"TELE-FIELD STUDY ON TRAFFIC ACCIDENT PROCESS 
BY MEANS OF IMAGE-RECORDING TYPE DRIVE-VIDEO-RECORDER 
-NEAR ACCIDENT ANALYSIS OF TAXI AGAINST BICYCLE"

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Abstracts: Although fatalities, injuries as well as the frequency of road accidents in Japan decreased in 2006, accidents among taxi cabs are increasing steadily. Reasons behind such increment are not certain, but effective countermeasures are highly expected. Image-recording type drive-video-recorder is a new technology to just meet this demand and has been distributed rapidly among taxi companies since 2004. When sudden breaking, running or abrupt steering happens with more than 0.4G, the drive-video-recorder installed on a vehicle records a facts-based-process of either an accident or a near accident. During three months in 2006, 111 cases of accidents and near accidents related to bicycle were collected among 200 taxi cabs in two taxi companies in Tokyo.

Data analysis revealed that bicycle rather than taxi caused either accident or near accident, and this fact was completely against the well known knowledge which showed bicycles were more or less harm receiver rather than harm producer. Furthermore, "tele-field study" considering the peripheral situation by making use of web map/air-view photo together with recorded video image disclosed specific local traffic environment in relation to them. Redesign of road environment was highly and urgently suggested as well as educational approach to solve this problem.

1. INTRODUCTION

The general trend of fatalities within 24 hours in traffic accident in Japan for the past 30 years indicated two peaks, at 1970(16,765) and 1992(11,451), and continued a slow decrement since 1993 till today, and finally achieved at such level below 7000 in 2005 for the first time in 49 years since 1956. However, the situation still remains very serious with 1.2 million injuries and 930 thousands accidents in 2005 and this increment trend continued steadily since 1979, and seems proportional to the increment curve of vehicle fleet (Figure 1).

![Figure 1. Trends of Road Traffic Accidents in Japan](image)

Although remarkable decrease of fatalities surely indicates something positive such as system reform of first-aid and remarkable development of safety vehicle technology contributing to prolong life of victims in accidents, the fact of still increasing accidents and injuries in accordance with the expanding vehicle fleet is eloquent evidence that implying simply all the measures taken so far by various sectors were not effective to decrease accident itself.
Why? Because, conventional paradigm is still dominant among traffic/road administrators. They emphasize careless drivers’ behaviors as for accident causes and enforce safety education mainly as for measures. It is clear that we need to improve a concept of mechanism to cause and prevent car accident in order to break through a blocking situation by making use of ergonomics and accident analysis based on facts.

Accidents frequency among different kinds of vehicles, by the way, per running 100 millions kilometers by year reveals the explicit steadily increment for taxi while other vehicles remain the same level (Figure 2). Accident frequency for the whole vehicles including private owner’s vehicle show the highest level, while that for trucks show the minimum level much lower than that for buses. Factors behind this uncanny increment for taxi are not certain. It is, however, considered that excessive competition in getting clients on the street triggered by easing administrative restrictions in registration procedures to carry taxi business caused more frequent accidents.

This general situation in taxi business stimulated to develop a quick and wide application of new device of recording an accidents process. Getting a hint from an idea of flight-recorder for air-craft accidents, author (Horino) proposed new idea of a drive recorder obtaining detailed scientific data on factors leading to an accident as well as image of accident process in Land Transport Engineering Council at 1999.

The government intending explicit decrease of road accident, promoted accident analysis by using a drive recorder, aiming also quantitative assessment of safety technologies for the promotion of truly effective preventive safety technologies. Practical application of data recorder widely spread especially in taxi companies for last few years, since the new and fresh value of drive recorder was recognized widely.

### 2. METHOD

Image recording type drive recorders (DRs) is quipped with a forward CCD camera, and records the forward view, speed, deceleration, operation of a winker and other vehicle data when a certain degree (0.4g or more) of deceleration (braking) is applied. DR-recorded data are kept in a small chip “compact flush”, enable in-depth accident analysis, and these data can also be utilized for the safe-drive training of taxi drivers, truck drivers and other heavy duty vehicle operators (Figure 3, 4).

Drive recorder (HORIBA, Ltd) data including front view and car motion accounted for 28 thousands events recorded in a small CF memory card with 128MB triggered with more than 0.4G by sudden brake/start and abrupt steering and etc., obtained from 200 taxicabs in two companies in Tokyo from May to July, 2006. Data of 111 (5 accidents and 106 near accidents) among them were related to bicycle. These data were analyzed in terms of age, category of near accident, main factor to lead accident/near accident. Tele-field study, new type of field study at laboratory, was carried out integrating various multiple data such as 15 seconds image before and after the triggered event, vehicle speed and acceleration, driver’s operation of brake and winker and GPS position data on map, air view photographs and direct field observation.
3. RESULTS

Type of near accidents included crossing (70%), changing lane/sideswipe (11%), head-on (10%), rushed into ahead (8%), rear-end(1%), namely crossing accounted for more than half of near accidents (Figure 5). Near accidents took place regardless of age. Age distribution in near accidents showed adult (65%), junior/senior high school students (17%) and primary school children (11%). Distribution of time of the day in near accidents showed 6 cases/hour during daytime(8:00-24:00), followed by 2 cases/hour during midnight(0:00-8:00)(Figure 6). Main factor leading to near accident among environment, taxi-side and bicycle-side was analyzed. These major factors include various items as follows; a. environmental factor: road, intersection structure, visibility, traffic signal, traffic volume, weather, lighting, etc., b. taxi-side: violation of safety confirmation, violation of moment stop, neglecting traffic signal, inadequate speed, inadequate lane change, etc. and c. bicycle-side: violation of safety confirmation, violation of moment stop, running without light, running against opposite direction, neglecting traffic signal, running with holding umbrella, riding with two persons, running with operating cellular phone.

As a result of analysis, the most (95%) of near accidents were caused by bicycle (Figure 7). Contents of these items were as follows; violation of safety confirmation(95 cases, 86%), violation of moment stop(51cases, 46%), running without light(31cases, 28%), running against opposite direction(25cases, 23%), neglecting traffic signal(12cases, 11%), running with holding umbrella(3cases, 3%), riding with two persons(2cases, 2%), running with operating cellular phone(1case, 1%). It should be noted that regardless of age, many cyclists were violating traffic rules and in bad social manner.
4. DISCUSSION

Age distribution in near accidents against bicycles reflected a distribution of population in Japan, and in regard with time distribution, few near accidents among adult took place during the time from midnight to early morning, primary school children experienced more near accidents during the daytime from morning to sunset, junior/senior high school students experienced more near accidents during the time from early morning to midnight. This tendency for time difference by age is very natural reflecting their habits in outdoor activities (Figure 6 and 7).

The analysis result that bicycle caused mainly 111 near accidents was completely against the statistics publicized by ITARDA indicating that bicycle was always less negligent than other vehicles in accidents (Figure 8). This new fact suggests we need more precise studies in regard with accident process and the way of collecting accident data related to bicycles, to overcome such fuzzy general situation where no explicit policy applied to safety education for cyclists and nor public road facility developed for comfortable bicycle riding. Safety for cyclists is left untouched somehow by public sectors, while bicycle is highly appreciated nowadays in the context of ecological transport in Japan.

Authors suggest that preventive safety including redesign for road environment such as adjustable bollard making use of road-vehicle communication technology installed along with the edge of the side walk of the street restricting “rushed into ahead” will be effective countermeasures. Another approach in education also is suggested to restrict violent behaviors among cyclists. These are identified as major causing factors to accidents such as violation of safety confirmation, violation of moment stop, neglecting traffic signal, non-light running, running against opposite direction.

Tele-field study was applied for 65 near accidents, and their sites were specified on the map and in 6 cases of them, environmental factors were identified to cause near accidents. This tele-field study developed by us for the first time making use of data obtained directly from drive recorder, GPS map data in conjunction with pinpointed field study in integrated manner enabled us very vivid and transparent accident analysis. And this method made invisible peripheral factors affecting cyclists behaviors related to accidents/near accidents clearly disclosed.

One example shows a comprehensive scenario of a near accident, almost head-to-head collision against taxi in which a senior high school student rushing into the opposite side of the road passing over a large truck who was slowly turning to the
left at an intersection, holding an umbrella at right hand in rainy day, was about one more kilometer to arrive at school to be on time, leaving 10 more minutes. A side-walk was narrow for him to run at his favorite speed.

This one example enabled us to predict foreseeable near accidents/accidents during the morning time in this limited area where 12 high schools are located, therefore some ergonomic countermeasures were proposed to avoid predictable accidents by intentional slow-down to 15km/hour of speed of taxi even if speed limit is restricted at 30km/h, secondly redesign of the side walk of the street for easy use for bicycle (Figure 9 and 10).

5. CONCLUSIONS

This study revealed that bicycle caused generally accidents/near accidents against taxi-cabs in downtown Tokyo which disproved a widely recognized common sense “cyclists are poor victims of traffic accidents”. Tele-field study based on data obtained from image-recording-type drive-video-recorder disclosed that accidents/near accidents were closely related to local unique traffic environmental conditions. Tele-field study brought not only the necessity of systematic and organic safety education for cyclists, but also the significant importance of keeping road environment in good condition into sharp relief.

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7. REFERENCES