

# A study on safety measures considering the psychological behavior characteristics of cyclists, from adolescents to the elderly

## 1. Background and goals

Compared with Western countries, Japan has a higher rate of bicycle accidents. In 2009, bicycle accidents caused 14.1% of traffic fatalities and 17.1% of traffic injuries. Preventing bicycle and pedestrian accidents has become an essential issue to address for further reducing the rate of traffic accidents in the future. Regarding bicycle accidents, young people, junior high school students in particular, accounted for nearly 70% of injuries, while the elderly accounted for 60% of fatalities. There is thus a need for determining the causes of these accidents and planning measures to prevent them.

This project therefore explores the possibilities for effective educational programs and awareness activities targeting cyclists, and gives recommendations for improving bicycle safety, including those related to road environments and social systems.

## 2. Research content

### 2-1. Conducting an educational program for junior high school students

In FY 2010 and 2011, we conducted an educational program at two junior high schools in Suzuka City, Mie Prefecture. Students participated in voluntary group work to create *hiyarihatto* maps,<sup>(1)</sup> investigate problems, and make specific proposals for improvement plans (Fig. 1).

As a result of these efforts, we found that students 1) plan routes to avoid major roads and large intersections that invoke psychological feelings of danger, 2) do not have sufficient space to walk or cycle due to narrowness of



Figure 1. Example of created traffic *hiyarihatto* map

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(1) A *hiyarihatto* map, named after a Japanese term for a close call, is a map that indicates areas in which participants feel a sense of danger.

streets, 3) hold the misunderstanding that the same traffic rules apply to pedestrians and cyclists, and 4) engage in what subjectively seems to be danger avoidance behavior, but instead puts them in more dangerous circumstances.

There were many cases where students shared problem awareness through actively developing discussions, resulting in specific opinions about what students themselves can do in regard to not only improving the traffic environment but also performing safety confirmation behaviors that do not rely on their senses, ensuring proper understanding of bicycle traffic rules, and finding safer routes for commuting to school.

## 2-2. Survey of bicycle behavior among the elderly and development of education programs

Previous research has shown that elderly adults who do not have a driver's license are far more likely to be involved in accidents than those who do. We conducted a study to elucidate differences in behavior characteristics between elderly adults with a driver's license and those without. We performed an investigation of cycling behavior at the Nara driving school in Nara Prefecture on October 4, 2010 and October 17, 2011. The participants were aged 62 to 94 years, comprising 21 individuals who had a driver's license and 27 who did not.

Gyro sensors were used to count the number of times participants looked left and right, and to measure viewing angles and viewing times. An external camera was also used to count the number of times participants looked left and right. A small helmet-mounted camera was used to monitor running positions (Fig. 2). Participants walked and cycled through an intersection with poor visibility and through an experimental course with parked cars.

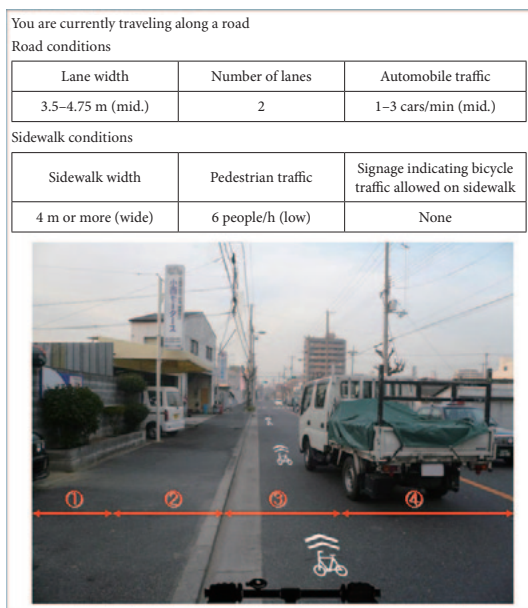


**Figure 2. Gyro sensors mounted on the head and knee**

A general tendency was found in all participants for a lower frequency of safety checks when riding bicycles compared with walking, as was a tendency for riding in the middle of the road. These tendencies were particularly pronounced in participants who did not have a driver's license. We therefore consider it necessary to focus on non-license holders when conducting instruction and training of elderly cyclists.

## 2-3. Image-based experiment on cycling environment

Bicycles are legally considered to be vehicles and therefore as a rule must travel on streets not sidewalks. However, there has been insufficient investigation of under what conditions cyclists actually adhere to this principle. It would be preferable to establish bicycle lanes, but there are many cases where the road width is insufficient to make that practical. One possible solution is road indicators with bicycle



**Figure 3. Example image of a virtual road space from a bicycle viewpoint**

marks<sup>(2)</sup> to promote road usage by cyclists.

We therefore performed an image-based experiment to grasp the effect of spatial development on the use of bicycle lanes and road markings from the perspective of both cyclists and automobile drivers (Fig. 3, 4). To better grasp general trends in bicycling behavior, we performed a preliminary investigation targeting 32 university students in January 2012, and then in March 2012 conducted an Internet-based survey involving 216 participants (aged 20–74 years, 107 men, 109 women).

For the experiment we created static images of a virtual road space under different conditions, showed participants each image, and asked questions. In the case of bicycle viewpoints, we asked participants to tell us where they would ride and their reasons for doing so. In the case of automobile viewpoints, we presented a bicycle

traveling in front of the automobile, and asked participants where they would pass by it and at what speed.

Also, knowledge likely has an effect on the decision to ride bicycles on the street or the sidewalk, so we divided participants into four groups and provided each with varying levels of information regarding traffic rules, traffic signs, and road indicators, thereby creating differences in knowledge. We also divided participants according to sex and driver's license status and investigated the relevance of these factors.

In the image-based experiments from the bicycle viewpoint, 66% of participants said they would travel on the road if a bicycle lane was present, indicating the effectiveness of bicycle lanes in promoting road usage. In contrast, the presence of on-road bicycle markings had nearly no effect on preference for road usage.

There was an association between participant knowledge and road use selection, with groups presented with less information indicating a lower preference for roads. Regarding sex and the presence or absence of a driver's license, male license holders and female non-license holders indicated an increased preference for roads.

In the image-based experiments from automobile viewpoints, the presence of signage for bicycle lanes had no effect on crossing behavior at large intersections, but bicycle lanes resulted in a trend for increased distance



**Figure 4. Example image of a virtual road space from an automobile viewpoint**

(2) Bicycle marks: Road surface markings placed at regular intervals to indicate where cyclists should ride.

from the road edge. While the presence of bicycle lanes worsened crossing behavior at smaller intersections by increasing distance from the road edge, the presence of bicycle signage indicated the same trend as in the case of no signage for riding closer to the road edge.

### **3. Conclusions**

Based on the above results, we provide recommendations as follows.

For young people, there is a need for education and activities that emphasize motivation. We also consider skill evaluation contests and the use of automotive simulators along with voluntary group work activities to be important. For the elderly, it is necessary to develop living environments and to devote substantial efforts toward elderly non-license holders. Finally, it is necessary to improve the cycling environment through the development and operation of bicycle lanes.

It is important that these measures be considered as guidelines for improving cycling safety. While this project has attempted to take on such issues in a practical manner, there is a need for continued separate studies toward their implementation.

### **4. Future outlook**

The Road Traffic Act of 2013 calls for stricter enforcement of bicycles traveling on roads near the edge. To promote both the development of road traffic environments, improved knowledge of the law and safety among cyclists, and improved driving skills, school-based education and community safety training programs should be implemented nationwide. Such development of cyclist training measures and improvement of the road traffic environment can likely be further implemented toward safety measures for automobile and scooter operators in developing countries.