

## ANALYSIS OF INFLUENTIAL FACTORS FOR DRIVERS' CAPABILITY OF HANDLING SPECIAL SITUATIONS

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**Abstract:** Traffic accident investigators usually pay more attention to drivers' skill and traffic rules in the analysis of various incidents, while they tend to ignore drivers' capability of handling traffic special situations. There is evidence that professional drivers' general skills are almost at the same level and the main difference between them lies in the capability of handling special situations. Traffic special situation is characterized by sudden, haphazard, variability and stressful, which is an important factor that threatens driving safety. Therefore, traffic safety is critically dependent on proper disposal of special situations; and most of them occur unexpectedly and the consequences are vastly different. In order to accurately detect, judge and handle various special situations, drivers must not only grasp driving knowledge and skills, but also have good mental state and right strategies of decision-making to respond to different kinds of emergencies. For a skilled driver, good psychological quality is the premise for safe driving, because it directly affects the complex conversion process from skill to decision-making and action. In this study qualitative research approach was chosen to find probable psychological factors that may affect drivers' capability of handling special situations, especially in the view of drivers. Focus group discussion analyzed the characteristics of driving special situations and driving behavior under stress, then identified main psychological factors in potential risk. We hope this study can provide some useful suggestion to train and improve drivers' emergency response capability, which may ensure traffic safety.

**Keywords:** *driver, special situations management, emergency, traffic safety*

### 1 Introduction

The total vehicle population in the world has dramatically increased in recent ten years, and the rate of growth keeps accelerating, especially in developing countries. A famous market research agency in Essen, Germany, R.L. Polk Marketing Systems, said that global vehicle population in 2010 exceeded 1 billion and it was expected to keep increasing up to 1.12 billion till 2015. More and more vehicles are crowding the nation's roadways, meanwhile, the number of traffic accidents increases in the world. These accidents kill around 1.3 million people every year. Traffic accident investigators usually pay more attention to drivers' skill and

traffic rules in the analysis of various incidents, while they tend to ignore drivers' capability of handling special situations (Rune Elvik, Alena Hoyer et al. 2009). There is evidence that professional drivers' general skills are almost at the same level and the main difference between them lies in the capability of handling special situations. It is an important guarantee for safe driving for drivers to handle various special situations timely and properly.

To a vehicle driver, there are many circumstances that can be referred to as special situations, such as pedestrians entering the road suddenly or falling down, vehicle failure, traffic accident, bad weather, continuous sharp turn and sudden brake taken by other cars in front. These circumstances are serious threat to road safety and the majority of drivers will experience an emotional tension when they face with such situation. It has been reported that extreme emotional stress will cause memory loss, decreased concentration, poor attention span, and delayed decision-making and even operational errors, which would ultimately lead to traffic accidents (Schnurr PP, Green BL et al. 2004). When special situations occur, drivers should not only be familiar with the disposal procedures, but also have the ability to deal with unexpected problems. In this study, focus group method was used to identify main psychological factors in driving risk in the view of drivers. Through the analysis of individual psychological and behavioral characteristics, researchers may find scientific ways to improve drivers' capacity to handle special situations and help them make the right decisions within the shortest period of time.

## 2 Method

Researchers have long debated the relative value of qualitative and quantitative inquiry. Now, qualitative research is considered a more accepted strategy than it was earlier. A growing number of scholars believe that qualitative methodologies are powerful tools for enhancing our understanding of human's conscious, behavior and mind. There are three kinds of common qualitative research methods: observation, individual interview and focus group discussion. In this paper, we choose focus group discussion.

### 2.1 Participants

The 30 participants recruited for this experiment are drivers. All of them have more than five years of driving experience in Beijing and have at least 80,000 Km of driving distance. The participants are between 25 and 46 years old. The age and gender distribution of the participants is provided in Table 1.

**Table 1. Characterization of participants**

Gender	Number of participants	Average age(years)
male	16	33.94±6.78
female	14	35.79±4.84

### 2.2 Experimental design

Focus group discussion is used in this research. By this qualitative research method, the author aims to find major psychological factors which might impair

drivers' capability of handling special situations. Focus group discussion is a research methodology in which a small group of participants gather to discuss a specific topic or an issue to generate data, during which group members talk freely and spontaneously about the certain topic. A group usually includes 6 to 12 persons who share the same or similar background. The main characteristic of a focus group is the interaction between the interviewer (also called the moderator) and the group, as well as the interaction between group members. Instead of the moderator asking questions, the group members are encouraged to communicate with one another, exchanging ideas and comments on each other's experiences or points of view. But it is more than a question-answer interaction; its ultimate goal is to obtain in-depth information on concepts, perceptions and ideas of a group, especially in the situation that the researcher himself/herself is not very familiar with the research problem.

### **2.3 Experimental procedures**

The participants were randomly divided into five groups, six members in each group. In addition to six participants, each group included two researchers, one as the moderator and the other as the note-taker. And a semi-structured interview outline was designed in advance. The moderator was responsible not only for guiding the participants through the discussion, but also for looking after the group dynamics to ensure all participants join in the discussion. When some participants dominated the discussion, the moderator would address questions to individuals who are reluctant to talk, in order to balance out participation. The note-taker captured what was said and expressed, noting the tone of discussion, and the order in which people spoke. Non-verbal expressions, such as facial expression or hand movements, were also noted. Each group of discussion lasted about 70 minutes and the whole discussion process was recorded. The experiment was conducted in a quiet meeting room and each person's position was shown in figure 1.

## **3 Results**

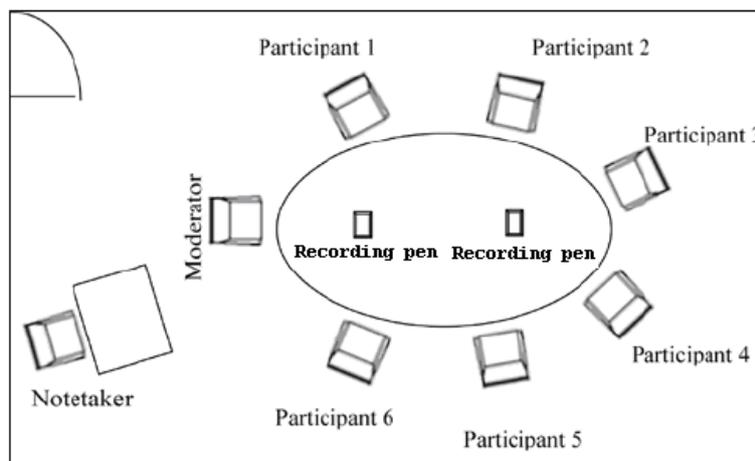
### **3.1 Data processing**

Firstly, the researchers assigned a serial number to each participant according to his speech order in the interview process. Then every participant's speech was encoded starting with "1". For example, number 1-10 represented the tenth sentence said by the first participant. With this method, every sentence of every participant had been encoded. The researchers used generic analysis for interview data processing, summarizing various types of information and giving the highest level definition for them. In this way, the psychological and behavioral factors which would affect driver's capability of handling special situations were found out.

### **3.2 Perception**

All the participants mentioned that drivers ought to have keen perception especially excellent space perception when special situations occur. Here, keen perception refers to drivers' traffic awareness of the overall driving environment, which is the primary factor to ensure driving safety. Traffic accident statistics

showed that almost 40% of all truck accidents were caused by drivers' perception error. In some cases, improper perception and poor traffic awareness may be involved; in other cases, driver fatigue may be to blame. Special situation is characterized by sudden and haphazard, so drivers must understand the changing road conditions rapidly and accurately. Through the use of focus group interviews, we found that six different kinds of perception might have a major impact on driving safety, as is shown in Table 2. A driver's traffic awareness largely depends on his sensory sensitivity. Meanwhile, driving experience is also an important factor.



**Figure 1. Sketch of the focus group seating plan**

### 3.3 Attention

Many participants mentioned that drivers should have the capability of observing real-time road condition effectively and capturing all of the valuable traffic information in a timely manner. This is a guarantee of handling special situations successfully. Drivers with poor attention skills can not understand its meaning even if they see the hazardous event. In this case, drivers will miss the opportunity to take measures or even take a wrong operation, eventually leading to traffic accidents. In order to ensure successful disposal of special situations, drivers need to improve the quality of attention. Firstly, the larger the attention scope is, the safer the driver will be. Research has shown that driver's attention span is closely related with traffic accidents. There is a significant negative correlation between attention span and traffic accidents. Secondly, proper attention distribution is necessary in the complex driving situation. Finally, drivers should improve their concentration and attention. Drivers may encounter a variety of interference, irrelevant voice, light, thoughts or emotions during the period of driving. An excellent driver is able to eliminate all environmental disturbances completely.

### 3.4 Judgment and decision-making under stress

There are a lot of studies on human decision-making ability, but the usual decision-making ability does not reflect the ability level under risk. Under normal driving condition, drivers may follow standard rules and procedures in order to

achieve efficient and accurate operation. But while driving in complex traffic environment especially in changing or perilous road conditions, drivers are obliged to face added stress and make rapid decision. In special situations, such as brake failure on road, drivers ought to find vehicle fault as soon as possible and take effective measures to control the situation. All the participants believe that drivers are likely to make wrong judgment or irrational decision under stress, and they also believe that this situation can be improved through specific training.

**Table2. Six kinds of perception for drivers in special situations**

No.	Perception	Description
1	Auto body perception	the awareness of vehicle length, width, height, ground clearance and tire location whether the vehicle is stationary or moving
2	Speed perception	judgment of both car and pedestrian walking speed
3	Distance Perception	recognizing distances between car, people or other objects in all directions
4	Road condition perception	recognition of road conditions, such as sharp turn, mountain road and slippery road surface
5	Traffic information perception	understanding real-time traffic environment (vehicle, pedestrian movement, traffic jam and accident et. al )
6	Vehicle handling perception	understanding of vehicle's feedback information while manipulating cars

### 3.5 Eye-hand coordination

Many participants mentioned that eye-hand coordination was a very important skill for drivers to handle special situation. Eye-hand coordination (or hand-eye coordination) uses the eyes to direct attention and the hands to execute a task, which is the coordinated control of eye movement with hand movement, and the processing of visual input to guide reaching and grasping along with the use of proprioception of the hands to guide the eyes (Roland S. 2001). It is the capability of the vision system to coordinate the information received through the eyes to guide and direct the hands finishing a given task, such as driving or handwriting. It is a way of performing daily work and in its absence most people would be unable to carry out even the simplest of actions such as pouring water into a cup, grasping an object and all the ball sports. For a driver, he will become unable to control vehicle.

### 4 Discussion

People, vehicles, roads and the environment are considered as a system by traffic psychology. The procedure of driving can be regarded as a process of information processing, including information input, information processing, decision-making and information output. Currently, traffic environment is becoming more complex. Especially, coexistence of people and vehicles in residential area will increase the unpredictable risk. This is an important factor of driving safety. Driving is considered a high risk activity. Special situations mainly refer to all the emergency situations during driving, which will make driver's physical and mental state change

rapidly. Drivers' arousal level, heart rate, blood pressure, muscle tension and hormone secretion will change. Then, drivers' psychological and behavioral states vary accordingly, inducing a high degree of emotional stress and an over-active behavior pattern. In this case, drivers usually fail to achieve their purpose and make appropriate response, which finally leading to accidents.

The capability of handling special situations might be improved by simulation training. Driving schools may create some scenario for traffic special situations, such as sudden brake taken by other cars in front, break failure, direction control failure and pedestrians entering the road suddenly. Drivers can experience the stressful state and accumulate special situations handling experience by these artificially designed dangerous scenarios. This simulation training will contribute to traffic safety.

In this paper, we collected thirty drivers' opinion on traffic special situation handling and summarized psychological and behavioral influential factors by discussing the response of people under stress. And in the future, we will study this issue through quantitative research.

## 5 Conclusions

Each participant has unique understanding of traffic special situations in this focus group study. Here we may draw the following conclusions.

- (1) Almost all participants considered that drivers' capability of handling traffic special situations was closely associated with their psychological and behavioral pattern. Perception, attention, eye-hand coordination, judgment and decision-making under stress are the prime influential factors, which can predict the success of special situations disposal.
- (2) When drivers encounter traffic special situations, they will fall into very stressful situations. Stress is a feeling that's created when one reacts to particular events. Stress is likely to cause cognitive impairment and wrong decision, which will lead to traffic accidents.
- (3) By simulation training of artificially designed traffic special situations disposal in driving schools, drivers' mental capacity is expected to be improved and dangerous special situations will be disposed successfully.

## 6 Acknowledgment

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## References

- Roland S. Johansson et al. (2001). "Eye-Hand Coordination in Object Manipulation." *The Journal of Neuroscience*, September 1, 2001, 21(17): 6917-6932
- Rune Elvik, Alena Hoye et al. (2009). "Part 1: Introduction" *The Handbook of Road Safety Measures*, Emerald Group Publishing Limited, British: 1-14
- Schnurr PP, Green BL et al. (2004). "Understanding relationships among trauma, post-traumatic stress disorder, and health outcomes." *Adv Mind Body Med*, 20(1):18-29