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Road Traffic in China

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Abstract

Traffic is tightly related to the social and economic development in a country. In China the development of the economy has been very fast in the past 30 years and this is still continuing. The transport infrastructure shows a similar pattern, while traffic is also rapidly growing. In urban areas this growth has led to severe congestion problems, lack of parking space, air pollution and unsafety. Many Chinese citizens intend to buy a car as soon as they have sufficiently money, and accordingly car ownership is steeply growing. The national government considers the motorized vehicle market as a stimulus for the national economy development; urban authorities try to reduce the utilization of cars in the urban areas and to slow down the growth of car ownership, e.g. by limiting the number of new number plates.

In China, the number of fatal accidents per motor vehicle is diminishing, as is common in countries with a growing car ownership. The general trend that novice drivers have a larger accident risk than experienced drivers may have a long lasting, rather than a temporal, influence on the Chinese accident statistics, because the driving population is keeping growing with novice drivers. The discipline of Chinese road users and especially drivers shows opportunities for improvement. Disobedience significantly contributes to the number of fatal accidents (3% of the road fatalities are due to alcohol abuse, 14% to speeding, 12% to ignorance of priority rules).

Some conclusions are drawn with respect to study methods and tools that can be applied In China. Since the traffic conditions and driving behaviour in China are so different from these in Europe and America, it is not warranted to apply the methods and tools developed in the Western world directly for the traffic studies in China.

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Keywords: Driver behaviour; China; economic development.

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1. Introduction

Transport systems are an important part of the social-economic system of countries. They grow with the development of the countries. The pressure on the transport system is high, especially in countries with a fast development, like China. The demand for transport can be influenced by lots of factors, like the rapid urbanization, moving millions of people from the countryside to the towns, industrialization, the economic growth, the changing of wishes of people with the increasing income, the development of social conditions with respect to labour and leisure, and the national and local policy, etc. At the same time there is a fast development of transportation infrastructure, roads, airports, railways, harbours, Bus Rapid Transit, metro and others.

This all creates a very dynamic process both on the national and local level. Even on a personal level the fast developments of society, economics and transportation create distinct changes in the life of people. It has to be realized that these developments are partly a reproduction of the developments that took place in Western Europe and North America after the Second World War, however, this is now two or three times faster on an enormous spatial scale.

The high pressure on the transport infrastructure in China is especially visible on the urban roads of the large cities. Congestion is so common in a large city like Beijing that there is nearly no difference between peak and off-peak hours. Many roads and intersections have a huge size but this is still insufficient to serve the traffic demand. It is remarkable that the capacity of the intersections in Chinese cities appears to be 20 to 30% less than in Europe and North America (Li et al. 2012). This discrepancy needs more analysis.

The inefficiency of road infrastructure in China is not only observable on urban intersections, but also on motorways. The research made by Wang et al. (2007) shows that the capacity of freeways is considerably lower than this in a European country, like The Netherlands.

Traffic safety is another concern in China. Even though the statistics might be not completely comprehensive, the reported road fatalities are still high. Traffic unsafety and inefficiency are not uncommon in countries with a developing transport system, but it might be beneficial to identify the reasons and to explore the measure to improve traffic safety in China.

This paper explains the development phases of the Chinese road transport, the process of the growing car and driver licence ownership and its consequences for traffic safety. Furthermore, the driving knowledge, skills, customs and attitudes of drivers in China appear to be different from those in a Western country. This is investigated by a questionnaire for drivers in a Chinese city (Changsha) and in The Netherlands. The notable results of this survey are reported in another article (Li et al. 2013).

2. The development of the car ownership

It has been shown in other countries that the ownership of passenger car tends to saturate when the GPD per capita passes the level of 3000 US$ (祁国燕 and 曾红颖, 2003). According to the statistics of the World bank (THE_WORLD_BANK, 2013) the GDP per capita in China was already 3,749 US$ in 2009. However, in 2009 the passenger car ownership was still at a low level: 47 cars per 1000 inhabitants. The average over the world is 175. This means that still a large growth of passenger car ownership has to be expected.

Since the disposable personal income and gross domestic product per capita are the main determinants for car ownership (Chen and Zhang 2012), the ownership of cars and consequently the road traffic has shown a large growth in the past 10 years.

Compared with developed countries, the ratio of driver license number to the vehicle ownership in China is still quite high; therefore, it is likely that a quite large number of vehicles will be sold in the short future. From 2009, China has become the largest vehicle market in the world. The sales volume of vehicle in 2011 is 18 million (Chanyezicum 2012), the vehicle ownership in China exceeded 100 million and became the second largest vehicle country in the world.

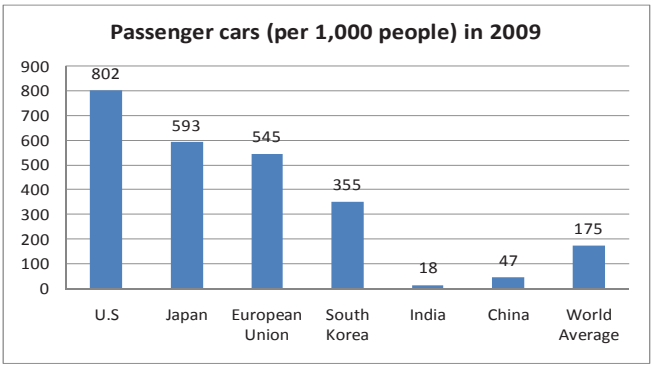

Fig. 1. Passenger cars per 1000 persons in 2009 (The World Bank, 2013)

Note: Passenger cars refer to road motor vehicles, other than two-wheelers, intended for the carriage of passengers and designed to seat no more than nine people (including the driver)

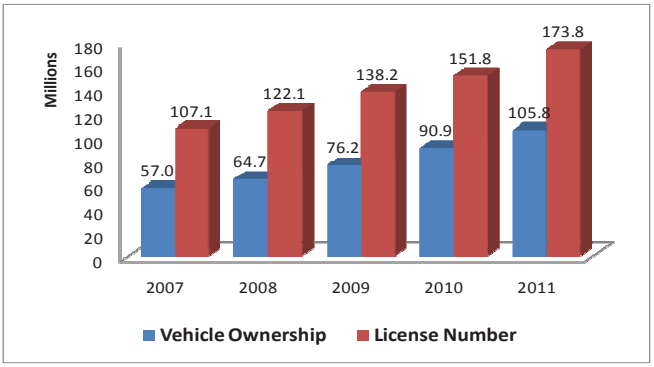

Fig. 2. Vehicle Ownership and license Number in China (2007~2011) (Chanyezicum 2012)

Note: Vehicles refer to road motor vehicles, other than two-wheelers, trailers, tractors and especial type vehicles.

Passenger cars present the main part of vehicles in cities. According to the analysis of passenger car market in developed countries, the development of passenger car market can be divided into two stages. The first stage, namely high speed growing, usually lasts for about 5 years with an average 30% yearly increase. At the end of this first stage, the passenger car ownership is about 20 per 1000 persons. The second stage is called 'persistent growth' where the yearly passenger car ownership may continue increasing with a yearly growth rate 20% for about 10 years. After the second period, the passenger car ownership is expected to be 100 per 1000 capita. The development of passenger vehicle in the other two neighbouring oriental countries is shown in Table1. China is a large country and is expected to experience a longer development period with lower growth than the other two countries Japan and South Korea. Based on the prediction made by the State Information Centre in China in 2010, the growth of the car ownership is about 1.5 times of the GDP increase percentage, i.e. the yearly increase is 13%~15%, as shown in Table 1. Until 2020, the total number of vehicle is expected to reach 200 million passenger cars in China.

Although according to the statistics in the neighbouring countries the growth of vehicle ownerships should be lower after 2009, the growth is still continuing on a high level (22.06% in 2011). That means that in the next several years China has to confront a relatively higher growth of vehicle ownership. The consequence is first of all that the traffic pressure will continue to increase and no saturation level will be attained yet. In China, just like in many other developing countries, the ownership and use of motorized vehicles are concentrated in the cities. In 2011, 36 of the bigger cities possess 34.54 % of the motorized vehicles; 14 of these cities have more than 1 million cars; Beijing owns even 4.7 million motorized vehicles. Several of the bigger cities experience severe congestion during the peak hours.

Table 1. Vehicle Ownership and license Number in China (2007~2011)

Country		Start year		End year
Japan	1st Stage	1960		1964
	Yearly sale increase		35.8%	
	Second stage	1965		1973
	Yearly sale increase		22.2%	
South Korea	1st Stage	1981		1985
	Yearly sale increase		25.0%	
	Second stage	1986		1997
	Yearly sale increase		2.0%	
China	1st Stage	2001		2008
	Yearly sale increase		30.4%	
	Second stage	2009		2021
	Yearly sale increase		13-15%	

The fast growing of vehicle ownership also influences the composition of drivers. The number of new driver keeps increasing with the yearly percentage of about 10%, as shown in Figure 3. The number of driver with less than 3 years driving experience is about 1/3 of the whole driver population. In terms of the statistic made in 2011, most of drivers are younger than 50. There are only about 10% driver older than 50. There is evidence that the driving behaviour of young drivers with limited driving experience is more risky than more mature drivers, which have influence on both the traffic performance and safety (Houtenbosch 2008).

Fig. 3. Percentage of new drivers and driver age distribution in China (2011)

The fact that car ownership in China develops differently from other countries is partly due to the policy of permissions to drive a car in a city (Chen and Zhang 2012). Many Chinese cities try to reduce the growth of traffic by rationing (having a fixed quota for the number of cars in a city), road or congestion pricing and vehicle usage restrictions (forbid the use of a specific vehicle on certain days). Zhu et al. (2013) show that rationing is effective in highly congested cities.

In Shanghai people can only drive a car in the city centre when they have bought a special vehicle number plate. A limited number of special number plates is yearly available and the number plates are sold on an auction. Such policy indeed reduces the growth of the number of cars in the city centre and probably also the purchase of cars. Another policy is applied in Beijing where the use of a car is limited. Also in Beijing limitations are imposed on the number of new licence plates by a lottery: people who want to buy a car have to win a licence plate from a lottery (Zhu et al. 2013).

3. Public transport

Public transport has much emphasis in the present transportation policy, also in China. Since at present congestion in China is especially an urban problem, the role of public transport is obviously significant (Mogridge 1997): building more road infrastructure to facilitate motorized traffics will deteriorate the accessibility of cities unless public transport is also improved. An improved public transport is also beneficial for the car traffic because congestion will be reduced by the travel modal shifting from car to public transport. The national policy has been directed to develop favourable public transport services. In the larger cities the public transit system is rapidly extended with a pace that is unique in the world. The metro system of Shanghai and Beijing has been extended in the past decennium and in several other cities metro networks are being built now. Bus Rapid Transit – bus services that receive priority at intersections and use dedicated bus infrastructure – is developed as experiment in Kunming (Kunming 2009, Wang et al. 2012) and afterwards in several other cities.

In the policy from 2004 the government set targets for the travel modal share (30% public transit in the mega cities, 20% in the big and medium sized cities) and the accessibility of public transit in cities (Wang et al. 2013). The modal share is indeed increasing in some cities: e.g. in Beijing from 24.1% in 2005 to 30.3% in 2010, Kunming from 14.7% in 2005 to 23.7% in 2009. In Shanghai the trend is just opposite, a diminishing PT share from 26.0% in 2005 to 23.2% in 2009. In Beijing the Olympics had certainly an influence on modal choice while in Kunming the experiments with Bus Rapid Transit might have stimulated public transport ridership.

Since this paper focusses mainly on private road traffic, the interesting and important subject of public transit in Chinese cities will not be elaborated further.

4. Traffic safety

Generally, traffic accidents are a serious problem in developing countries. Since the infrastructure is still in a development phase, road users have not matured their behaviour on the road; inappropriate habits and disobedience are common in practice. The consequences are many accidents and a huge number of fatalities.

The Chinese government made much effort to improve traffic safety in the past few years by improving the road infrastructure and reinforcing the obedience to the rules of the road. The effect is visible in the decrease of the absolute number of serious accidents and the number of accidents per driver. All these data are obtained from the official Chinese statistics (Neteasy, 2011).

Traffic accidents not only deteriorate traffic safety, but also worsen congestion. For instance, in Changsha, the capital of Hunan Province, in June, 2012, 13% of the congestion was due to traffic accidents. Except road construction and imbalance between traffic volume and road capacity, traffic accidents are the main cause of congestion. Figure 5 shows the different reasons for congestion in Changsha city.

Table 2. The development of total number of drivers, serious accidents, drivers involved, fatalities and injured persons

(Data from http://auto.163.com/10/0709/10/6B53JH6B000816HJ.html)

Year	Driver	Accident	Fatalities	Injured
2001	44 626 768	754 919	105 930	546 485
2002	48 270 803	773 137	109 381	562 074
2003	53 680 656	667 507	104 372	494 174
2004	71 016 414	567 753	99 217	451 810
2005	80 177 560	450 254	98 738	469 911
2006	93 172 381	378 781	89 455	431 139
2007	107 087 137	327 209	81 649	380 442
2008	122 092 132	265 204	73 484	304 919
2009	138 203 911	238 351	67 759	275 125
2010	151 819 016	219 521	65 225	254 075
2011	173 813 961	210 812	62 387	

Death ratios to 1000 vehicles in the past 5 years are shown in Figure 3. In 2007, the fatality ratio of is 1.4 deaths per 1000 motor vehicles, which has decreased to 0.6 in 2011. But the fact that more than 20,000 people died because of traffic incidents indicates the traffic safety situation in China still has opportunities for improvement. Transverse comparison of traffic incidents between different countries is not easy, because of the absence of identical international standard for the accident analysis.

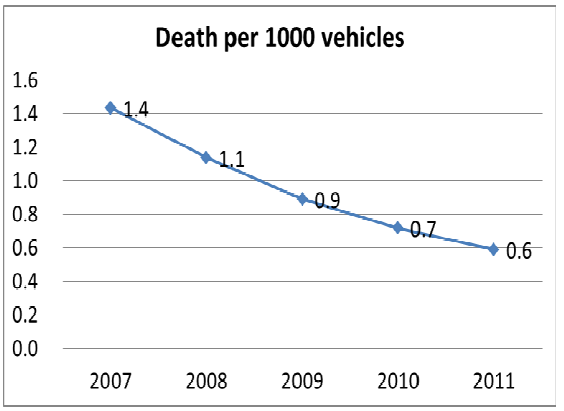

Fig. 4. Death per 1000 vehicles (2007~2011)

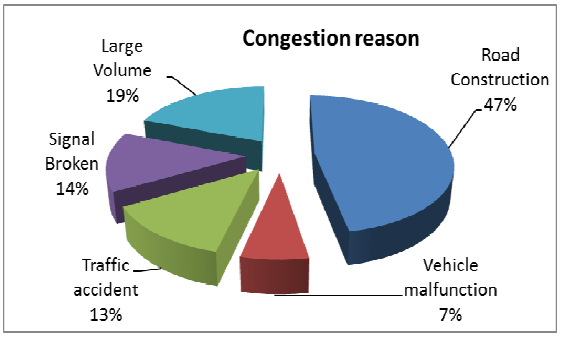

Fig. 5. Congestion reason analysis in Changsha, June. 2012 (Data from http://www.rednet.cn）

5. Offences

Traffic flows in most Western countries are rather smooth due to the fact that the majority of drivers behave is in a consistent and predictable way. Homogeneity makes flows more efficient but turbulence caused by deviating behaviour of individual drivers often reduces average speeds and throughput. Therefore a disciplined way of driving and obedience to the traffic rules create a situation in which drivers know from each other what they will do. In this case, drivers can drive more confidently with less reason to 'expect the unexpected' (Houtenbos 2008). This section gives some insight in the (dis)obedience of Chinese drivers to traffic rules. More information on this issue can be found in Jie et al (2013).

In the first half year of 2011, traffic policemen in China totally dealt with about 171 million cases of disobedience by drivers in China with respect to the driving rules. Among the recorded 171 millions of disobediences, 45 million actions, i.e. 26.3%, were determined as slight offences and were corrected in the field by a verbal admonition. The other kinds of disobedience were penalized by giving the drivers a summons. Among the penalized disobediences, 54.7% took place in urban areas, and 34.9% and 10.4% were made on highways and freeways respectively. The distribution of penalized disobedient behaviour in different regions is shown in Figure 6 (left). Totally there were 25.6 million driver are recorded with offensive behaviours, namely 11.4% of the whole driver population. The statistic results show that drivers in the age between 30 and 50 years committed 69% offenses of the rules. Given the fact that this group is about 63% of the total population, this high percentage is understandable. The smaller group of young drivers (about 17% of the total population) shows a relative higher disobedience rate of 23%. More details can be seen in Figure 6 (right).

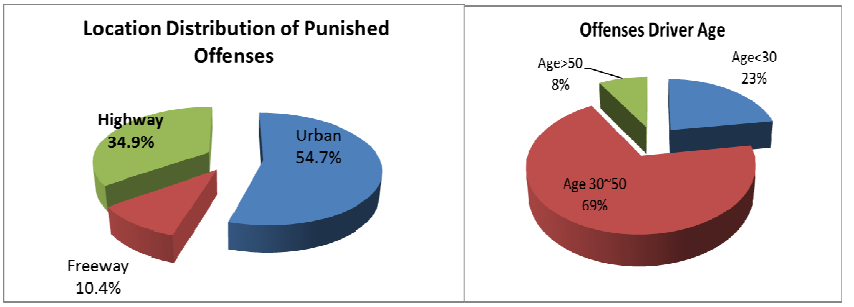

Fig. 6. Observed disobedience in different road types (left) and for different driver age groups (right) (Data from http://www.hljjj.gov.cn/）

Further statistical analyses have been done for the disobedience data from October, 2011. October is a typical working month in China with no festivals apart from October 1st. In terms of the official statistic in October 2011, drivers represent the largest proportion of disobediences with the percentage of 85.9%. The percentage of cyclists and pedestrians/passengers who disregard the traffic rules are 7.5% and 6.6% respectively, as shown in Figure 7. It is not sure whether these official statistics can be considered as representative for the disobedience of all road users, since traffic police men might be more focussed on drivers than on pedestrians and cyclists.

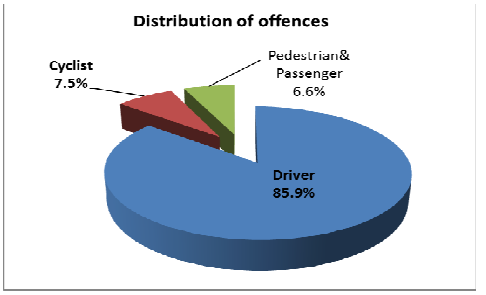

Fig. 7. Distribution od offenses over road user classes (Data from http://www.hljjj.gov.cn/）

Speeding is the most frequent offence and occupies 20.36% of the observed offences which have been punished in Oct, 2011 in China. In most of cases, driving in excessive speed is the typical offence on freeways and motorways, where 70.6% of such aggressive behaviours were recorded. The other frequently punished offences are illegal parking, driving on wrong lanes, disregarding signs and signals, which are all typical offences in urban areas. Besides the above described offences, over-loading, driving under influence of alcohol, fault in lightning, etc., are named as 'Others' in the statistics, which formed 36.27% of punished driving behaviour. More details are shown in Figure 8.

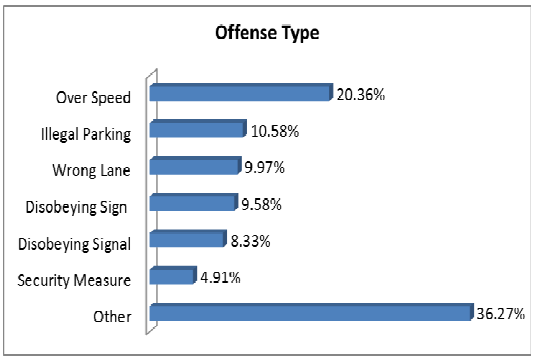

Fig. 8. Offence Type Distribution
(Data from http://www.hljjj.gov.cn/）

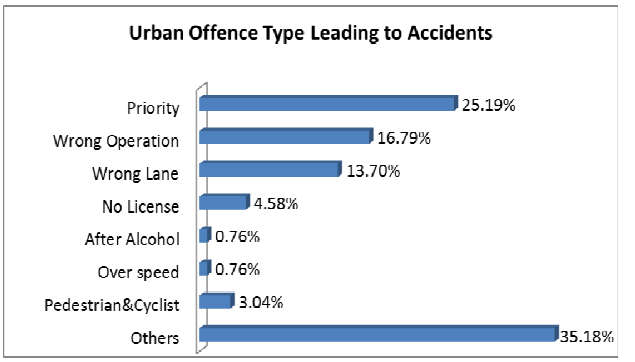

Fig. 9. Offence Type Distribution in Changsha, Mar. 2012 (Data from http://www.rednet.cn）

Disobedience is one of the main causes of traffic accidents in China. In 2004, the percentage of traffic accidents induced by drivers' failures is 89.8%, which constituted a large percentage of deaths and wounded in all traffic incidents, i.e. 87.4% and 90.6%. (www.xinhua.com). Main offences causing serious traffic accidents are speeding, ignoring priority rules, and no-license driving. In 2010, speeding and ignoring priority rules constituted 14% and 11.9% of the traffic fatalities respectively. No-license driving led to 6.8% of the traffic deaths, among which 64% were motorcyclists. Two other typical offences are driving under influence of alcohol and illegal converse driving, which resulted in 3% and 2.7% traffic death in 2010 in China.

In urban areas, the main inducements of traffic accidents are usually different from those in the country region. In Changsha, the capital of Hunan province, ignoring of priority rules is the most dangerous behaviour, since this kind of offences led to 25.19% of the accidents in March, 2012. Choosing the wrong lane, illegal lane changing, converse driving, and illegal overtaking totally resulted in 13.7% traffic accidents. These kinds of offences are typical examples of improper driving behaviour which are expected to be improved by education,

enforcement by the traffic police and by more experienced driver population. The distribution of offences in Changsha is shown in Figure 9.

Offences of traffic rules can directly reduce traffic safety, initiate congestion, and furthermore can influence the behaviour of all drivers. Every driver has to anticipate that another driver will bring him in danger with behaviour that is not according to the rules. Every driver has to be cautious, which is visible in the slow acceleration and the keeping of too large time headway (Jie et al. 2012).

6. Conclusions

Driving behavior of Chinese drivers has specific characteristics that are influenced by the phase of the motorization and the driving culture. A large proportion of the drivers have only a short experience. Due to the continuing inflow of new cars and new drivers, the effect of novice drivers will continue to exist for many years. Furthermore, traffic offences are common and influence safety and driving culture. The results are observable, for instance the road and intersection capacity in China are significantly lower than those in a European country such as The Netherlands. The difference in driving culture between China and Western countries is similar to the difference between an ant hill and a machine. In an ant hill every ant behaves in its own way, with its own objectives and limitations, there are similarities between the different ants and they interact with each other, but the ant hill is a self-organizing society. In Western countries the behaviour of drivers is controlled by rules and indications along the road. This results in an organized instead of a self-organizing traffic flow. Better discipline will certainly improve traffic performance in China with 20 to 30% and increase traffic safety.

However, one has to realize that an improvement of road capacity with 20 to 30% can't solve the sustainable traffic problems because it is just sufficient to handle the growth of traffic for 1 or 2 years. Even though, the capacity improvement is important because it can be integrated in a comprehensive approach of urban road traffic performance and safety improvement.

Traffic studies are often executed as a part of planning processes. The researchers and consultants should be aware of the fact that Chinese traffic is different from traffic in North America and Western Europe. That means that the study and design instruments have to be adapted for Chinese conditions (Li et al. 2011).

The impact of the continuing growth of the car ownership and driver licenses in the coming years will also be very important for the fuel consumption and emissions. The air quality in the bigger cities in China is now already a reason for concern. When the number of cars per 1000 inhabitants will reach the average level of 175, the total number of passenger cars in China will become 227 million. Assuming a yearly distance traveled of 30,000 km and fuel consumption of 1 liter per 15 km, the fuel demand will become 454 million m^3 per year, about 10% of the present total global oil consumption and about 40% of the present total fuel consumption in the USA. The CO_2 emission will become 1.8 billion ton per year. It is obvious that the uncontrolled growth of car ownership will have extremely serious consequences for the environment and energy economy. On a national and municipal level measures are necessary to manage the growing demand for car travel.

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