattern measures over the street network

In tables 6–12 the values of various driving pattern measures are reported for different street types. In table 6 the values of stop, speed and engine speed measures are reported and the corresponding standard errors are presented in table 7. As expected, the average speed and the distribution of stops and speed vary a lot over the street net, with more stops and lower speeds at CBD and at local streets in general and higher speeds at main streets and arterial roads.

The distribution of engine speeds over the street net also differs to a large extent, and it can be noted that CBD not only has low average speeds, but also has a high proportion of low engine speeds. The overall share of very high engine speeds was small; it reached its highest values at the streets with speed limits of 70 or 90 km/h.

In table 8 the measures of the frequency and distribution of decelerations and accelerations is reported together with measures of how much power is used, i.e., RPA and the speed × acceleration distribution. In table 9 the corresponding standard error is reported. The measure relative positive acceleration (RPA) is calculated by integrating the curve $\left(v \cdot a^{+}\right)$and dividing it by the total length driven.

$$\frac{1}{x}\int va^{+}\ \mathrm{dt},\quad \boldsymbol{x} = \text{total distance},\quad a^{+} = \text{when } \frac{dv}{dt} > 0$$

The number of oscillations of the speed curve is calculated by counting the number of local maximum and minimum values, defined by the number of times:

$$\frac{dv}{dt} = 0 \text{ , when the difference between adjacent max and min is > 2km/h}$$

This oscillation number is related to the time driven expressed as number of oscillations per 100 s. The oscillation measure describes the frequency of acceleration and deceleration shifts in the driving pattern.

The speed oscillation reached its highest mean value in CBD, but had as well its highest standard error here. This implies much speed oscillation on the average but large individual variation between driving patterns.

The highest acceleration levels was most common on:

- All local and main streets at CBD with four lanes
- Main residential streets with four lanes (speed limit 50 or 70 km/h)
- Arterial streets with speed limit 50 km/h and four lanes

High power demand defined as high RPA was especially common at:

- Local streets in CBD and residential areas
- Main streets in CBD with four lanes
- Local industrial streets with two and four lanes
- Main residential streets with speed limit 50 km/h and four lanes

In table 10 the distributions of different engine speeds at different gears are reported. Note that the table does not report the percentage of time at different gears but the distribution of engine speeds when at a certain gear i.e. how common different engine speeds are when driving at a certain gear on a certain street type. The intervals that are reported in table 10 have been found to be of certain interest in influencing fuel use and emissions or represent a certain dimension (***factor***) in driving pattern, see tables 3 and 4. High percentages of time at very high engine speeds (> 3500) when at gear 2 was most common on the streets with speed limit 70 km/h. Very high engine speeds at gear 3 and 4 appeared most commonly at the arterial with speed limit 90 km/h. Low engine speeds at gear 4 was most common at main residential street with speed limit 70 km/h and at main streets in CBD (speed limit 50 km/h). Finally low engine speeds at gear 5 was appeared with highest percentages at main industrial streets and at arterial streets with two lanes and speed limit 70 km/h.

In table 11 the mean values of the 16 driving pattern ***factors*** (according to the factorial analysis reported in table 5) are presented for different street types. The mean is here calculated over cases and the corresponding standard error is reported in table 12.

The driving pattern ***factors*** have the overall mean 0 and standard deviation 1 for the whole sample of 19 230 driving patterns. Many of the factors had according to table 11 averages over street types near the overall mean of 0. This implies that a large variation appear for individual cases. However for some street types the ***factors*** have a mean that deviate from the overall mean for example:

- The ***factor*** for deceleration was low on the average on the arterial with speed limit 90 km/h.
- The stop ***factor*** was high on the average on streets in CBD (with the exception of main street with two lanes).

- The speed oscillation ***factor*** was high on the average on local streets in CBD and on local industrial streets.
- The ***factor*** for speed 15-30 km/h was high on the average on streets in CBD and on local residential streets.
- The ***factor*** for speed 50-70 km/h was low on the average on streets in CBD and on local residential streets and was high on the average on streets with speed limit 70 km/h and arterial streets with speed limit 50 km/h.
- The ***factors*** for speed 70-90 km/h, 90-110 km/h and > 110 km/h were highest for the arterial street with speed limit 90 km/h and low for other street types.

Table 5 Distribution of driving patterns over the street net. Means are computed as averages over cases.

Street type	No lanes	Speed limit km/h	No cases	Length avg. m	Length percentiles 5	Length percentiles 95	Total length 1000 m	Duration avg. s	Duration percentiles 5	Duration percentiles 95	Total duration 1000s	Passed intersect. avg. /1000 m	Passed intersect. percentiles 5	Passed intersect. percentiles 95	Passed signalized intersect. avg. /1000m	Passed signalized intersect. percentiles 5	Passed signalized intersect. percentiles 95	Passed roundab. avg. /1000m	Passed roundab. percentiles 5	Passed roundab. percentiles 95
Local res. str.	2	30	28[1)]	390	66	2277	11	69.5	11.1	296.8	1.9	1.15	0.0	9.1						
Local res. str.	2	50	3182	237	54	569	753	32.0	6.9	82.8	101.9	8.69	0.0	20.8	0.20	0	0	0.14	0	0
Main res. Str.	2	50	1027	455	105	1352	468	35.2	10.4	86.9	36.1	5.94	1.8	11.8	0.43	0	3.63	0.02	0	0
Main res. Str.	2	70	363	404	160	647	147	27.5	8.9	49.8	10.0	5.85	3.1	8.6				0.62	0	2.06
Main res. Str.	4	50	750	250	72	764	188	25.2	7.4	58.4	18.9	7.50	2.5	14.1	3.22	0	11.6			
Main res. Str.	4	70	152	229	52	345	35	52.2	4.9	55.9	7.9	7.84	0.0	19.0	4.09	0	18.6			
Local ind. Str.	2	50	374	210	56	509	78	27.9	7.4	509.0	10.4	5.14	0.0	14.8	0.28	0	0	0.02	0	0
Local ind. Str.	4	50	176	274	46	619	48	36.0	6.4	619.4	6.3	6.96	0.0	21.9	0.89	0	6.41	0.03	0	0
Local ind. Str.	2	50	731	334	86	700	244	25.8	6.4	53.4	18.8	7.88	1.9	21.2	0.33	0	4.5	0.92	0	10.2
Local ind. Str.	4	50	405	375	167	736	152	30.9	11.4	60.2	12.5	4.22	0.0	10.4	1.16	0	5.22	0.32	0	5.07
Local CBD, str.	2	30/50 [2)]	124	106	44	223	13	26.9	7.4	75.8	3.3	12.25	0.0	24.4	0.39	0	0			
Local CBD, str.	4	50	80	152	49	360	12	27.8	7.4	63.6	2.2	10.57	0.0	20.4	1.48	0	9.22			
Main CBD, str.	2	30	38[1)]	127	59	214	5	24.7	9.4	64.5	0.9	21.35	12.8	36.1	4.37	0	13.1			
Main CBD, str.	2	50	151	166	59	328	25	22.5	6.2	52.7	3.4	14.53	6.0	25.4	0.90	0	5.62			
Main CBD, str.	4	30	21[1)]	66	40	125	1	21.9	5.9	78.3	0.5	16.75	8.1	24.9	8.72	0	24			
Main CBD, str.	4	50	87	210	58	264	18	28.2	12.1	58.2	2.4	7.36	0.0	16.2	1.28	0	5.95	0.04	0	0
Arterial	2	50	571	278	101	747	159	23.7	6.9	68.9	13.6	7.79	1.4	16.1	0.96	0	7.06			
Arterial	2	70	597	583	138	1016	348	39.2	9.3	72.6	23.4	3.83	0.0	11.1	0.14	0	1.48	0.63	0	5.21
Arterial	4	50	2253	273	67	577	616	25.5	5.9	63.4	57.5	8.41	0.0	24.0	1.85	0	5.67	0.33	0	0
Arterial	4	70	1571	450	98	1062	707	31.1	6.0	73.9	48.8	4.57	0.8	13.0	0.61	0	3.94	0.28	0	2.12
Arterial/Freeway	4	90	1370	898	128	2463	1230	37.4	5.4	95.4	51.2	2.87	0.0	9.0				0.00	0	0
Total			13964				5258				432.1									

Table 6 Measures of speed, stops and engine speed on different street types. Means are computed as ratios between sample totals

			Means														
	No lanes	**Speed limit**	**Average speed**	**Stop**			**Speed distribution**							**Engine speed distibution** % of time in engine speed			
				% of time	No	Mean stop	% of time in speed interval (km/h):										
Street type		(km/h)	(km/h)	v < 2km/h	stop/km	time (s)	0-15	15-30	30-50	50-70	70-90	90-110	>110	<1500	1500-2500	2500-3500	>3500
Local res. str.	2	30	20.2	18.4	2.38	13.8	44.2	23.1	30.5	2.2	0.0	0.0	0.0	60.2	37.1	2.6	0.0
Local res. str.	2	50	26.6	18.6	1.80	14.0	29.1	26.8	33.4	9.8	1.0	0.0	0.0	50.5	44.8	4.6	0.2
Main res. Str.	2	50	46.6	3.8	0.25	11.8	6.3	8.3	33.8	49.2	2.4	0.0	0.0	21.7	67.7	10.4	0.3
Main res. Str.	2	70	52.9	4.8	0.20	15.9	7.1	5.0	18.9	59.3	9.6	0.0	0.0	17.4	63.2	18.2	1.2
Main res. Str.	4	50	35.6	16.0	1.08	15.0	21.7	17.1	34.1	19.6	7.5	0.1	0.0	37.6	50.3	11.6	0.5
Main res. Str.	4	70	35.7	14.9	1.21	12.4	20.9	11.1	42.6	24.6	0.8	0.0	0.0	38.8	51.2	9.9	0.2
Local ind. Str.	2	50	27.1	15.4	2.09	9.8	27.4	27.2	34.7	10.1	0.6	0.0	0.0	46.9	46.4	6.4	0.3
Local ind. Str.	4	50	27.4	20.5	1.84	14.6	31.9	20.8	31.1	16.1	0.2	0.0	0.0	44.9	43.6	11.2	0.3
Main ind. Str.	2	50	46.7	7.6	0.35	16.6	11.8	8.6	25.0	46.1	8.3	0.2	0.0	30.1	59.3	10.3	0.3
Main ind. Str.	4	50	43.7	7.7	0.34	18.6	10.2	9.0	36.5	42.1	2.2	0.0	0.0	27.0	64.0	8.6	0.4
Local CBD, str.	2	30/50	14.3	23.1	6.06	9.6	50.8	40.9	7.8	0.5	0.0	0.0	0.0	73.0	24.5	2.3	0.2
Local CBD, str.	4	50	19.7	23.5	4.51	9.5	38.2	35.5	24.4	1.5	0.5	0.0	0.0	54.2	36.9	8.4	0.5
Main CBD, str.	2	30	18.5	20.1	3.72	10.5	34.2	46.0	18.6	1.2	0.0	0.0	0.0	72.3	25.6	2.1	0.1
Main CBD, str.	2	50	26.6	8.7	1.36	8.7	20.2	34.9	43.8	1.1	0.0	0.0	0.0	50.4	44.8	4.5	0.3
Main CBD, str.	4	30	10.9	44.0	11.53	12.7	65.0	24.5	10.1	0.4	0.0	0.0	0.0	72.4	24.5	2.8	0.4
Main CBD, str.	4	50	26.8	23.1	1.92	16.2	32.5	16.3	44.5	5.1	1.6	0.0	0.0	48.0	42.4	9.0	0.6
Arterial	2	50	42.1	7.0	0.57	10.4	11.6	12.8	38.4	32.1	5.2	0.0	0.0	31.4	59.8	8.4	0.4
Arterial	2	70	53.6	5.3	0.27	13.4	9.2	7.3	16.7	46.7	17.6	2.4	0.1	22.4	55.8	21.0	0.9
Arterial	4	50	38.6	12.9	0.90	13.3	19.1	13.8	33.8	26.7	6.0	0.4	0.1	34.3	54.8	10.4	0.5
Arterial	4	70	52.1	5.8	0.30	13.6	9.2	7.4	18.3	47.9	16.5	0.7	0.0	20.3	63.8	15.1	0.8
Arterial, Freeway	4	90	86.5	0.2	0.02	5.9	0.7	0.7	1.9	6.0	48.2	38.9	3.7	2.2	48.3	47.4	2.1

Table 7 Standard errors of the means of speed, stops and engine speed (means reported in table 6)

			Standard errors:														
	No lanes	**Speed limit**	**Average speed**	**Stop**			**Speed distribution**							**Engine speed distibution**			
				% of time	No	Mean stop	% of time in speed interval (km/h):							% of time in engine speed			
Street type		(km/h)	(km/h)	v < 2km/h	stop/km	time (s)	0-15	15-30	30-50	50-70	70-90	90-110	>110	<1500	1500-2500	2500-3500	>3500
Local res. str.	2	30	4.2	8.1	1.19	3.9	13.8	5.9	9.3	1.3	0.0	0.0	0.0	10.7	9.6	1.1	0.0
Local res. str.	2	50	0.5	1.2	0.07	1.0	1.2	0.6	0.8	0.5	0.2	0.0	0.0	0.9	0.9	0.2	0.0
Main res. Str.	2	50	0.5	0.7	0.03	1.9	0.9	0.4	1.2	1.4	0.3	0.0	0.0	1.1	1.2	0.7	0.0
Main res. Str.	2	70	1.1	1.3	0.04	3.2	1.5	0.5	1.2	2.0	1.1	0.0	0.0	1.5	1.8	1.5	0.2
Main res. Str.	4	50	0.8	1.1	0.08	0.8	1.2	0.6	1.1	1.2	0.9	0.1	0.0	1.3	1.1	0.8	0.1
Main res. Str.	4	70	1.5	2.5	0.19	1.6	2.9	1.0	2.7	2.7	0.4	0.0	0.0	2.9	2.6	1.5	0.1
Local ind. Str.	2	50	1.2	2.4	0.21	1.7	2.6	1.3	1.9	1.3	0.3	0.0	0.0	2.3	2.1	0.7	0.1
Local ind. Str.	4	50	1.9	4.7	0.23	4.1	4.5	2.0	2.6	2.2	0.1	0.0	0.0	3.2	2.4	1.7	0.1
Main ind. Str.	2	50	1.6	2.5	0.05	5.6	2.7	0.6	1.3	2.1	1.0	0.1	0.0	2.4	2.1	0.9	0.1
Main ind. Str.	4	50	1.2	2.1	0.05	4.8	2.1	0.6	1.9	2.2	0.5	0.0	0.0	2.1	2.1	1.1	0.2
Local CBD, str.	2	30/50	0.8	3.2	0.83	1.5	3.4	2.9	1.5	0.3	0.0	0.0	0.0	2.5	2.1	0.5	0.1
Local CBD, str.	4	50	1.6	4.0	0.87	1.9	4.3	2.8	3.4	0.8	0.5	0.0	0.0	3.7	2.8	1.4	0.2
Main CBD, str.	2	30	1.7	4.8	1.14	2.5	6.2	5.2	3.6	1.3	0.0	0.0	0.0	4.6	3.7	0.9	0.1
Main CBD, str.	2	50	1.0	1.8	0.26	1.7	2.7	2.4	3.0	0.4	0.0	0.0	0.0	2.7	2.5	1.0	0.2
Main CBD, str.	4	30	2.3	8.9	3.82	2.3	10.0	6.0	4.0	0.4	0.0	0.0	0.0	8.4	5.3	1.5	0.3
Main CBD, str.	4	50	1.9	3.9	0.36	2.8	4.2	1.6	4.1	1.2	1.1	0.0	0.0	3.9	3.5	1.8	0.2
Arterial	2	50	0.9	1.1	0.07	1.4	1.4	0.6	1.6	1.8	0.8	0.0	0.0	1.6	1.5	0.7	0.1
Arterial	2	70	1.4	1.2	0.04	2.8	1.4	0.5	0.8	1.8	1.7	1.2	0.1	1.5	1.7	1.9	0.2
Arterial	4	50	0.6	0.6	0.05	0.6	0.8	0.4	0.7	0.8	0.6	0.1	0.1	0.8	0.8	0.5	0.1
Arterial	4	70	0.5	0.5	0.02	0.9	0.7	0.4	0.5	0.9	0.7	0.2	0.0	0.7	0.8	0.7	0.1
Arterial, Freeway	4	90	0.7	0.1	0.01	1.6	0.3	0.1	0.4	0.6	1.6	1.5	0.5	0.4	1.7	1.6	0.4

Table 8 Measures of deceleration, acceleration, oscillation and power demand on different street types. Means are computed as ratios between sample totals

			Means																		
	No	**Speed**	**Deceleration distribution**					**Acceleration distribution**					**No**	**RPA**	***v*a*** **distribution**						
	lanes	**limit**	% of time in dec. interval (m/s^2):					% of time in acc. interval (m/s^2):					**speed**		% of time in v*a interval (m^2/s^3):						
Street type		(km/h)	<-2.5	-2.5 - -1.5	-1.5 - -1.0	-1.0 - -0.5	-0.5 - 0	0 - 0.5	0.5 - 1.0	1.0 - 1.5	1.5 - 2.5	>2.5	**osc. / 100 s**		<0	0- 3	3- 6	6- 10	10- 15	>15
Local res. str.	2	30	0.0	0.5	1.1	4.7	43.6	41.8	4.7	1.0	0.4	0.0	8.58	1.22	58.7	35.0	4.6	1.1	0.5	0.2
Local res. str.	2	50	0.4	2.8	4.1	9.2	31.9	28.5	9.5	4.6	2.0	0.3	7.41	2.31	60.2	20.7	9.1	5.9	2.8	1.3
Main res. Str.	2	50	0.3	1.9	2.5	5.7	39.1	39.3	6.3	2.9	1.4	0.1	5.86	1.39	51.5	29.6	9.4	5.4	2.7	1.4
Main res. Str.	2	70	0.6	2.6	3.1	7.0	39.4	34.3	7.6	2.6	1.3	0.3	5.34	1.58	55.2	21.4	10.1	6.6	4.0	2.7
Main res. Str.	4	50	0.5	3.9	5.3	8.8	32.7	29.8	9.6	5.4	3.1	0.5	5.65	2.37	58.5	16.9	9.8	7.6	4.5	2.6
Main res. Str.	4	70	0.5	4.1	4.0	7.9	36.3	32.6	7.6	3.6	2.8	0.5	5.66	2.01	58.9	18.0	11.3	7.0	3.6	1.3
Local ind. Str.	2	50	0.4	2.9	4.6	11.2	30.8	26.9	10.8	4.5	2.3	0.2	8.35	2.45	59.8	20.1	9.0	6.6	2.9	1.6
Local ind. Str.	4	50	0.4	2.9	4.6	8.6	33.3	27.2	9.2	4.4	2.4	0.3	6.31	2.32	63.0	18.5	7.1	6.0	3.6	1.8
Main ind. Str.	2	50	0.3	2.3	3.4	7.0	37.4	35.9	6.9	3.1	1.5	0.1	5.05	1.52	54.8	24.3	9.8	6.0	3.1	1.8
Main ind. Str.	4	50	0.3	1.8	3.0	6.7	38.5	37.1	6.5	2.8	1.5	0.2	5.30	1.51	54.5	26.2	9.2	5.4	3.1	1.6
Local CBD, str.	2	30/50	0.3	2.0	4.0	10.1	35.5	28.9	9.5	4.0	2.2	0.2	8.49	2.56	64.1	24.8	6.2	3.1	1.3	0.5
Local CBD, str.	4	50	0.7	3.6	4.8	9.5	32.7	28.0	9.5	5.9	3.4	0.8	9.18	2.92	62.5	19.1	9.2	5.5	2.6	1.2
Main CBD, str.	2	30	0.3	2.0	4.6	11.7	37.5	30.4	8.1	3.7	1.7	0.1	8.73	1.77	65.6	22.6	7.4	3.9	0.3	0.2
Main CBD, str.	2	50	0.2	2.4	4.4	10.4	38.7	29.4	8.7	3.6	1.5	0.2	7.37	1.71	60.2	24.9	8.3	4.8	1.5	0.3
Main CBD, str.	4	30	0.6	2.3	4.5	7.3	34.1	33.2	9.2	6.0	2.6	0.2	7.60	3.63	69.2	17.6	7.4	4.1	1.0	0.7
Main CBD, str.	4	50	0.5	2.9	4.0	7.8	35.8	32.3	8.4	4.5	3.2	0.6	6.65	2.48	61.4	18.1	9.6	6.0	3.0	1.9
Arterial	2	50	0.5	3.2	3.8	8.0	35.5	31.5	9.5	4.9	2.6	0.3	6.04	2.07	54.1	19.9	10.7	8.3	4.5	2.5
Arterial	2	70	0.4	2.4	3.4	8.1	37.5	34.9	8.0	3.2	1.3	0.1	5.48	1.60	54.6	21.2	10.0	7.0	4.3	2.9
Arterial	4	50	0.5	3.3	4.3	8.5	34.0	32.6	8.6	4.5	2.7	0.4	5.91	2.01	56.7	20.7	9.7	6.7	3.8	2.3
Arterial	4	70	0.4	2.9	3.9	8.5	35.7	34.1	8.3	3.8	2.0	0.2	5.16	1.80	54.0	20.6	9.8	7.1	4.9	3.7
Arterial, Freeway	4	90	0.1	0.3	0.5	2.9	45.8	47.1	2.6	0.5	0.2	0.0	4.22	0.75	49.7	30.5	11.5	4.7	2.1	1.5

Table 9 Standard errors of the deceleration, acceleration, oscillation and power demand (means reported in table 8)

Standard errors:

Street type	No lanes	Speed limit (km/h)	Deceleration distribution % of time in dec. interval (m/s^2): <-2.5	-2.5 - -1.5	-1.5 - -1.0	-1.0 - -0.5	-0.5 - 0	Acceleration distribution % of time in acc. interval (m/s^2): 0 - 0.5	0.5 - 1.0	1.0 - 1.5	1.5 - 2.5	>2.5	No speed osc. / 100 s	RPA	*v*a* distribution % of time in v*a interval (m^2/s^3): <0	0- 3	3- 6	6- 10	10- 15	>15
Local res. str.	2	30	0.0	0.3	0.4	0.9	3.8	3.7	1.0	0.4	0.2	0.0	1.02	0.228	5.7	4.9	1.5	0.4	0.2	0.1
Local res. str.	2	50	0.0	0.1	0.1	0.2	0.4	0.4	0.2	0.1	0.1	0.0	0.12	0.03	0.6	0.4	0.2	0.1	0.1	0.1
Main res. Str.	2	50	0.0	0.1	0.1	0.2	0.5	0.5	0.2	0.1	0.1	0.0	0.12	0.037	0.6	0.6	0.3	0.2	0.1	0.1
Main res. Str.	2	70	0.1	0.2	0.2	0.4	0.8	0.9	0.5	0.2	0.2	0.1	0.20	0.065	1.1	0.7	0.5	0.4	0.3	0.3
Main res. Str.	4	50	0.1	0.2	0.2	0.3	0.6	0.6	0.3	0.2	0.2	0.1	0.15	0.069	0.8	0.5	0.3	0.3	0.2	0.2
Main res. Str.	4	70	0.1	0.5	0.4	0.7	1.3	1.3	0.6	0.3	0.4	0.1	0.35	0.109	1.9	1.2	0.8	0.5	0.5	0.3
Local ind. Str.	2	50	0.1	0.2	0.3	0.5	0.9	0.9	0.5	0.3	0.2	0.1	0.33	0.081	1.3	0.8	0.4	0.4	0.3	0.2
Local ind. Str.	4	50	0.1	0.4	0.4	0.7	2.0	1.7	0.8	0.4	0.3	0.1	0.48	0.119	2.4	1.5	0.6	0.6	0.4	0.3
Main ind. Str.	2	50	0.1	0.2	0.2	0.3	0.9	1.0	0.4	0.2	0.1	0.0	0.21	0.056	1.5	0.9	0.4	0.4	0.3	0.2
Main ind. Str.	4	50	0.1	0.2	0.2	0.4	1.1	1.1	0.4	0.2	0.2	0.0	0.26	0.071	1.3	1.1	0.5	0.4	0.2	0.2
Local CBD, str.	2	30/50	0.1	0.3	0.4	0.6	1.5	1.3	0.6	0.4	0.4	0.1	0.49	0.178	1.9	1.6	0.6	0.5	0.3	0.2
Local CBD, str.	4	50	0.2	0.5	0.5	0.7	1.7	1.8	0.8	0.6	0.5	0.2	0.77	0.198	2.3	1.6	0.9	0.7	0.4	0.4
Main CBD, str.	2	30	0.2	0.5	0.6	1.3	1.9	2.6	0.9	0.6	0.4	0.1	1.07	0.168	3.2	2.9	1.1	0.9	0.2	0.2
Main CBD, str.	2	50	0.1	0.3	0.5	0.7	1.5	1.2	0.7	0.4	0.2	0.1	0.43	0.12	1.5	1.3	0.6	0.5	0.3	0.1
Main CBD, str.	4	30	0.4	0.6	0.8	1.6	3.5	3.2	1.7	1.4	1.2	0.1	0.94	0.711	7.4	2.9	2.2	1.4	0.6	0.7
Main CBD, str.	4	50	0.2	0.4	0.5	0.8	1.5	1.6	0.8	0.5	0.4	0.2	0.55	0.178	2.5	1.6	0.9	0.6	0.4	0.5
Arterial	2	50	0.1	0.2	0.2	0.3	0.8	0.8	0.4	0.3	0.2	0.0	0.22	0.073	1.0	0.7	0.4	0.4	0.3	0.2
Arterial	2	70	0.1	0.1	0.2	0.3	0.7	0.8	0.3	0.2	0.1	0.0	0.19	0.048	0.9	0.7	0.4	0.3	0.2	0.3
Arterial	4	50	0.0	0.1	0.1	0.2	0.4	0.4	0.2	0.1	0.1	0.0	0.11	0.04	0.5	0.4	0.2	0.2	0.1	0.1
Arterial	4	70	0.0	0.1	0.1	0.2	0.4	0.5	0.2	0.1	0.1	0.0	0.10	0.035	0.5	0.4	0.2	0.2	0.2	0.2
Arterial, Freeway	4	90	0.0	0.0	0.1	0.2	0.4	0.5	0.2	0.1	0.0	0.0	0.11	0.02	0.5	0.5	0.3	0.2	0.1	0.1

Table 10 Percentage of time at different engine speed when driving at different gears. Means are computed as averages over cases. St E = standard error

	No	Speed	% of the time in gear																	
	lanes	limit	2						3						4				5	
			when the engine speed is (rpm):																	
Street type		(km/h)	1500-2500	*St E*	2500-3500	*St E*	>3500	*St E*	1500-2500	*St E*	2500-3500	*St E*	>3500	*St E*	<1500	*St E*	>3500	*St E*	<1500	*St E*
Local res. str.	2	30	30.3	7.19	5.6	2.98			29.5	7.77	2.7	2.74			5.7	3.79				
Local res. str.	2	50	44.9	0.71	9.0	0.37	0.5	0.09	44.2	0.79	3.7	0.26	0.0	0.02	5.9	0.38			1.1	0.17
Main res. Str.	2	50	24.1	1.12	11.5	0.76	1.1	0.23	39.5	1.36	12.9	0.87	0.0	0.00	3.8	0.47			3.4	0.52
Main res. Str.	2	70	10.4	1.43	7.9	1.13	3.2	1.12	29.5	2.10	23.6	1.94	0.7	0.40	3.2	0.80	0.1	0.07	2.7	0.78
Main res. Str.	4	50	40.0	1.48	17.0	1.06	1.0	0.27	45.6	1.63	10.4	0.89	0.3	0.16	6.5	0.81			1.4	0.39
Main res. Str.	4	70	21.0	2.85	9.9	2.04	0.4	0.23	38.3	3.62	10.7	2.15			12.0	2.21			1.6	0.95
Local ind. Str.	2	50	43.7	2.15	11.2	1.20	0.3	0.11	38.5	2.23	4.7	0.86	0.1	0.06	6.1	1.10			1.8	0.66
Local ind. Str.	4	50	41.3	3.05	11.5	1.69	0.5	0.20	40.5	3.05	12.6	1.93			6.9	1.67			0.8	0.57
Main ind. Str.	2	50	18.1	1.25	6.9	0.73	1.0	0.29	26.6	1.48	13.0	1.08	0.2	0.12	4.0	0.62			9.0	1.01
Main ind. Str.	4	50	22.8	1.80	6.9	0.91	0.7	0.29	36.7	2.14	11.7	1.28	0.1	0.09	5.7	0.93			5.7	0.99
Local CBD, str.	2	30/50	42.4	3.49	4.7	1.36	0.0	0.01	9.8	2.50	0.1	0.09			2.4	1.39				
Local CBD, str.	4	50	56.2	4.36	11.7	2.44	0.3	0.24	26.5	4.58	2.1	1.35			2.1	1.34				
Main CBD, str.	2	30	47.8	6.76	2.4	1.15			12.2	4.74	0.9	0.88			2.6	2.63				
Main CBD, str.	2	50	41.0	3.39	6.7	1.60			41.1	3.68	0.3	0.24			8.6	2.16				
Main CBD, str.	4	30	41.7	9.92	3.4	1.99	0.6	0.55	15.2	6.51										
Main CBD, str.	4	50	37.5	4.21	21.7	3.54	0.9	0.49	56.4	4.95	5.4	1.86			8.1	2.69				
Arterial	2	50	26.0	1.53	12.0	1.02	1.0	0.32	36.1	1.82	12.2	1.15	0.3	0.21	5.1	0.74			3.2	0.64
Arterial	2	70	18.0	1.35	9.4	0.91	2.6	0.51	28.9	1.54	24.3	1.46	1.4	0.36	2.1	0.48	0.0	0.01	4.2	0.70
Arterial	4	50	29.2	0.81	12.4	0.53	1.1	0.15	40.3	0.94	11.1	0.55	0.2	0.08	4.0	0.34	0.0	0.00	2.3	0.29
Arterial	4	70	18.4	0.83	12.4	0.66	2.1	0.28	29.0	0.98	20.7	0.85	1.1	0.21	1.6	0.21	0.1	0.06	1.9	0.26
Arterial, Freeway	4	90	1.9	0.35	0.4	0.13	0.1	0.07	2.7	0.40	3.4	0.45	1.7	0.32	0.3	0.13	1.4	0.27	0.6	0.17

Table 11 The mean values of the16 independent driving pattern ***factors*** (defined in table 3) for different street types. Means are computed as averages over cases.

Street type	No Lanes	Speed limit	Deceleration factor	Factor for accelerations with strong power	Stop factor	Speed oscillation factor	Factor for acceleration with moderate power	Extreme acceleration factor	Factor for even speed 15-30	Factor for speed 90-110	Factor for speed 70-90	Factor for speed 50-70	Factor for late gear changing from gear 2 and	Factor for engine speed>3500	Factor for speed > 110	Factor for moderate engine speeds at gear 2	Factor for low engine speed at gear 4	Factor for low engine speed at gear 5
Local res. str.	2	50	0.12	0.07	0.18	0.31	0.04	-0.02	0.44	-0.17	-0.37	-0.41	-0.15	-0.04	-0.05	0.07	0.12	-0.15
Main res. str.	2	50	-0.07	-0.20	-0.19	0.03	-0.08	-0.02	-0.17	-0.19	-0.31	0.39	0.13	-0.04	-0.05	0.00	0.03	0.01
Main res.str.	2	70	-0.01	-0.29	-0.16	-0.11	-0.09	0.04	-0.24	-0.20	0.21	0.79	0.39	0.13	-0.03	-0.14	0.00	0.01
Main res. str.	4	50	0.27	0.18	0.19	0.03	0.05	0.12	-0.11	-0.14	-0.21	-0.20	0.10	-0.07	-0.04	0.31	0.16	-0.08
Main res. str.	4	70	0.12	-0.05	0.12	-0.26	0.12	0.17	-0.07	-0.12	-0.33	0.17	0.06	-0.08	-0.06	-0.14	0.52	-0.13
Local ind. str.	2	50	0.17	0.02	0.19	0.45	-0.02	-0.08	0.36	-0.17	-0.38	-0.45	-0.03	-0.05	-0.05	0.00	0.12	-0.11
Local ind. str.	4	50	0.22	0.11	0.25	0.15	-0.08	0.01	0.30	-0.13	-0.30	-0.17	0.12	-0.09	-0.02	0.25	0.15	-0.08
Local ind. str.	2	50	-0.09	-0.22	-0.18	-0.17	-0.10	-0.04	-0.10	-0.17	-0.16	0.50	0.09	-0.03	-0.05	-0.20	0.01	0.42
Local ind. str.	4	50	-0.14	-0.11	-0.11	-0.15	-0.07	0.04	-0.05	-0.22	-0.24	0.52	-0.03	-0.03	-0.04	0.07	0.09	0.21
Local CBD, str.	2	30/50	-0.04	0.05	0.59	0.52	-0.17	-0.20	1.24	-0.19	-0.42	-0.81	-0.14	-0.05	-0.05	-0.78	-0.31	-0.10
Local CBD, str.	4	50	0.16	-0.03	0.50	0.80	-0.03	0.17	0.49	-0.12	-0.39	-0.77	-0.04	-0.08	-0.05	-0.28	-0.21	-0.15
Main CBD, str.	2	50	-0.09	-0.26	-0.09	0.25	-0.20	-0.06	0.62	-0.21	-0.45	-0.66	-0.14	-0.01	-0.06	0.15	0.34	-0.25
Main CBD, str.	4	50	-0.10	-0.02	0.45	0.25	-0.03	0.18	-0.24	-0.15	-0.45	-0.56	0.16	-0.04	-0.07	0.16	0.38	-0.25
Arterial	2	70	0.03	0.06	-0.13	-0.09	0.02	0.03	-0.18	-0.24	-0.19	0.28	0.02	-0.04	-0.04	-0.02	0.02	0.09
Arterial	2	50	0.15	-0.10	-0.10	-0.03	-0.11	-0.14	-0.10	-0.18	0.53	0.53	0.37	0.11	-0.02	0.19	-0.06	0.19
Arterial	4	50	0.07	-0.01	0.04	-0.10	0.03	0.04	-0.14	-0.19	-0.22	0.11	0.06	-0.03	-0.03	0.06	0.00	-0.04
Arterial	4	70	0.06	0.00	-0.11	-0.13	-0.07	0.04	-0.27	-0.25	0.52	0.47	0.24	0.07	-0.02	0.09	-0.21	0.07
Arterial	4	90	-0.45	-0.37	-0.30	-0.22	-0.11	-0.01	-0.37	1.76	1.19	-0.53	-0.36	0.14	0.44	-0.17	-0.18	-0.08

Table 12 Standard errors of the means of the 16 independent driving pattern ***factors***, (means reported in table 11).

Street type	No Lanes	Speed limit	Deceleration factor	Factor for accelerations with strong power	Stop factor	Speed oscillation factor	Factor for acceleration with moderate power	Extreme acceleration factor	Factor for speed 15-30	Factor for speed 90-110	Factor for speed 70-90	Factor for speed 50-70	Factor for late gear changing from gear 2	Factor for engine speed>3500	Factor for speed > 110	Factor for moderate engine speeds at gear 2	Factor for low engine speed at gear 4	Factor for low engine speed at gear 5
Local res. Str.	2	50	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.00	0.01	0.01	0.01	0.01	0.00	0.02	0.02	0.01
Main res. Str.	2	50	0.03	0.02	0.02	0.03	0.03	0.02	0.02	0.01	0.02	0.03	0.03	0.01	0.00	0.02	0.03	0.04
Main res. Str.	2	70	0.06	0.04	0.03	0.04	0.04	0.06	0.03	0.02	0.05	0.05	0.07	0.06	0.01	0.04	0.04	0.05
Main res. Str.	4	50	0.04	0.04	0.04	0.04	0.03	0.04	0.03	0.01	0.03	0.04	0.04	0.02	0.01	0.03	0.04	0.03
Main res. Str.	4	70	0.10	0.08	0.08	0.07	0.07	0.07	0.08	0.02	0.05	0.08	0.08	0.02	0.01	0.08	0.12	0.07
Local ind. Str.	2	50	0.05	0.04	0.07	0.07	0.04	0.05	0.06	0.01	0.02	0.05	0.04	0.01	0.01	0.06	0.06	0.05
Local ind. Str.	4	50	0.07	0.06	0.11	0.09	0.07	0.08	0.09	0.02	0.03	0.07	0.07	0.02	0.01	0.09	0.09	0.05
Main ind. Str.	2	50	0.04	0.03	0.03	0.03	0.04	0.04	0.03	0.01	0.03	0.04	0.04	0.02	0.00	0.03	0.03	0.07
Main ind. Str.	4	50	0.05	0.05	0.04	0.04	0.05	0.04	0.04	0.02	0.03	0.05	0.04	0.02	0.01	0.04	0.05	0.07
Local CBD, str.	2	30/50	0.07	0.07	0.13	0.12	0.07	0.08	0.13	0.02	0.03	0.05	0.04	0.02	0.01	0.13	0.09	0.04
Local CBD, str.	4	50	0.10	0.07	0.18	0.18	0.09	0.15	0.15	0.03	0.05	0.06	0.07	0.02	0.01	0.25	0.11	0.06
Main CBD, str.	2	50	0.06	0.04	0.07	0.08	0.07	0.06	0.11	0.02	0.02	0.05	0.04	0.02	0.01	0.06	0.12	0.04
Main CBD, str.	4	50	0.09	0.08	0.15	0.11	0.08	0.11	0.11	0.03	0.06	0.07	0.10	0.03	0.01	0.13	0.15	0.04
Arterial	2	50	0.04	0.04	0.03	0.04	0.05	0.05	0.03	0.02	0.03	0.04	0.04	0.03	0.01	0.03	0.04	0.04
Arterial	2	70	0.04	0.04	0.03	0.03	0.03	0.04	0.03	0.03	0.05	0.04	0.05	0.04	0.01	0.03	0.03	0.05
Arterial	4	50	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.02
Arterial	4	70	0.03	0.03	0.02	0.02	0.03	0.03	0.02	0.02	0.03	0.02	0.03	0.03	0.01	0.02	0.02	0.02
Arterial	4	90	0.02	0.02	0.01	0.01	0.03	0.02	0.01	0.06	0.04	0.02	0.03	0.06	0.09	0.01	0.02	0.02

4 The relation between driving conditions and driving patterns

4.1 Design of a cause effect model – methodology

4.1.1 Model design strategy

The second aim of the study was to investigate how driving pattern varies due to different kinds of conditions. This analysis differs from the descriptive analysis as it aims at studying ***why*** the driving patterns vary. That is to investigate if the variation of a certain driving pattern measure could be related to variations in specific external factors. To study this a prediction model for the 16 driving pattern ***factors***[8] and for the average speed was estimated. The 16 ***factors*** are independent measures describing different dimensions that vary over driving patterns. Note however that average speed is not representing such independent measure. Yet, since average speed has been used in many applications it was included as a dependent variable in the analysis.

The study was preceded by a review of the concept of driving patterns and the possible causes that affect the variation of driving patterns. The review resulted in a presentation of the problem according to figure 1. In figure 1 different categories of explanatory variables and examples of variables within each category are described. To be able to analyse the complex system affecting driving patterns the data collection aimed at gathering variables from the different variable categories. However, at an early stage it was decided not to collect travel behaviour data, i.e. to let the subjects fill in a travelling diary with purpose, number of passengers etc. for each trip. This choice was made since we thought that a procedure with travelling diaries would make a daily reminder for the drivers that they were participators in an investigation and maybe this would affect their driving behaviour. Apart from this the data collection resulted in a very large set of cases as well as explanatory variables from all other categories in figure 1.

When designing the prediction model the model structure was chosen a priori to be linear model with interaction effects. At start, it was tempting to design a full factorial model that included all measured variables and all (or at least a lot of) interactions. However, preliminary tests showed that of practical, computer and software reasons the model had to be limited in number of variables as well as in number of interactions. As a general approach for the model design of this initial model three main principles was adopted:

1. To design a model that included explanatory variables from the different categories of variables as seen in figure 1.
2. To limit the size of the model and thus limit the number of explanatory variables
3. To limit the number of studied interactions between variables.

The finally chosen model consisted of variables from all categories except the for the travel behaviour category. Thus, a model was formulated to investigate the relation between driving pattern properties and: (1) street characteristics; (2) traffic flow conditions; (3) weather; (4) drivers in general, as well as different driver categories; and (5) the drivers handling of cars that have different performances (effect/mass). The approach to use variables from different parts of the system was done to get an overall view of different kinds of influences on driving patterns.

[8] As defined in table 3

The model design considers effects of the outside environment as well as the vehicle and the driver. Yet, the chosen approach lead to that some measured variables was not used in this first analysis. The explanatory variables used and their levels are listed in table 13.

The chosen model structure included main effects and interaction effects. The included main effects are described in table 13 and in figure 4. Furthermore, the model included some selected interaction effects based on the results of an earlier study (Ericsson 2000a). In that study interaction effects was found between street type and driver category and between street type and traffic flow condition. Further, interaction effects were found between driver categories (in that case gender) and traffic flow conditions. In the present study it was decided to include interaction effects of street type and all other main effects. The definition of street type was here formed by: (1) local environment – type of area; (2) street function; and (3) speed limit resulting in ten different types of streets. The interaction among those three variables was checked to investigate what variables and/or variable levels within the street type definition that were of certain importance. Further interaction between driver category age respective gender and traffic flow was included. The thus selected interaction effects are illustrated in figure 5. Hence, model parameters were estimated for a linear regression model including the main effects defined in figure 4 and the interactions defined in figure 5.

Type of area and location

To describe the street environment five variables were used: type of area, street function, speed limit, number of lanes and intersection density. The type of area was adopted since this has been suggested to affect the driving pattern. Kenworthy (1986) and Lyons et al. (1989) found that driving patterns were affected by urban structure and local environment. Kenworthy (1986) suggested that distance from the central business district (CBD) should be used as an explanatory variable since he found that several traffic- and street- characteristics such as vehicles per kilometre and intersection density varied with the distance to the CBD. The present study used four types of local environments: CBD, industrial areas, residential areas and communication area[9]. Initially, the cases were as well divided into three localisation intervals central, semi-central and peripheral areas. However, preliminary analyses found, that as the model included intersection density and traffic-flow conditions and as CBD formed an exclusive type of environment, no significant differences occurred between semi-central and peripheral areas in Västerås. The division on semi-central and peripheral streets was then abandoned.

Street function and other street design variables

Street function was coded in three levels local streets, main streets and arterial roads. This division is closely connected to a division of streets on the bases of function that have been adopted in Swedish cities, Brandberg et al (1999). Speed limit included three classes, 50, 70 and 90 km/h. In Swedish cities speed limit 30 km/h is becoming increasingly common. However in this study streets with speed limit 30 had few cases and a biased sample of drivers. They were thus excluded from the analysis. Further street design parameters taken into the analysis was number of lanes and intersection distance. The division of streets depending on type of area and street function is illustrated in figure 6.

[9] i.e., the area around arterial roads

Table 13 Explanatory variables used in the model. * marks the overall most common level for each variable.

Variable	Intervals used	Overall frequency (%)	Note
Driver	1–24	0.5- 7.0	Drivers that could not be categorised to age and/or gender were excluded.
Age	18–35 36–59 >59	40.2 48.0* 11.8	Because few drivers in the sample were <25 years, interval 18–25 and 26–35 was re-coded to form one group 18–35.
Gender	Women Man	29.5 70.5*	When the car was driven 75% or more by one driver, all cases in that measuring period were attributed the gender code of the most frequent driver.
Car performance	Power/mass >0.7 Power/mass 0.6–0.69 Power/mass <0.59	21.1 40.3* 38.7	Each car was driven by a person who normally drove a car of similar performance.
Type of area	CBD Industrial area Residential area Communication area	3.6 12.0 39.1 45.3*	Communication area = areas around arterial, i.e., nearest surroundings to arterial formed a separate category
Street function	Local street Main street Arterial	28.2 26.5 45.3*	Coded by the local employees in the community of Västerås
Speed limit	90 km/h 70 km/h 50 km/h	9.8 19.2 71.0*	Cases with speed limit 30 were few and had a smaller sample of drivers. They were thus excluded from this analysis.
Number of lanes	4 lanes 2 lanes	49.8 50.2*	For street type 3 (table 2) the number of lanes was not given. Main streets wider than 10 metres were coded 4-lane streets.
Intersection density	< 50 m 50–100 m 100–200 m >200 m	4.6 19.6 34.0 41.9*	Number of passed intersections per case was registered and divided by total case length and then allocated to one of the four distance classes.
Weather	Snow No snow	33.0 67.0*	Only two weather conditions were compared.
Traffic flow	>900 700–900 500–700 300–500 100–300 <100	0.9 2.4 4.6 12.0 42.6* 37.4	Traffic flow, ADT, was recalculated to vehicles per hour and than divided by number of lanes (vehicles/lane and hour)

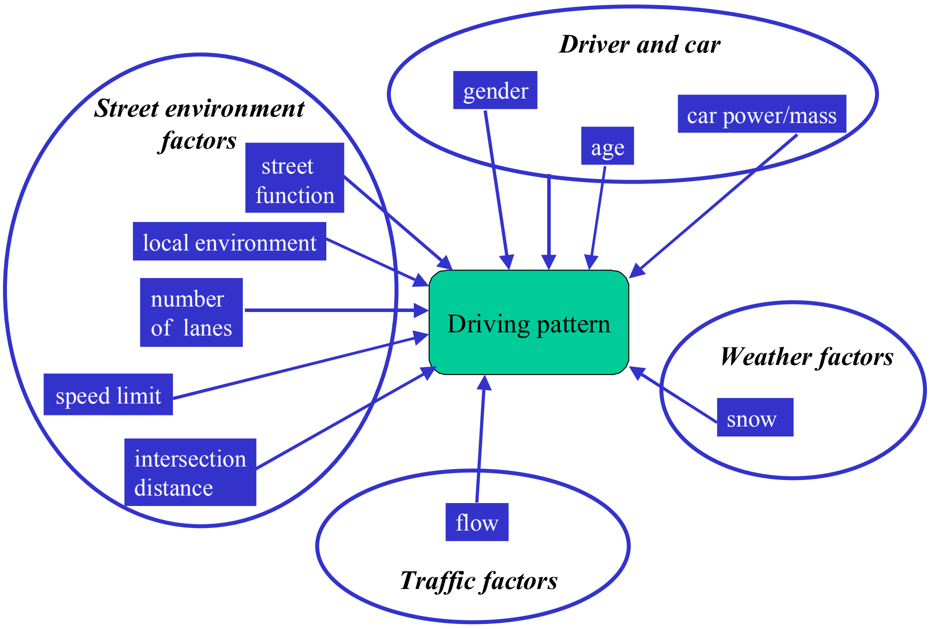


Figure 4 Modelled main effects.

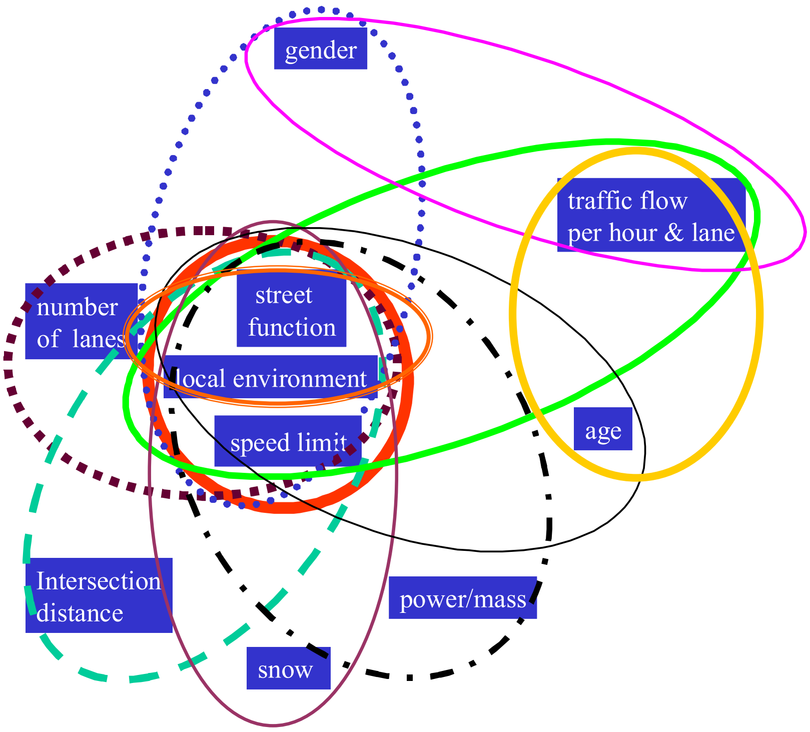


Figure 5 Modelled interaction effects.

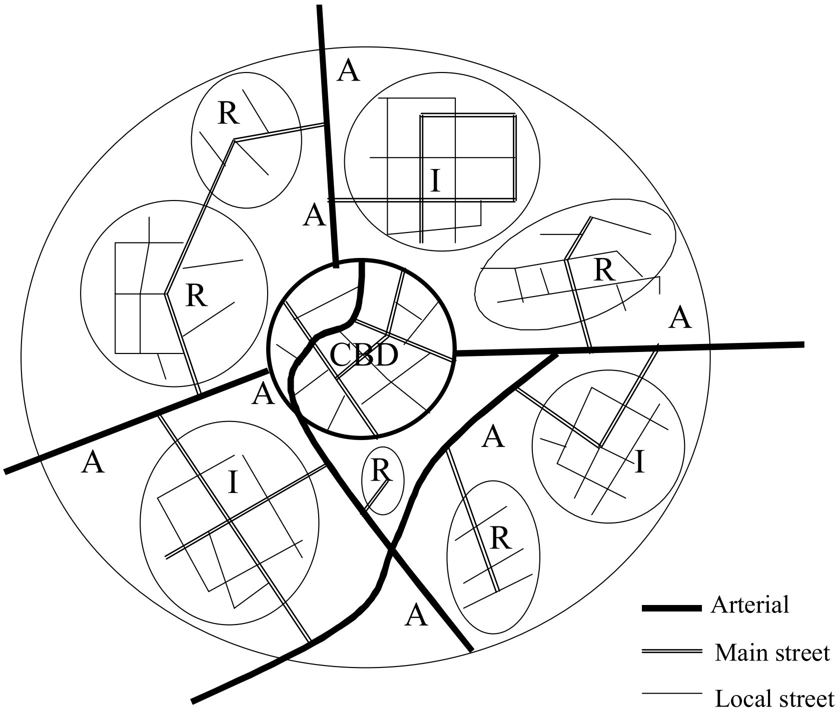


Figure 6 Division of streets according to type of area and street function.
CBD = central business district, I = industrial area, R = residential area,
A = communication area, i.e., thoroughfare areas around arterial roads.

Traffic flow

The traffic flow categorisation is based on traffic flow registrations performed by the local authorities in Västerås reported as average daily traffic (ADT). Since traffic flow varies significantly over the year, the week and the day, ADT was too coarse of a measure to use to characterise the traffic flow conditions on a particular street on a particular occasion. For each case the date and time for passing a certain street had been registered. Using fractions, (Jensen 1997), for diurnal and weekly variation of passenger cars on urban roads, the ADT was broken down to hourly flows for cars working days, Saturdays and Sundays. For heavy vehicles the flow was distributed over the day, only, see figure 7 and 8. The fractions of vehicular flow extracted by Jensen are based on measurements on urban streets in Denmark. However, the data in Jensen (1997) did not include separated fractions for streets at CBD. In this study the traffic flow at CBD was not considered to have the same pattern as traffic flow on streets outside CBD. The flow of personal cars outside CBD is characterised by morning and evening peaks, whereas the traffic flow at the CBD was considered to be more affected by mid-day activities. In an on-going project (Ekman 2000), traffic flow data was registered in the CBD of Lund. Data from that project was used to extract fractions for diurnal and weekly variation of passenger cars and heavy vehicles at CBD for use in the present study (see figure 8).

Weather

For representing different weather conditions, this study used a dummy variable for snow, taking into account whether snow had fallen. Many other weather conditions might affect driving patters, but we could not account for them in this study.

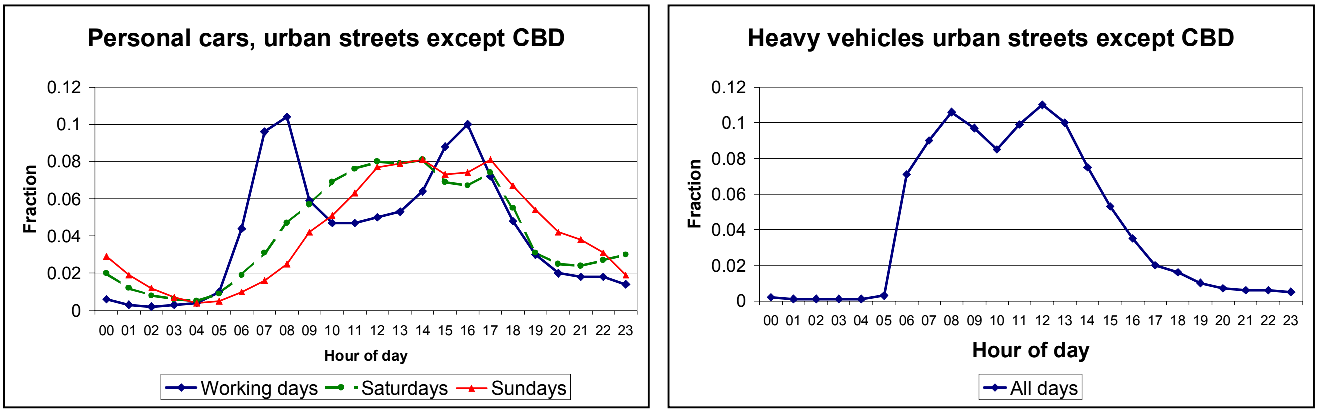


Figure 7 Fractions for diurnal and weekly variation of ADT for personal cars and heavy vehicles for urban streets except CBD (Jensen 1997).

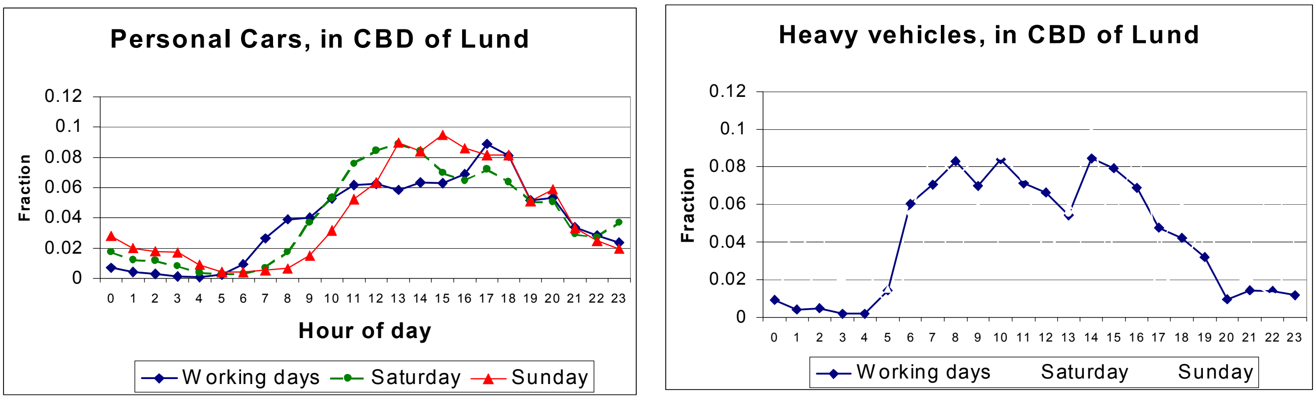


Figure 8 Fractions for diurnal and weekly variation of ADT for personal cars and heavy vehicles for streets in CBD (Ekman 2000).

Driver and driver categorisation

Age, gender and car performance was used as driver category variables. The categorisation of drivers according to age and gender was done because other studies have shown that those driver characteristics affect driving behaviour, Fildes et al. (1991), Waielewski and Evans (1985), Sakshaug (1991), Haglund and Åberg (1990), Yagil (1998) and Ericsson (2000a). Other possible bases for characterising driver types could be, e.g., driving experience, drivers with different attitudes towards driving or drivers with different cultural backgrounds. However, further subdivisions need larger samples, which were not possible in this study.

The properties of the car were looked upon as a driver variable in this study. The reason for this was that the subjects drove a measuring car of the same size and performance as their normal car. To represent different car types several characterisations were possible. Initially, the cars were assigned the attributes of size and car model, as well as power/mass. Depending on the earlier mentioned computer restrictions and practical considerations the size of the cause effect model had to be limited and the parameter power/mass was chosen to represent car type. The effects of car performance is then to be interpreted as the effect of owning (and driving) a high, medium or low performance car.

The variable driver takes into account differences among drivers that is not due to their belonging to any of the categories age, gender and choice of car performance.

Number of cases
The number of cases that could be included in the model estimation was dependent on the completeness of the coding. Some cases lacked some of the codes for explanatory variables and had to be excluded from the analysis. Furthermore, streets with speed limits of 30 km/h were excluded since they were few and had a biased driver sample. Altogether, this left 11,249 cases for this analysis.

4.2 Model interpretation strategies

The chosen model design was limited in size but yet it was complex with a large set of terms. The interpretation of a model of this complexity is difficult since many effects and interactions interfere with each other. In addition as a consequence of the observational design of the study the sample was unbalanced with missing values. An unbalanced design makes the division of effects upon main effects and interaction effects more uncertain than at balanced experimental designs. It would appear that a complex system demand a complex model. Yet any model of high complexity decrease the possibilities to interpret the results. Brundell-Freij (1999) discussed model complexity contra simplicity and stated that a high complexity tends to lead to lower computability and higher difficulties in interpretation. Further she emphasis the fact that results obtained through observational data has to be supported by a theoretical framework, that is the model design has to be preceded by considerations of probable causes and effects and decisions of what relationships that are to be investigated. The complexity of the estimated model of this study made it necessary to interpret main effects in combination with interaction effects. To accomplish this, the estimated model was used to, calculate the values of the driving pattern measures for certain given conditions. To define those conditions of three tools were used:

1. The concept of street type. Street type was formed by type of area, street function and speed limit.
2. To let other street environment factors (that were not studied for the moment) i.e. number of lanes, intersection distance, traffic flow and snow is assigned to a base value equivalent to the overall most common level.
3. An average driver population including a sample mix distributed over ages, gender and car performances.

The concept of street type formed 10 different street types, see table 14. The street types mirror the types of streets that existed in the city of Västerås were the investigation was performed.

Table 14 The street types according to the concept of street type in the prediction model. Each X represents one street type.

Street function	Type of area	Speed limit		
		50	70	90
Local street	CBD	X		
	Industrial	X		
	Residential	X		
Main street	CBD	X		
	Industrial	X		
	Residential	X	X	
Arterial	Communication	X	X	X

The other explanatory variables that described the outside environment, see table 15, was assigned the overall most common value as base in the model. Thus, the base value for number of lanes was 2 (one in each direction), intersection density > 200 metres between intersections, traffic flow was 100-300 vehicles per lane and hour and the base value for the snow variable was no snow.

Table 15 Model base values for variables (except street type) that describe outside conditions.

Variable	Base value
Number of lanes	2 lanes (one in each direction)
Intersection density	>200 metres
Traffic flow	100-300 vehicles per lane and hour
Snow	No snow

The average driver population was formed based on the overall distribution of different driver ages, gender and car performance according to this study, with weights reported in table 16.

Table 16 Distribution of driver age, gender and car performance

Variable	Relative frequency		
Age: <36 /36-59 />59 years	0.4	0.48	0.12
Gender: man/woman	0.7		0.3
Car performance: low /medium /high	0.39	0.4	0.21

The analysis was divided into two main parts. The first parts assessed effects of external conditions while the second part investigated driver effects. For each of the analysis an appropriate set of these three tools were applied.

4.3 Model for the relation between driving conditions and driving patterns - Results

A model was estimated to investigate the effects of different categories of specific driving conditions on the driving pattern. The model was able to estimate significant model parameters and thus explain how different driving conditions affected different driving pattern measures. However, apart from showing significant model parameters, the estimated model had low explanatory power for some of the investigated variables (see table 17). This means that the model were able to reveal significant effects of the included explanatory variables but yet a large amount of unexplained variation appeared. The highest explanatory powers were found for the speed variables, and the interpretations will emphasis those results. However, results for other factors will be enlightened when showing certain systematic or large effects according to the model. It should then be noted that those effects represent only a small share of the total variance.

Table 17 The estimated model's explanatory power for different driving pattern measures.

Factor no.	Driving pattern measure	R^2
-	v_avg	0.63
1	Deceleration factor	0.11
2	Factor for accelerations with strong power demand	0.08
3	Stop factor	0.05
4	Speed oscillation factor	0.11
5	Factor for acceleration with moderate power demand	0.04
6	Extreme acceleration factor	0.06
7	Factor for even speed 15–30	0.19
8	Factor for speed 90–110	0.44
9	Factor for speed 70–90	0.33
10	Factor for speed 50–70	0.29
11	Factor for late gear changing from gear 2 and 3	0.18
12	Factor for engine speed >3500	0.04
13	Factor for speed >110	0.08
14	Factor for moderate engine speeds at gear 2 and 3.	0.12
15	Factor for low engine speed at gear 4	0.12
16	Factor for low engine speed at gear 5	0.16

The results are illustrated by plots showing estimated main effects together with estimated interaction effects. In these plots the driving conditions are defined using the tools, according to section 4.2, to facilitate the interpretation. The plots serve as illustrations of the results that were tested through the model estimation. The estimated model parameters are reported together with the corresponding standard error in appendix 1.

4.3.1 Effect of outside conditions - street type and traffic environment

Effects of street function, local environment and speed limit

In the model street type was defined by the local environment – type of area, the street function and the speed limit. These definitions formed 10 different urban street types. The effects of each of the three variables included in the street type concept were studied through their respective main effect plus the effects of interactions between them. In this part the tool of using an average driver population was utilised. Further, the other variables describing external conditions was assigned base values i.e. the overall most common level.

In figure 9 the average speed for different types of area, street functions and speed limits are shown. Different street functions and different types of areas are grouped on the x-axis to illustrate the effects of those variables. Different speed limits are presented with separate marks. It was found that average speed was higher for main streets and arterial streets than for local streets; however, streets in CBD, main and local, had the lowest overall average speed. Increased speed limit from 50 to 70 km/h was found to raise the average speed to some minor extent while the speed limit 90 km/h (which in this study was equivalent to change to freeway conditions) induced high raises in average speed.

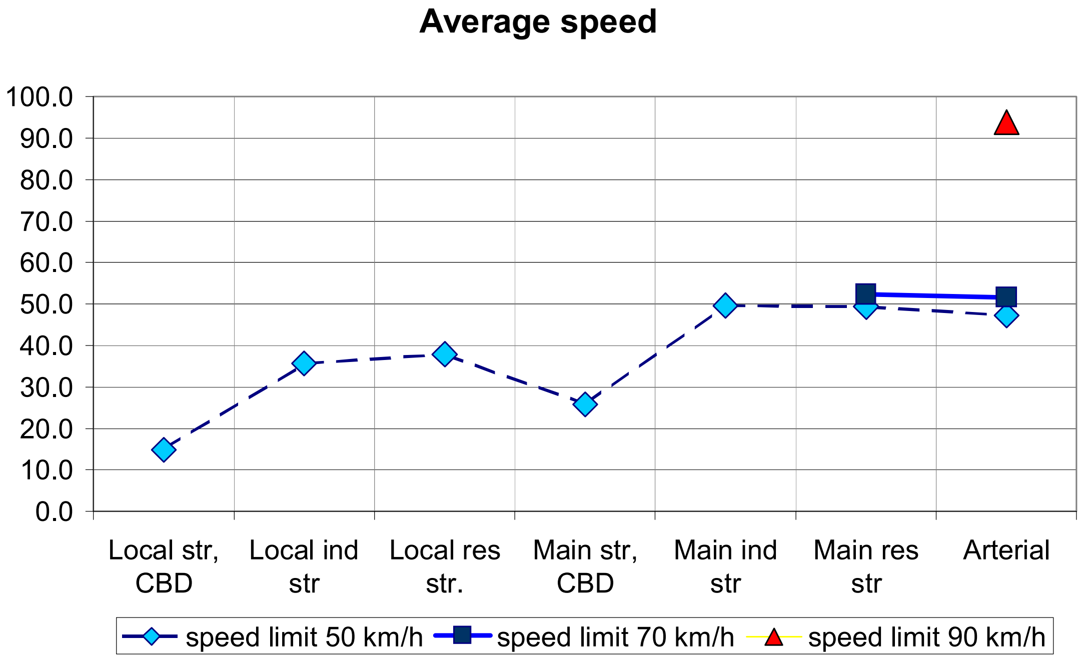


Figure 9 Average speed (km/h) for different street functions, types of environments and speed limits. Average driver population and base values for external conditions except street type.

The ***factors*** for different speed intervals are reported in figure 10. The ***factor*** for speed 15-30 had highest values on main streets in CBD; other street types had values around zero. The ***factor*** for speed 50–70 reached the highest values on main streets in industrial and residential areas (speed limit 50 km/h). In CBD the factor had negative values and on other street types values around zero. The ***factor*** for speed interval 70–90 km/h had highest values on streets with speed limit 70 km/h particularly on arterials, streets with speed limits 50 had values less or equal to zero. The ***factor*** for speed 90–110 km/h had highest weight on the arterial with speed limit 90 km/h.

As could be expected, CBD seems to form a certain kind of environment with lower speed than other environments on local as well as on main streets. Within CBD local streets had lower speed than main streets, which was a relation found generally. Furthermore, the difference between residential and industrial areas was small. Changes in speed limit from 50 to 70 km/h had some minor effect on average speed. Larger difference appeared for raise of speed limit to 90 km/h. The last effect is probably to high extent influenced by the fact that when changing speed limit to 90 km/h the street design changed to freeway conditions as well.

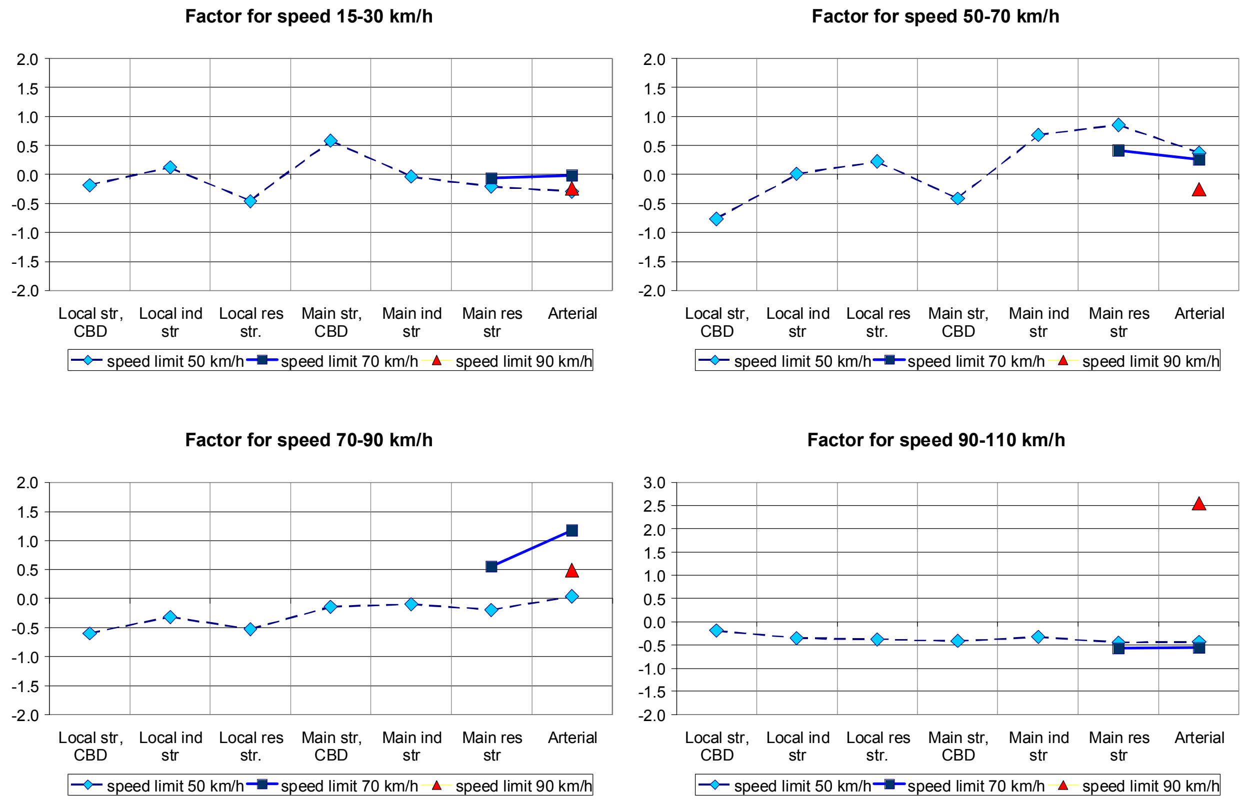


Figure 10 Factors for speed 15-30, 50-70, 70–90 km/h and 90–110 km/h, respectively, for different street functions, types of environments and speed limits. Average driver population and base values for external conditions except street type.

Other driving pattern measures than speed were as well affected by the components defining street type. However, those effects were generally more uncertain and should be seen as interpretations of tendencies that could serve as hypothesis generation for further studies. In figure 11-13 is the values of six important driving pattern ***factors*** presented for different street types. According to figure 11 the stop ***factor*** had large values on local streets in CBD while oscillations of the speed curve is enhanced on local streets in general (especially in CBD) and on main streets in CBD. The two factors illustrated in figure 11 would then suggest that speed oscillations that comprise stops are especially common on local streets in CBD while other local streets and main streets at CBD have a lot of oscillations on the speed curve that not necessarily include stops. However some at some of the variable levels the estimated parameters had large standardised errors.

Figure 12 illustrates that the amount of extreme accelerations tended to have higher values on local streets in CBD. High accelerations do not necessarily mean that a high power is used, if it is depend for example on the product of speed and acceleration. The factor for high power showed the same pattern as extreme accelerations but the difference between street types was larger for high power demand. Thus, extreme accelerations had high values at local CBD and so had high power demand. Further, extreme accelerations were as common as the overall average for main streets in CBD while high power demand here had low amounts. For streets with speed limit 70 km/h extreme accelerations had equivalent low values for main streets as arterial streets while high power demand is more common on arterial streets than on main streets.

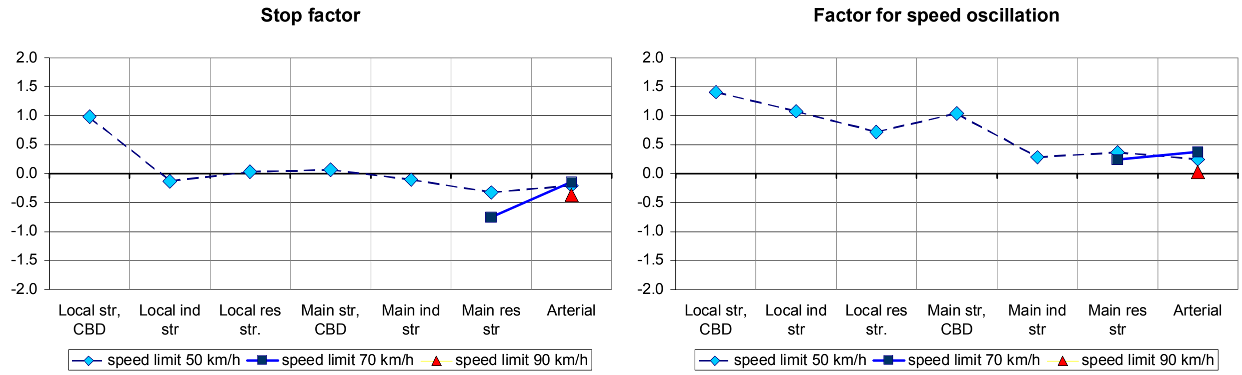


Figure 11 The stop factor and the speed oscillation factor for different types of areas, street functions and speed limits. Average driver population and base values for external conditions except street type.

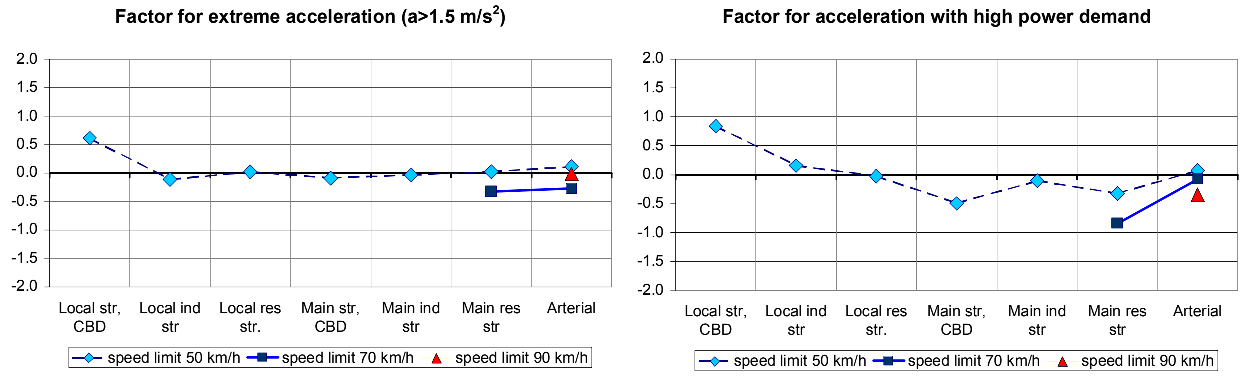


Figure 12 The factors for respective RPA and extreme acceleration for different types of areas, street functions and speed limits. Average driver population and base values for external conditions except street type.

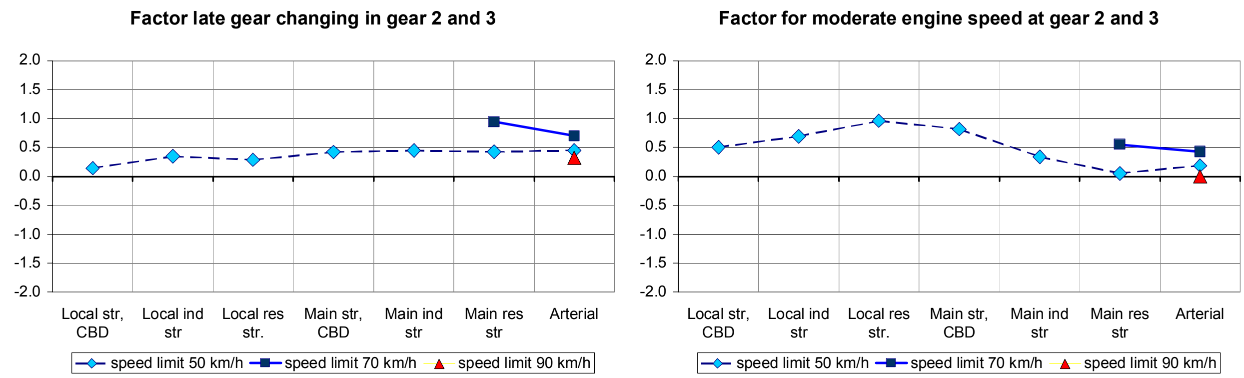


Figure 13 Factors for respective late gear changing and moderate engine speed in gear 2 and 3 for different types of areas, street functions and speed limits. Average driver population and base values for external conditions except street type.

Figure 13 illustrates that the gear changing behaviour might to some extent be affected by the different street type variables. Late gear changing from gear 2 and 3 tended to be more common on streets with speed limit 70 km/h than on other streets. The factor for moderate engine speed at gear 2 and 3 had high values for local streets (particularly residential), for main streets in CBD.

Figure 11 to 13 illustrates that some driving pattern ***factors***, that have high effect on emission and fuel consumption per km, tend to vary to some extent with street type characteristics. It should be noted that the variation explained is low for those driving pattern ***factors*** and the findings ought to be further investigated.

Street type and intersection density

The intersection density was found to have significant effect on the speed measures. On all street types (except streets in CBD), the lowest average speed occurred for the highest intersection densities (see figure 14). Note that all street types did not have intersection distances as short as <50 metres. Furthermore, most street types had their highest average speed for the lowest intersection density i.e. intersection distances >200 metres.

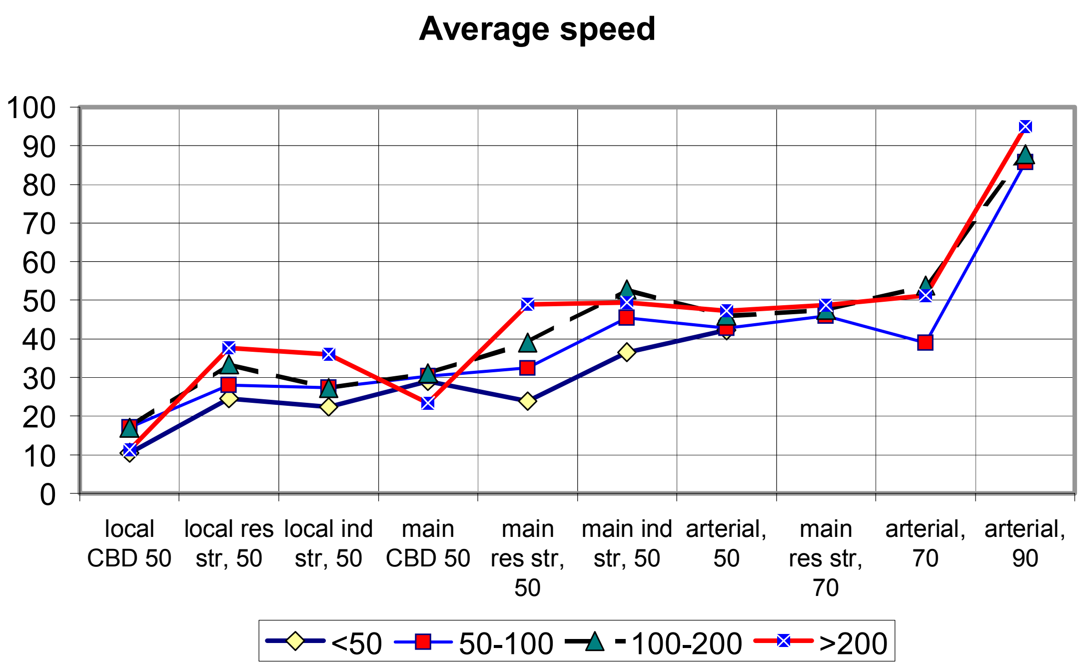


Figure 14 Average speed (km/h) at various types of streets for different intersection distances (m). Average driver population and base values for external conditions except street type and intersection density.

In figure 15 the factors for four speed intervals are presented for different street types and intersection densities. The factor for speed 15–30 km/h was, in general, high for local streets in CBD but had also significant increases for other local streets when the intersection density increase. It also had high values for main streets in residential areas when at high intersection density. All speed intervals over 50 km/h were found to have their highest values when the distance between intersections was over 200 metres. The factor for speed 70–90 km/h had negative values for all street types except the streets with speed limits of 70 km/h or 90 km/h. On arterial 70 km/h streets, the values of speed 70–90 km/h decrease significantly if intersection distance is <100 metres. The factor for speed 90–110 km/h had negative values for all street types, except for arterial roads with speed limit 90 km/h. The value was significantly higher when the distance between intersections was large.

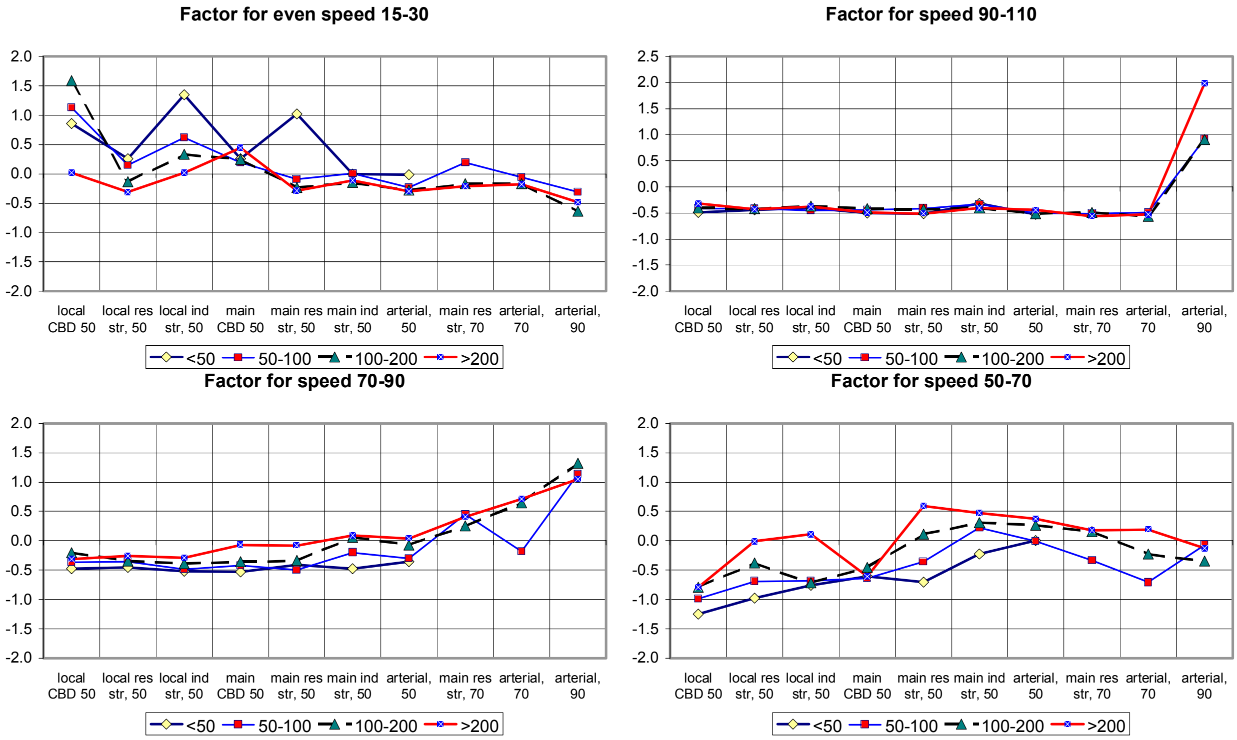


Figure 15 Factors for speed interval 15-30, 30-50, 70–90 km/h and 90–110 km/h, respectively, for various street types and different intersection distances. Average driver population and base values for external conditions except street type and intersection density.

A common idea about driving patterns is the image of an even speed profile at links while decelerations and accelerations are assigned to intersections. This simplified picture has lately been questioned by Smidfelt Rosqvist (1998), who found that emissions in residential areas significantly decreased with the amount of passed intersections. The present study indicated a significant ***increase*** in speed oscillation occurred with ***lower*** intersections density. Figure 16 shows that the lowest values on oscillation factors were present for the highest intersection densities (< 50 metres between intersections). Furthermore, for most street types the amount of oscillation increased systematically for lower intersection densities. This result indicates that the common concept of speed profiles at links and intersection ought to be revised at least in urban street nets.

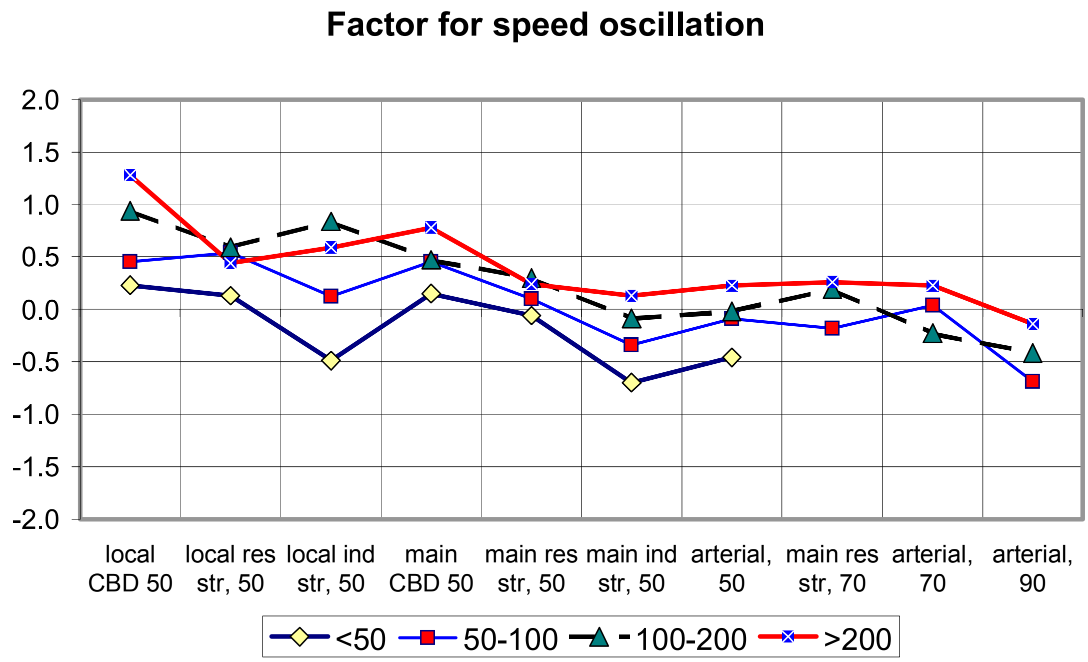


Figure 16 The factor for speed oscillations for various street types and different intersection distances (m). Average driver population and base values for external conditions except street type and intersection density.

The frequency of accelerations affect emissions and fuel consumption and so does the power used when accelerations are performed. As the frequency of accelerations ***decreased*** with short intersection distances, a natural question would be whether the amount of ***powerful*** accelerations would increase or decrease at high intersection density. However, this study could not show any systematic effect of intersection distance on the factors for acceleration with high respective moderate power demand (see figure 17).

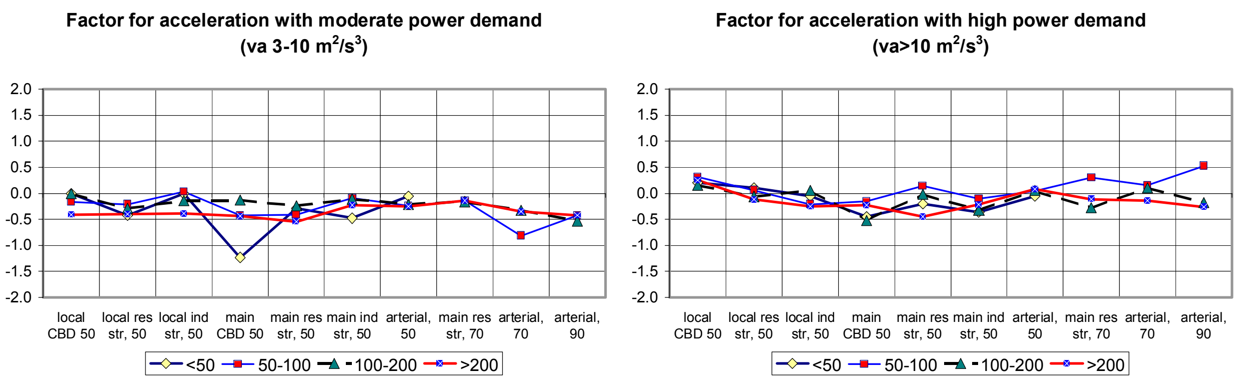


Figure 17 Factors for different power demand for various street types and different intersection distances. Average driver population and base values for external conditions except street type and intersection density.

Street type and number of lanes

The number of lanes did not affect the driving pattern to any large extent according to this study. A limited but significant reduction of speed was found for streets with four lanes compared to two (see figure 18). Arterial streets with speed limit 90 km/h existed only with four lanes in this investigation. The ***factor*** for speed 15–30 km/h that was common on streets in the city centre was significantly lower if the street had four lanes (figure 18).

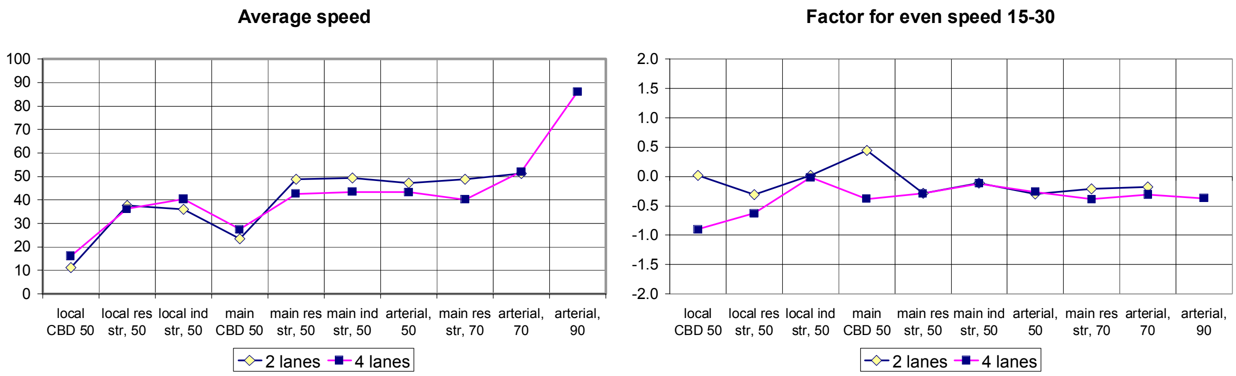


Figure 18 Average speed and factor for even speed 15–30 km/h for different street types having two or four lanes. Average driver population and base values for external conditions except street type and intersection density.

The effect of snowy conditions

It is rather natural to include weather conditions in a cause effect model for driving patterns. In this study two weather conditions were compared: the condition before and after snow had fallen. During the study a heavy snowfall hit Västerås the November 20, and the snow was still there at the end of the measuring period December 21. Thus, snowy conditions prevailed for about 40% of the measuring period. However, the study found hardly any significant effects of snowy conditions on the driving pattern factors investigated. The factor for low engine speeds at gear 5 was less on some street types with snowy conditions, and furthermore, the stop factor on streets in the CBD was higher. This result was unexpected and it suggests that the division in before and after a snowfall is too coarse of a measure or that the local maintenance was very well performed. There are reasons to believe that more detailed measures of the condition of the road surface would give more significant effects on the driving pattern. However, the results indicates that occurrence of snow alone is not enough reasons for assuming that the driving pattern in an urban site would be very different from otherwise. Probably would a variable describing the occurrence of icy pavement induce higher effects. Möller et al (1991) showed large effects on speed during snowfalls and icy road conditions.

Street type and traffic flow

Some significant effects of traffic flow were found, but they were to some extent difficult to interpret. The reason for this may be the general dependence between traffic flow and level of service, e.g., the highest traffic flows occur only at the street types with the highest accessibility. This sometimes resulted in an increase in speed when the traffic flow exceeded the level of 500–700 vehicles per lane and hour. This is explained by the fact that such large flows only appear at some, probably very high standard streets. At the beginning of this study efforts were made to find measures of capacity for each street type and relate the actual flow level to the capacity. However, most studies of capacity have been made for freeways, and no detailed measures of capacity were found for the variety of urban street types that were used in this study (local, main and arterial streets in different types of areas and with different numbers of lanes). General capacity measures for different urban street types would, of course, be useful to measure the degree to which the traffic flow was disturbed. However, in urban areas intersections affect the capacity a lot and capacity for links might not give an appropriate image of the situation.

Average speed and the factor for speed 15-30 km/h was found to be affected by the traffic flow conditions to some extent (see figure 19). Thus, the average speed on a given street type tends to decrease when the traffic flows increase. The factor for speed 15-30 km/h was found to grow when the number of vehicles per lane and hour increased.

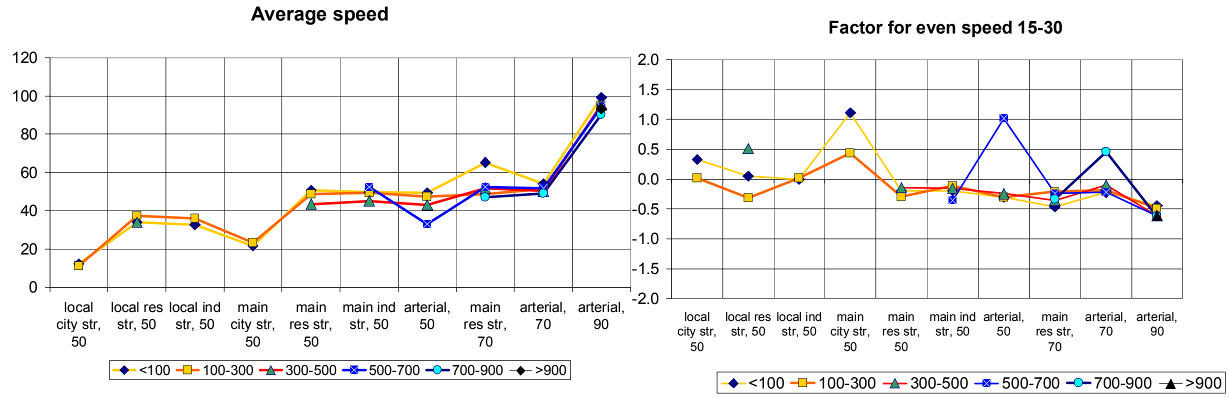


Figure 19 Average speed and the factor for even speed 15–30 km/h on different street types at different traffic flow (vehicles/lane and hour). Average drivers, other outside conditions than street type and traffic flow was assigned to base values.

4.3.2 The effect of driver characteristics

When interpreting the effect of driver characteristics two of the three interpretation tools according to 4.2 namely:

1. To use concept of street type formed by type of area, street function and speed limit.
2. To let other street environment factors i.e. number of lanes, intersection distance, traffic flow and snow have base values according to the overall most common level.

Since the purpose of this part was to investigate the effect of driver characterisations the average driver is not used her. Yet, while investigating the effect of one driver characteristic the other driver characteristics have the distributions as the overall sample.

The effect of driver age

In general the age factor had several significant effects. Elderly drivers especially had frequent deviations from the values of middle aged and young drivers.

Drivers over 59 years had significantly lower average speed in urban driving (see figure 20). In numbers the difference was approximately 5–20 km/h depending on the street type. However, elderly drivers had less time at speeds below 30 when driving at local city streets, (see figure 21), but had, on the other hand, more of this factor at other streets, e.g., local streets in residential areas. Younger drivers (<36 years) had, in general, increasing effects on the factor for driving at speed 50–70, except on arterial roads with a speed limit of 90 km/h (figure 21). On street types with speed limit 70 or 90 km/h elderly drivers had higher values on driving at 50-70 km/h than other drivers According to this study both elderly and younger drivers showed a main negative effect for the factor driving over 110 km/h compared with middle-aged drivers.

Elderly drivers were found to have the lowest values for high as well as moderate power demand when accelerating (see figure 22) compared to other ages. It can thus be concluded that they performed more low power accelerations than other drivers. On the other hand, younger drivers tended to have high values the factor for accelerating with the highest power demand (see figure 22). According to table 4 acceleration with high power demand have increasing effect on emissions and fuel consumption while acceleration with moderate power demand have increasing effect fuel consumption.

Young drivers showed a main effect in lower values on the factor for late gear changing from gear 2 and 3 (figure 23). Younger drivers also had significant positive effect for driving at gear 2 and 3 at lower engine speeds (see figure 23). In summary the results indicate that the younger drivers to some extent had a more energy-efficient gear-changing behaviour, that is, not driving long periods at high engine speeds before changing to a higher gear. The results indicate that young drivers had a better gear changing behaviour from an environmental point of view.

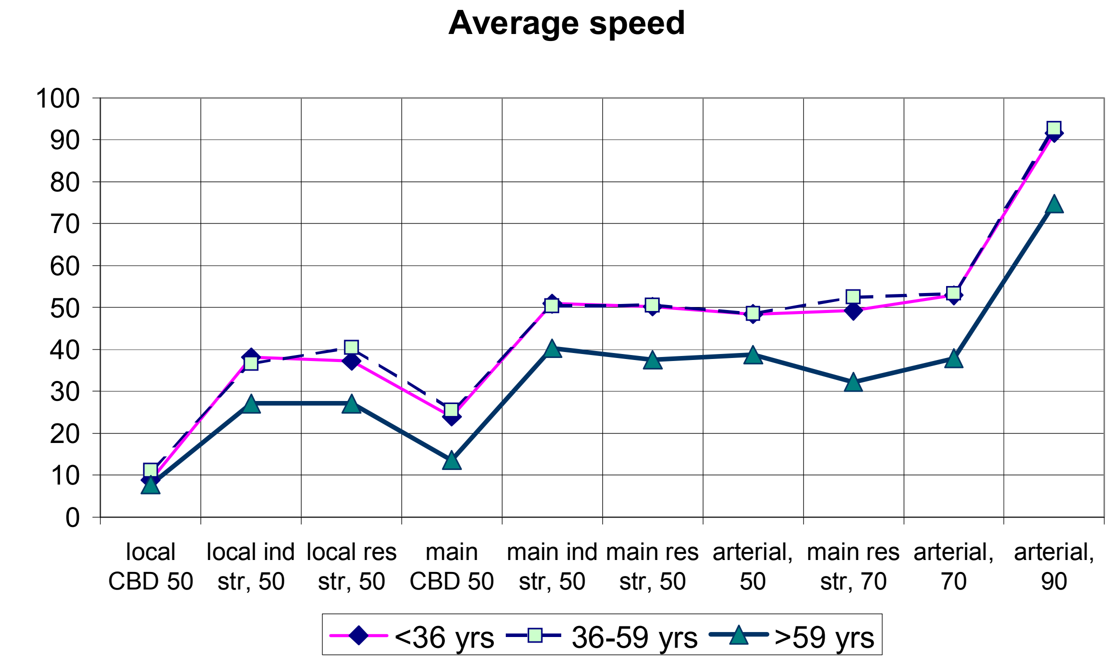


Figure 20 Average speed at different street types for different driver ages. Drivers distributed over gender and car performances as in sample. Other outside conditions than street type was assigned base values.

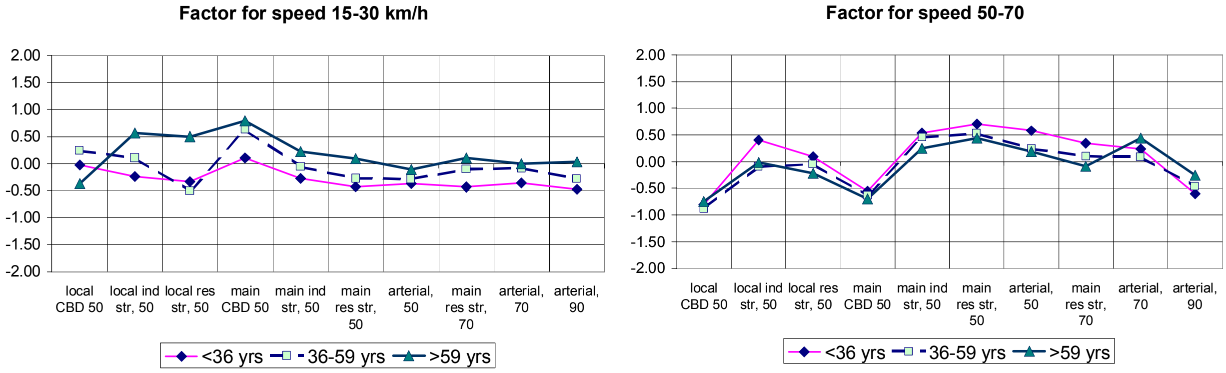


Figure 21 Factor for speed 15-30 km/h and for speed 50-70 km/h at different street types for different driver ages. Drivers distributed over gender and car performances as in sample. Other outside conditions than street type was assigned base values.

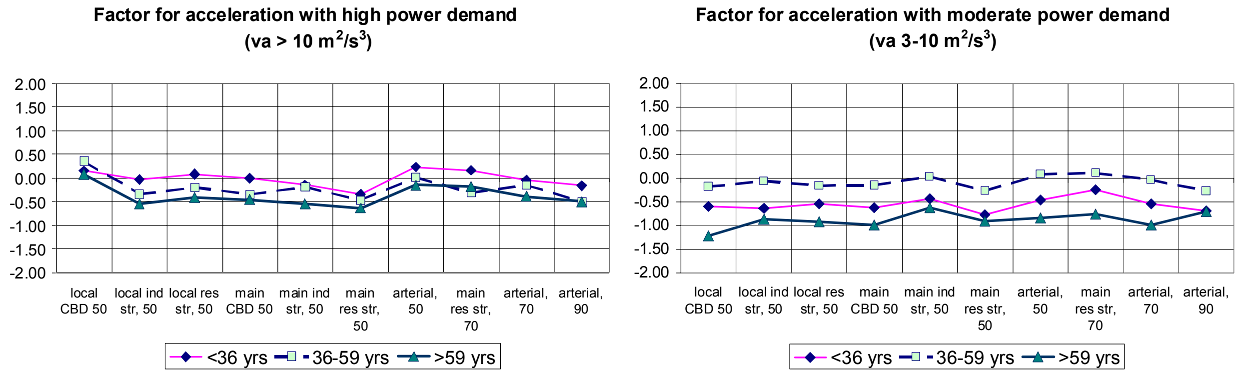


Figure 22 Factor for acceleration with high respective moderate power demand at different street types for different driver ages. Drivers distributed over gender and car performances as in sample. Other outside conditions than street type was assigned base values.

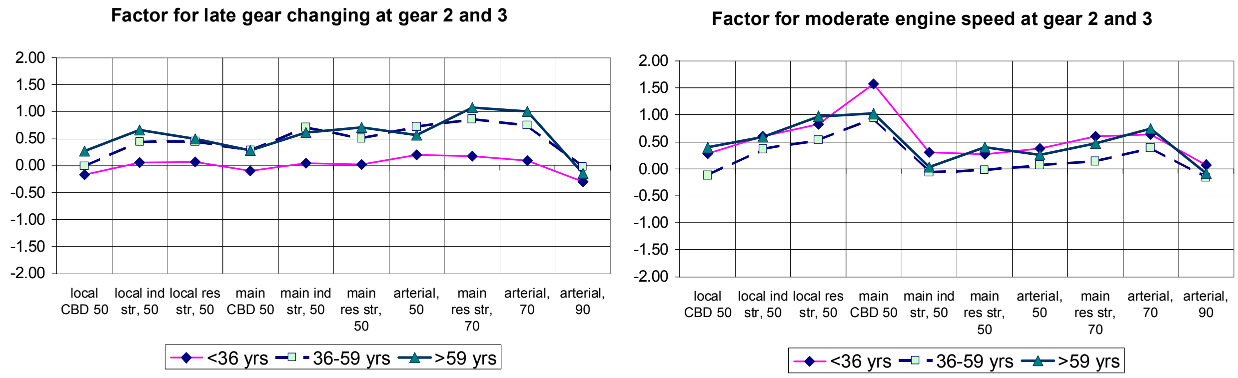


Figure 23 Factor for late gear changing from gear 2 and 3 and the factor for moderate engine speeds when at gear 2 and 3 at different street types for different driver ages. Drivers distributed over gender and car performances as in sample. Other outside conditions than street type was assigned base values.

Effect of gender

Comparing female and male drivers, female drivers had significantly lower average speed in general (see figure 24). The overall difference was about 8-12 km/h.

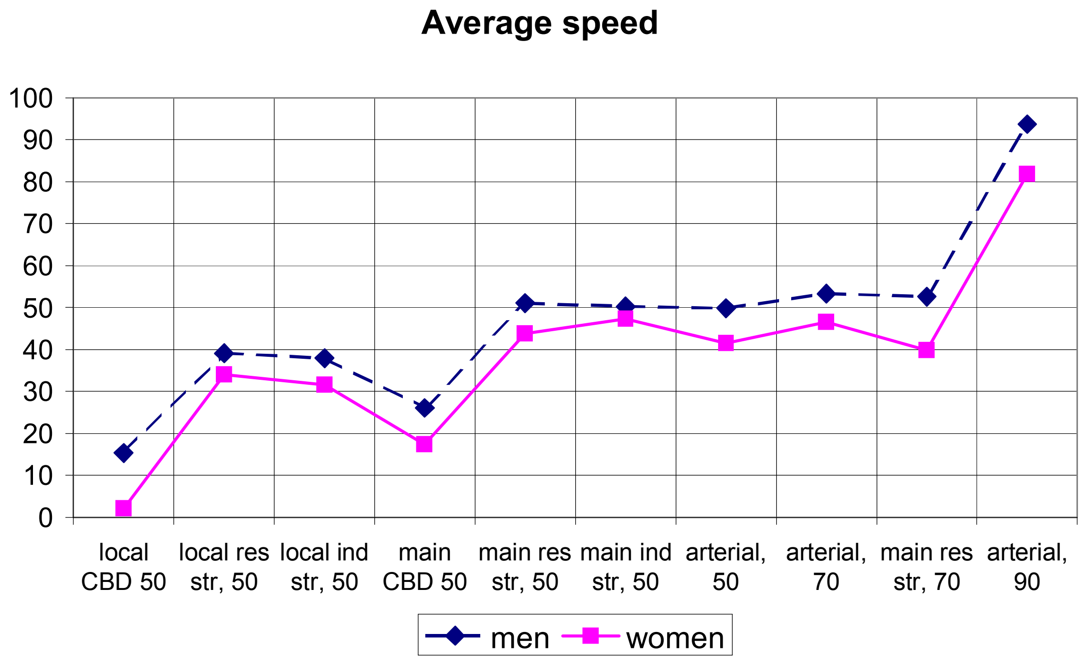


Figure 24 Average speed for male and female drivers at different street types. Drivers distributed over ages and car performances as in sample. Other outside conditions than street type was assigned base values.

Other differences in speed behaviour was that female drivers had lower values on the factors for speed 50–70 km/h and for speed 90–110 km/h and very much lower on speed over 110 km/h. On local city streets female drivers had much higher values on the factor for speed 15–30 km/h (figure 25).

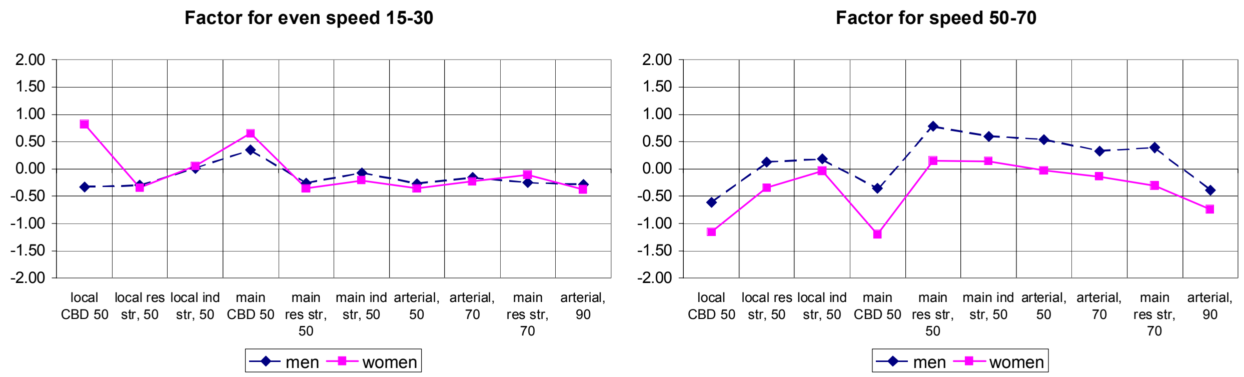


Figure 25 Factors for 15-30 km/h and 50–70 km/h, respectively, for male and female drivers at different street types. Drivers distributed over ages and car performances as in sample. Other outside conditions than street type was assigned base values.

In an earlier study, Ericsson (2000a) found that male and female drivers had significant differences in acceleration patterns, stating that men had higher proportions of high acceleration levels. In this study female drivers as well as elderly drivers tended to have lower values on moderate as well as high-power demand accelerations, figure 22 and 26. Accelerations with high as well as moderate power demand have increasing effects on the environmental effects according to table 4.

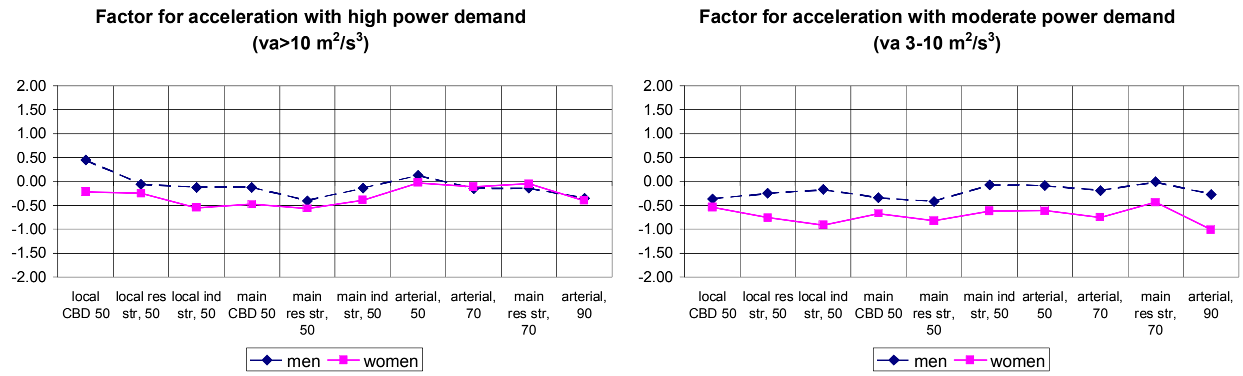


Figure 26 Factors for accelerations with respective high and moderate power demand for male and female drivers at different street types. Drivers distributed over ages and car performances as in sample. Other outside conditions than street type was assigned base values.

Concerning gear-changing behaviour, significant differences were found between male and female drivers. Women had higher values in general on the factor for late gear changing, describing the existence of high percentages of time at high engine speeds when in gear 2 and 3 (figure 27). This factor implies driving relatively long periods at gear 2 and 3 while the engine speed exceeds 2500 rpm, without changing to a higher gear. However, women also tended to have higher values at moderate engine speed s when at gear 2 and 3. This indicate that female drivers had some higher tendency to drive at moderate engine speeds at the low gears[10], yet when raising their speed they tended to keep the lower gear longer than male drivers did. The factor for late gear changing has increasing effect on emissions and fuel consumption.

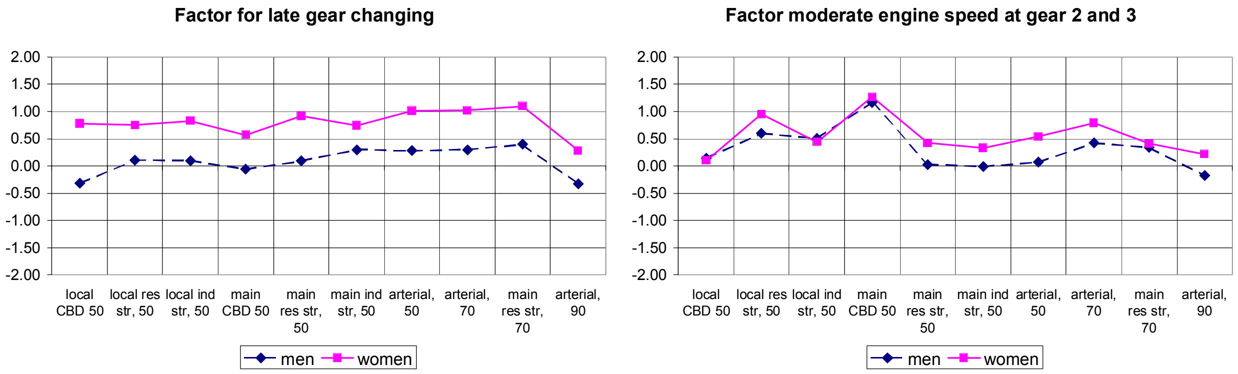


Figure 27 Factor for late gear changing and factor for moderate engine speed at gear 2 and 3 for male and female drivers at different street type. Drivers distributed over ages and car performances as in sample. Other outside conditions than street type was assigned base values.

Effect of car performance

One simple hypothesis about people's choice of car could be that people who buy a high-performance car like to drive fast and/or to accelerate using high power. In this study of urban driving nothing supports this hypotheses. The high-performance car was found to have lower average speed compared with lower-performance cars (see figure 28). The owner of high-performance cars in this study seemed to use moderate speed and to avoid exceeding speed limits. In figure 29 it is shown that the high-performance cars had low values on the factor for speed 70–90 km/h except on arterial roads with speed limit 90 km/h. Further, they had low values for the

[10] Which have decreasing effect on the factors for emissions of NOx and fuel consumption according to table 4.

factor for speed 90–110 km/h and for speed > 110 on all streets types. High performance cars had higher values on the factor for speed 15-30 on local streets and on main streets in CBD. Medium performance cars tended to have the highest values on the fastest speed levels according to this investigation.

When studying the amount of acceleration with high or moderate power demand high-performance cars tended to have lowest values for both. Consequently according to this study cars of high-performance might be driven in to a greater extent using low power by their owners (figure 30). Yet, on one street type, main residential streets with speed limit 70 km/h, the high-performance car had significantly higher values for use of high power.

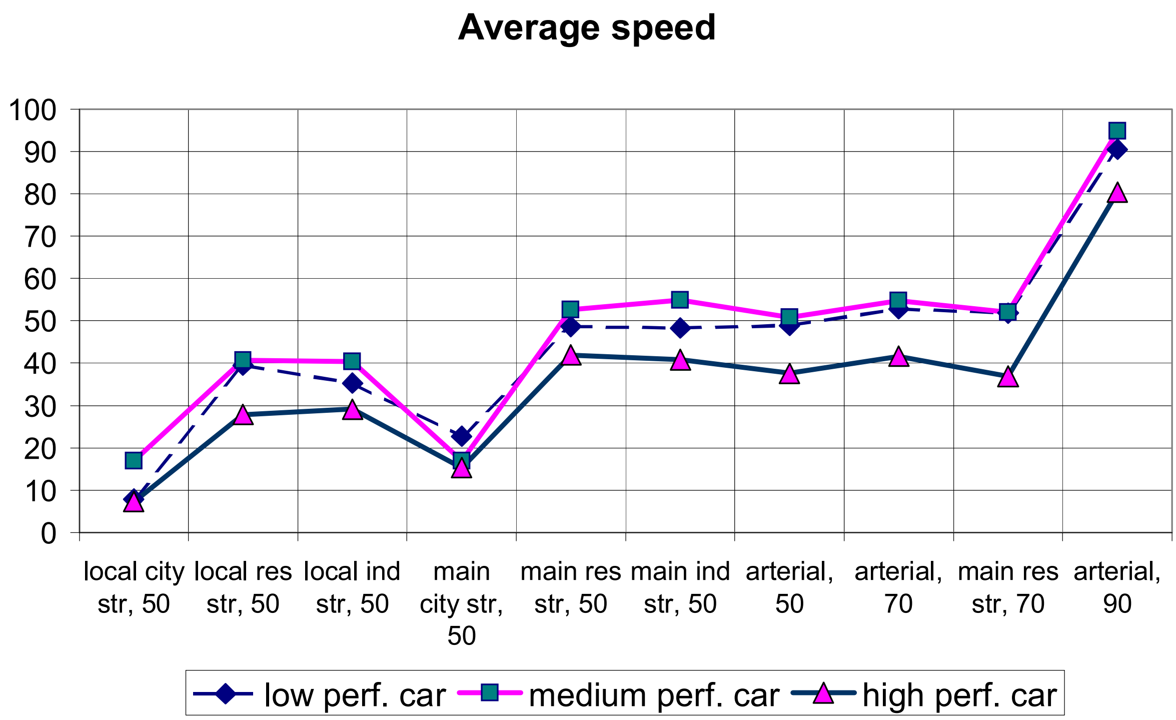


Figure 28 Average speed for cars with different levels of performance at different types of streets. Drivers distributed over ages and gender as in sample. Other outside conditions than street type was assigned base values.

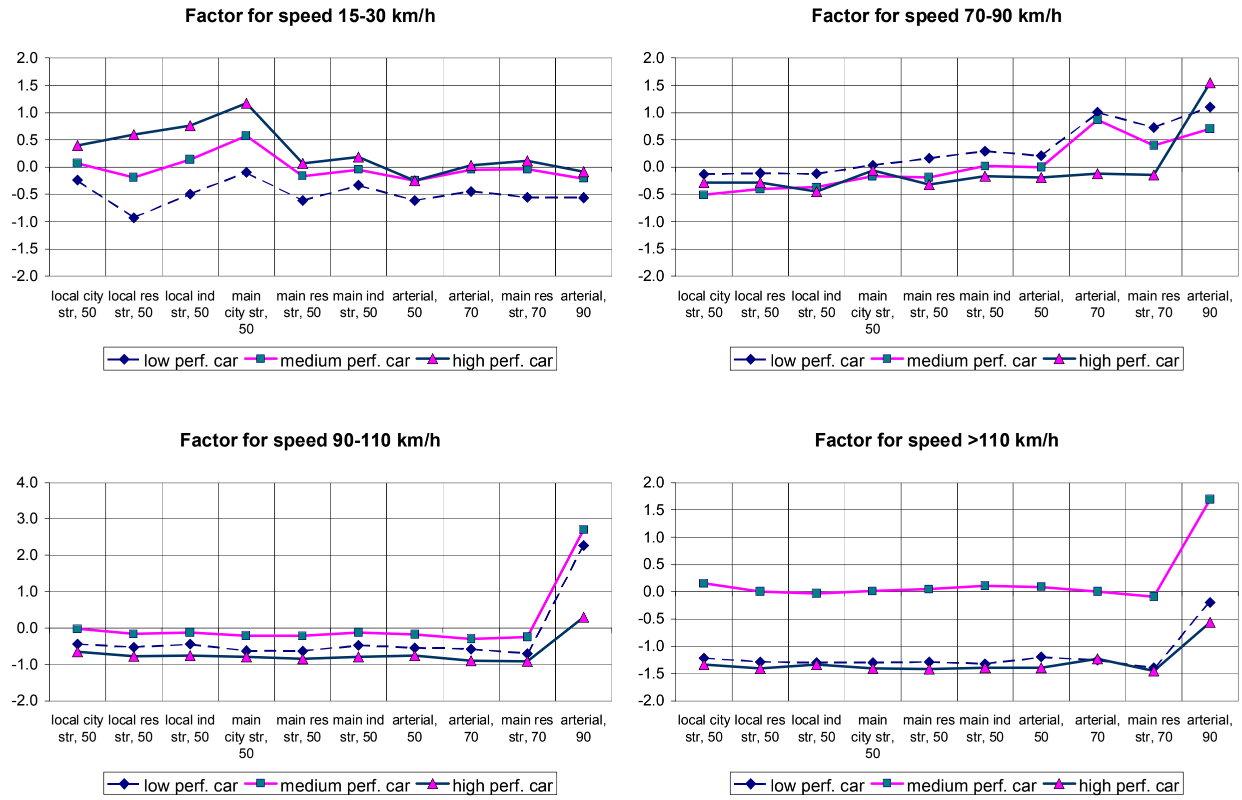
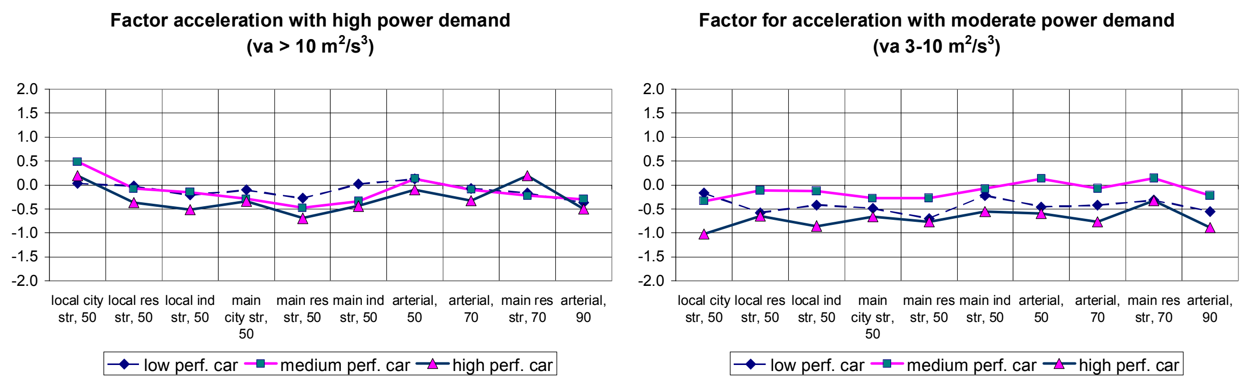


Figure 29 Factors for speed 15-30 km/h, 70-90 km/h, 90–110 and > 110 km/h for cars with different levels of performance at different types of streets. Drivers distributed over ages and gender as in sample. Other outside conditions than street type was



assigned base values.

Figure 30 Factors for medium and high power demand for cars of different performance at different types of streets. Drivers distributed over ages and gender as in sample. Other outside conditions than street type was assigned base values.

The factor for late gear changing from gear 2 and 3 showed a significant and systematic effect for different car performance. Low-performance cars had higher values and high-performance cars had lower values (figure 31). This pattern has an exception on main residential streets with speed limit 70 km/h where the values of medium performance cars exceeded the low-performance cars. The factor for moderate engine speed when at gear 2 and 3 was in general highest for the high-performance car. Altogether this indicates that driving a high-performance car might promote quick gearing up from gear 2 and 3, maybe due to a feeling that extra power is available if needed. Yet the results do not support quicker gear changing for high-performance cars at higher gears as well.

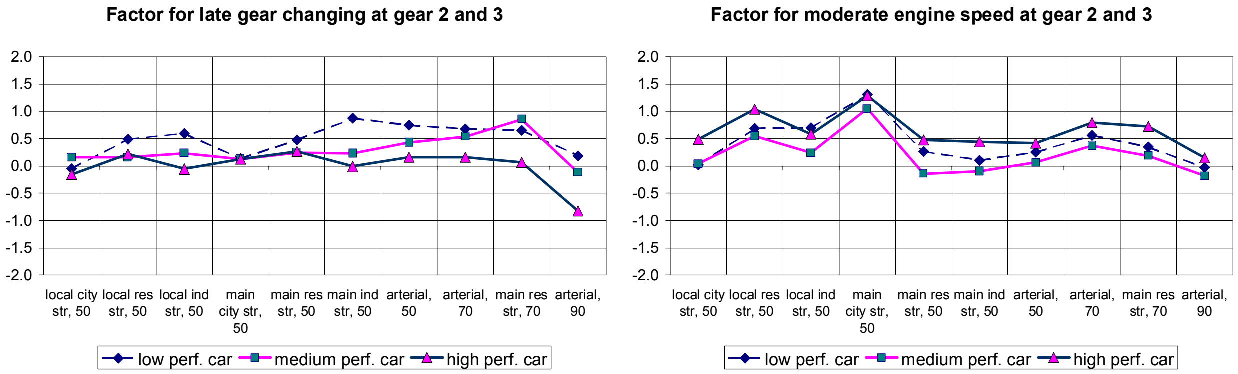


Figure 31 Factors for late gear changing from gear 2 and 3, respectively, for moderate engine speed at gear 2 and 3 for different car performance and various street types. Drivers distributed over ages and gender as in sample. Other outside conditions than street type was assigned base values.

Further driver effects

Gender, age and car choice are not the only properties that characterise a driver, still the results above show that these subsections are useful explanatory variables for the variation of driving patterns. The general variation among drivers was, of course, larger than the estimated differences for gender, age and type of car. In table 18 the maximum variation between drivers in the study is reported. This deviation is a measure of the variation that is not explained by the fact that the drivers were of different gender and age, that they had chosen different car performances when buying a car and that the differences that are explained by their driving on different street types at different traffic flow conditions.

Table 18 Maximum deviation of driving pattern factors for different drivers.

Driving pattern factor	Driver difference (max – min)
Average speed	19.1
Deceleration factor	1.83
Factor for accelerations with strong power demand	0.55
Stop factor	0.64
Speed oscillation factor	1.00
Factor for acceleration with moderate power demand	1.77
Extreme acceleration factor	0.70
Factor for even speed 15–30	1.42
Factor for speed 90–110	1.53
Factor for speed 70–90	1.11
Factor for speed 50–70	1.20
Factor for late gear changing from gear 2 and 3	2.42
Factor for engine speed >3500	1.40
Factor for speed >110	4.5
Factor for moderate engine speeds at gear 2 and 3.	1.22
Factor for low engine speed at gear 4	1.64
Factor for low engine speed at gear 5	1.78

4.3.3 Summary of the effects

The estimated model had highest amount of variance explained for speed variables. In table 19 different external variables effect on average speed is summarised.

CBD was found to be the ***type of area*** that deviated the most from other environments. At CBD the average speed was lower on local streets as well as on main streets compared to other types of areas. No significant difference was found between residential and industrial areas when it concerned average speed. Looking at ***street functions***, local streets deviated most significant from other street functions (main streets and arterial streets). Changed ***speed limit*** from 50 to 70 km/h showed a minor effect while raised speed limit to 90 km/h increased speed considerable. Short distances between intersections, i.e. high ***intersection density*** decreased speed systematically except on local and main streets except in the CBD. Four lanes instead of two showed a minor lowering effect on the speed. Higher ***traffic flow*** did not have such clear effect that could have been expected. However it is important to keep in mind that the street net of an ordinary sized Swedish city is normally very little congested. Further high traffic flow most commonly occur at streets with a high traficability standard. Arterial streets and main street in residential areas showed lower average speeds at higher traffic flow. The effect of ***age*** was foremost shown to consist of differences between drivers > 59 years and other drivers. Elderly drivers were found to drive more slowly. ***Female*** drivers were found to have lower average speeds than men had and owners of high ***performance*** cars drove slower than owners of medium or low performance cars.

Table 19 The effect of different variables on average speed. **~** = no effect

Variable	Effect on average speed (km/h)	Comment
Type of area	+(20-25)	CBD and other
	~	Between areas except CBD
Street function	+(10-14)	Local and main street in same type of area.
	~	No significant effect between main and arterial streets
Speed limit	<+5	50➪70
	+42	Large effect for 70➪90 km/h on arterial.
Intersection distance	-(4-5) per level	Systematic effects on local and main streets except CBD.
Number of lanes	-(0-6)	Low effect, 4 lanes
Snow	~	No effect
Traffic flow	~	Local streets no systematic effect
	~	Main CBD and Ind no systematic effect
	-(2-10) per flow level	Main streets in res areas and arerials, systematic decreasing effect of higher flow
Driver age	~	Local CBD
	-(10-20)	Other than local CBD, elderly drivers
Driver gender	-(5–13)	Different effect on different street types, female drivers
Choice of car performance	-(7-15)	Different effect on different street types
Other driver effect	20	Different effect on different drivers

For the driving pattern factors, with the exception of speed, it is even more important to emphasise that fact that the values vary significantly beyond what is explained by the model. Nevertheless some systematic and significant effects were found:

- Longer distances between passed intersections tended to increase the amount of speed oscillations.
- Elderly drivers, female drivers and drivers of high-performance cars tended to use less power while accelerating, i.e., had lower product of speed and acceleration.
- Younger drivers, male drivers and drivers of high-performance cars tended to have more energy-efficient gear changing in gear 2 and 3.

The results presented above were based on significant and fairly large effects. However, many of the from and environmental point of view most important driving pattern ***factors*** was not modelled with any high degree of accuracy by the presented prediction model. Yet in table 20 some tendencies for those factors are presented. In the table the influence of street environment is presented separate from the influence of driver characteristics. Thus, the table gives an indication whether a certain driving pattern characteristic seems to be especially influenced by street- and traffic- variables or if it is more depending on the driver characteristics. For street environment the effects is reported if it deviate 0.5 standard deviation or more from the overall mean (that is 0). For driver characteristics the effect is reported if the difference between two levels is 0.5 standard deviation or more.

Table 20 indicate that the street environment as well as the driver characteristics affect the reported driving pattern factors. Yet some of the driving pattern ***factors*** are predominantly affected by street environment while some are more influenced by the driver characteristics according to this study. Thus, the stop factor and the speed oscillation factor was found to be more influenced by street environment than by driver characteristics while the ***factors*** for extreme accelerations and engine speeds (>3500 rpm) was found to be mainly affected by driver characteristics. The other driving pattern factors was found to be influenced by a mix of street environment and driver variables.
The results presented in table 20 have to be used with caution since so large proportions of the total variance remain unexplained. Other interactions than the ones here investigated and/or other explanatory variables might have larger influence than the ones that was tested in this model. The so far found relations, should be seen as hypothesises that ought to be tested in further research.

Table 20 The influence of street environment respective driver characteristics on nine driving pattern ***factors*** (for definition see table 3 and 4). Pluses and minuses describe the effect size and sign, on plus/- mean approximately a difference of 0.5 standard deviation.

Driving pattern factor	Street characteristic	Effect Size	Driver characteristic	Effect Size
Factor for accelerations with strong power demand	Local streets in CBD	++	Elderly >Young drivers	+
	Main street in CBD	-	Male drivers at local streets in CBD	+
	Main res. Street 70	--		
	Arterial 90	-	High performance car	-
Stop factor	Local streets in CBD	++		
	Main res. Street 70	-		
Speed oscillation factor	Local streets in CBD	+++		
	Local ind street	++		
	Local res street	+		
	Main street in CBD	++		
	High intersection density	--		
Factor for acceleration with moderate power demand	Local streets in CBD	--	Middle aged >Elderly drivers	--
	Main streets 50	--	Female drivers	-
	Local ind street	-	Medium perf. car >High perf. car	-
	Local res street	-		
			High perf. car on main res. Street 70	+
Extreme acceleration factor	Local streets in CBD	+	Low perf. car on local street	+
			High perf. car on local street in CBD	--
			Female driver in CBD	-
Factor for late gear changing from gear 2 and 3	Main res. street 70	++	Female driver	++
	Arterial 70	+	Young driver	-
			High performance car	-
Factor for engine speed >3500	Arterial 70	+	Medium perf car	+
			Medium perf car on arterial 90	++
			Middle aged driver	+
Factor for moderate engine speeds at gear 2 and 3.	Local res. street	++	Female driver	+
	Local ind. street	+	Young driver in main CBD	+
	Local street CBD	+	High performance car	+
	Main street CBD	+		
	Main res. street	+		
No effects > 0.5 standard deviation		24		18

5 Discussion

In the initial descriptive analysis the average of certain driving pattern measures was reported for different street types. In the second analysis the aim was to investigate what driving conditions (street environment variables, traffic flow, weather, driver and car characteristics) that cause differences in driving patterns.

A cause-effect model was tested. The model attracted attention to some phenomenon causing significant changes in the driving patterns.

Speed was found to be affected by outside conditions as well as driver characteristics. Speed was highly affected if driving at CBD compared to other types of areas. Note that this effect was significant while intersection density, traffic flow, number of lanes, drivers etc was held constant. This illustrates that the driving pattern, in this case speed, is affected by other outside conditions than street function and street design. At CBD other traffic-related variables, not included in the model, probably have influence e.g. traffic mix (inclusive vulnerable road users), signalised intersection density and the general complexity of the outside environment. When it concerns street function a large effect on speed appeared when comparing local streets to main and arterial streets. Most driving pattern studies have been performed at main and arterial streets while local streets are less represented. According to this study driving at local streets included 18 % of the distance and 30 % of the total duration of urban driving.

Speed oscillation was found to increase with lower intersection density. This result partly contradict the traditional concept where the street net is divided into links and nodes (intersections) while assuming that stops and oscillations of the speed curve is assigned to the nodes (figure 32).

An alternative hypothesis about speed and speed oscillation can be generated by combining the presented results on speed and speed oscillations, figure 33. Larger intersection distances makes it possible to raise the speed more at links between intersection which is one reason for increased speed oscillation. Possibilities to raise speed more is likely to induce less homogenous speed distributions among vehicles on the links which leads to more interactions between vehicles and consequently higher amounts of speed oscillations at the links. Further shorter intersection distances is likely to lead to lower speeds at the links since it might neither be possible nor worth while to accelerate a lot when new intersections (or other obstacles) appear with short distances. Lower speeds give larger possibilities to take action in time before intersections, which reduce the risk of getting high amounts of speed oscillations. According to the hypothesis illustrated in figure 33 shorter intersection distances would induce lower speeds and fewer oscillations of the speed curve compared to longer intersection distances. The generated hypothesis is supported by the result of the present study saying that 1) increased intersection density decreases speed and 2) increased intersection density decrease speed oscillation while decreased intersection density increase speed oscillation (number of local max and min values on the speed curve).

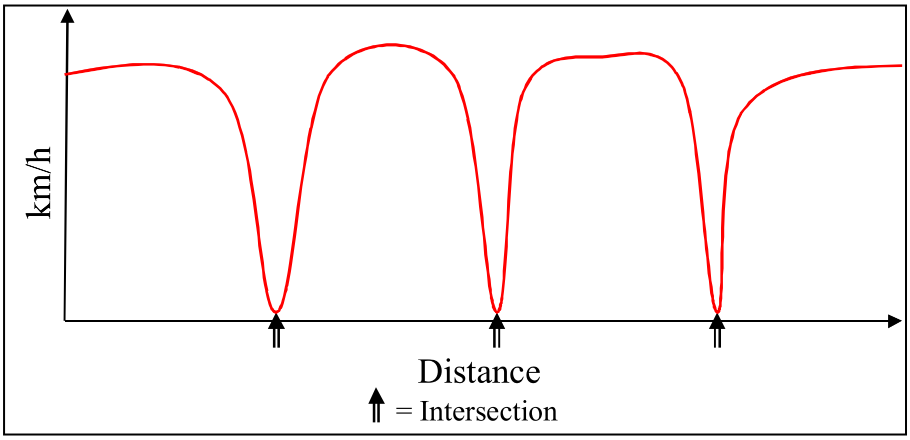


Figure 32 Common concept of driving patterns at links and intersections.

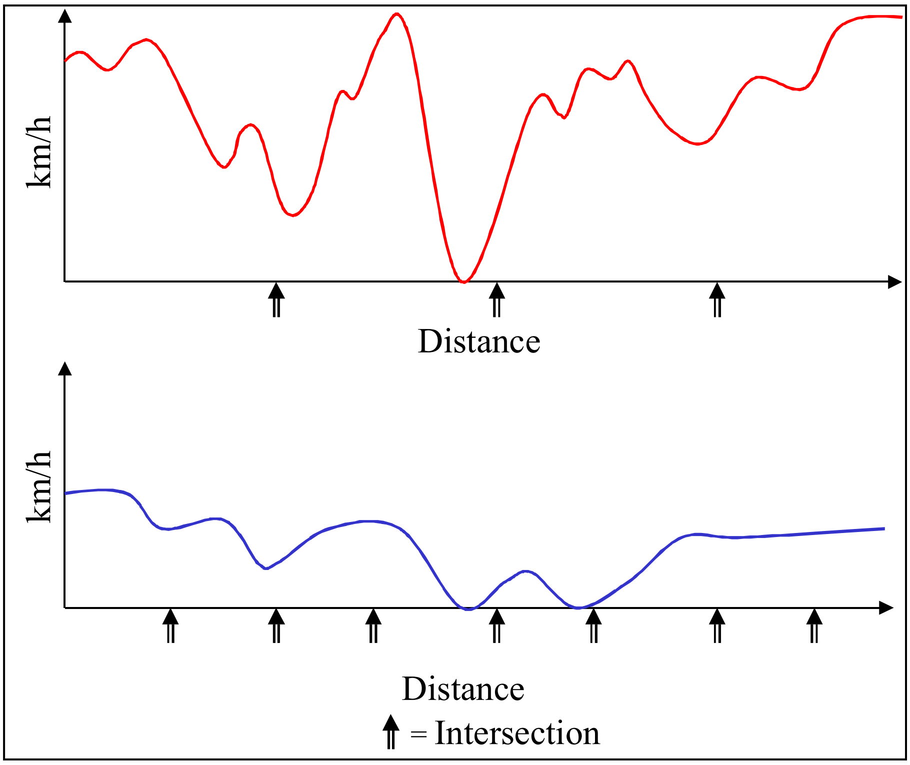


Figure 33 New hypothesis of the effect of increased intersection density on speed and oscillation of the speed curve based on the results of the present study.

Smidfelt Rosqvist (1998) found that intersections and humps in residential areas induced an overall ***decrease*** in emission and fuel consumption. In her study emissions were studied as a function of street design without analysing the corresponding driving patterns. Yet Smidfelt Rosqvist (1999) hypothesised that the results of her study could be explained by lower average speeds and reduced possibilities to drive with a high level of jerkiness when obstacles, e.g. intersections or humps, are present. Maybe her most interesting conclusion is that "***Characteristics of the street configurations affect the driving pattern in a way that can not be limited to a certain spot in space or time.***"(Smidfelt Rosqvist, 1999). The findings discussed above supports those theories and results.

The results on the effects on car performance were unexpected. The high performance cars were found to be driven with significantly lower speeds by their owners than other cars. As have been earlier emphasised the car performance was interpreted as a driver characteristic since the subjects that drove the high performance cars was owners of a high performance car as well. Then it might be, that people that buy a large[11] strong car is not the kind of drivers that like to drive fast or accelerate a lot when driving in urban areas. However, since the total number of cars in the investigation was low and since the class of high performance cars consisted or just one car these results ought to be studied more thoroughly in further investigations. The characteristic that was assigned "high performance car" might also be an effect of driving a large car, driving a car were the relative positions of the gears were adapted to urban driving or simply an effect of that particular car model. However, the result shows that different cars are driven differently by their owners and that system effects between drivers and cars exist. The findings of Austin et al (1993) at first sight seem all over contradictory to the present results. Austin et al compared drivers that were sat to drive two cars of different performance. According to that study almost all drivers experienced their maximum accelerations when driving the higher performance car. However it is not for certain that drivers that are sat to drive cars of different performance behave the same way as drivers that actually owns a car of a certain performance level. Both studies conclude that driver – car effects ought to be investigated more.

The study revealed differences between female and male drivers and drivers of different ages. Here as well it should be pointed out that the number of female drivers as well as elderly drivers in the investigation was fairly small. However the results agree with other studies e.g. Fildes et al (1991), Ericsson (2000a).

The tested cause-effect model reached low shares of explained variance for the driving pattern factors except speed variables. Possible causes for low explanatory power is:

1) The individual variation between driving pattern is due to other factors than those included in the model. Then higher explanatory power could be achieved with other variables.
2) Interactions are present other than those included in the model. Higher explanatory power would be achieved with another model structure.
3) The explanatory variables are not described with enough accuracy. The division on street type could be too coarse, which might induce large variations within street types. However, a more detailed model would have disadvantages since it already is reasonably large. Yet, higher explanatory power could be possible if variables with low contribution to the variance were exchanged by others that improve the model.

This first model served as a preliminary test of the effect of the different types of factors described in the cause effect model in figure 1. Several variables beyond those included in the model have been measured, e.g., number of passed signalled intersections, share of heavy vehicles, frequency of right and left turning at intersections, etc. For practical reasons and because of computer restrictions it was not possible to test a full model with all variables and interactions included. Even if possible, the results of a more complex model would have been even more difficult to present as well as interpret (Brundell-Freij, 1999). Thus, the present study used a set of variables and interactions that was judged a priori to be reasonable.

There are reasons to believe that models with higher explanatory power could be estimated for the driving pattern dimensions with the exception of speed. For example, the R^2 for the model predicting the factor for acceleration with high power demand was increased from 0.1 to 0.2 after

[11] The high performance car in the study was as well a large car

some systematic exchanges of variables and testing of new interactions. Yet, additional testing might induce further improvement, but the results of this study indicate that any cause effect models for different driving pattern dimensions will have rather large shares of unexplained variations. Any useful model for predicting in what direction driving patterns will change due to different circumstances would most certainly have a large individual variation around the result. Besides fixed conditions, traffic is always affected by occasional incidents outside and inside the car that is neither possible or even interesting to account for in a planning situation. However, the result indicates that it is possible to find significant differences among driving patterns for measurable external conditions. It is probable that different model specifications should be estimated for different driving-pattern dimensions.

Grant (1998) estimated models for vehicle modal activities[12] as a function of external conditions on freeways with high explanatory power. He suggests that separate models ought to be built not only for each modal variable but for each modal-activity level as well. Yet, freeways represent a much more homogenous environment than the variety of street types used in the model of the present study. Models for freeways exclusively thus ought to have very good prerequisite in order to get high shares of explained variance. Grant emphasises that the presented models are restricted to prediction of freeway segments.

The result illustrates the difficulty of simulating driving behaviour for a certain situation. Simulations of driving pattern that account for the variations of the different driving pattern dimensions probably ought to be preceded by additional analysis of real traffic driving pattern data.

6 Further research

The present study was able to present a prediction model that could predict speed variation in urban driving as a function of different conditions. In further research models for other driving patterns, dimensions will be estimated by using other measured, but not yet used, independent variables and model modifications.

The collected data could be used for validations and modifications of existing emission models, e.g., AIG, VTI and Trivector (1992), and EVA, Hammarström et al. (1994), Swedish National Road Administration (1996), as well as new model formulations. The data would be especially useful for description of real traffic modal activity at different kinds of intersections and links.

In Ericsson (2000b) a factorial analysis was performed to describe which dimensions driving pattern comprise. In a planned future analysis cluster, analysis will be used to study which different kinds of driving patterns existed in this urban environment.

LeBlanc et al. (1995) compared driving patterns on the same street types at three different cities. They found that significant differences in vehicle activity profiles existed among the cities investigated. The results suggest that it is not enough to collect driving pattern data within one single city. Further research ought to be performed to compare driving patterns collected in earlier studies if available and to make additional investigations to make comparisons possible. Most studies has so far been carried out on arterial roads and freeways. In future studies driving patterns on local streets and main streets ought to be included.

[12] Modal activities: stop, acceleration, deceleration and cruise

In this study as well as in Ericsson (1999) interaction effects was found between street type and driver type. In a further perspective more research ought to be performed about why different persons behave differently when the outer environment changes and what measures that would be effective for change the behaviour of different types of drivers. Such project must include researcher from different disciplines as behaviour science, social science besides traffic engineering.

7 Conclusions

An observational study of driving patterns of randomly chosen subjects has made it possible to study driving patterns in new ways. With the use of GPS, the driving patterns of each trip could be connected to a certain street environment. Driving patterns could then be described on a street-type level using a large set of parameters. The description includes distributions with respect to speed and acceleration/deceleration intervals, measures of oscillation of the speed curve, measures of power used and gear changing. Both traditionally used measures and new ***factors*** and dimensions of driving patterns are reported. Several of the investigated variables was found to vary reasonably over the street net while some variables were rather constant. Obviously the driving pattern ***factors*** that were found to have minor variations on the average over the street net are affected by other circumstances than the ones included in the street type definition.

The use of GPS was found to be more problematic and time consuming than had been anticipated. In co-operation with experts of optimisation and GIS, a method matching the GPS points to the street net was invented. The method was a necessary tool for connecting the driving patterns to the street attributes.

A model for the relation between driving pattern factors and different outside circumstances was designed and tested. The model was able to explain the variations of traffic speed in an acceptable way. For other tested driving pattern parameters the explanatory power was very low. Preliminary results indicate that higher explanatory power could be reached with partly changed explanatory variables and a modified model structure.
For speed it was found that:

- Driving in CBD had lowered the speed.
- Driving on a local street lowered the speed.
- Speed limit of 70–90 km/h raised the speed.
- Short distance between passed intersections lowered the speed.
- Four lanes instead of two had a small decreasing effect.
- Snow had no effect (the measure “snow” did not describe the actual condition of the road surface, but the general state: snow on the ground or not).
- Higher traffic flows decreased speed.
- Elderly drivers had lower speed on the average.
- Female drivers had lower speed than males.
- Drivers that usually drove a high-performance car had lower speed.

Some additional tendencies were found for driving pattern factors, with the exception of speed:

- Longer distances between passed intersections tended to increase the amount of speed oscillations.
- Elderly drivers, female drivers and drivers of high-performance cars tended to use less power while accelerating, i.e., had lower product of speed and acceleration.
- Younger drivers, male drivers and drivers of high-performance cars tended to have more energy-efficient gear changing in gear 2 and 3.

The results of driver behaviour suggest that different drivers ought to be influenced in different directions. Lately, the concept of eco-driving has been common, i.e. teaching drivers to drive more economically and more environmentally friendly, Smith (1999), Ahlvik et al. (1999). Eco-driving education for male drivers could concentrate on promoting lower power demand. For female drivers emphasis on gear changing would be of importance. The gear-changing issue might as well be solved by use of an automatic gearbox.

The results suggest that higher-performance cars in some aspects were driven in a more environmentally friendly manner. This hypothesis must be more thoroughly investigated since the present study included only one high-performance car. The fact that this car tended to be driven more calmly and with better gear changing than other cars could have explanations other than the effect/mass quotient. However, car performance had a significant and systematic effect on the factors describing gear changing in gear 2 and 3. Thus, the generally higher fuel-consumption factors of high-performance cars may in ***urban traffic*** to some extent be compensated for by more energy-efficient gear changing by their owners. Further investigations of emission and fuel consumption factors of different vehicles ought to be performed in connection with studies of how they are driven since system effects between car and driver was shown.

The overall conclusion of the investigation is that driving pattern is a complicated phenomenon that must be investigated with awareness of system effects that include the detailed as well as the overall external environment, the driver and the vehicle.

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APPENDIX 1

Table A Estimated model parameters for average speed and the 16 independent driving pattern factors. Significantly estimated parameters bold and underlined.

APPENDIX 1

MAIN EFFECTS	Average speed		Deceleration factor		Mod. power demand acc.		Stong power demand acc		Extreme acc		Oscillating speed curve		Stop factor		Factor for Speed 15-30	
Parameter	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E
Intercept	**56.63**	1.64	0.19	0.12	**0.69**	0.12	**0.00**	0.11	0.04	0.12	-0.22	0.11	**-0.29**	0.12	-0.21	0.11
[CBD]	**-25.22**	5.44	0.61	0.40	-0.55	0.39	-0.57	0.37	-0.20	0.39	**0.79**	0.38	0.27	0.39	**1.55**	0.37
[Ind. area]	0.49	2.08	-0.03	0.15	**-0.57**	0.15	**-0.18**	0.14	-0.14	0.15	0.04	0.14	0.10	0.15	0.17	0.14
[Res. area]	1.70	1.67	**-0.35**	0.12	**-0.64**	0.12	**-0.40**	0.11	-0.09	0.12	0.12	0.12	-0.12	0.12	0.18	0.11
[Art. area]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Local str]	**-16.74**	1.50	**0.68**	0.11	**0.32**	0.11	**0.30**	0.10	0.00	0.11	**0.35**	0.10	**0.36**	0.11	0.02	0.10
[Main str]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Arterial]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Sp. lim. 90]	**48.57**	3.08	**-0.55**	0.23	-0.19	0.22	-0.42	0.21	-0.12	0.22	-0.22	0.21	-0.16	0.22	0.11	0.21
[Sp. lim. 70]	**5.03**	1.70	0.18	0.12	-0.18	0.12	-0.15	0.11	**-0.38**	0.12	0.12	0.12	0.06	0.12	**0.24**	0.12
[Sp. lim. 50]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[4 lanes]	**-4.02**	0.71	**0.12**	0.05	-0.05	0.05	-0.04	0.05	-0.04	0.05	0.07	0.05	**0.15**	0.05	0.04	0.05
[2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Int. dist < 50]	**-5.01**	1.15	**-0.21**	0.08	**0.20**	0.08	**-0.13**	0.08	-0.11	0.08	**-0.69**	0.08	0.04	0.08	**0.28**	0.08
[Int. dist 50-100]	**-4.45**	0.74	-0.10	0.05	0.00	0.05	-0.04	0.05	-0.05	0.05	**-0.32**	0.05	-0.08	0.05	0.07	0.05
[Int. dist 100-200]	-1.33	0.68	-0.03	0.05	0.04	0.05	-0.03	0.05	-0.02	0.05	**-0.25**	0.05	0.06	0.05	0.02	0.05
[Int. dist >200]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow> 900]	-2.35	4.53	-0.22	0.33	-0.28	0.32	-0.28	0.30	0.12	0.32	-0.04	0.31	0.09	0.32	0.08	0.31
[Flow 700-900]	-5.83	3.61	0.19	0.26	0.45	0.26	-0.02	0.24	-0.08	0.26	-0.10	0.25	0.31	0.26	**0.74**	0.25
[Flow 500-700]	**-19.17**	6.96	0.67	0.51	-0.78	0.50	-0.08	0.47	-0.20	0.49	-0.32	0.48	0.38	0.49	**1.47**	0.48
[Flow 300-500]	**-8.12**	1.24	**0.28**	0.09	-0.11	0.09	0.32	0.08	**0.17**	0.09	**0.24**	0.09	**0.33**	0.09	0.12	0.09
[Flow 100-300]	**-3.66**	0.94	**0.23**	0.07	-0.13	0.07	0.11	0.06	0.12	0.07	0.10	0.07	**0.20**	0.07	0.05	0.06
[Flow<100]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Snow]	-1.43	0.91	0.11	0.07	0.10	0.06	0.01	0.06	0.03	0.06	-0.02	0.06	-0.03	0.06	-0.04	0.06
[No snow]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[High perf. car]	**-13.24**	1.61	**-0.74**	0.12	**-0.72**	0.11	**-0.23**	0.11	-0.15	0.11	**0.23**	0.11	0.17	0.11	**0.43**	0.11
[Low perf. car]	-1.91	1.42	**-0.23**	0.10	**-0.59**	0.10	**-0.01**	0.10	0.04	0.10	**0.38**	0.10	-0.06	0.10	**-0.37**	0.10
[Med. perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[>59 yrs]	**-9.72**	2.02	**-0.67**	0.15	**-0.92**	0.14	**-0.17**	0.14	-0.15	0.14	**0.38**	0.14	0.06	0.14	0.17	0.14
[<36 yrs]	-0.06	1.49	-0.14	0.11	**-0.54**	0.11	**0.21**	0.10	0.04	0.11	**0.24**	0.10	**-0.22**	0.11	-0.09	0.10
[36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Woman]	**-8.38**	1.79	**-0.62**	0.13	**-0.52**	0.13	**-0.16**	0.12	-0.13	0.13	0.12	0.12	-0.15	0.13	-0.09	0.12
[Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[F_PERSON, highest]	**16.12**	2.91	**1.23**	0.21	**1.25**	0.21	**-0.21**	0.05	**0.43**	0.08	**-0.83**	0.16	**-0.18**	0.08	**-0.72**	0.08
[F_PERSON, lowest]	**-3.00**	0.76	**-0.60**	0.10	**-0.52**	0.09	**0.34**	0.08	**-0.27**	0.08	0.17	0.09	**0.46**	0.12	**0.70**	0.12

Table A. Continuation. Estimated model parameters for average speed and the 16 independent driving pattern factors. Significantly estimated parameters bold and underlined.

MAIN EFFECTS	Factor for Speed 50-70		Factor for Speed 70-90		Factor for Speed 90-110		Factor for Speed >110		Gear 2 or 3 2500-3500 rpm		Engine speed >3500		Gear 2 or 3 1500-2500 rpm		Gear 4 < 1500 rpm		Gear 5 < 1500 rpm	
forts. Parameter	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E
Intercept	**0.40**	0.11	-0.10	0.11	0.14	0.10	**1.25**	0.15	0.20	0.12	**0.55**	0.13	**-0.38**	0.11	-0.13	0.12	-0.01	0.12
[CBD]	**-0.95**	0.36	-0.14	0.36	0.11	0.32	-0.05	0.50	-0.03	0.39	-0.20	0.42	0.63	0.36	**1.43**	0.39	-0.12	0.41
[Ind. area]	0.25	0.14	0.01	0.14	0.06	0.12	-0.02	0.19	0.00	0.15	0.05	0.16	0.15	0.14	-0.18	0.15	0.12	0.16
[Res. area]	**0.50**	0.11	**-0.24**	0.11	0.03	0.10	-0.07	0.15	-0.03	0.12	-0.01	0.13	-0.13	0.11	0.05	0.12	0.11	0.13
[Art. area]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Local str]	**-0.73**	0.10	**-0.25**	0.10	0.05	0.09	-0.06	0.14	-0.14	0.11	-0.16	0.12	**0.91**	0.10	**0.52**	0.11	-0.19	0.11
[Main str]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Arterial]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Sp. lim. 90]	**-0.53**	0.20	0.06	0.20	**3.29**	0.18	**4.39**	0.28	-0.13	0.22	0.36	0.24	-0.19	0.20	0.16	0.22	-0.13	0.23
[Sp. lim. 70]	**-0.39**	0.11	**1.34**	0.11	-0.09	0.10	-0.23	0.16	**0.25**	0.12	**0.55**	0.13	**0.24**	0.11	0.22	0.12	-0.02	0.13
[Sp. lim. 50]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[4 lanes]	**-0.17**	0.05	-0.01	0.05	0.06	0.04	0.02	0.07	**0.13**	0.05	-0.02	0.05	**0.24**	0.05	0.02	0.05	**-0.14**	0.05
[2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Int. dist < 50]	**-0.37**	0.08	**-0.40**	0.07	-0.10	0.07	-0.08	0.11	**-0.51**	0.08	-0.08	0.09	**-0.92**	0.08	0.00	0.08	0.03	0.09
[Int. dist 50-100]	**-0.37**	0.05	**-0.34**	0.05	-0.07	0.04	-0.07	0.07	**-0.18**	0.05	0.01	0.06	**-0.37**	0.05	**0.13**	0.05	0.01	0.06
[Int. dist 100-200]	**-0.11**	0.04	**-0.11**	0.04	-0.07	0.04	-0.03	0.06	**-0.29**	0.05	0.00	0.05	**-0.17**	0.05	0.07	0.05	-0.02	0.05
[Int. dist >200]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow> 900]	-0.36	0.30	0.14	0.30	**1.20**	0.27	**-3.80**	0.42	-0.06	0.33	-0.47	0.35	0.06	0.30	0.05	0.33	-0.10	0.34
[Flow 700-900]	**0.82**	0.24	-0.05	0.24	0.11	0.21	-0.33	0.33	0.16	0.26	0.31	0.28	0.03	0.24	0.35	0.26	0.30	0.27
[Flow 500-700]	-0.37	0.46	0.03	0.45	-0.09	0.41	-0.45	0.64	0.17	0.50	0.33	0.53	0.28	0.46	0.87	0.50	0.06	0.52
[Flow 300-500]	**-0.25**	0.08	-0.05	0.08	**0.18**	0.07	0.07	0.11	0.15	0.09	-0.13	0.10	**0.27**	0.08	0.06	0.09	**0.24**	0.09
[Flow 100-300]	-0.06	0.06	0.02	0.06	0.07	0.06	-0.01	0.09	**0.19**	0.07	0.03	0.07	**0.13**	0.06	0.04	0.07	**0.21**	0.07
[Flow<100]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Snow]	**-0.15**	0.06	-0.08	0.06	0.04	0.05	0.13	0.08	-0.10	0.07	-0.06	0.07	**0.15**	0.06	**0.20**	0.07	0.02	0.07
[No snow]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[High perf. car]	**-0.21**	0.11	-0.20	0.11	**-0.58**	0.09	**-1.49**	0.15	**-0.27**	0.12	**-0.48**	0.12	**0.36**	0.11	0.04	0.12	**-0.32**	0.12
[Low perf. car]	0.14	0.09	**0.20**	0.09	**-0.37**	0.08	**-1.29**	0.13	**0.32**	0.10	**-0.60**	0.11	**0.19**	0.09	**-0.20**	0.10	0.02	0.11
[Med. perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[>59 yrs]	-0.05	0.13	-0.12	0.13	**-0.36**	0.12	**-1.38**	0.19	-0.16	0.15	**-0.68**	0.16	0.19	0.13	0.24	0.15	-0.14	0.15
[<36 yrs]	**0.34**	0.10	0.17	0.10	**-0.43**	0.09	**-1.25**	0.14	**-0.52**	0.11	**-0.56**	0.11	**0.30**	0.10	**-0.22**	0.11	-0.06	0.11
[36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Woman]	**-0.57**	0.12	-0.08	0.12	**-0.38**	0.11	**-1.48**	0.17	**0.73**	0.13	-0.18	0.14	**0.46**	0.12	**-0.26**	0.13	-0.18	0.13
[Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[F_PERSON, highest]	**-0.43**	0.08	**-0.57**	0.17	**1.08**	0.17	**3.01**	0.27	**0.90**	0.09	**0.73**	0.11	**-0.80**	0.19	**1.17**	0.13	**1.49**	0.09
[F_PERSON, lowest]	**0.77**	0.17	**0.44**	0.08	**-0.45**	0.08	**-1.49**	0.13	**-1.52**	0.13	**-0.67**	0.10	**0.42**	0.13	**-0.47**	0.08	**-0.28**	0.10

APPENDIX 1

Table A. Continuation. Estimated model parameters for average speed and the 16 independent driving pattern factors. Significantly estimated parameters bold and underlined.

INTERACTION EFFECTS	Average speed		Deceleration factor		Mod. power demand acc.		Stong power demand acc		Extreme acc		Oscillating speed curve		Stop factor		Factor for Speed 15-30	
	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	**B**	Std. E
[CBD] * [Local str] * [Sp. lim. 50]	8.53	8.91	-0.81	0.65	-0.52	0.63	1.03	0.60	0.70	0.63	0.01	0.62	0.56	0.63	-1.15	0.61
[CBD] * [Main str] * [Sp. lim. 50]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Local str] * [Sp. lim. 50]	-0.85	2.96	-0.14	0.22	-0.14	0.21	-0.04	0.20	-0.08	0.21	**0.44**	0.21	-0.38	0.21	0.20	0.20
[Ind. area] * [Main str] * [Sp. lim. 50]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Local str] * [Sp. lim. 50]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 70]	**12.66**	4.83	**-0.88**	0.35	**1.12**	0.34	**-0.36**	0.33	0.03	0.34	-0.25	0.34	-0.49	0.34	-0.44	0.33
[Res. area] * [Main str] * [Sp. lim. 50]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[CBD] * [Local str] * [Sp. lim. 50] * [>59 yrs]	6.39	4.66	-0.03	0.34	-0.11	0.33	-0.12	0.31	-0.32	0.33	-0.10	0.32	-0.06	0.33	**-0.78**	0.32
[CBD] * [Local str] * [Sp. lim. 50] * [<36 yrs]	-2.19	3.40	-0.24	0.25	0.12	0.24	-0.42	0.23	-0.27	0.24	-0.43	0.24	**0.48**	0.24	-0.18	0.23
[CBD] * [Local str] * [Sp. lim. 50] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[CBD] * [Main str] * [Sp. lim. 50] * [>59 yrs]	-2.22	3.39	0.41	0.25	0.09	0.24	0.06	0.23	-0.22	0.24	0.03	0.24	0.11	0.24	-0.01	0.23
[CBD] * [Main str] * [Sp. lim. 50] * [<36 yrs]	-1.48	3.66	-0.21	0.27	0.07	0.26	0.13	0.25	0.34	0.26	-0.28	0.25	0.03	0.26	-0.44	0.25
[CBD] * [Main str] * [Sp. lim. 50] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Local str] * [Sp. lim. 50] * [>59 yrs]	0.19	3.43	-0.31	0.25	0.11	0.24	-0.04	0.23	-0.05	0.24	-0.20	0.24	0.02	0.24	0.29	0.24
[Ind. area] * [Local str] * [Sp. lim. 50] * [<36 yrs]	1.63	2.15	-0.22	0.16	-0.04	0.15	0.10	0.14	0.01	0.15	**-0.29**	0.15	0.14	0.15	-0.26	0.15
[Ind. area] * [Local str] * [Sp. lim. 50] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Main str] * [Sp. lim. 50] * [>59 yrs]	-0.43	2.51	0.15	0.18	0.27	0.18	-0.19	0.17	0.23	0.18	-0.20	0.17	-0.21	0.18	0.11	0.17
[Ind. area] * [Main str] * [Sp. lim. 50] * [<36 yrs]	0.58	1.72	**-0.26**	0.13	0.07	0.12	-0.18	0.12	0.13	0.12	-0.09	0.12	0.18	0.12	-0.13	0.12
[Ind. area] * [Main str] * [Sp. lim. 50] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Local str] * [Sp. lim. 50] * [>59 yrs]	**-3.68**	1.72	-0.18	0.13	0.16	0.12	-0.04	0.12	0.11	0.12	-0.13	0.12	0.04	0.12	**0.83**	0.12
[Res. area] * [Local str] * [Sp. lim. 50] * [<36 yrs]	**-3.17**	1.12	-0.10	0.08	0.15	0.08	0.06	0.08	-0.13	0.08	0.06	0.08	0.09	0.08	**0.26**	0.08
[Res. area] * [Local str] * [Sp. lim. 50] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 70] * [>59 yrs]	**-10.53**	2.25	**0.46**	0.16	0.06	0.16	0.30	0.15	0.18	0.16	-0.09	0.16	**0.33**	0.16	0.03	0.15
[Res. area] * [Main str] * [Sp. lim. 70] * [<36 yrs]	-3.15	2.51	-0.03	0.18	0.19	0.18	0.26	0.17	-0.03	0.18	0.07	0.17	0.14	0.18	-0.25	0.17
[Res. area] * [Main str] * [Sp. lim. 70] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 50] * [>59 yrs]	**-3.37**	1.59	**0.38**	0.12	**0.28**	0.11	**0.00**	0.11	-0.13	0.11	-0.18	0.11	0.05	0.11	0.19	0.11
[Res. area] * [Main str] * [Sp. lim. 50] * [<36 yrs]	-0.32	1.10	-0.16	0.08	0.04	0.08	-0.09	0.07	-0.12	0.08	-0.10	0.08	-0.03	0.08	-0.06	0.08
[Res. area] * [Main str] * [Sp. lim. 50] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90] * [>59 yrs]	**-8.24**	2.48	0.16	0.18	**0.49**	0.18	**0.17**	0.17	0.22	0.18	-0.13	0.17	0.28	0.18	0.14	0.17
[Art. area] * [Arterial] * [Sp. lim. 90] * [<36 yrs]	-1.01	1.57	-0.05	0.11	0.12	0.11	0.12	0.11	-0.02	0.11	0.02	0.11	0.12	0.11	-0.11	0.11
[Art. area] * [Arterial] * [Sp. lim. 90] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70] * [>59 yrs]	**-5.75**	1.63	0.19	0.12	-0.04	0.12	-0.08	0.11	0.14	0.12	-0.11	0.11	0.10	0.12	-0.09	0.11
[Art. area] * [Arterial] * [Sp. lim. 70] * [<36 yrs]	-0.33	1.09	**-0.29**	0.08	0.03	0.08	-0.11	0.07	**0.22**	0.08	-0.07	0.08	0.00	0.08	**-0.19**	0.07
[Art. area] * [Arterial] * [Sp. lim. 70] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [>59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [<36 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.

APPENDIX 1

Table A. Continuation. Estimated model parameters for average speed and the 16 independent driving pattern factors. Significantly estimated parameters bold and underlined.

INTERACTION EFFECTS	Factor for Speed 50-70		Factor for Speed 70-90		Factor for Speed 90-110		Factor for Speed >110		Gear 2 or 3 2500-3500 rpm		Engine speed >3500		Gear 2 or 3 1500-2500 rpm		Gear 4 < 1500 rpm		Gear 5 < 1500 rpm	
forts.	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	**B**	Std. E
[CBD] * [Local str] * [Sp. lim. 50]	0.58	0.58	-0.23	0.58	0.14	0.52	0.18	0.82	-0.14	0.64	0.40	0.68	**-1.22**	0.59	**-1.51**	0.65	0.52	0.67
[CBD] * [Main str] * [Sp. lim. 50]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Local str] * [Sp. lim. 50]	0.07	0.19	-0.08	0.19	0.03	0.17	-0.17	0.27	0.04	0.21	-0.08	0.23	**-0.55**	0.20	0.05	0.21	0.16	0.22
[Ind. area] * [Main str] * [Sp. lim. 50]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Local str] * [Sp. lim. 50]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 70]	0.28	0.32	-0.34	0.32	-0.27	0.28	0.07	0.45	0.27	0.35	-0.17	0.37	0.26	0.32	-0.21	0.35	-0.45	0.36
[Res. area] * [Main str] * [Sp. lim. 50]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[CBD] * [Local str] * [Sp. lim. 50] * [>59 yrs]	0.18	0.31	0.17	0.30	-0.10	0.27	-0.01	0.43	0.43	0.33	0.14	0.36	0.33	0.31	0.05	0.34	0.23	0.35
[CBD] * [Local str] * [Sp. lim. 50] * [<36 yrs]	-0.27	0.22	0.02	0.22	-0.11	0.20	-0.12	0.31	0.37	0.24	0.07	0.26	0.10	0.23	0.05	0.25	-0.15	0.26
[CBD] * [Local str] * [Sp. lim. 50] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[CBD] * [Main str] * [Sp. lim. 50] * [>59 yrs]	-0.01	0.22	0.13	0.22	-0.11	0.20	-0.03	0.31	0.16	0.24	0.18	0.26	-0.10	0.22	-0.02	0.25	-0.10	0.25
[CBD] * [Main str] * [Sp. lim. 50] * [<36 yrs]	-0.25	0.24	-0.27	0.24	-0.09	0.22	-0.10	0.34	0.14	0.26	0.11	0.28	0.33	0.24	**-0.77**	0.26	-0.01	0.27
[CBD] * [Main str] * [Sp. lim. 50] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Local str] * [Sp. lim. 50] * [>59 yrs]	0.13	0.22	-0.06	0.22	-0.07	0.20	0.13	0.32	0.38	0.25	0.28	0.26	0.04	0.23	-0.09	0.25	-0.04	0.26
[Ind. area] * [Local str] * [Sp. lim. 50] * [<36 yrs]	0.16	0.14	-0.14	0.14	0.00	0.13	0.12	0.20	0.13	0.15	0.17	0.17	-0.06	0.14	0.26	0.16	-0.21	0.16
[Ind. area] * [Local str] * [Sp. lim. 50] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Main str] * [Sp. lim. 50] * [>59 yrs]	-0.15	0.16	-0.10	0.16	-0.07	0.15	-0.04	0.23	0.07	0.18	-0.05	0.19	-0.09	0.17	0.24	0.18	-0.06	0.19
[Ind. area] * [Main str] * [Sp. lim. 50] * [<36 yrs]	**-0.25**	0.11	**0.26**	0.11	-0.09	0.10	-0.02	0.16	-0.14	0.12	-0.03	0.13	0.06	0.11	-0.09	0.12	0.03	0.13
[Ind. area] * [Main str] * [Sp. lim. 50] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Local str] * [Sp. lim. 50] * [>59 yrs]	-0.13	0.11	**0.29**	0.11	-0.10	0.10	0.03	0.16	0.21	0.12	**0.32**	0.13	**0.25**	0.11	-0.14	0.12	-0.03	0.13
[Res. area] * [Local str] * [Sp. lim. 50] * [<36 yrs]	**-0.20**	0.07	0.09	0.07	-0.04	0.07	-0.04	0.10	0.13	0.08	0.05	0.09	-0.02	0.07	**-0.17**	0.08	0.12	0.08
[Res. area] * [Local str] * [Sp. lim. 50] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 70] * [>59 yrs]	-0.14	0.15	**-0.45**	0.15	0.06	0.13	0.07	0.21	**0.37**	0.16	0.13	0.17	0.15	0.15	0.07	0.16	0.25	0.17
[Res. area] * [Main str] * [Sp. lim. 70] * [<36 yrs]	-0.10	0.16	-0.24	0.16	0.10	0.15	0.07	0.23	-0.16	0.18	-0.37	0.19	0.16	0.17	0.11	0.18	**0.41**	0.19
[Res. area] * [Main str] * [Sp. lim. 70] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 50] * [>59 yrs]	-0.04	0.10	-0.07	0.10	-0.05	0.09	-0.03	0.15	**0.36**	0.11	0.14	0.12	**0.23**	0.11	0.02	0.12	**-0.28**	0.12
[Res. area] * [Main str] * [Sp. lim. 50] * [<36 yrs]	**-0.16**	0.07	0.04	0.07	-0.10	0.06	-0.05	0.10	0.03	0.08	0.01	0.08	-0.01	0.07	-0.06	0.08	0.04	0.08
[Res. area] * [Main str] * [Sp. lim. 50] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90] * [>59 yrs]	0.26	0.16	0.22	0.16	**-0.63**	0.15	**-0.96**	0.23	0.03	0.18	**0.96**	0.19	-0.11	0.16	0.00	0.18	-0.09	0.19
[Art. area] * [Arterial] * [Sp. lim. 90] * [<36 yrs]	**-0.48**	0.10	**0.22**	0.10	**0.33**	0.09	**-1.11**	0.14	**0.25**	0.11	**-0.33**	0.12	-0.07	0.10	0.03	0.11	**0.28**	0.12
[Art. area] * [Arterial] * [Sp. lim. 90] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70] * [>59 yrs]	**0.40**	0.11	**-0.94**	0.11	0.10	0.10	0.20	0.15	**0.41**	0.12	**-0.41**	0.13	0.17	0.11	-0.13	0.12	-0.04	0.12
[Art. area] * [Arterial] * [Sp. lim. 70] * [<36 yrs]	**-0.19**	0.07	**-0.30**	0.07	0.01	0.06	0.13	0.10	-0.14	0.08	**-0.35**	0.08	-0.05	0.07	**-0.22**	0.08	**0.18**	0.08
[Art. area] * [Arterial] * [Sp. lim. 70] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [>59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [<36 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.

APPENDIX 1

Table A. Continuation. Estimated model parameters for average speed and the 16 independent driving pattern factors. Significantly estimated parameters bold and underlined.

INTERACTION EFFECTS	Average speed B	Average speed Std. E	Deceleration factor B	Deceleration factor Std. E	Mod. power demand acc. B	Mod. power demand acc. Std. E	Stong power demand acc B	Stong power demand acc Std. E	Extreme acc B	Extreme acc Std. E	Oscillating speed curve B	Oscillating speed curve Std. E	Stop factor B	Stop factor Std. E	Factor for Speed 15-30 B	Factor for Speed 15-30 Std. E
[CBD] * [Local str] * [Sp. lim. 50] * [Woman]	-4.80	3.82	-0.23	0.28	0.34	0.27	-0.51	0.26	-0.32	0.27	-0.21	0.27	0.21	0.27	**1.23**	0.26
[CBD] * [Local str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[CBD] * [Main str] * [Sp. lim. 50] * [Woman]	-0.26	3.80	0.15	0.28	0.19	0.27	-0.20	0.26	**-0.70**	0.27	0.19	0.26	-0.26	0.27	0.39	0.26
[CBD] * [Main str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Local str] * [Sp. lim. 50] * [Woman]	2.07	2.30	-0.31	0.17	-0.22	0.16	-0.28	0.15	-0.02	0.16	-0.18	0.16	**0.37**	0.16	0.13	0.16
[Ind. area] * [Local str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Main str] * [Sp. lim. 50] * [Woman]	**5.43**	2.02	0.24	0.15	-0.03	0.14	-0.09	0.14	**0.43**	0.14	0.06	0.14	-0.23	0.14	-0.05	0.14
[Ind. area] * [Main str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Local str] * [Sp. lim. 50] * [Woman]	**3.31**	1.13	-0.02	0.08	0.02	0.08	-0.03	0.08	0.08	0.08	-0.07	0.08	-0.01	0.08	0.03	0.08
[Res. area] * [Local str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 70] * [Woman]	-4.49	2.47	**0.66**	0.18	0.09	0.18	0.25	0.17	0.15	0.18	0.00	0.17	0.13	0.18	0.23	0.17
[Res. area] * [Main str] * [Sp. lim. 70] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 50] * [Woman]	1.08	1.11	**0.19**	0.08	0.12	0.08	0.00	0.07	-0.02	0.08	-0.08	0.08	0.02	0.08	-0.01	0.08
[Res. area] * [Main str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90] * [Woman]	**-3.59**	1.57	0.15	0.12	-0.22	0.11	0.11	0.11	0.04	0.11	0.11	0.11	-0.04	0.11	0.00	0.11
[Art. area] * [Arterial] * [Sp. lim. 90] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70] * [Woman]	1.46	1.11	0.03	0.08	-0.04	0.08	0.20	0.07	0.08	0.08	0.04	0.08	**-0.23**	0.08	0.02	0.08
[Art. area] * [Arterial] * [Sp. lim. 70] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Woman]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[CBD] * [Local str] * [Sp. lim. 50] * [4 lanes]	**8.78**	2.52	-0.08	0.18	0.00	0.18	-0.22	0.17	0.23	0.18	0.15	0.18	-0.34	0.18	**-0.95**	0.17
[CBD] * [Local str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[CBD] * [Main str] * [Sp. lim. 50] * [4 lanes]	**7.98**	2.73	**-0.56**	0.20	0.09	0.19	0.40	0.18	0.19	0.19	-0.29	0.19	0.27	0.19	**-0.86**	0.19
[CBD] * [Main str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Local str] * [Sp. lim. 50] * [4 lanes]	**8.34**	1.72	0.01	0.13	0.05	0.12	-0.01	0.12	0.00	0.12	**-0.47**	0.12	-0.05	0.12	-0.07	0.12
[Ind. area] * [Local str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Main str] * [Sp. lim. 50] * [4 lanes]	-1.92	1.38	-0.15	0.10	0.13	0.10	0.23	0.09	0.07	0.10	-0.07	0.10	-0.07	0.10	-0.05	0.09
[Ind. area] * [Main str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Local str] * [Sp. lim. 50] * [4 lanes]	2.70	1.71	**0.25**	0.13	0.14	0.12	0.38	0.11	0.19	0.12	0.15	0.12	0.04	0.12	**-0.35**	0.12
[Res. area] * [Local str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 70] * [4 lanes]	-4.54	2.48	-0.13	0.18	0.03	0.18	0.15	0.17	0.04	0.18	-0.04	0.17	0.11	0.18	-0.21	0.17
[Res. area] * [Main str] * [Sp. lim. 70] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 50] * [4 lanes]	**-2.16**	1.04	**0.20**	0.08	**0.22**	0.07	**0.35**	0.07	**0.17**	0.07	-0.05	0.07	**0.23**	0.07	-0.03	0.07
[Res. area] * [Main str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90] * [4 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70] * [4 lanes]	**4.78**	1.12	-0.06	0.08	0.08	0.08	0.11	0.08	**0.18**	0.08	-0.14	0.08	-0.04	0.08	**-0.17**	0.08
[Art. area] * [Arterial] * [Sp. lim. 70] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [4 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.

APPENDIX 1

Table A. Continuation. Estimated model parameters for average speed and the 16 independent driving pattern factors. Significantly estimated parameters bold and underlined.

INTERACTION EFFECTS																		
	Factor for Speed 50-70		Factor for Speed 70-90		Factor for Speed 90-110		Factor for Speed >110		Gear 2 or 3 2500-3500 rpm		Engine speed >3500		Gear 2 or 3 1500-2500 rpm		Gear 4 < 1500 rpm		Gear 5 < 1500 rpm	
forts.	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	**B**	Std. E
[CBD] * [Local str] * [Sp. lim. 50] * [Woman]	0.03	0.25	0.33	0.25	-0.14	0.22	-0.01	0.35	0.38	0.27	0.19	0.29	**-0.50**	0.25	-0.20	0.28	0.18	0.29
[CBD] * [Local str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[CBD] * [Main str] * [Sp. lim. 50] * [Woman]	-0.27	0.25	0.35	0.25	-0.04	0.22	0.04	0.35	-0.10	0.27	-0.03	0.29	-0.36	0.25	**0.62**	0.27	0.37	0.29
[CBD] * [Main str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Local str] * [Sp. lim. 50] * [Woman]	**0.35**	0.15	0.17	0.15	-0.07	0.14	0.14	0.21	0.00	0.16	0.04	0.18	**-0.53**	0.15	0.11	0.17	0.11	0.17
[Ind. area] * [Local str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Main str] * [Sp. lim. 50] * [Woman]	0.11	0.13	0.21	0.13	-0.04	0.12	0.07	0.19	**-0.29**	0.15	-0.04	0.16	-0.12	0.13	-0.20	0.15	**0.47**	0.15
[Ind. area] * [Main str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Local str] * [Sp. lim. 50] * [Woman]	0.09	0.07	**0.30**	0.07	-0.08	0.07	0.03	0.10	-0.09	0.08	0.10	0.09	-0.12	0.07	0.11	0.08	0.05	0.08
[Res. area] * [Local str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 70] * [Woman]	-0.13	0.16	0.12	0.16	0.05	0.15	-0.05	0.23	-0.03	0.18	**0.59**	0.19	**-0.39**	0.16	-0.07	0.18	0.31	0.19
[Res. area] * [Main str] * [Sp. lim. 70] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 50] * [Woman]	-0.06	0.07	0.12	0.07	0.04	0.07	0.01	0.10	0.10	0.08	0.00	0.08	-0.07	0.07	**0.18**	0.08	-0.01	0.08
[Res. area] * [Main str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90] * [Woman]	**0.22**	0.10	**0.45**	0.10	**-0.56**	0.09	**-0.62**	0.15	-0.12	0.11	**0.28**	0.12	-0.06	0.10	0.01	0.11	0.09	0.12
[Art. area] * [Arterial] * [Sp. lim. 90] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70] * [Woman]	0.10	0.07	-0.13	0.07	-0.08	0.07	0.10	0.10	0.00	0.08	-0.04	0.09	-0.10	0.07	0.01	0.08	0.10	0.08
[Art. area] * [Arterial] * [Sp. lim. 70] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Woman]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[CBD] * [Local str] * [Sp. lim. 50] * [4 lanes]	0.22	0.17	-0.02	0.16	0.00	0.15	-0.04	0.23	0.00	0.18	-0.02	0.19	**0.61**	0.17	**0.42**	0.18	0.21	0.19
[CBD] * [Local str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[CBD] * [Main str] * [Sp. lim. 50] * [4 lanes]	0.13	0.18	-0.07	0.18	-0.05	0.16	-0.05	0.25	0.13	0.20	0.04	0.21	**-0.44**	0.18	-0.03	0.20	0.05	0.20
[CBD] * [Main str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Local str] * [Sp. lim. 50] * [4 lanes]	**0.68**	0.11	0.12	0.11	-0.04	0.10	0.02	0.16	-0.02	0.12	-0.10	0.13	-0.10	0.11	0.09	0.12	0.14	0.13
[Ind. area] * [Local str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Main str] * [Sp. lim. 50] * [4 lanes]	0.09	0.09	**-0.28**	0.09	-0.08	0.08	-0.02	0.13	-0.10	0.10	0.01	0.11	-0.15	0.09	**0.38**	0.10	0.12	0.10
[Ind. area] * [Main str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Local str] * [Sp. lim. 50] * [4 lanes]	0.17	0.11	0.01	0.11	0.06	0.10	0.03	0.16	**-0.28**	0.12	0.01	0.13	**-0.45**	0.11	-0.03	0.12	0.19	0.13
[Res. area] * [Local str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 70] * [4 lanes]	0.09	0.16	**-0.56**	0.16	0.11	0.15	0.11	0.23	-0.23	0.18	**-0.63**	0.19	0.09	0.16	**0.51**	0.18	-0.08	0.19
[Res. area] * [Main str] * [Sp. lim. 70] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 50] * [4 lanes]	**-0.27**	0.07	**0.23**	0.07	0.02	0.06	0.01	0.10	-0.06	0.07	0.04	0.08	0.08	0.07	0.09	0.08	0.06	0.08
[Res. area] * [Main str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90] * [4 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70] * [4 lanes]	**0.37**	0.07	0.01	0.07	-0.05	0.07	-0.06	0.10	-0.10	0.08	-0.01	0.09	**-0.24**	0.07	0.00	0.08	0.00	0.08
[Art. area] * [Arterial] * [Sp. lim. 70] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [4 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.

APPENDIX 1

Table A. Continuation. Estimated model parameters for average speed and the 16 independent driving pattern factors. Significantly estimated parameters bold and underlined.

INTERACTION EFFECTS						
	Factor for Speed 50-70		Factor for Speed 70-90		Factor for Speed 90-110	
forts.	B	Std. E	B	Std. E	B	Std. E
[CBD] * [Local str] * [Sp. lim. 50] * [Woman]	0.03	0.25	0.33	0.25	-0.14	0.22
[CBD] * [Local str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.
[CBD] * [Main str] * [Sp. lim. 50] * [Woman]	-0.27	0.25	0.35	0.25	-0.04	0.22
[CBD] * [Main str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.
[Ind. area] * [Local str] * [Sp. lim. 50] * [Woman]	**0.35**	0.15	0.17	0.15	-0.07	0.14
[Ind. area] * [Local str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.
[Ind. area] * [Main str] * [Sp. lim. 50] * [Woman]	0.11	0.13	0.21	0.13	-0.04	0.12
[Ind. area] * [Main str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.
[Res. area] * [Local str] * [Sp. lim. 50] * [Woman]	0.09	0.07	**0.30**	0.07	-0.08	0.07
[Res. area] * [Local str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 70] * [Woman]	-0.13	0.16	0.12	0.16	0.05	0.15
[Res. area] * [Main str] * [Sp. lim. 70] * [Man]	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 50] * [Woman]	-0.06	0.07	0.12	0.07	0.04	0.07
[Res. area] * [Main str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90] * [Woman]	**0.22**	0.10	**0.45**	0.10	**-0.56**	0.09
[Art. area] * [Arterial] * [Sp. lim. 90] * [Man]	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70] * [Woman]	0.10	0.07	-0.13	0.07	-0.08	0.07
[Art. area] * [Arterial] * [Sp. lim. 70] * [Man]	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Woman]	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.
[CBD] * [Local str] * [Sp. lim. 50] * [4 lanes]	0.22	0.17	-0.02	0.16	0.00	0.15
[CBD] * [Local str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.
[CBD] * [Main str] * [Sp. lim. 50] * [4 lanes]	0.13	0.18	-0.07	0.18	-0.05	0.16
[CBD] * [Main str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.
[Ind. area] * [Local str] * [Sp. lim. 50] * [4 lanes]	**0.68**	0.11	0.12	0.11	-0.04	0.10
[Ind. area] * [Local str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.
[Ind. area] * [Main str] * [Sp. lim. 50] * [4 lanes]	0.09	0.09	**-0.28**	0.09	-0.08	0.08
[Ind. area] * [Main str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.
[Res. area] * [Local str] * [Sp. lim. 50] * [4 lanes]	0.17	0.11	0.01	0.11	0.06	0.10
[Res. area] * [Local str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 70] * [4 lanes]	0.09	0.16	**-0.56**	0.16	0.11	0.15
[Res. area] * [Main str] * [Sp. lim. 70] * [2 lanes]	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 50] * [4 lanes]	**-0.27**	0.07	**0.23**	0.07	0.02	0.06
[Res. area] * [Main str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90] * [4 lanes]	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70] * [4 lanes]	**0.37**	0.07	0.01	0.07	-0.05	0.07
[Art. area] * [Arterial] * [Sp. lim. 70] * [2 lanes]	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [4 lanes]	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.

INTERACTION EFFECTS						
	Factor for Speed >110		Gear 2 or 3 2500-3500 rpm		Engine speed >3500	
forts.	B	Std. E	B	Std. E	B	Std. E
[CBD] * [Local str] * [Sp. lim. 50] * [Woman]	-0.01	0.35	0.38	0.27	0.19	0.29
[CBD] * [Local str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.
[CBD] * [Main str] * [Sp. lim. 50] * [Woman]	0.04	0.35	-0.10	0.27	-0.03	0.29
[CBD] * [Main str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.
[Ind. area] * [Local str] * [Sp. lim. 50] * [Woman]	0.14	0.21	0.00	0.16	0.04	0.18
[Ind. area] * [Local str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.
[Ind. area] * [Main str] * [Sp. lim. 50] * [Woman]	0.07	0.19	**-0.29**	0.15	-0.04	0.16
[Ind. area] * [Main str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.
[Res. area] * [Local str] * [Sp. lim. 50] * [Woman]	0.03	0.10	-0.09	0.08	0.10	0.09
[Res. area] * [Local str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 70] * [Woman]	-0.05	0.23	-0.03	0.18	**0.59**	0.19
[Res. area] * [Main str] * [Sp. lim. 70] * [Man]	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 50] * [Woman]	0.01	0.10	0.10	0.08	0.00	0.08
[Res. area] * [Main str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90] * [Woman]	**-0.62**	0.15	-0.12	0.11	**0.28**	0.12
[Art. area] * [Arterial] * [Sp. lim. 90] * [Man]	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70] * [Woman]	0.10	0.10	0.00	0.08	-0.04	0.09
[Art. area] * [Arterial] * [Sp. lim. 70] * [Man]	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Woman]	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.
[CBD] * [Local str] * [Sp. lim. 50] * [4 lanes]	-0.04	0.23	0.00	0.18	-0.02	0.19
[CBD] * [Local str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.
[CBD] * [Main str] * [Sp. lim. 50] * [4 lanes]	-0.05	0.25	0.13	0.20	0.04	0.21
[CBD] * [Main str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.
[Ind. area] * [Local str] * [Sp. lim. 50] * [4 lanes]	0.02	0.16	-0.02	0.12	-0.10	0.13
[Ind. area] * [Local str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.
[Ind. area] * [Main str] * [Sp. lim. 50] * [4 lanes]	-0.02	0.13	-0.10	0.10	0.01	0.11
[Ind. area] * [Main str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.
[Res. area] * [Local str] * [Sp. lim. 50] * [4 lanes]	0.03	0.16	**-0.28**	0.12	0.01	0.13
[Res. area] * [Local str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 70] * [4 lanes]	0.11	0.23	-0.23	0.18	**-0.63**	0.19
[Res. area] * [Main str] * [Sp. lim. 70] * [2 lanes]	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 50] * [4 lanes]	0.01	0.10	-0.06	0.07	0.04	0.08
[Res. area] * [Main str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90] * [4 lanes]	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70] * [4 lanes]	-0.06	0.10	-0.10	0.08	-0.01	0.09
[Art. area] * [Arterial] * [Sp. lim. 70] * [2 lanes]	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [4 lanes]	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.

INTERACTION EFFECTS						
	Gear 2 or 3 1500-2500 rpm		Gear 4 < 1500 rpm		Gear 5 < 1500 rpm	
forts.	B	Std. E	B	Std. E	**B**	Std. E
[CBD] * [Local str] * [Sp. lim. 50] * [Woman]	**-0.50**	0.25	-0.20	0.28	0.18	0.29
[CBD] * [Local str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.
[CBD] * [Main str] * [Sp. lim. 50] * [Woman]	-0.36	0.25	**0.62**	0.27	0.37	0.29
[CBD] * [Main str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.
[Ind. area] * [Local str] * [Sp. lim. 50] * [Woman]	**-0.53**	0.15	0.11	0.17	0.11	0.17
[Ind. area] * [Local str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.
[Ind. area] * [Main str] * [Sp. lim. 50] * [Woman]	-0.12	0.13	-0.20	0.15	**0.47**	0.15
[Ind. area] * [Main str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.
[Res. area] * [Local str] * [Sp. lim. 50] * [Woman]	-0.12	0.07	0.11	0.08	0.05	0.08
[Res. area] * [Local str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 70] * [Woman]	**-0.39**	0.16	-0.07	0.18	0.31	0.19
[Res. area] * [Main str] * [Sp. lim. 70] * [Man]	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 50] * [Woman]	-0.07	0.07	**0.18**	0.08	-0.01	0.08
[Res. area] * [Main str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90] * [Woman]	-0.06	0.10	0.01	0.11	0.09	0.12
[Art. area] * [Arterial] * [Sp. lim. 90] * [Man]	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70] * [Woman]	-0.10	0.07	0.01	0.08	0.10	0.08
[Art. area] * [Arterial] * [Sp. lim. 70] * [Man]	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Woman]	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.
[CBD] * [Local str] * [Sp. lim. 50] * [4 lanes]	**0.61**	0.17	**0.42**	0.18	0.21	0.19
[CBD] * [Local str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.
[CBD] * [Main str] * [Sp. lim. 50] * [4 lanes]	**-0.44**	0.18	-0.03	0.20	0.05	0.20
[CBD] * [Main str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.
[Ind. area] * [Local str] * [Sp. lim. 50] * [4 lanes]	-0.10	0.11	0.09	0.12	0.14	0.13
[Ind. area] * [Local str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.
[Ind. area] * [Main str] * [Sp. lim. 50] * [4 lanes]	-0.15	0.09	**0.38**	0.10	0.12	0.10
[Ind. area] * [Main str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.
[Res. area] * [Local str] * [Sp. lim. 50] * [4 lanes]	**-0.45**	0.11	-0.03	0.12	0.19	0.13
[Res. area] * [Local str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 70] * [4 lanes]	0.09	0.16	**0.51**	0.18	-0.08	0.19
[Res. area] * [Main str] * [Sp. lim. 70] * [2 lanes]	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 50] * [4 lanes]	0.08	0.07	0.09	0.08	0.06	0.08
[Res. area] * [Main str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90] * [4 lanes]	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70] * [4 lanes]	**-0.24**	0.07	0.00	0.08	0.00	0.08
[Art. area] * [Arterial] * [Sp. lim. 70] * [2 lanes]	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [4 lanes]	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.

APPENDIX 1

Table A. Continuation. Estimated model parameters for average speed and the 16 independent driving pattern factors. Significantly estimated parameters bold and underlined.

INTERACTION EFFECTS	Factor for Speed 50-70		Factor for Speed 70-90		Factor for Speed 90-110		Factor for Speed >110		Gear 2 or 3 2500-3500 rpm		Engine speed >3500		Gear 2 or 3 1500-2500 rpm		Gear 4 < 1500 rpm		Gear 5 < 1500 rpm	
forts.	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E
[CBD] * [Local str] * [Sp. lim. 50] * [Woman]	0.03	0.25	0.33	0.25	-0.14	0.22	-0.01	0.35	0.38	0.27	0.19	0.29	**-0.50**	0.25	-0.20	0.28	0.18	0.29
[CBD] * [Local str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[CBD] * [Main str] * [Sp. lim. 50] * [Woman]	-0.27	0.25	0.35	0.25	-0.04	0.22	0.04	0.35	-0.10	0.27	-0.03	0.29	-0.36	0.25	**0.62**	0.27	0.37	0.29
[CBD] * [Main str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Local str] * [Sp. lim. 50] * [Woman]	**0.35**	0.15	0.17	0.15	-0.07	0.14	0.14	0.21	0.00	0.16	0.04	0.18	**-0.53**	0.15	0.11	0.17	0.11	0.17
[Ind. area] * [Local str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Main str] * [Sp. lim. 50] * [Woman]	0.11	0.13	0.21	0.13	-0.04	0.12	0.07	0.19	**-0.29**	0.15	-0.04	0.16	-0.12	0.13	-0.20	0.15	**0.47**	0.15
[Ind. area] * [Main str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Local str] * [Sp. lim. 50] * [Woman]	0.09	0.07	**0.30**	0.07	-0.08	0.07	0.03	0.10	-0.09	0.08	0.10	0.09	-0.12	0.07	0.11	0.08	0.05	0.08
[Res. area] * [Local str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 70] * [Woman]	-0.13	0.16	0.12	0.16	0.05	0.15	-0.05	0.23	-0.03	0.18	**0.59**	0.19	**-0.39**	0.16	-0.07	0.18	0.31	0.19
[Res. area] * [Main str] * [Sp. lim. 70] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 50] * [Woman]	-0.06	0.07	0.12	0.07	0.04	0.07	0.01	0.10	0.10	0.08	0.00	0.08	-0.07	0.07	**0.18**	0.08	-0.01	0.08
[Res. area] * [Main str] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90] * [Woman]	**0.22**	0.10	**0.45**	0.10	**-0.56**	0.09	**-0.62**	0.15	-0.12	0.11	**0.28**	0.12	-0.06	0.10	0.01	0.11	0.09	0.12
[Art. area] * [Arterial] * [Sp. lim. 90] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70] * [Woman]	0.10	0.07	-0.13	0.07	-0.08	0.07	0.10	0.10	0.00	0.08	-0.04	0.09	-0.10	0.07	0.01	0.08	0.10	0.08
[Art. area] * [Arterial] * [Sp. lim. 70] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Woman]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[CBD] * [Local str] * [Sp. lim. 50] * [4 lanes]	0.22	0.17	-0.02	0.16	0.00	0.15	-0.04	0.23	0.00	0.18	-0.02	0.19	**0.61**	0.17	**0.42**	0.18	0.21	0.19
[CBD] * [Local str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[CBD] * [Main str] * [Sp. lim. 50] * [4 lanes]	0.13	0.18	-0.07	0.18	-0.05	0.16	-0.05	0.25	0.13	0.20	0.04	0.21	**-0.44**	0.18	-0.03	0.20	0.05	0.20
[CBD] * [Main str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Local str] * [Sp. lim. 50] * [4 lanes]	**0.68**	0.11	0.12	0.11	-0.04	0.10	0.02	0.16	-0.02	0.12	-0.10	0.13	-0.10	0.11	0.09	0.12	0.14	0.13
[Ind. area] * [Local str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Main str] * [Sp. lim. 50] * [4 lanes]	0.09	0.09	**-0.28**	0.09	-0.08	0.08	-0.02	0.13	-0.10	0.10	0.01	0.11	-0.15	0.09	**0.38**	0.10	0.12	0.10
[Ind. area] * [Main str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Local str] * [Sp. lim. 50] * [4 lanes]	0.17	0.11	0.01	0.11	0.06	0.10	0.03	0.16	**-0.28**	0.12	0.01	0.13	**-0.45**	0.11	-0.03	0.12	0.19	0.13
[Res. area] * [Local str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 70] * [4 lanes]	0.09	0.16	**-0.56**	0.16	0.11	0.15	0.11	0.23	-0.23	0.18	**-0.63**	0.19	0.09	0.16	**0.51**	0.18	-0.08	0.19
[Res. area] * [Main str] * [Sp. lim. 70] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 50] * [4 lanes]	**-0.27**	0.07	**0.23**	0.07	0.02	0.06	0.01	0.10	-0.06	0.07	0.04	0.08	0.08	0.07	0.09	0.08	0.06	0.08
[Res. area] * [Main str] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90] * [4 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70] * [4 lanes]	**0.37**	0.07	0.01	0.07	-0.05	0.07	-0.06	0.10	-0.10	0.08	-0.01	0.09	**-0.24**	0.07	0.00	0.08	0.00	0.08
[Art. area] * [Arterial] * [Sp. lim. 70] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [4 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [2 lanes]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.

APPENDIX 1

Table A. Continuation. Estimated model parameters for average speed and the 16 independent driving pattern factors. Significantly estimated parameters bold and underlined

INTERACTION EFFECTS	Average speed		Deceleration factor		Mod. power demand acc.		Stong power demand acc		Extreme acc		Oscillating speed curve		Stop factor		Factor for Speed 15-30	
	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	**B**	Std. E
[CBD] * [Local str] * [Sp. lim. 50] * [Int. dist < 50]	4.17	7.03	-0.07	0.52	0.21	0.50	0.10	0.47	-0.52	0.50	-0.36	0.49	-0.55	0.50	0.56	0.48
[CBD] * [Local str] * [Sp. lim. 50] * [Int. dist 50-100]	10.29	6.26	-0.03	0.46	0.24	0.45	0.10	0.42	0.17	0.44	-0.52	0.43	**-1.05**	0.45	**1.05**	0.43
[CBD] * [Local str] * [Sp. lim. 50] * [Int. dist 100-200]	7.00	6.43	-0.05	0.47	0.38	0.46	-0.06	0.43	-0.15	0.46	-0.10	0.45	**-1.41**	0.46	**1.56**	0.44
[CBD] * [Local str] * [Sp. lim. 50] * [Int. dist >200]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[CBD] * [Main str] * [Sp. lim. 50] * [Int. dist < 50]	**10.58**	4.99	**-1.27**	0.37	**-0.99**	0.36	**-0.09**	0.34	0.12	0.35	0.07	0.35	-0.36	0.35	-0.47	0.34
[CBD] * [Main str] * [Sp. lim. 50] * [Int. dist 50-100]	**11.41**	4.35	**-0.79**	0.32	0.01	0.31	0.12	0.29	0.28	0.31	-0.01	0.30	-0.56	0.31	-0.32	0.30
[CBD] * [Main str] * [Sp. lim. 50] * [Int. dist 100-200]	**9.02**	3.88	**-0.77**	0.28	0.27	0.28	-0.26	0.26	0.24	0.28	-0.07	0.27	**-0.66**	0.28	-0.20	0.27
[CBD] * [Main str] * [Sp. lim. 50] * [Int. dist >200]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Local str] * [Sp. lim. 50] * [Int. dist < 50]	**-8.65**	3.92	**0.59**	0.29	0.18	0.28	0.33	0.26	**0.64**	0.28	-0.39	0.27	-0.04	0.28	**1.05**	0.27
[Ind. area] * [Local str] * [Sp. lim. 50] * [Int. dist 50-100]	-4.10	2.24	0.15	0.16	**0.42**	0.16	**0.08**	0.15	0.15	0.16	-0.16	0.16	0.06	0.16	**0.53**	0.15
[Ind. area] * [Local str] * [Sp. lim. 50] * [Int. dist 100-200]	**-7.40**	1.81	0.21	0.13	0.21	0.13	0.33	0.12	0.23	0.13	**0.49**	0.13	-0.15	0.13	**0.29**	0.12
[Ind. area] * [Local str] * [Sp. lim. 50] * [Int. dist >200]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Main str] * [Sp. lim. 50] * [Int. dist < 50]	**-7.81**	2.52	**1.24**	0.18	**-0.45**	0.18	**-0.01**	0.17	-0.05	0.18	-0.14	0.18	0.06	0.18	-0.17	0.17
[Ind. area] * [Main str] * [Sp. lim. 50] * [Int. dist 50-100]	0.54	1.89	**0.39**	0.14	0.13	0.13	0.16	0.13	0.00	0.13	-0.15	0.13	-0.01	0.13	0.04	0.13
[Ind. area] * [Main str] * [Sp. lim. 50] * [Int. dist 100-200]	**4.68**	1.37	**-0.28**	0.10	0.09	0.10	-0.07	0.09	0.00	0.10	0.03	0.09	-0.10	0.10	-0.06	0.09
[Ind. area] * [Main str] * [Sp. lim. 50] * [Int. dist >200]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Local str] * [Sp. lim. 50] * [Int. dist < 50]	**-7.92**	1.67	**0.38**	0.12	-0.22	0.12	0.35	0.11	**0.25**	0.12	**0.38**	0.12	**0.28**	0.12	**0.29**	0.11
[Res. area] * [Local str] * [Sp. lim. 50] * [Int. dist 50-100]	**-5.05**	1.11	0.13	0.08	**0.19**	0.08	**0.21**	0.08	0.01	0.08	**0.42**	0.08	**0.17**	0.08	**0.39**	0.08
[Res. area] * [Local str] * [Sp. lim. 50] * [Int. dist 100-200]	**-2.78**	1.07	0.03	0.08	0.08	0.08	0.08	0.07	0.00	0.08	**0.40**	0.07	**-0.15**	0.08	**0.16**	0.07
[Res. area] * [Local str] * [Sp. lim. 50] * [Int. dist >200]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 70] * [Int. dist < 50]	**-17.21**	5.69	**1.43**	0.42	0.51	0.41	0.24	0.38	**0.96**	0.40	0.26	0.39	**0.80**	0.40	-0.24	0.39
[Res. area] * [Main str] * [Sp. lim. 70] * [Int. dist 50-100]	1.56	2.73	0.38	0.20	-0.01	0.19	0.46	0.18	**0.42**	0.19	-0.12	0.19	0.04	0.19	0.33	0.19
[Res. area] * [Main str] * [Sp. lim. 70] * [Int. dist 100-200]	0.08	1.67	-0.05	0.12	-0.06	0.12	-0.14	0.11	0.08	0.12	0.18	0.12	0.06	0.12	0.02	0.11
[Res. area] * [Main str] * [Sp. lim. 70] * [Int. dist >200]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 50] * [Int. dist < 50]	**-19.96**	4.12	**1.15**	0.30	0.05	0.29	0.38	0.28	0.41	0.29	0.40	0.29	0.21	0.29	**1.03**	0.28
[Res. area] * [Main str] * [Sp. lim. 50] * [Int. dist 50-100]	**-11.97**	1.45	**0.73**	0.11	0.13	0.10	0.63	0.10	0.17	0.10	0.18	0.10	**0.30**	0.10	0.13	0.10
[Res. area] * [Main str] * [Sp. lim. 50] * [Int. dist 100-200]	**-8.47**	1.03	**0.37**	0.08	**0.27**	0.07	**0.45**	0.07	**0.14**	0.07	**0.31**	0.07	0.05	0.07	0.04	0.07
[Res. area] * [Main str] * [Sp. lim. 50] * [Int. dist >200]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90] * [Int. dist < 50]	-3.64	13.07	-0.25	0.96	-1.53	0.93	0.26	0.88	0.45	0.93	0.28	0.91	-0.02	0.93	-0.26	0.90
[Art. area] * [Arterial] * [Sp. lim. 90] * [Int. dist 50-100]	**-4.78**	2.25	0.21	0.16	-0.02	0.16	0.83	0.15	-0.21	0.16	-0.24	0.16	0.05	0.16	0.10	0.15
[Art. area] * [Arterial] * [Sp. lim. 90] * [Int. dist 100-200]	**-5.87**	1.35	0.15	0.10	-0.15	0.10	0.11	0.09	-0.06	0.10	-0.04	0.09	-0.12	0.10	-0.18	0.09
[Art. area] * [Arterial] * [Sp. lim. 90] * [Int. dist >200]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70] * [Int. dist < 50]	**-17.10**	3.94	0.13	0.29	**-0.56**	0.28	**0.85**	0.27	**1.47**	0.28	-0.22	0.27	0.32	0.28	0.24	0.27
[Art. area] * [Arterial] * [Sp. lim. 70] * [Int. dist 50-100]	**-7.94**	1.47	**0.37**	0.11	**-0.46**	0.10	**0.33**	0.10	**0.46**	0.10	0.13	0.10	-0.11	0.10	0.05	0.10
[Art. area] * [Arterial] * [Sp. lim. 70] * [Int. dist 100-200]	**3.85**	1.09	**-0.27**	0.08	0.00	0.08	0.28	0.07	**0.19**	0.08	**-0.21**	0.08	-0.15	0.08	0.00	0.07
[Art. area] * [Arterial] * [Sp. lim. 70] * [Int. dist >200]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Int. dist < 50]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Int. dist 50-100]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Int. dist 100-200]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Int. dist >200]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.

APPENDIX 1

Table A. Continuation. Estimated model parameters for average speed and the 16 independent driving pattern factors. Significantly estimated parameters bold and underlined

INTERACTION EFFECTS forts.	Factor for Speed 50-70 B	Std. E	Factor for Speed 70-90 B	Std. E	Factor for Speed 90-110 B	Std. E	Factor for Speed >110 B	Std. E	Gear 2 or 3 2500-3500 rpm B	Std. E	Engine speed >3500 B	Std. E	Gear 2 or 3 1500-2500 rpm B	Std. E	Gear 4 < 1500 rpm B	Std. E	Gear 5 < 1500 rpm **B**	Std. E
[CBD] * [Local str] * [Sp. lim. 50] * [Int. dist < 50]	-0.09	0.46	0.24	0.46	-0.07	0.41	0.02	0.65	0.55	0.51	0.05	0.54	-0.59	0.47	-0.01	0.51	-0.50	0.53
[CBD] * [Local str] * [Sp. lim. 50] * [Int. dist 50-100]	0.17	0.41	0.28	0.41	-0.03	0.37	0.04	0.58	0.01	0.45	-0.08	0.48	-0.17	0.42	-0.25	0.45	-0.34	0.47
[CBD] * [Local str] * [Sp. lim. 50] * [Int. dist 100-200]	0.10	0.42	0.22	0.42	-0.01	0.38	0.01	0.60	0.06	0.46	-0.06	0.49	-0.36	0.43	-0.17	0.47	-0.32	0.48
[CBD] * [Local str] * [Sp. lim. 50] * [Int. dist >200]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[CBD] * [Main str] * [Sp. lim. 50] * [Int. dist < 50]	0.38	0.33	-0.07	0.33	0.09	0.29	0.03	0.46	0.13	0.36	0.15	0.38	-0.21	0.33	0.39	0.36	-0.25	0.37
[CBD] * [Main str] * [Sp. lim. 50] * [Int. dist 50-100]	0.34	0.28	-0.01	0.28	0.12	0.26	0.08	0.40	-0.10	0.31	0.04	0.33	-0.35	0.29	0.31	0.31	-0.14	0.33
[CBD] * [Main str] * [Sp. lim. 50] * [Int. dist 100-200]	0.26	0.25	-0.19	0.25	0.15	0.23	0.07	0.36	0.04	0.28	0.06	0.30	-0.30	0.26	0.36	0.28	-0.04	0.29
[CBD] * [Main str] * [Sp. lim. 50] * [Int. dist >200]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Local str] * [Sp. lim. 50] * [Int. dist < 50]	-0.50	0.26	0.17	0.26	0.07	0.23	-0.02	0.36	-0.31	0.28	-0.03	0.30	-0.24	0.26	0.04	0.28	-0.25	0.29
[Ind. area] * [Local str] * [Sp. lim. 50] * [Int. dist 50-100]	**-0.42**	0.15	0.14	0.15	0.00	0.13	-0.02	0.21	0.04	0.16	-0.01	0.17	**-0.49**	0.15	-0.18	0.16	-0.17	0.17
[Ind. area] * [Local str] * [Sp. lim. 50] * [Int. dist 100-200]	**-0.72**	0.12	0.00	0.12	0.08	0.11	0.00	0.17	0.18	0.13	-0.02	0.14	-0.07	0.12	-0.16	0.13	-0.04	0.14
[Ind. area] * [Local str] * [Sp. lim. 50] * [Int. dist >200]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Main str] * [Sp. lim. 50] * [Int. dist < 50]	**-0.32**	0.17	-0.17	0.16	0.18	0.15	0.05	0.23	0.16	0.18	-0.06	0.19	0.09	0.17	**0.78**	0.18	-0.34	0.19
[Ind. area] * [Main str] * [Sp. lim. 50] * [Int. dist 50-100]	0.13	0.12	0.05	0.12	0.14	0.11	0.07	0.17	0.19	0.14	-0.15	0.15	-0.14	0.13	0.19	0.14	-0.04	0.14
[Ind. area] * [Main str] * [Sp. lim. 50] * [Int. dist 100-200]	-0.04	0.09	0.08	0.09	0.08	0.08	0.03	0.13	**0.21**	0.10	-0.09	0.10	**-0.33**	0.09	-0.13	0.10	**0.36**	0.10
[Ind. area] * [Main str] * [Sp. lim. 50] * [Int. dist >200]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Local str] * [Sp. lim. 50] * [Int. dist < 50]	**-0.59**	0.11	0.20	0.11	0.09	0.10	0.12	0.15	**0.43**	0.12	0.12	0.13	-0.11	0.11	**-0.45**	0.12	-0.17	0.13
[Res. area] * [Local str] * [Sp. lim. 50] * [Int. dist 50-100]	**-0.30**	0.07	**0.25**	0.07	0.07	0.07	0.06	0.10	-0.03	0.08	-0.04	0.09	**-0.28**	0.07	**-0.33**	0.08	-0.14	0.08
[Res. area] * [Local str] * [Sp. lim. 50] * [Int. dist 100-200]	**-0.26**	0.07	0.02	0.07	0.08	0.06	0.04	0.10	**0.18**	0.08	0.01	0.08	**-0.21**	0.07	-0.13	0.08	-0.09	0.08
[Res. area] * [Local str] * [Sp. lim. 50] * [Int. dist >200]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 70] * [Int. dist < 50]	-0.35	0.37	-0.22	0.37	0.39	0.33	0.06	0.53	-0.17	0.41	-0.37	0.44	0.19	0.38	-0.48	0.41	-0.44	0.43
[Res. area] * [Main str] * [Sp. lim. 70] * [Int. dist 50-100]	-0.14	0.18	**0.38**	0.18	0.12	0.16	0.01	0.25	-0.09	0.20	-0.18	0.21	**-0.67**	0.18	**-0.54**	0.20	-0.07	0.20
[Res. area] * [Main str] * [Sp. lim. 70] * [Int. dist 100-200]	0.09	0.11	-0.05	0.11	0.15	0.10	0.06	0.15	0.19	0.12	-0.23	0.13	-0.13	0.11	**-0.39**	0.12	-0.02	0.13
[Res. area] * [Main str] * [Sp. lim. 70] * [Int. dist >200]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 50] * [Int. dist < 50]	**-0.92**	0.27	0.07	0.27	0.09	0.24	0.11	0.38	-0.26	0.30	-0.12	0.32	0.45	0.27	-0.05	0.30	-0.30	0.31
[Res. area] * [Main str] * [Sp. lim. 50] * [Int. dist 50-100]	**-0.58**	0.09	-0.07	0.09	0.16	0.09	0.07	0.13	**-0.23**	0.10	-0.19	0.11	0.15	0.10	**-0.24**	0.10	-0.17	0.11
[Res. area] * [Main str] * [Sp. lim. 50] * [Int. dist 100-200]	**-0.38**	0.07	**-0.15**	0.07	**0.15**	0.06	0.05	0.10	**0.21**	0.07	-0.06	0.08	**0.22**	0.07	0.01	0.07	-0.07	0.08
[Res. area] * [Main str] * [Sp. lim. 50] * [Int. dist >200]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90] * [Int. dist < 50]	-0.12	0.86	0.93	0.85	-1.37	0.77	0.51	1.21	-0.13	0.94	0.01	1.00	0.74	0.87	0.16	0.95	-0.18	0.98
[Art. area] * [Arterial] * [Sp. lim. 90] * [Int. dist 50-100]	**0.43**	0.15	**0.43**	0.15	**-1.00**	0.13	**-0.42**	0.21	**0.59**	0.16	**-0.51**	0.17	-0.14	0.15	-0.18	0.16	-0.16	0.17
[Art. area] * [Arterial] * [Sp. lim. 90] * [Int. dist 100-200]	-0.12	0.09	**0.38**	0.09	**-1.00**	0.08	**-0.92**	0.12	0.18	0.10	-0.20	0.10	-0.07	0.09	-0.16	0.10	-0.09	0.10
[Art. area] * [Arterial] * [Sp. lim. 90] * [Int. dist >200]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70] * [Int. dist < 50]	**-0.61**	0.26	**-0.80**	0.26	0.09	0.23	0.08	0.36	0.02	0.28	0.23	0.30	-0.43	0.26	-0.51	0.29	-0.26	0.30
[Art. area] * [Arterial] * [Sp. lim. 70] * [Int. dist 50-100]	**-0.52**	0.10	**-0.55**	0.10	0.11	0.09	0.02	0.14	-0.05	0.11	-0.19	0.11	**-0.37**	0.10	**-0.25**	0.11	-0.09	0.11
[Art. area] * [Arterial] * [Sp. lim. 70] * [Int. dist 100-200]	**-0.31**	0.07	0.04	0.07	0.04	0.06	0.02	0.10	0.12	0.08	0.05	0.08	**-0.49**	0.07	**-0.18**	0.08	0.00	0.08
[Art. area] * [Arterial] * [Sp. lim. 70] * [Int. dist >200]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Int. dist < 50]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Int. dist 50-100]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Int. dist 100-200]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Int. dist >200]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.

APPENDIX 1

Table A. Continuation. Estimated model parameters for average speed and the 16 independent driving pattern factors. Significantly estimated parameters bold and underlined

INTERACTION EFFECTS	Average speed		Deceleration factor		Mod. power demand acc.		Stong power demand acc		Extreme acc		Oscillating speed curve		Stop factor		Factor for Speed 15-30	
	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	**B**	Std. E
[CBD] * [Local str] * [Sp. lim. 50] * [Flow 100-300]	1.07	3.81	0.27	0.28	0.14	0.27	-0.08	0.26	**-0.62**	0.27	-0.18	0.26	0.13	0.27	-0.31	0.26
[CBD] * [Local str] * [Sp. lim. 50] * [Flow<100]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[CBD] * [Main str] * [Sp. lim. 50] * [Flow 100-300]	3.76	2.98	-0.07	0.22	0.04	0.21	0.15	0.20	0.26	0.21	-0.22	0.21	0.05	0.21	**-0.67**	0.20
[CBD] * [Main str] * [Sp. lim. 50] * [Flow<100]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Local str] * [Sp. lim. 50] * [Flow 100-300]	**5.40**	2.04	**-0.43**	0.15	0.20	0.15	-0.31	0.14	0.05	0.14	-0.21	0.14	**-0.41**	0.14	0.02	0.14
[Ind. area] * [Local str] * [Sp. lim. 50] * [Flow<100]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Main str] * [Sp. lim. 50] * [Flow 500-700]	**19.07**	7.71	**-1.67**	0.57	0.63	0.55	-0.07	0.52	0.11	0.55	0.57	0.54	-0.48	0.55	**-1.47**	0.53
[Ind. area] * [Main str] * [Sp. lim. 50] * [Flow 300-500]	1.83	2.08	-0.29	0.15	0.20	0.15	-0.37	0.14	-0.21	0.15	-0.07	0.14	-0.17	0.15	-0.02	0.14
[Ind. area] * [Main str] * [Sp. lim. 50] * [Flow 100-300]	1.87	1.40	-0.16	0.10	**0.30**	0.10	**-0.17**	0.09	-0.17	0.10	-0.07	0.10	**-0.25**	0.10	0.08	0.10
[Ind. area] * [Main str] * [Sp. lim. 50] * [Flow<100]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Local str] * [Sp. lim. 50] * [Flow 300-500]	6.38	9.34	0.48	0.68	0.28	0.67	0.26	0.63	-0.77	0.66	-0.26	0.65	-0.68	0.66	0.40	0.64
[Res. area] * [Local str] * [Sp. lim. 50] * [Flow 100-300]	**5.66**	1.20	-0.05	0.09	0.00	0.09	-0.13	0.08	0.01	0.08	**-0.20**	0.08	**-0.28**	0.08	**-0.37**	0.08
[Res. area] * [Local str] * [Sp. lim. 50] * [Flow<100]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 70] * [Flow 700-900]	**-12.90**	6.11	**0.95**	0.45	**-1.22**	0.43	**0.69**	0.41	-0.07	0.43	0.37	0.42	0.24	0.43	-0.55	0.42
[Res. area] * [Main str] * [Sp. lim. 70] * [Flow 500-700]	3.61	8.10	0.35	0.59	0.57	0.58	0.56	0.55	0.12	0.58	0.30	0.56	0.16	0.58	**-1.09**	0.56
[Res. area] * [Main str] * [Sp. lim. 70] * [Flow 300-500]	-7.03	4.10	**0.62**	0.30	-0.49	0.29	0.06	0.28	0.03	0.29	-0.10	0.28	0.22	0.29	0.05	0.28
[Res. area] * [Main str] * [Sp. lim. 70] * [Flow 100-300]	**-14.33**	3.71	**0.87**	0.27	-0.40	0.26	0.34	0.25	0.01	0.26	0.11	0.26	0.32	0.26	0.25	0.25
[Res. area] * [Main str] * [Sp. lim. 70] * [Flow<100]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 50] * [Flow 300-500]	-0.77	1.77	-0.23	0.13	**0.28**	0.13	**-0.17**	0.12	0.14	0.13	**-0.28**	0.12	0.19	0.13	-0.01	0.12
[Res. area] * [Main str] * [Sp. lim. 50] * [Flow 100-300]	0.37	1.13	**-0.19**	0.08	0.15	0.08	-0.18	0.08	-0.02	0.08	-0.07	0.08	0.06	0.08	-0.09	0.08
[Res. area] * [Main str] * [Sp. lim. 50] * [Flow<100]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90] * [Flow> 900]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90] * [Flow 700-900]	-3.83	4.67	-0.09	0.34	-0.62	0.33	0.24	0.31	-0.02	0.33	0.21	0.32	-0.22	0.33	**-0.86**	0.32
[Art. area] * [Arterial] * [Sp. lim. 90] * [Flow 500-700]	11.59	7.26	-0.69	0.53	0.87	0.52	0.03	0.49	0.40	0.51	0.29	0.50	-0.30	0.52	**-1.49**	0.50
[Art. area] * [Arterial] * [Sp. lim. 90] * [Flow 300-500]	2.56	3.00	-0.18	0.22	-0.02	0.21	-0.31	0.20	-0.05	0.21	-0.30	0.21	-0.22	0.21	-0.24	0.21
[Art. area] * [Arterial] * [Sp. lim. 90] * [Flow 100-300]	-2.07	3.02	-0.23	0.22	-0.20	0.21	-0.11	0.20	-0.15	0.21	-0.09	0.21	-0.11	0.21	-0.05	0.21
[Art. area] * [Arterial] * [Sp. lim. 90] * [Flow<100]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70] * [Flow 700-900]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70] * [Flow 500-700]	**14.19**	7.04	-0.26	0.52	0.81	0.50	0.10	0.47	0.18	0.50	0.30	0.49	0.00	0.50	**-1.32**	0.48
[Art. area] * [Arterial] * [Sp. lim. 70] * [Flow 300-500]	2.54	1.63	0.05	0.12	0.07	0.12	-0.31	0.11	-0.22	0.12	-0.21	0.11	0.08	0.12	0.07	0.11
[Art. area] * [Arterial] * [Sp. lim. 70] * [Flow 100-300]	-0.66	1.20	-0.05	0.09	-0.02	0.09	-0.09	0.08	-0.11	0.08	-0.07	0.08	-0.01	0.09	0.04	0.08
[Art. area] * [Arterial] * [Sp. lim. 70] * [Flow<100]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Flow 500-700]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Flow 300-500]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Flow 100-300]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Flow<100]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.

APPENDIX 1

Table A. Continuation. Estimated model parameters for average speed and the 16 independent driving pattern factors. Significantly estimated parameters bold and underlined

INTERACTION EFFECTS	Factor for Speed 50-70		Factor for Speed 70-90		Factor for Speed 90-110		Factor for Speed >110		Gear 2 or 3 2500-3500 rpm		Engine speed >3500		Gear 2 or 3 1500-2500 rpm		Gear 4 < 1500 rpm		Gear 5 < 1500 rpm	
forts.	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	**B**	Std. E
[CBD] * [Local str] * [Sp. lim. 50] * [Flow 100-300]	-0.03	0.25	-0.02	0.25	-0.04	0.22	0.04	0.35	-0.28	0.27	-0.09	0.29	-0.27	0.25	-0.06	0.28	-0.18	0.29
[CBD] * [Local str] * [Sp. lim. 50] * [Flow<100]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[CBD] * [Main str] * [Sp. lim. 50] * [Flow 100-300]	0.16	0.20	-0.04	0.19	-0.08	0.18	0.01	0.28	-0.32	0.21	-0.02	0.23	0.35	0.20	-0.30	0.22	-0.33	0.22
[CBD] * [Main str] * [Sp. lim. 50] * [Flow<100]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Local str] * [Sp. lim. 50] * [Flow 100-300]	0.05	0.13	-0.05	0.13	-0.05	0.12	0.01	0.19	-0.19	0.15	-0.13	0.16	-0.15	0.14	0.10	0.15	**-0.32**	0.15
[Ind. area] * [Local str] * [Sp. lim. 50] * [Flow<100]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Main str] * [Sp. lim. 50] * [Flow 500-700]	0.26	0.51	-0.17	0.50	0.12	0.45	0.35	0.71	0.03	0.55	-0.26	0.59	-0.49	0.51	-0.89	0.56	0.51	0.58
[Ind. area] * [Main str] * [Sp. lim. 50] * [Flow 300-500]	0.03	0.14	-0.21	0.14	-0.03	0.12	-0.01	0.19	0.02	0.15	0.03	0.16	**-0.59**	0.14	**0.36**	0.15	**-0.33**	0.16
[Ind. area] * [Main str] * [Sp. lim. 50] * [Flow 100-300]	0.06	0.09	-0.15	0.09	0.04	0.08	0.03	0.13	-0.06	0.10	-0.04	0.11	**-0.29**	0.09	0.08	0.10	**-0.26**	0.10
[Ind. area] * [Main str] * [Sp. lim. 50] * [Flow<100]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Local str] * [Sp. lim. 50] * [Flow 300-500]	0.12	0.61	-0.16	0.61	0.10	0.55	0.09	0.86	-0.22	0.67	0.23	0.72	0.40	0.62	-1.13	0.68	-0.39	0.70
[Res. area] * [Local str] * [Sp. lim. 50] * [Flow 100-300]	0.09	0.08	-0.08	0.08	-0.01	0.07	0.04	0.11	-0.16	0.09	-0.09	0.09	**-0.28**	0.08	0.09	0.09	0.02	0.09
[Res. area] * [Local str] * [Sp. lim. 50] * [Flow<100]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 70] * [Flow 700-900]	**-0.82**	0.40	-0.60	0.40	0.64	0.36	0.32	0.56	-0.06	0.44	-0.50	0.47	-0.23	0.41	0.48	0.44	-0.03	0.46
[Res. area] * [Main str] * [Sp. lim. 70] * [Flow 500-700]	0.22	0.53	-0.33	0.53	0.60	0.48	0.53	0.75	0.16	0.58	-0.51	0.62	-0.69	0.54	-0.44	0.59	0.33	0.61
[Res. area] * [Main str] * [Sp. lim. 70] * [Flow 300-500]	0.03	0.27	-0.30	0.27	0.15	0.24	0.13	0.38	-0.19	0.29	-0.12	0.31	-0.53	0.27	0.37	0.30	0.04	0.31
[Res. area] * [Main str] * [Sp. lim. 70] * [Flow 100-300]	-0.35	0.24	-0.26	0.24	0.19	0.22	0.03	0.34	-0.03	0.27	0.10	0.28	-0.20	0.25	0.23	0.27	0.08	0.28
[Res. area] * [Main str] * [Sp. lim. 70] * [Flow<100]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 50] * [Flow 300-500]	-0.20	0.12	-0.03	0.12	-0.05	0.10	0.03	0.16	-0.15	0.13	0.07	0.14	-0.13	0.12	-0.12	0.13	-0.21	0.13
[Res. area] * [Main str] * [Sp. lim. 50] * [Flow 100-300]	-0.01	0.07	0.00	0.07	-0.04	0.07	0.05	0.10	**-0.25**	0.08	-0.07	0.09	-0.07	0.08	0.01	0.08	-0.14	0.09
[Res. area] * [Main str] * [Sp. lim. 50] * [Flow<100]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90] * [Flow> 900]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90] * [Flow 700-900]	**-0.87**	0.31	**0.71**	0.30	**-0.61**	0.27	**-2.95**	0.43	-0.62	0.34	-0.27	0.36	0.08	0.31	-0.39	0.34	-0.22	0.35
[Art. area] * [Arterial] * [Sp. lim. 90] * [Flow 500-700]	0.16	0.48	0.35	0.47	-0.20	0.43	**-2.22**	0.67	-0.61	0.52	-0.18	0.56	-0.32	0.48	-0.96	0.53	0.11	0.54
[Art. area] * [Arterial] * [Sp. lim. 90] * [Flow 300-500]	-0.01	0.20	**0.43**	0.20	-0.31	0.18	**-2.44**	0.28	**-0.62**	0.22	0.34	0.23	-0.21	0.20	-0.15	0.22	-0.10	0.23
[Art. area] * [Arterial] * [Sp. lim. 90] * [Flow 100-300]	-0.09	0.20	**0.39**	0.20	-0.30	0.18	**-2.05**	0.28	**-0.48**	0.22	0.37	0.23	0.00	0.20	-0.04	0.22	-0.16	0.23
[Art. area] * [Arterial] * [Sp. lim. 90] * [Flow<100]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70] * [Flow 700-900]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70] * [Flow 500-700]	0.82	0.46	-0.01	0.46	0.29	0.41	0.33	0.65	-0.06	0.51	-0.41	0.54	0.02	0.47	-0.88	0.51	0.17	0.53
[Art. area] * [Arterial] * [Sp. lim. 70] * [Flow 300-500]	**0.63**	0.11	-0.06	0.11	-0.04	0.10	0.07	0.15	-0.02	0.12	-0.22	0.13	0.01	0.11	-0.05	0.12	-0.02	0.12
[Art. area] * [Arterial] * [Sp. lim. 70] * [Flow 100-300]	**0.28**	0.08	**-0.21**	0.08	-0.03	0.07	0.04	0.11	-0.13	0.09	**-0.21**	0.09	0.10	0.08	-0.01	0.09	-0.10	0.09
[Art. area] * [Arterial] * [Sp. lim. 70] * [Flow<100]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Flow 500-700]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Flow 300-500]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Flow 100-300]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Flow<100]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.

APPENDIX 1

Table A. Continuation. Estimated model parameters for average speed and the 16 independent driving pattern factors. Significantly estimated parameters bold and underlined

INTERACTION EFFECTS	Average speed		Deceleration factor		Mod. power demand acc.		Stong power demand acc		Extreme acc		Oscillating speed curve		Stop factor		Factor for Speed 15-30	
	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	**B**	Std. E
[CBD] * [Local str] * [Sp. lim. 50] * [High perf. car]	3.61	3.43	0.31	0.25	0.04	0.24	-0.06	0.23	-0.41	0.24	0.27	0.24	-0.10	0.24	-0.11	0.24
[CBD] * [Local str] * [Sp. lim. 50] * [Low perf. car]	-7.17	3.76	-0.08	0.28	**0.76**	0.27	**-0.44**	0.25	**0.60**	0.27	**0.68**	0.26	**0.54**	0.27	0.06	0.26
[CBD] * [Local str] * [Sp. lim. 50] * [Med. perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[CBD] * [Main str] * [Sp. lim. 50] * [High perf. car]	0.15	2.98	0.22	0.22	0.34	0.21	0.18	0.20	-0.12	0.21	0.05	0.21	0.07	0.21	0.16	0.20
[CBD] * [Main str] * [Sp. lim. 50] * [Low perf. car]	-3.79	3.13	**0.47**	0.23	0.38	0.22	0.20	0.21	-0.27	0.22	0.03	0.22	0.32	0.22	-0.30	0.21
[CBD] * [Main str] * [Sp. lim. 50] * [Med. perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Local str] * [Sp. lim. 50] * [High perf. car]	1.99	2.23	**-0.39**	0.16	-0.01	0.16	-0.13	0.15	0.13	0.16	-0.06	0.15	0.02	0.16	0.19	0.15
[Ind. area] * [Local str] * [Sp. lim. 50] * [Low perf. car]	-3.24	2.93	0.14	0.21	0.30	0.21	-0.05	0.20	**0.61**	0.21	-0.13	0.20	**0.45**	0.21	-0.27	0.20
[Ind. area] * [Local str] * [Sp. lim. 50] * [Med. perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Main str] * [Sp. lim. 50] * [High perf. car]	-0.90	1.79	0.16	0.13	0.25	0.13	0.13	0.12	-0.05	0.13	0.03	0.12	0.01	0.13	-0.20	0.12
[Ind. area] * [Main str] * [Sp. lim. 50] * [Low perf. car]	**-4.75**	2.05	0.17	0.15	**0.45**	0.15	**0.37**	0.14	-0.03	0.15	-0.08	0.14	0.18	0.15	0.08	0.14
[Ind. area] * [Main str] * [Sp. lim. 50] * [Med. perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Local str] * [Sp. lim. 50] * [High perf. car]	0.40	1.07	-0.04	0.08	**0.19**	0.08	**-0.05**	0.07	0.07	0.08	0.04	0.07	-0.08	0.08	**0.35**	0.07
[Res. area] * [Local str] * [Sp. lim. 50] * [Low perf. car]	0.68	1.07	0.01	0.08	0.13	0.08	0.07	0.07	**0.22**	0.08	**-0.15**	0.07	0.05	0.08	**-0.37**	0.07
[Res. area] * [Local str] * [Sp. lim. 50] * [Med. perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 70] * [High perf. car]	-1.86	2.89	0.08	0.21	0.26	0.21	0.65	0.19	**0.44**	0.21	-0.19	0.20	-0.06	0.21	-0.27	0.20
[Res. area] * [Main str] * [Sp. lim. 70] * [Low perf. car]	1.76	2.09	-0.07	0.15	0.13	0.15	0.07	0.14	0.18	0.15	-0.13	0.14	-0.02	0.15	-0.15	0.14
[Res. area] * [Main str] * [Sp. lim. 70] * [Med. perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 50] * [High perf. car]	**2.48**	1.16	**0.35**	0.08	**0.24**	0.08	**0.02**	0.08	-0.08	0.08	0.00	0.08	**-0.18**	0.08	**-0.20**	0.08
[Res. area] * [Main str] * [Sp. lim. 50] * [Low perf. car]	-2.07	1.23	0.07	0.09	0.16	0.09	0.21	0.08	0.05	0.09	0.12	0.09	-0.03	0.09	-0.08	0.08
[Res. area] * [Main str] * [Sp. lim. 50] * [Med. perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90] * [High perf. car]	-1.22	1.27	-0.15	0.09	0.05	0.09	0.03	0.09	**0.26**	0.09	**0.28**	0.09	-0.15	0.09	**-0.30**	0.09
[Art. area] * [Arterial] * [Sp. lim. 90] * [Low perf. car]	-2.42	1.47	-0.14	0.11	**0.26**	0.10	**-0.06**	0.10	-0.10	0.10	0.00	0.10	0.01	0.10	0.02	0.10
[Art. area] * [Arterial] * [Sp. lim. 90] * [Med. perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70] * [High perf. car]	0.08	1.27	-0.16	0.09	0.03	0.09	0.00	0.09	**0.27**	0.09	0.10	0.09	**-0.23**	0.09	**-0.35**	0.09
[Art. area] * [Arterial] * [Sp. lim. 70] * [Low perf. car]	-0.03	1.17	0.00	0.09	**0.24**	0.08	**0.03**	0.08	0.09	0.08	-0.13	0.08	0.07	0.08	-0.03	0.08
[Art. area] * [Arterial] * [Sp. lim. 70] * [Med. perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [High perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Low perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Med. perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.

APPENDIX 1

Table A. Continuation. Estimated model parameters for average speed and the 16 independent driving pattern factors. Significantly estimated parameters bold and underlined

INTERACTION EFFECTS	Factor for Speed 50-70		Factor for Speed 70-90		Factor for Speed 90-110		Factor for Speed >110		Gear 2 or 3 2500-3500 rpm		Engine speed >3500		Gear 2 or 3 1500-2500 rpm		Gear 4 < 1500 rpm		Gear 5 < 1500 rpm	
forts.	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	**B**	Std. E
[CBD] * [Local str] * [Sp. lim. 50] * [High perf. car]	0.30	0.22	0.43	0.22	-0.05	0.20	0.00	0.32	-0.04	0.25	-0.20	0.26	0.08	0.23	**-0.91**	0.25	0.27	0.26
[CBD] * [Local str] * [Sp. lim. 50] * [Low perf. car]	0.00	0.25	0.18	0.25	-0.05	0.22	-0.08	0.35	-0.53	0.27	-0.20	0.29	-0.21	0.25	**-0.55**	0.27	-0.15	0.28
[CBD] * [Local str] * [Sp. lim. 50] * [Med. perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[CBD] * [Main str] * [Sp. lim. 50] * [High perf. car]	0.03	0.20	0.31	0.19	0.00	0.18	0.07	0.28	0.27	0.21	0.00	0.23	-0.12	0.20	**-1.06**	0.22	-0.11	0.22
[CBD] * [Main str] * [Sp. lim. 50] * [Low perf. car]	-0.03	0.20	0.00	0.20	-0.05	0.18	-0.02	0.29	-0.31	0.22	0.07	0.24	0.07	0.21	**-0.68**	0.23	-0.21	0.23
[CBD] * [Main str] * [Sp. lim. 50] * [Med. perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Local str] * [Sp. lim. 50] * [High perf. car]	0.08	0.15	0.12	0.15	-0.05	0.13	0.18	0.21	-0.02	0.16	0.20	0.17	-0.03	0.15	**-0.61**	0.16	-0.05	0.17
[Ind. area] * [Local str] * [Sp. lim. 50] * [Low perf. car]	-0.24	0.19	0.04	0.19	0.04	0.17	0.02	0.27	0.04	0.21	0.13	0.22	0.27	0.19	-0.06	0.21	-0.24	0.22
[Ind. area] * [Local str] * [Sp. lim. 50] * [Med. perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Main str] * [Sp. lim. 50] * [High perf. car]	-0.22	0.12	0.01	0.12	-0.09	0.11	-0.02	0.17	0.03	0.13	0.06	0.14	0.18	0.12	**-0.31**	0.13	**0.98**	0.13
[Ind. area] * [Main str] * [Sp. lim. 50] * [Low perf. car]	-0.21	0.13	0.07	0.13	0.02	0.12	-0.14	0.19	**0.32**	0.15	0.09	0.16	0.01	0.14	0.12	0.15	0.10	0.15
[Ind. area] * [Main str] * [Sp. lim. 50] * [Med. perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Local str] * [Sp. lim. 50] * [High perf. car]	-0.10	0.07	**0.32**	0.07	-0.02	0.06	0.08	0.10	**0.34**	0.08	0.12	0.08	0.13	0.07	**-0.59**	0.08	-0.14	0.08
[Res. area] * [Local str] * [Sp. lim. 50] * [Low perf. car]	**-0.37**	0.07	0.09	0.07	0.01	0.06	0.00	0.10	0.02	0.08	0.04	0.08	-0.05	0.07	0.00	0.08	-0.13	0.08
[Res. area] * [Local str] * [Sp. lim. 50] * [Med. perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 70] * [High perf. car]	-0.10	0.19	-0.34	0.19	-0.08	0.17	0.12	0.27	**-0.52**	0.21	-0.09	0.22	0.18	0.19	**-0.56**	0.21	**0.53**	0.22
[Res. area] * [Main str] * [Sp. lim. 70] * [Low perf. car]	**-0.30**	0.14	0.12	0.14	-0.09	0.12	-0.02	0.19	**-0.52**	0.15	-0.06	0.16	-0.03	0.14	-0.19	0.15	-0.08	0.16
[Res. area] * [Main str] * [Sp. lim. 70] * [Med. perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 50] * [High perf. car]	**-0.17**	0.08	0.08	0.08	-0.04	0.07	0.02	0.11	**0.29**	0.08	0.07	0.09	**0.25**	0.08	-0.13	0.08	-0.01	0.09
[Res. area] * [Main str] * [Sp. lim. 50] * [Low perf. car]	**-0.38**	0.08	0.15	0.08	-0.05	0.07	-0.05	0.11	-0.09	0.09	0.06	0.09	**0.22**	0.08	**0.26**	0.09	-0.17	0.09
[Res. area] * [Main str] * [Sp. lim. 50] * [Med. perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90] * [High perf. car]	0.16	0.08	**1.04**	0.08	**-1.82**	0.07	**-0.76**	0.12	**-0.44**	0.09	**-0.51**	0.10	-0.03	0.08	**-0.57**	0.09	0.12	0.10
[Art. area] * [Arterial] * [Sp. lim. 90] * [Low perf. car]	**-0.46**	0.10	**0.20**	0.10	-0.08	0.09	**-0.60**	0.14	-0.01	0.11	**-0.86**	0.11	-0.03	0.10	-0.17	0.11	0.09	0.11
[Art. area] * [Arterial] * [Sp. lim. 90] * [Med. perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70] * [High perf. car]	0.06	0.08	**-0.78**	0.08	-0.01	0.07	**0.25**	0.12	-0.11	0.09	**-0.36**	0.10	0.06	0.08	**-0.42**	0.09	**0.26**	0.10
[Art. area] * [Arterial] * [Sp. lim. 70] * [Low perf. car]	**-0.21**	0.08	-0.07	0.08	0.09	0.07	0.03	0.11	**-0.18**	0.08	-0.03	0.09	0.00	0.08	**-0.16**	0.08	-0.07	0.09
[Art. area] * [Arterial] * [Sp. lim. 70] * [Med. perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [High perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Low perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Med. perf. car]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.

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Table A. Continuation. Estimated model parameters for average speed and the 16 independent driving pattern factors. Significantly estimated parameters bold and underlined

INTERACTION EFFECTS	Average speed		Deceleration factor		Mod. power demand acc.		Stong power demand acc		Extreme acc		Oscillating speed curve		Stop factor		Factor for Speed 15-30	
	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	**B**	Std. E
[CBD] * [Local str] * [Sp. lim. 50] * [Snow]	-4.62	3.36	**-0.59**	0.25	0.19	0.24	-0.60	0.23	-0.24	0.24	-0.15	0.23	**1.14**	0.24	0.24	0.23
[CBD] * [Local str] * [Sp. lim. 50] * [No snow]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[CBD] * [Main str] * [Sp. lim. 50] * [Snow]	-4.64	2.74	0.09	0.20	0.12	0.19	0.24	0.18	-0.17	0.19	-0.04	0.19	**0.58**	0.19	0.21	0.19
[CBD] * [Main str] * [Sp. lim. 50] * [No snow]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Local str] * [Sp. lim. 50] * [Snow]	1.83	1.77	-0.12	0.13	0.09	0.13	0.19	0.12	-0.01	0.13	0.00	0.12	0.18	0.13	-0.21	0.12
[Ind. area] * [Local str] * [Sp. lim. 50] * [No snow]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Main str] * [Sp. lim. 50] * [Snow]	0.61	1.50	0.15	0.11	0.03	0.11	0.18	0.10	0.05	0.11	0.13	0.10	0.11	0.11	-0.03	0.10
[Ind. area] * [Main str] * [Sp. lim. 50] * [No snow]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Local str] * [Sp. lim. 50] * [Snow]	1.44	1.06	**-0.17**	0.08	**-0.20**	0.08	**0.03**	0.07	0.01	0.08	-0.03	0.07	**0.20**	0.08	**0.18**	0.07
[Res. area] * [Local str] * [Sp. lim. 50] * [No snow]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 70] * [Snow]	**7.05**	1.91	-0.06	0.14	-0.02	0.14	0.15	0.13	0.06	0.14	-0.05	0.13	0.06	0.14	0.05	0.13
[Res. area] * [Main str] * [Sp. lim. 70] * [No snow]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 50] * [Snow]	**2.97**	1.21	-0.12	0.09	-0.01	0.09	-0.07	0.08	-0.02	0.09	0.14	0.08	-0.05	0.09	-0.07	0.08
[Res. area] * [Main str] * [Sp. lim. 50] * [No snow]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90] * [Snow]	0.64	1.27	**0.22**	0.09	0.01	0.09	0.19	0.09	-0.04	0.09	0.03	0.09	-0.02	0.09	-0.01	0.09
[Art. area] * [Arterial] * [Sp. lim. 90] * [No snow]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70] * [Snow]	**3.98**	1.11	-0.05	0.08	-0.02	0.08	0.00	0.07	-0.04	0.08	0.05	0.08	0.01	0.08	-0.03	0.08
[Art. area] * [Arterial] * [Sp. lim. 70] * [No snow]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Snow]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [No snow]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.

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Table A. Continuation. Estimated model parameters for average speed and the 16 independent driving pattern factors. Significantly estimated parameters bold and underlined

INTERACTION EFFECTS	Factor for Speed 50-70		Factor for Speed 70-90		Factor for Speed 90-110		Factor for Speed >110		Gear 2 or 3 2500-3500 rpm		Engine speed >3500		Gear 2 or 3 1500-2500 rpm		Gear 4 < 1500 rpm		Gear 5 < 1500 rpm	
forts.	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	B	Std. E	**B**	Std. E
[CBD] * [Local str] * [Sp. lim. 50] * [Snow]	0.24	0.22	0.26	0.22	-0.08	0.20	-0.13	0.31	0.11	0.24	0.04	0.26	**-0.93**	0.22	**-0.77**	0.24	-0.20	0.25
[CBD] * [Local str] * [Sp. lim. 50] * [No snow]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[CBD] * [Main str] * [Sp. lim. 50] * [Snow]	-0.07	0.18	0.14	0.18	-0.02	0.16	0.01	0.25	0.29	0.20	0.14	0.21	-0.30	0.18	**-1.52**	0.20	0.31	0.21
[CBD] * [Main str] * [Sp. lim. 50] * [No snow]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Local str] * [Sp. lim. 50] * [Snow]	-0.19	0.12	0.15	0.12	0.00	0.10	0.12	0.16	0.11	0.13	-0.02	0.14	-0.04	0.12	**-0.49**	0.13	0.02	0.13
[Ind. area] * [Local str] * [Sp. lim. 50] * [No snow]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Ind. area] * [Main str] * [Sp. lim. 50] * [Snow]	0.15	0.10	**0.23**	0.10	0.01	0.09	0.02	0.14	0.18	0.11	-0.04	0.12	0.12	0.10	-0.18	0.11	**-0.25**	0.11
[Ind. area] * [Main str] * [Sp. lim. 50] * [No snow]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Local str] * [Sp. lim. 50] * [Snow]	0.11	0.07	**0.17**	0.07	0.00	0.06	0.06	0.10	-0.03	0.08	-0.01	0.08	**-0.36**	0.07	**-0.43**	0.08	0.15	0.08
[Res. area] * [Local str] * [Sp. lim. 50] * [No snow]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 70] * [Snow]	**0.55**	0.13	**0.29**	0.12	0.02	0.11	0.05	0.18	-0.24	0.14	0.05	0.15	-0.13	0.13	-0.16	0.14	-0.06	0.14
[Res. area] * [Main str] * [Sp. lim. 70] * [No snow]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Res. area] * [Main str] * [Sp. lim. 50] * [Snow]	0.02	0.08	**0.18**	0.08	-0.01	0.07	0.00	0.11	**0.18**	0.09	-0.01	0.09	-0.14	0.08	**-0.18**	0.09	0.09	0.09
[Res. area] * [Main str] * [Sp. lim. 50] * [No snow]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 90] * [Snow]	**0.25**	0.08	**0.41**	0.08	**-0.24**	0.07	**-0.81**	0.12	0.00	0.09	0.04	0.10	**-0.23**	0.08	**-0.21**	0.09	**0.25**	0.10
[Art. area] * [Arterial] * [Sp. lim. 90] * [No snow]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 70] * [Snow]	**0.43**	0.07	-0.11	0.07	0.06	0.07	0.04	0.10	**0.23**	0.08	0.13	0.08	**-0.28**	0.07	**-0.20**	0.08	0.12	0.08
[Art. area] * [Arterial] * [Sp. lim. 70] * [No snow]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [Snow]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Art. area] * [Arterial] * [Sp. lim. 50] * [No snow]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.

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INTERACTION EFFECTS	Average speed		Deceleration factor		Mod. power demand acc.		Stong power demand acc		Extreme acc		Oscillating speed curve		Stop factor		Factor for Speed 15-30	
[Flow> 900] * [>59 yrs]	-13.96	7.89	0.88	0.58	-0.38	0.56	-0.01	0.53	**1.37**	0.56	0.58	0.55	-0.39	0.56	-0.66	0.54
[Flow> 900] * [<36 yrs]	-6.90	4.87	0.14	0.36	-0.09	0.35	-0.31	0.33	-0.05	0.35	-0.20	0.34	0.01	0.35	0.07	0.33
[Flow> 900] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow 700-900] * [>59 yrs]	-1.46	4.19	-0.20	0.31	0.39	0.30	-0.55	0.28	0.32	0.30	-0.10	0.29	-0.42	0.30	-0.56	0.29
[Flow 700-900] * [<36 yrs]	**-5.51**	2.79	-0.20	0.20	0.18	0.20	0.32	0.19	-0.23	0.20	-0.19	0.19	0.10	0.20	0.31	0.19
[Flow 700-900] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow 500-700] * [>59 yrs]	**5.92**	2.75	-0.09	0.20	-0.08	0.20	-0.02	0.18	0.24	0.19	0.14	0.19	-0.28	0.20	-0.27	0.19
[Flow 500-700] * [<36 yrs]	1.24	2.14	-0.01	0.16	-0.27	0.15	-0.31	0.14	0.10	0.15	0.08	0.15	-0.18	0.15	-0.14	0.15
[Flow 500-700] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow 300-500] * [>59 yrs]	**6.97**	1.76	-0.17	0.13	-0.09	0.13	0.03	0.12	-0.12	0.13	0.05	0.12	**-0.44**	0.13	-0.17	0.12
[Flow 300-500] * [<36 yrs]	-1.76	1.26	-0.01	0.09	0.07	0.09	-0.18	0.08	-0.11	0.09	-0.03	0.09	0.02	0.09	0.06	0.09
[Flow 300-500] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow 100-300] * [>59 yrs]	**3.34**	1.25	-0.11	0.09	0.09	0.09	0.01	0.08	-0.03	0.09	0.01	0.09	**-0.21**	0.09	-0.10	0.09
[Flow 100-300] * [<36 yrs]	1.40	0.82	-0.04	0.06	0.06	0.06	-0.04	0.06	0.04	0.06	-0.11	0.06	-0.01	0.06	0.02	0.06
[Flow 100-300] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow<100] * [>59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow<100] * [<36 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow<100] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow> 900] * [Woman]	3.18	5.43	0.09	0.40	0.28	0.39	0.09	0.37	0.19	0.39	0.28	0.38	-0.37	0.39	-0.65	0.37
[Flow> 900] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow 700-900] * [Woman]	**10.33**	2.78	0.05	0.20	0.25	0.20	-0.61	0.19	0.36	0.20	0.05	0.19	-0.28	0.20	**-0.38**	0.19
[Flow 700-900] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow 500-700] * [Woman]	**5.24**	2.09	0.09	0.15	0.10	0.15	0.02	0.14	-0.12	0.15	-0.05	0.15	-0.09	0.15	-0.22	0.14
[Flow 500-700] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow 300-500] * [Woman]	**5.52**	1.35	-0.06	0.10	0.03	0.10	0.01	0.09	0.01	0.10	0.08	0.09	**-0.27**	0.10	**-0.20**	0.09
[Flow 300-500] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow 100-300] * [Woman]	**1.95**	0.89	-0.02	0.07	0.07	0.06	0.06	0.06	-0.03	0.06	0.08	0.06	-0.08	0.06	**-0.14**	0.06
[Flow 100-300] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow<100] * [Woman]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow<100] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.

APPENDIX 1

Table A. Continuation. Estimated model parameters for average speed and the 16 independent driving pattern factors. Significantly estimated parameters bold and underlined

INTERACTION EFFECTS	Factor for Speed 50-70		Factor for Speed 70-90		Factor for Speed 90-110		Factor for Speed >110		Gear 2 or 3 2500-3500 rpm		Engine speed >3500		Gear 2 or 3 1500-2500 rpm		Gear 4 < 1500 rpm		Gear 5 < 1500 rpm	
[Flow> 900] * [>59 yrs]	**1.15**	0.52	0.92	0.52	**-3.68**	0.46	**1.62**	0.73	-0.43	0.57	-0.20	0.61	0.57	0.52	-0.29	0.57	0.24	0.59
[Flow> 900] * [<36 yrs]	0.21	0.32	0.18	0.32	**-1.26**	0.29	**1.37**	0.45	0.04	0.35	0.25	0.37	0.05	0.32	0.25	0.35	-0.01	0.37
[Flow> 900] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow 700-900] * [>59 yrs]	-0.19	0.27	-0.09	0.27	**-1.48**	0.25	0.39	0.39	-0.23	0.30	-0.54	0.32	-0.07	0.28	-0.02	0.30	**0.76**	0.31
[Flow 700-900] * [<36 yrs]	0.18	0.18	**0.92**	0.18	**-1.20**	0.16	-0.01	0.26	-0.03	0.20	**0.83**	0.21	0.00	0.19	0.21	0.20	-0.16	0.21
[Flow 700-900] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow 500-700] * [>59 yrs]	0.11	0.18	**0.39**	0.18	**-0.40**	0.16	0.13	0.25	-0.19	0.20	0.30	0.21	0.25	0.18	0.13	0.20	**-0.42**	0.21
[Flow 500-700] * [<36 yrs]	-0.03	0.14	-0.08	0.14	-0.11	0.13	-0.10	0.20	-0.02	0.15	0.05	0.16	-0.01	0.14	-0.01	0.16	-0.16	0.16
[Flow 500-700] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow 300-500] * [>59 yrs]	-0.02	0.12	**0.24**	0.12	**-0.29**	0.10	-0.13	0.16	-0.14	0.13	**0.40**	0.14	0.03	0.12	0.05	0.13	-0.23	0.13
[Flow 300-500] * [<36 yrs]	**0.24**	0.08	**-0.18**	0.08	-0.11	0.07	-0.12	0.12	0.16	0.09	0.16	0.10	-0.02	0.08	0.07	0.09	**-0.24**	0.09
[Flow 300-500] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow 100-300] * [>59 yrs]	-0.04	0.08	0.04	0.08	-0.05	0.07	-0.03	0.12	0.06	0.09	0.03	0.10	**0.18**	0.08	0.00	0.09	-0.12	0.09
[Flow 100-300] * [<36 yrs]	0.00	0.05	**0.12**	0.05	**-0.10**	0.05	-0.05	0.08	0.06	0.06	0.04	0.06	-0.08	0.05	-0.01	0.06	-0.06	0.06
[Flow 100-300] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow<100] * [>59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow<100] * [<36 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow<100] * [36-59 yrs]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow> 900] * [Woman]	0.05	0.36	0.27	0.35	**-1.42**	0.32	0.52	0.50	-0.26	0.39	0.10	0.42	-0.07	0.36	-0.48	0.39	-0.06	0.41
[Flow> 900] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow 700-900] * [Woman]	-0.22	0.18	**-0.66**	0.18	**0.57**	0.16	**1.28**	0.26	0.33	0.20	**-0.53**	0.21	-0.07	0.18	-0.13	0.20	-0.09	0.21
[Flow 700-900] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow 500-700] * [Woman]	0.06	0.14	0.10	0.14	-0.01	0.12	**0.47**	0.19	0.27	0.15	-0.22	0.16	0.12	0.14	-0.01	0.15	-0.12	0.16
[Flow 500-700] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow 300-500] * [Woman]	0.05	0.09	**0.29**	0.09	-0.11	0.08	-0.17	0.12	0.05	0.10	0.06	0.10	0.10	0.09	-0.07	0.10	-0.16	0.10
[Flow 300-500] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow 100-300] * [Woman]	**0.19**	0.06	0.00	0.06	-0.01	0.05	-0.04	0.08	0.05	0.06	0.08	0.07	0.11	0.06	-0.10	0.06	-0.09	0.07
[Flow 100-300] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow<100] * [Woman]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.
[Flow<100] * [Man]	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.	0.00	.

APPENDIX 1