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## In-Depth-Study in JiaDing District, Shanghai Considering as an Example for Accident Research in the Peoples Republic of China

### 1 Abstract

76 severe traffic accidents had been investigated in depth in an ongoing Volkswagen-Tongji University joint accident research project in JiaDing district, Shanghai, PR China since June 2005. With a methodology similar to German accident research units in Dresden and Hannover, a research team proceeds to the scene immediately after the incident to investigate and collect various data on environment, accident occurrence, vehicle state and deformations as well as injuries. The data combined with the results of accident reconstruction will be stored in a database for further statistical and casuistic analysis. The first outcome of the project supports the hypothesis that a main causation for the large number of traffic accidents in China is the lacking of risk awareness in Chinese driver behaviour. Low seat-belt use and the high proportion of vulnerable and poorly protected two-wheelers in traffic are reasons for the high injury and fatality rate in China. The research work shows that accident research in China is feasible and able to give support to tackle one of the urging problems in Chinese development.

### 2 Motivation/Why Accident Research in China

China has one of the most developing economies in the world. The average annual GDP growth from 1994 to 2004 is 8.3%.<sup>1</sup> This economic growth leads

to an increase in mobility and as a side effect also to an increase in traffic accidents (Figure 1).

Compared to other developed countries in Figure 2 China is far behind in the number of vehicles and in the ratio vehicle per inhabitant but ahead in the number of fatalities and in the ratio fatalities per 1,000 vehicles. With the ongoing economical success in China and the combined increase of vehicles, there is little space for hope that a general change in the trend of accident figures occurs without establishing countermeasures. This joint research project will help to define countermeasures by analysing Chinese road traffic accidents in depth. The goal of this project is to get a deep understanding of traffic accidents in China and to identify the effects on traffic safety to ensure a sustainable mobility. Therefore it is necessary to

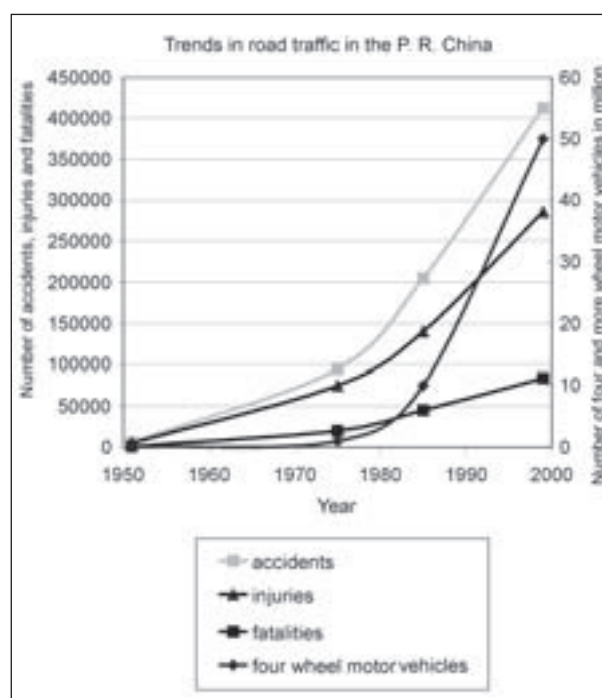


Figure 1: Development of fleet and accident figures in China

	USA	PR China	15 EU Countries	Germany
Population (Mio.)	293	1.298	380	82
Area (Mio. km <sup>2</sup> )	9,1	9,6	3,2	0,36
Fleet (Mio. passenger cars)	130	ca. 13	186	44
Fatalities (1000)	42,8	ca. 105	37,3	6,6 (2004: 5,85)
Passenger cars 1000 inhabitants	443	ca. 10	488	538
Length of road net (Mio. km)	6,4	1,4	3,8	0,23
Fatalities per 1000 vehicles	0,33	8,1	0,20	0,15 (2004: 0,13)
Data from	2002	2003	2001-2003	2003

Figure 2: A comparison of traffic and accident related figures<sup>2</sup>

<sup>1</sup> [http://www.worldbank.org.cn/English/Content/chn\\_aag02.pdf](http://www.worldbank.org.cn/English/Content/chn_aag02.pdf)

<sup>2</sup> Data from: IRTAD, CIA World-Fact-Book, Eurostat, Stat. BA, China Internet Information Center

investigate the accident situation in this country in depth both statistically and in case studies.

### 3 The Volkswagen-Tongji University Joint Research Project

The Volkswagen-Tongji University joint research project started in May 2005 under executive of the professorship of Body Structure Design and Passive Safety at Tongji University by initially forming a research team which consists of 10 students of automotive department and one team leader. The training is conducted by scientists from Volkswagen

group accident research which also formed the advisory board. Training procedure includes investigation of accident scene, investigation of vehicles, accident reconstruction and accident data processing. A holistic approach to accidents should lead the research team to see an accident not only as an accumulation of data but to gain a fully understanding of the accident from the situation the driving process becomes critical to the identification of impact points inside and outside the vehicle and their related injuries. Finally the team members are not only able to collect data but also gain understanding of traffic safety and accident causation.



Figure 3: Accident research vehicle of joint research

The research area is at first restricted to JiaDing district, an area of 458.8 km<sup>2</sup> with a population of 474,100 (as of 2001).<sup>3</sup> JiaDing district covers urban as well as rural area with also industrial area and farm land. The surface is plain and its altitude is close to sea level. The distribution of different road types can be seen in Figure 4.

Shanghai traffic police authorities were involved in the project at a very early stage which results in a

<sup>3</sup> <http://en.wikipedia.org/wiki/Jiading>

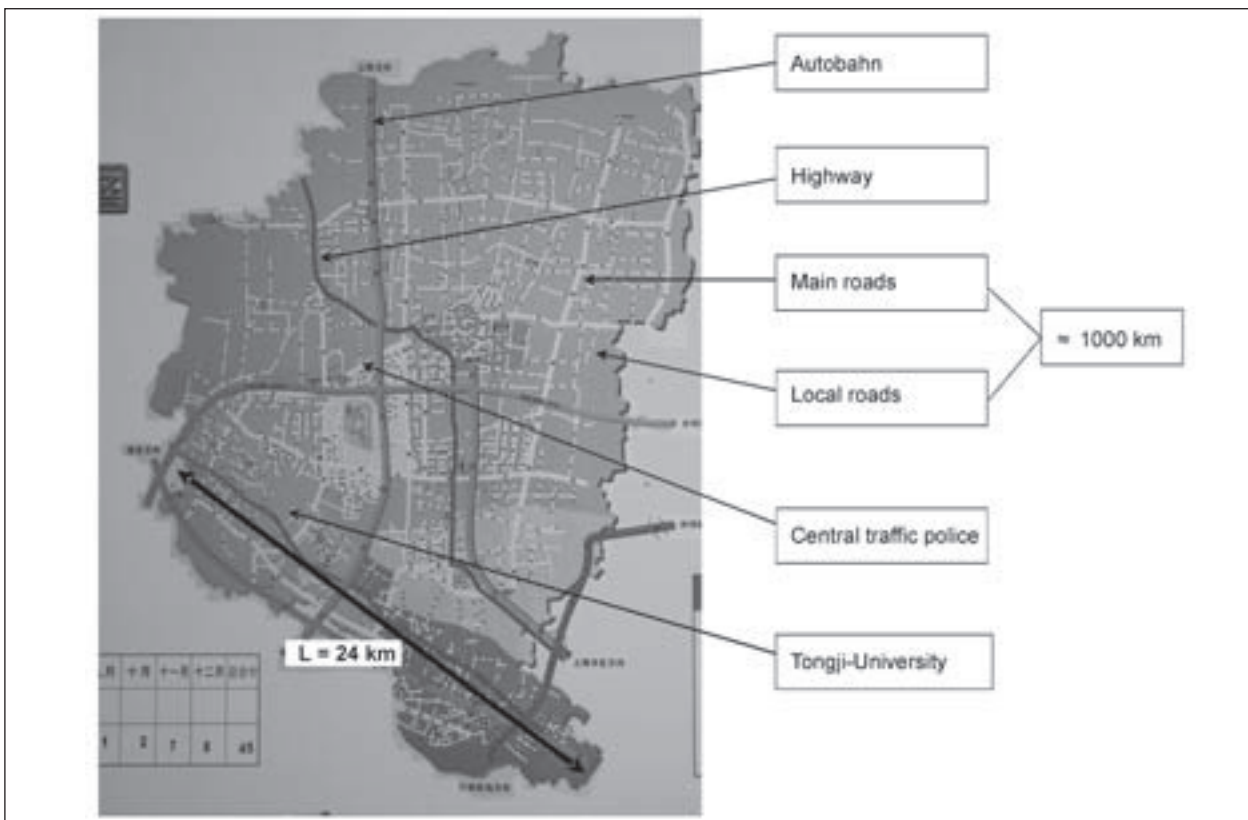


Figure 4: JiaDing District Shanghai

good acceptance and relationship. Beneficial for the project is that both Shanghai central traffic police and JiaDing traffic police support the research work to a large extent.

## 4 Methodology

The accident investigation is conducted in order of the subsequently listed steps:

1. Informed by police, the research team members proceed immediately to the accident scene. A full investigation of the scene including measurement and photographing of final positions, marks and the surrounding of the spot is accomplished.
2. Investigation of all involved vehicles on scene or later including general vehicle data, deformations, impact points inside and outside the vehicles and marks indicating the movement of passengers and/or pedestrians/cyclists. Also the state and usage of restraint systems or protection devices like helmets will be recorded.
3. Documentation of accident related injuries as well as blood-alcohol concentration or drug use. Further personal related data as age, gender, age of driving license or education are collected.

4. Accident reconstruction to gain information on impact speed, direction and momentum of impact and loss of velocity. A time-path analysis figures out closing speed, distance and time between point of reaction to point of impact and accident avoidance.
5. Internal discussion on every accident to get a full comprehension of accident causes, outcome, mitigation and avoidance possibilities according to a holistic approach
6. Data proceeding. Similar to the data scheme of GIDAS<sup>4</sup>, the accident data will be filed in a database for further statistical analysis.

## 5 First Outcome

From June 2005 to June 2006 76 accidents had been recorded and investigated in depth. 50 (65.7%) of them are accidents with at least one injured person and 9 (11.8%) of them are fatal. 33 (43.4%) cases from the overall sample are accidents involving trucks or busses and 23 (30.2%) are accidents with two-wheelers. The recorded number of pedestrian accidents is with 2 (2.6%)

<sup>4</sup> German In-Depth Accident Study; [www.gidas.org](http://www.gidas.org)

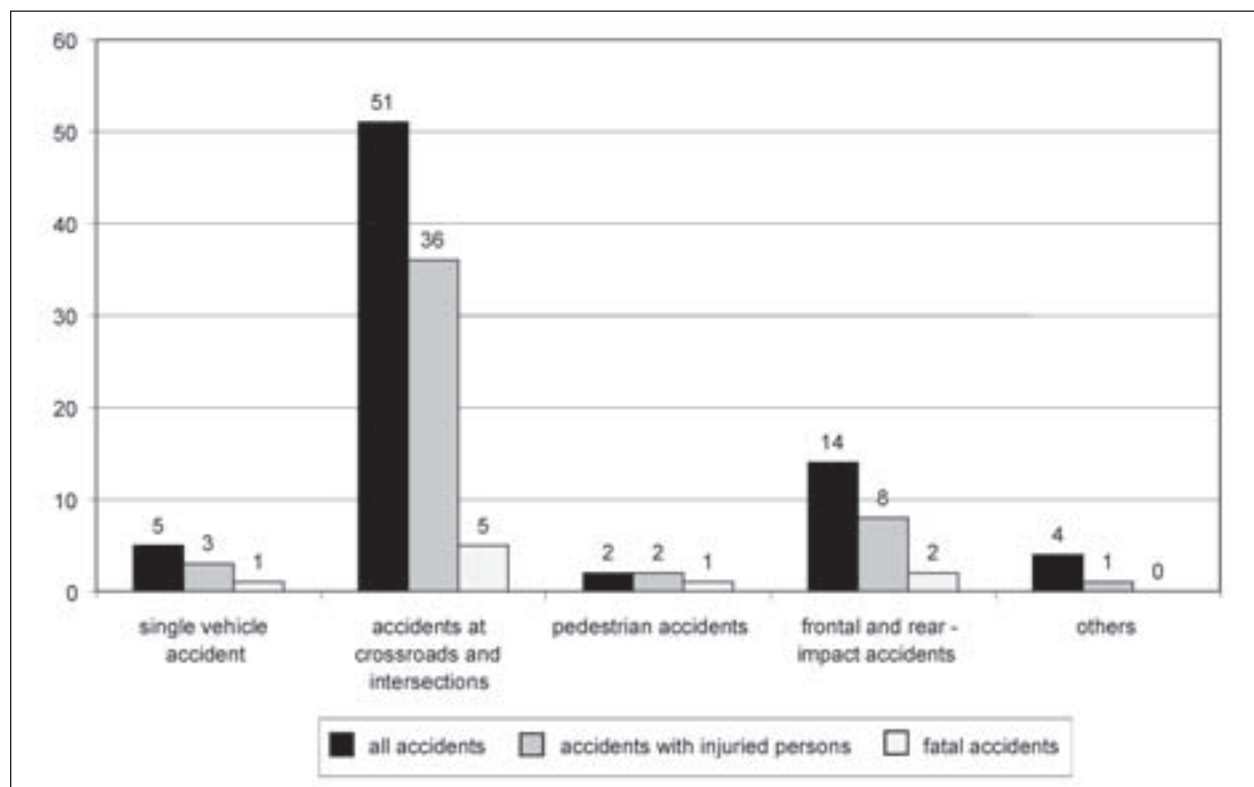


Figure 5: Accident type distribution

comparably small. Figure 5 displays the distribution of type of accidents within the sample. Besides of the fact that the number of accidents is not statistically representative, yet, some basic conclusions on accidents in China concerning causation and injury risk can already be derived from the data.

A hypothesis for Chinese biggest problem concerning traffic safety is the lack of risk awareness.<sup>5</sup> One possible reason for this problem can be a missing “automotive socialisation”. In developed countries people obtain their driving license after a long period of automotive socialisation. They grew up with high traffic density and they are used to drive with their parents from early childhood days, they are familiar with traffic when they enter driving school. China’s enormous economical growth changes society from a “kingdom of cyclists” to modern traffic within less than 20 years. It is presumed that the development of individual risk awareness could not keep pace with development of traffic. People in their middle ages now become wealthy enough to afford their first own vehicle but didn’t have much experience in traffic. This hypothesis is supported by three findings:

### Accidents on crossroads

51 accidents (67.1%) of all accidents in the sample occurred at intersections and 39 (51.3%) of all accidents are represented by only three different

types, impact to a vehicle coming from left which represents 17 cases (22.4%), impact to a vehicle coming from right (14 cases i.e. 18.4%) and heading into oncoming vehicles when turning left (8 case i.e. 10.5%). China has appropriate traffic rules<sup>6</sup> and crossroads in JiaDing district are often spacious and major crossroads are usually equipped with traffic lights. Main causes for the above mentioned accidents are violating of right of way and misinterpreting the time gap between two oncoming vehicles in a case of making a left turn. Violating the right of way refers basically to a lack of risk awareness. The false estimation of speed and distance of oncoming vehicles is – if not an enforcement of right of way – primarily a problem of being short on experience. A case study will illustrate the above mentioned:

A Santana was hit at nighttimes by a DongFeng truck on a crossroad shown in Figure 6. Impact speed of the truck was 69 km/h while the Santana was travelling at 80 km/h. The truck driver claims



Figure 6: Accident scene Santana vs. truck



Figure 7: Lateral impact of Santana by truck

<sup>5</sup> cp. ZHANG, W. et al.: Driver’s view and behaviors about safety in China – What do they NOT know about driving. In: Accident analysis and prevention, 2006 38 (1) 22-7

<sup>6</sup> [http://english.gov.cn/laws/2005-09/07/content\\_29966.htm](http://english.gov.cn/laws/2005-09/07/content_29966.htm) Article 38;44

that he had the priority when entering the crossroad. Due to a severe head trauma, the driver of the Santana was not able to give a statement. The traffic lights are working, both vehicles used headlights and there was no limitation of visibility besides darkness. It can be stated that one of the participants violated the way of right by running over red light. The high impact speed of both vehicles indicates that none of the drivers had been aware of the risk at crossroads, neither the driver who had the right of way nor his opponent, violating it.

### Poor seat-belt usage

The usage of seat-belts in combination with rigid driver compartment is life-saver number one in car accidents.<sup>7</sup> The sample of 76 cases includes 86 passenger cars and delivery vans. In 36 of the cars the had been clear indications for not wearing a seat-belt for any of the passengers. This is a belt wearing ratio of 58.1%. It has to be stated clearly, that this could be an overestimation, because even at accidents with a minor crash pulse (e.g. car vs. two-wheeler) indicators for seat-belt use as belt marks can hardly be found.

A case study: A Volkswagen Polo with five passengers was going along an autobahn when caused by driver distraction the car suddenly turned right and had a frontal impact to the guard-rail at a speed of approx. 40km/h. The guard-rail collapsed and the car fell down a four meter slope and had a second impact on the ground with the rear end. All passengers had been unbelted and were severely injured. A young woman aged 25 was ejected from the co-driver's seat through the closed hatch

<sup>7</sup> ZOBEL, R.: The safety effect of active and passive systems, ITS World Congress, San Francisco, 2005-11-0

window and remains paralyzed. The paralysis was caused by a vertebral fracture. As can be seen in Figure 8 there is no deformation in the driver compartment. so it can clearly be stated that this accident only would have caused minor injuries if all passenger did buckle up.

### Risk of two-wheelers

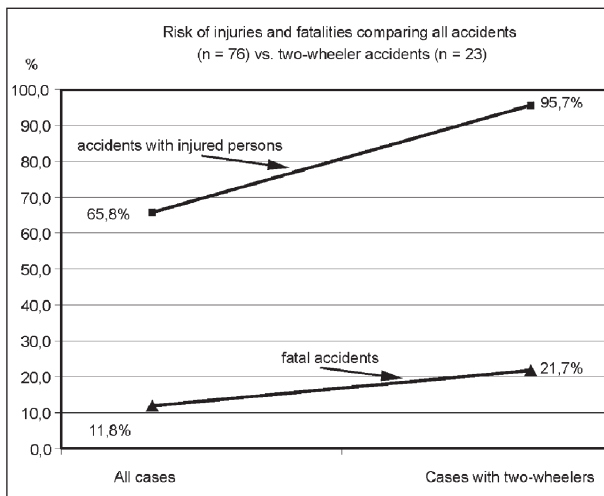
Cases with bicycle and motor-cycle involvement are 30.3% of all investigated accidents which is a comparably high figure to developed countries. According to Figure 9 the probability of injuries rises by involvement of two-wheelers from 11.8% to 21.7% (fatalities from 65.8% to 95.7%). All accidents analysed so far within this project, the opponent, i.e. the passengers of car or truck, remains unharmed. This leads to the conclusion that cyclists show a high vulnerability. This is supported by the fact that in all recorded accidents, none of the motorcyclists had worn a helmet. Helmets for bicyclists are nearly unknown in China.

From all 23 cases with involvement of two-wheelers, 19 (82.6%) cases occurred on crossroads. One possible outcome of further accident research within this project can be that a separation of bicycles and small motorcycles from all other vehicles and safe crossing possibilities will have an impact on these figures.

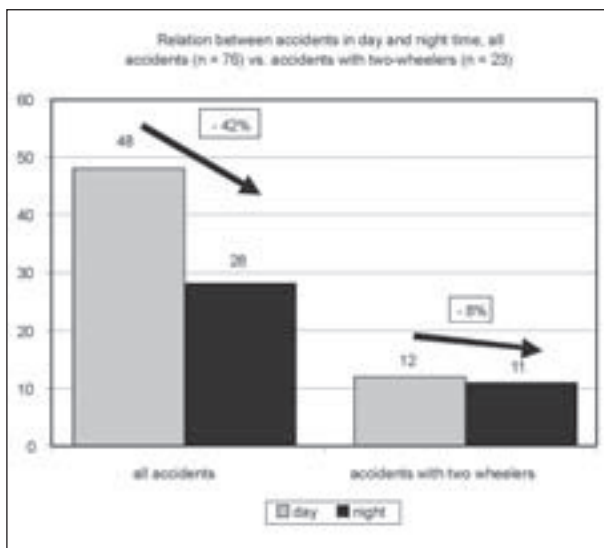
Besides, cyclists should also train their personal risk awareness. As shown in Figure 10, a 42% decrease in the number of accidents can be found when day changes to nighttime. By contrast accidents with two-wheelers decrease only by 8%. Proper lighting can be the key so lighting of bicycles and retro-reflective devices are widely unknown and even motorcycles drive sometimes without light at nighttimes.



Figure 8: Accident scene (with refurbished guard-rail) and VW Polo



**Figure 9:** Increase of risk for driver of two-wheelers



**Figure 10:** Increase of risk in nighttimes

Once again it should be mentioned that these findings are based on 76 investigated accidents in Shanghai and they are not statistically representative for China in general, but they point out first conclusions.

## 6. Conclusions and Next Steps

It can be noticed after nearly one year of accident research in JiaDing district that in-depth accident research in China is feasible and achieves reasonable results giving a first insight into Chinese problems in traffic safety. Together with Chinese authorities and the scientific community in China research partners and stakeholders came to the conclusion that it will be beneficial for China to further carry on with accident research. Besides of

the positive results, there are some further actions to take to intensify the research work and getting a wider view on accidents in China. These steps are mainly:

- widen the area of accident investigation to cover all Shanghai districts,
- improve the medical data collection,
- prove the statistical representativeness of the accident data,
- further data collecting.