Traffic Safety Analysis of Highway Plane Intersection

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Abstract. As a meeting point of motor vehicles, non-motor vehicles, pedestrians, etc., road intersections are prone to traffic safety accidents, which in turn seriously affect traffic order. This paper studies the causes of frequent occurrences of road intersections from the aspects of people, vehicles, road traffic environment and management, analyses the existing road junction accident prevention measures, and bases on the intersection accidents and existing accident prevention measures, proposes several measures for the government and related enterprises. The effective prevention and control of traffic accidents at highway intersections is a complex system project, which requires the participation and efforts of all parties. This study can also provide reference for this.

1. Introduction
According to statistics, about one-third of road traffic accidents occur at intersections in the United Kingdom, France, Austria and other countries; China's relevant sampling statistics show that accidents at road intersections account for more than 30% of the total number of traffic accidents. Accidents occur frequently at highway intersections. It is especially necessary to conduct research and analysis on traffic safety at highway intersections and provide reference for effective prevention and control of traffic accidents at intersections.

2. Analysis of accident cause of highway
As for road intersection accidents, it is possible to analyse the four aspects of people, vehicles, road traffic environment and management to find out the main causes of frequent occurrences.

2.1. Human reason
Motorists are subjective and often subject to physical, psychological and environmental factors. Traffic participants at plane intersections mainly include motorists, non-motorized drivers and pedestrians, and they are also the main victims of traffic accidents.

2.1.1. Reasons for motorists
As a motor vehicle operator, a motorized driver's driving behavior is affected by factors such as age, gender, and education level.

(1) Gender. Studies show that male is more prone to red light violations than female. Male are more aggressive, while female are more cautious and conservative.
(2) Level of education\[3\]. The higher the culture, the stronger the safety awareness
(3) Driving age\[4\]. The longer the driving experience, the less likely it is to have a traffic accident.
Once accident happens, the death rate is higher. Because they have fatal driving habits.
(4) Rushing time. Sometimes drivers often rob light in order to save time.

2.1.2. Reasons for non-motorized motorists and pedestrians
The street crossing behavior of non-motorized drivers and pedestrians is also affected by factors such as luck and tolerance.
(1) Fortunately\[4-5\]. When they cross the street, they always think that they are the protagonists, and use the traffic flow to cross the road.
(2) Endurance limits\[4-6\]. Everyone has their own endurance limit, and once they exceed the endurance limit of people, they will find ways to cross the intersection.
(3) Distraction\[6-7\]. The use of mobile phones when crossing the street has a distracting effect on pedestrians, seriously affects the speed of crossing the street. Non-motorized motorists believe that the risk of non-motor vehicles is small, while watching the mobile phone while riding a bicycle, it greatly distracts attention, causing the danger to come when it is too late to react.
(4) Different street crossing speeds. Pedestrian crossing speeds of different age groups are different.
For example, the speed of the elderly and children is relatively slow.

2.2. Reason for the vehicle
Vehicles facilitate people's travel, but at the same time, factors such as large vehicle holdings, fast vehicle speeds, overloaded vehicles, mechanical failures, blind spots, and non-motorized mobility greatly increase the risk of traffic accidents at intersections.
(1) Large vehicle holdings. By the end of 2018, the number of car ownership in the country reached 240 million, an increase of 22.85 million and 10.51% compared with 2017.
(2) Fast vehicle speeds. Some car drivers have speeding behavior, ignoring the limit sign.
(3) Mechanical breakdown\[8\]. Failure of any one of braking, steering, power, parts, etc. may result in a traffic accident.
(4) Blind spots. Most motor vehicles have blind areas of vision and cannot see every angle.
(5) Non-motor vehicle mobility is strong. It is rarely constrained in actual road traffic.

2.3. Causes of road traffic environment
The road traffic environment is also an important factor affecting the safety of intersections. It mainly includes the setting of the crosswalk width, the setting of the speed limit measure, the setting of the left turn lane, the setting of the traffic sign, and the season reasons.
(1) There is a problem with the crosswalk width. Pedestrians cannot cross the street during the specified green time, which reduces the safety of pedestrians crossing the street\[9\].
(2) Within the range of intersections, unreasonable speed limit measures are adopted to control the vehicle speed within a reasonable range\[9\].
(3) The left turn lane is not set up properly and the driver cannot turn around at once\[9\].
(4) The traffic sign has a large amount of information carrying capacity, which greatly distracts the driver's attention\[10\].

2.4. Reason for management
The level of management affects the traffic safety of intersections to a certain extent, usually involving government, enterprises, and society.
(1) Insufficient data statistics\[3\]. High-quality data statistics is a prerequisite for accident prevention. Due to the special nature of China's traffic, data statistics have evolved into "digital statistics."
(2) Insufficient management of traffic services. The basic traffic management of road traffic is not in place, and pedestrians who are running red lights cannot be punished in time.
3. The supervision of the vehicle is insufficient. In order to pursue economic benefits, some enterprises turn a blind eye to the behavior of driving fast and driving heavy vehicles.

4. Driver safety training is not in place. There is no regular organization of driver safety training. And even carry out safety training just to cope with inspections, and have no effect.

5. The quality of training is not uniform. As of 2017, there are more than 16,000 driving schools in China, with an average annual increase of 1,000. Many driving schools have insufficient qualifications and coaches are of low quality.

6. The publicity and education work of relevant associations is not in place. Many times, the publicity and education work is in the form, and it has not been implemented.

3. Current situation of accident prevention and control at highway intersections

In view of traffic accidents at highway intersections, a series of accident prevention measures have been taken mainly from people, vehicles, rings and pipes.

3.1. Motor vehicle drivers, non-motorized motorists and pedestrians

The relevant laws and regulations mainly impose penalties and fines on illegal motor vehicle drivers, and raise the driving skills by increasing the difficulty of driving test. For non-motorized drivers and pedestrians, they are mainly punished in the form of fines and education.

1. According to the latest "Regulations on the Application and Use of Motor Vehicle Driving Licenses", if a motorized vehicle violates the road traffic signal, it will be charged 6 points at a time and a fine of 200 yuan.

2. By amending the "Motor Driver's Test Contents and Methods", the difficulty of driving test is increased, so as to improve the driver's driving skills.

3. Article 89 of the Law of the People's Republic of China on Road Traffic Safety stipulates that pedestrians, occupants, and non-motorized motorists violate the road traffic safety laws and regulations regarding road traffic regulations, and warned not less than 5 yuan but not more than 50 yuan. Non-motorized drivers who refuse to accept fines can detain their non-motor vehicles.

4. A comprehensive traffic safety publicity and education activity with the road traffic safety law as the main content was carried out nationwide.

5. Relevant policies issued by some cities require non-motorized drivers to take non-motor vehicle lanes and wear helmets when riding; otherwise a fine will be imposed.

3.2. Vehicle aspect

In terms of motor vehicles, the safety of intersections is improved mainly through means of restricting policies, strengthening inspection and inspection by inspection agencies, joint special rectification actions, and application of speed measurement systems. In the case of non-motor vehicles, supervision and management are enhanced through the use of licenses.

1. Some cities have successively introduced motor vehicle restriction policies. This policy has alleviated traffic pressure to some extent and improved road traffic efficiency.

2. By strengthening the supervision and inspection of motor vehicle inspection agencies, implementing the responsibility system and standardizing inspection behaviors, thereby achieving the purpose of improving the safety performance of motor vehicles.

3. Joint special rectification actions across the country, strengthen the supervision of over-limit overload, and severely crack down on private modification and illegal behavior.

4. Application of the speed measuring system. By installing a speed measuring device beside the road near the intersection, the speed of the motor vehicle is detected, and the illegal behavior is photographed and evidenced, thereby achieving the purpose of speed limit.

5. Some cities have introduced relevant policies requiring non-motor vehicles to be licensed; otherwise they will not be able to drive on the road.
3.3. Road traffic environment
In terms of road traffic environment, the safety of intersections is mainly ensured by clearing obstacles on both sides of the intersection, setting guardrails, setting crosswalk width reasonably, designing traffic lights properly, and applying intelligent pedestrian crossing systems.

1. Clear the obstacles on both sides of the intersection to provide a good visibility for the motor vehicle driver. Avoid traffic accidents caused by blind spots in sight.

2. Set crosswalk width reasonably so that pedestrians can pass the intersection within the specified time. Set up a second street safe island to protect pedestrians who fail to cross the street in time[10].

3. Design traffic lights properly so that the traffic light time can be automatically adjusted according to the traffic conditions[15].

4. The use of intelligent pedestrian crossing system. Different types of crossing systems are used depending on the characteristics of each intersection.

3.4. Management aspect
It mainly prevents the occurrence of intersection accidents by improving relevant laws, enhancing transportation service management capabilities, implementing relevant departmental supervision responsibilities, strengthening data statistics, and implementing subject responsibility.

1. Since 2004, the Road Traffic Safety Law has been promulgated and continuously revised, making China's road traffic management business legally available.

2. The ability of transportation service management is continuously strengthened[16]. By highlighting the key points of remediation and strengthen the road management to improve the management system.

3. Strengthening the supervision and management of roads by constructing a coordinated linkage mechanism, implementing departmental supervisory responsibilities, and strengthening accountability assessment[17].

4. More and more attention is paid to the statistics of data. Through the collection, statistics, analysis and comparison of traffic accident data to provide a basis for accidents[18].

5. The enterprise actively implements the main responsibility system, establishes relevant rules and regulations, and eliminates existing safety hazards through self-examination.

6. Strengthen the supervision of the driver; correct the unsafe behaviors and illegal behaviors in the driving process in a timely manner.

7. Improve the access threshold of driving training institutions, strengthen the supervision and management of coaches, and strengthen the training responsibilities of driving training institutions to improve the quality of training for drivers[19].

8. Carry out a variety of forms of education and training. Improve the awareness of traffic safety among all people.

4. Suggestions on prevention and control measures for highway intersections
The existing measures have achieved certain results in preventing accidents. However, the total number of intersection accidents is still high, and it is necessary to continue to explore countermeasures to improve the traffic safety situation at highway intersections.

1. The government proposes to strengthen the work from the following aspects: integrating traffic safety education into primary education and setting up special courses; establishing professional traffic safety publicity and education team, setting the goal of traffic safety publicity and education; conducting annual training and re-assessment for drivers who have experienced traffic accidents, or conducting triennial training and re-assessment for drivers who have not experienced traffic accidents; establishing a complete traffic accident rescue system etc. While relevant departments are doing their supervisory work, they should also clarify their own work rules to ensure the maintenance of intersections and the maintenance and renewal costs of transportation facilities.

2. The enterprise proposes to strengthen the work from the following aspects: checking from the source, carrying out the supervision responsibility of the vehicle and making certain that the person in
charge, to ensure the effective investment and use of the logistics costs of the unit, setting up its own logistics fleet, inspecting and maintaining the vehicles regularly; organizing safety training regularly for the driver of the car (the content of the training should be advancing with the times, and the form should be rich and varied); doing the management of the vehicle and the driver to ensure the stability and reliability of the vehicle will not be faulty, and the driver's driving behavior will be safe and secure; establishing an emergency rescue plan for traffic accidents in this unit, purchasing corresponding equipment, and conducting emergency rescue drills on a regular basis.

5. Conclusion
This paper studies the causes of frequent accidents at highway intersections from the aspects of people, vehicles, road traffic environment and management. It analyzes the existing road junction accident prevention measures, and bases on the intersection accidents and existing accident prevention measures, proposes several measures for the government and related enterprises. The effective prevention and control of traffic accidents at highway intersections is a complex system project, which requires the participation and efforts of all parties. This study can also provide reference for this.

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