

Construction of probabilistic causal structure model for unsafe driving behavior of older people

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In recent years, traffic accidents caused by older drivers have become a social problem in Japan. In order to control unsafe driving by older drivers, which leads to traffic accidents and violations, it is necessary to clarify the process and factors leading to it. According to the existing research on unsafe driving behavior of older drivers, it was shown the comparison the driving behavior of skilled and elderly. Those studies took advantage of multivariate analysis or machine learning to understand the relationship between driving characteristics and driving behavior. In this paper, we aim to clarify the factors and processes that lead to unsafe driving by older drivers, and to propose a method for structurization of driving behavior along the time series.

The functions required for structurization of model aimed at in this paper are the ability to visualize the relationship between driving behavior, the unsafe driving behavior, and driving characteristics, and the ability to visualize the driving characteristics of drivers with different driving characteristics (e.g., elderly and non-elderly). By using a Bayesian network as a structuring method, we can propose the method to analyze driving behavior from the relationship between each element, including indices related to driving characteristics and indices for objectively evaluating unsafety such as accidents and violations.

In order to satisfy the required functions of the model, the necessary elements and their requirements are set. The criteria for units and values are used as indicators, and the requirements for the elements and indicators are set with reference to the points that have been clarified from existing research on driving behavior. In this paper, we set three structuring indexes: an index for evaluating driving behavior, an objective index for evaluating unsafe driving, and the driving characteristics and the presence of other vehicles as factors that affect driving behavior. In addition, for structure learning in Bayesian network, three constraints were set: following time series, no influence between driving characteristics and surrounding environment, and generation limit up to two new nodes. Based on the above settings, it is possible to structure driving behavior by calculating driving behavior indices and objective indices for evaluating unsafety from the data acquired by each driver, and using the calculated indices to build a Bayesian network.

In this paper, we set driving at an intersection with stop control as the target scene for structuring driving behavior. For structurization of the driving behavior at stop intersections, an experiment was conducted in a driving school to acquire driving data for non-elderly and elderly people. As a result of constructing a model from the data obtained by the experiment, we were able to obtain the results of structuring as shown in Figure 1.

In order to grasp the characteristics of the driving behavior of the older drivers implied by the structured model, the driving behavior index was calculated by probabilistic inference according to age. From the above results, it was found that the driving behavior of the older drivers is delayed, the speed at the start of deceleration is high, the required deceleration is high, and the driver stops (does not stop) beyond the stop line. These results are the same driving behavior characteristics of older drivers that were clarified in the above-mentioned previous research, which is confirmed that the characteristics are consistent. Therefore, it was shown that the model structured by the proposed method can express the characteristics of older people, and the proposed method of structurization of driving behavior in this paper is appropriate.

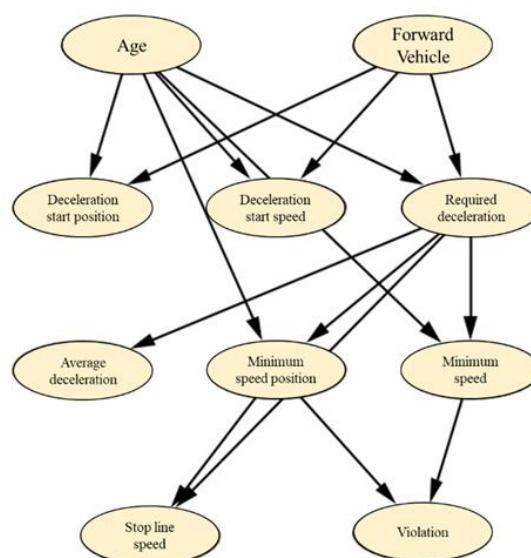


Fig.1 Structured results of deceleration behavior