

Literature review on the influence of road environment on driving behavior

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Abstract

The road traffic system is a dynamic system composed of people, cars and roads. Only the orderly coordination of these three elements can make the dynamic system run normally. The interaction of various factors is also essential, among which, the conditions of road environment have a certain influence on drivers' behavior. Many traffic accidents are ostensibly caused by drivers' carelessness. However, if we have a deeper understanding, we will find that the road environment around the accident-prone section has an impact on drivers' psychology, physiology and behavior. This paper refers to domestic and foreign literature on the influence of road environment on drivers' driving behavior, and obtains driving behavior habits under different road environment conditions. It can prevent some traffic accidents caused by road conditions.

Keywords

Road environment, eye tracker, gaze area, driving behavior.

1. Introduction

In recent years, China's social and economic development has been rapid, the road traffic infrastructure is increasingly perfect, motor vehicle ownership has increased significantly, people travel and goods transport convenience and fast has been basically realized. According to statistics, in 2018 the number of vehicles increased by 22.85 million to 240 million, the number of drivers increased by 24.55 million to 409 million, and the length of roads open to traffic increased by 86,000 kilometers to 4.86 million kilometers. However, there were 244,937 traffic accidents and 63,194 deaths. Direct property losses amounted to 1.384559 million yuan. Therefore, it is necessary to control and prevent traffic accidents. To prevent traffic accidents, it is necessary to control the factors affecting the stability of road traffic system. As the operator of the vehicle, the user of the road and the feeler of the environmental conditions, the driver is the main body of the activity of the road traffic system. He is in a leading position in the dynamic system and has great initiative to ensure the stability of the system. He is the primary factor affecting traffic safety. Therefore, the study of traffic environment on drivers' driving behavior has a certain positive role in controlling the increase of traffic accidents.

2. Foreign literature

In this paper, foreign literature was consulted, and foreign studies found that drivers' driving behaviors were different under different road conditions. Chapman et al. [1] found that drivers' eye movements were different on different road sections, and drivers with different driving experiences also had different driving behaviors. Konstantopoulos et al. [2] studied the relationship between driving experience and driver attention under three different visibility conditions: day, night and rainy day. The results showed that the information sampling rate of the coach was twice as high as that of the beginner, and the coach could process information in a shorter time and have a wider scanning range of vision. Coaches look into car mirrors more

than beginners do. Young et al. [3] studied the influence of billboards on drivers' attention, mental load and performance in urban, highway and rural road environments.

Some studies have proved that different road forms have different effects on driving behavior through experimental methods. The study found that drivers looked further into the distance, giving them different expectations about the road they were on and how crooked it was. Salvucci and Gray[4] believe that drivers usually use two points to help them when perceiving surrounding scenery during driving. The far point provides expected information about the road ahead, while the near point provides feedback about the vehicle's location. In general, driving in a curved road can be very dangerous if the driver does not have a good forecast of the driving situation ahead.

Kountouriotis and Merat[5] found in their study that compared with driving on curved roads, drivers have lower vision when driving on straight roads. On curved roads, drivers are more likely to be distracted, their gaze is significantly higher than the horizon and they can see further. The findings support the idea that drivers' ability to see far behind the wheel provides drivers with expected information about the road and its curvature. Generally speaking, the road design and the improvement of road conditions should mainly be based on the safety needs of people and vehicles on the road, but due to the impact of the actual landform, such as mountain area, it is necessary to design continuous curves. Some studies have found that if the continuous curves are very different from each other and lack certain regularity, the driver will often slow down sharply when driving, resulting in the body approaching the curve. And the small radius of the curve leads to violent acceleration and deceleration. Many drivers underestimate how fast they are driving. When the radius of the curve is less than 200m, the transverse position of the car will change greatly [6].

Coutton et al. believe that in order to ensure the vehicle to run on the road, drivers need to be able to quickly and accurately analyze space-time parameters when passing curves [7]. Hummer[8] et al. found that curves, as a special part of road design, have relatively complex road geometry, which makes driving more difficult for drivers. Drivers need to change their driving speed and the position of the car on the road to adapt to driving on curves.

Therefore, it can be seen that the road shape has a great influence on drivers' driving behavior. Drivers take different driving behaviors when driving in different road shapes.

3. Domestic literature

From the perspective of visual psychological safety, Wang Fa [9] took drivers' visual characteristics as an important factor, combined with the characteristics of mountain highway landscape environment, and studied the correlation between drivers' visual sensitive areas and highway landscape environment. In order to characterize the spatio-temporal characteristics of driving behavior, a modified weighted search area algorithm was proposed to calculate the sensitive area of driver's vision. According to the drivers' dynamic fixation behavior and k-means clustering algorithm, the drivers' visual field space is divided, and the probability of gaze shift and steady distribution of gaze in each region are analyzed. The comprehensive evaluation index system and evaluation model of highway landscape environment based on sensitive area response of driving vision were established.

Tian jiajin [10] used driving simulators to construct road meteorological environments with three visibility types (500,100 and 50 m), selected driving speed and vehicle-to-vehicle distance as key variables for statistical analysis, studied driving behavior characteristics under two specified driving speeds, and explored the variation rules of drivers' vehicle-to-vehicle distance and speed under different visibility. The test results show that there is an obvious difference in drivers' following ability in foggy conditions, and driving speed has a significant effect on driving behavior.

Guo Yingshi. [11] chose 24 pilot samples, with different driving experience in urban road, the common road, four kinds of typical mountainous area highway, urban and rural road traffic environment test drive, with rapid eye movement tracking system records the driver in the process of driving looking time, stare at its target for, scanning and scanning speed dynamic eye movement data; Physiological signals such as electrocardiogram, skin electrocardiogram and respiration were recorded by physiological tester. GPS was used to record the speed of the vehicle during the test. Statistical methods were used to process and analyze the collected data. The results show that different traffic environment and driving experience have significant influence on drivers' eye movement behavior and workload. The results show that drivers' gaze duration, horizontal and vertical visual search span, saccade range and saccade speed all change with road conditions. Drivers will adjust their attention target and attention allocation according to different traffic environments. Saccade behavior can reflect the mental effort and workload of drivers.

Hu Zhe [12] studied and analyzed the correlation between environmental visibility, road alignment parameters and autonomous safety speed on driver's heart rate characteristics, and established a four-parameter relationship model of heart rate growth rate. Based on the threshold value of heart rate index, visibility and road alignment parameters, autonomous safety speed limits corresponding to actual road sections can be deduced. With 30% for the driver's psychological stress threshold, the driver on the straight path of independent safety limit road speed limit, therefore, on the flat road, as long as the driver speed to follow the road speed limit, will not achieve mental tension worshipping value, can avoid the driver's mental tension caused by traffic accidents caused by improper operation, etc. The autonomous safety limits of drivers in curves and uphill sections vary with curves radius and visibility, which is of practical significance to provide theoretical guidance for road traffic safety control in low visibility weather.

4. Conclusion

By referring to domestic and foreign studies on the impact of road environment on drivers' driving behavior, the following conclusions are drawn: different road environments have different visual effects on drivers, so that the road environment significantly affects drivers' fixation time and fixation frequency on different areas and targets; On urban roads and mountain roads, drivers' driving pressure was higher, and the fixation area was concentrated near and the fixation time was longer. On the rural-urban road, drivers pay more attention to distant areas and irrelevant information, and the average fixation time is shorter. Furthermore, the drivers adjusted their visual search behavior according to the changes of road environment. On the road with relatively simple traffic environment, the drivers' gaze was longer and the average gaze duration was shorter, while on the road with complex and changeable traffic environment, the drivers' gaze was shorter and the average gaze duration was longer.

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