

Experimental Study on Driving Behaviour

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ABSTRACT

Driving behaviour diversity is one of the key issues in related studies. In recent years, influence of beverage type to human behaviour has got more and more research attention. How beverage type influence driving behaviour is a new research topic. In this paper, beverage type is considered as independent variables with driving behaviour being dependent variable. The independent variable has two levels, water and black tea. Experimental study is carried out with virtual driving on a driving simulator. Totally 54 subjects in two groups participated the experiments. Experimental data show that compared with drinking water, drinking black tea obviously reduced maximum deceleration of driving, and influence of black tea on average acceleration of driving is critically significant. The results show that drinking black tea may lead to increasing safety level of driving behaviour in disasters and may help with driving performance. The results of this paper may provide scientific support to emergency management in disasters.

CCS CONCEPTS

- **General and reference** → Empirical studies
- **Computing methodologies** → Simulation environments

KEYWORDS

Driving behaviour diversity, Black Tea, Disaster, Driving simulator

1 INTRODUCTION

As an important transportation tool for people to travel, automobiles are widely used in daily life. However, according to a report issued by the World Health Organization, 1.2 million people were killed in traffic accidents and 20-50 million people had been hurt by different degrees in traffic accidents for each year worldwide, traffic accidents have become a major factor threatening the safety of people's life and property. In addition to the high incidence of traffic accidents, due to the abnormal global climate change, earthquakes, floods, hurricanes, lightning and other natural disasters frequently occur. The affected areas are becoming more and more widespread. How to improve driving safety level and reduce casualty rate in the condition of high incidence of natural disasters? This is a problem to be solved urgently.

Driving behaviour diversity is one of the key issues in related studies. Driving behaviour may be influenced by many factors, such as emotions [1], cognition [2], thinking [3], etc. Human attention and emotion may be influenced by many factors. In recent years, more and more researches pay attentions to effect of tea on human attention and emotion [4]. Aspen and Quinlan found that the self-reported alertness increased between 30 minutes and

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60 minutes after drinking tea compared to drinking decaffeinated beverages [5]. In particular, studies have shown that the alertness score improved after drinking black tea [6]. In a recent study, researchers found that drinking tea immediately increased emotional well-being, compared to drinking water. In addition, the cross-sectional data of healthy Japanese adults showed that a large number of tea drinking (more than five cups per day) was associated with reduced psychological distress [7]. Tea is known to be benefit to cognitive nerves, especially in terms of attention [8]. Hindmarch et al. found that, compared with water contain caffeine, drinking caffeinated tea increases the Critical Flicker Fusion Threshold (CFFT), and that the higher the concentration of tea, the greater the effect. Drinking tea is good for improving attention [9]. De Bruin et al. used double-blind, placebo-controlled cross-design and more complex attention tasks to further study these effects in two recent studies [6].

More researches focused on effect of psychological performance, especially on the effect of attention and emotion [8]. For instance, Taubman-Ben-Ari compared the positive emotions drivers with neutral and negative emotions drivers, and the analysis indicated positive emotions lead to a higher willingness to drive recklessly [10]. Hu et al. found that negative emotions lead to higher risk perception, risk attitude and self-report risk driving [11]. In addition, Aspen and Quinlan evaluated subjects' mood immediately after drinking tea, and collected physiological measurements (e.g., skin conductance and blood pressure) in a controlled laboratory conditions. The results showed that drinking tea can better stimulate the autonomic nervous system in the form of increased awareness compared with drinking water [5].

Researches of driving behaviour diversity in disasters has been paid more attention in recent years while less research has been published considering influence of beverage type. In this paper, influence of beverage type to driving behaviour is studied in the context of earthquake disaster with virtual driving on a driving simulator.

2 EXPERIMENTAL STUDY

2.1 Subjects

Totally 54 subjects were recruited for this experiment, with male subjects accounting for 79.6% of the total sample size and 20.4% for female subjects. In addition, more than 59.3% of the subjects have more than 3 years of driving experience. All of the subjects had a certain experience in urban driving and were able to report their emotional state normally. Before the start of the experiment, the experiment process and equipment will be told to the subjects, but the purpose of each experiment link is secret in order to reduce the interference by the subjective thinking of the subjects.

2.2 Experimental design

Previous studies have shown that drinking tea has certain effect to the emotions and attention, while emotions and attention have a very important effect on driving behaviour. Therefore, drinking tea may influence driving behaviour. We conclude that drinking

black tea makes people reflect higher alertness and reduces psychological distress. Although there has been a lot of literature on the effects of emotions on driving behaviour, however, there are few specific studies on the effect of beverage on driving behaviour. In this paper, beverage type is considered as independent variables with driving behaviour being dependent variable. The independent variable has two levels, water and black tea. Experimental study is carried out with virtual driving on a driving simulator. Earthquake disaster is supposed as environment. Since this paper focused on the influence of beverage on driving behaviour, virtual driving on a driving simulator is designed with car-following behaviour. Fig. 1 and Fig. 2 show the experimental equipment and interface of the software used for virtual driving.



Figure 1: **Driving simulator.**



Figure 2: **Interface of software.**

In order to ensure that each subject has the same experimental condition in car-following state, the velocity of front car is pre-set in the experimental studies, as shown in Fig. 3. There are several braking during driving process of the front-car. This is to record following car's car-following behaviour. The following car is driven by each subject on the driving simulator.

Experiment was performed in three separate areas. Area No. 1 is for waiting and rest. Area No. 2 is driving simulator lab, area No. 3 is used for watch video and drink beverage. Each area has one

experimenter. Each experimenter knows only information of their own area thus forms the double-blind experiments.

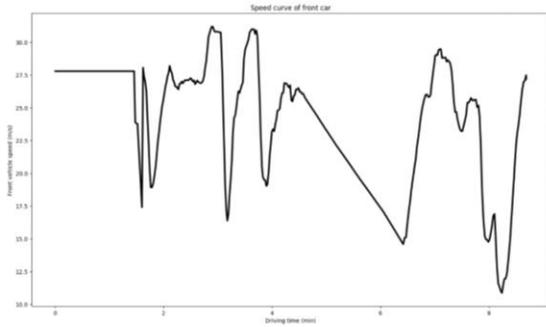


Figure 3: Velocity of front car.

A 2-minutes video of earthquake was shown to each subject to let them has the feeling of being in the environment of earthquake. The variable of beverage type has two levels, water and black tea. Bottle water and bottle black tea with sugar-free bought from supermarket were applied in the experiments. Unified, disposable paper cups were used for drinking beverage by subjects. The task given to each subject is: Please recall the video you just watched. Imaging that, the city had just suffered from an earthquake. the houses collapsed, the water supply was crippled, the food was in short supply, the city was in a dangerous state. There may be aftershocks in the city area. Fortunately, you're not in the epicentre. Now your company needs you to drive to another city of about 50 kilometres away, and you need to arrive as soon as possible. Arriving late will have a great impact on the follow-up work. If you are ready, your business trip begins.

2.3 Experimental procedure

Experimental procedure is as follows:

- 1) Subject was directed to area No. 1 to wait and rest for several minutes.
- 2) Subject moves to area No. 2 and do some practice on the driving simulator.
- 3) Subject moves to area No. 3 to watch the 2-minutes video of earthquake disaster. During watching video, serve subject with beverage.
- 4) Subject moves to area No. 2 and do the experimental task.
- 5) After finishing experimental task, subject moves to area No. 1 and get 50 RMB as experimental payment.

3 RESULTS

Experimental results are shown in Table 1 and Table 2. Table 1 shows mean value of maximum deceleration of different beverage groups. Table 2 shows One-Way ANOVA of maximum deceleration of different beverage groups.

Table 1: The mean value of maximum deceleration of different beverage groups

Group	The average value of the maximum deceleration	N	Standard deviation
DW	52.60	27	57.48
DBT	15.43	27	20.44
Total	34.02	54	46.67

Note: DW (Drink Water), DBT (Drink Black Tea)

The results of Table 1 show that the mean value of maximum deceleration of drinking black tea group is much less than that of drinking water group. The mean value of maximum deceleration of drinking black tea group is 15.43m/s² while the mean value of maximum deceleration of drinking water group is 52.60m/s².

Table 2: One-Way ANOVA of the maximum deceleration of different beverage groups

	Sum of square	DF	Mean square	F	Significance
Inter-group	18652	1	18652	10	0.003
Intra-group	96762	52	1860		
Total	115415	53			

Note: ***p<0.01, ** p<0.05, * p<0.1

The results of Table 2 show that the maximum deceleration of drinking water group is significantly different from drinking black tea group (p value is 0.003, which is much less than 0.01). The results show that, compared with drinking water, drinking black tea may significantly reduce the maximum deceleration of the drivers in disasters. The research results indicated that drinking black tea may improve driving safety level and thus help in emergency response and rescue.

4 CONCLUSIONS

Experimental study on influence of beverage on driving behaviour in disasters is carried out. Beverage type is considered as independent variables with driving behaviour being dependent variable. The independent variable has two levels, water and black tea. Experimental study is carried out with virtual driving on a driving simulator. Totally 54 subjects in two groups participated the experiments. Experimental results show that the maximum deceleration of drinking water group is significantly different from drinking black tea group. The mean value of maximum deceleration of drinking black tea group is much less than that of drinking water group.

The research results indicated that drinking black tea may improve driving safety level and thus help in emergency response

and rescue. During disasters, for traffic evacuation and rescues, providing black tea to the drivers may greatly help in improving driving safety level.

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