1. Dimension reduction and multivariate analysis of variance for drivers' forward collision avoidance behavior characteristics

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Abstract: The process of collision avoidance under rear-end scenarios can be divided into several stages (e.g., pre-brake and post-brake). In each stage, different analysis perspectives (e.g., brake delay and brake intensity) exist, and different key time moments and measurements can be defined. Therefore, lots of parameters are involved in systematically describing drivers' collision avoidance behaviors. Studies that focused on a certain parameter can only give information on a specified parameter rather than the underlying behavioral patterns behind the parameters. This study did dimension reduction analyses for the multiple parameters of collision avoidance behaviors, and investigated the impacts of situational urgency on each type of parameters. The high fidelity Tongji University driving simulator was used to test drivers' collision avoidance behaviors under different initial headways (1.5 s, 2.5 s) and different lead vehicle (LV) deceleration rates (0.30 g, 0.50 g, 0.75 g). Parameters characterizing drivers' hazard perception, throttle releasing and braking process were recorded. Dimension reduction analyses on collision avoidance behaviors was conducted with principal component analysis, which generalized collision avoidance behaviors into three aspects: perception response, braking delay and braking intensity. Multivariate analysis of variance was applied to investigate how initial headway and LV deceleration affect these three aspects. Results showed that perception response was affected by both initial headways and LV deceleration; braking delay was affected by initial headway, LV deceleration and their interaction simultaneously; and braking intensity depended solely on lead vehicle's deceleration. As situational urgency increased, drivers responded faster and braked to maximum more quickly, and braked harder. © 2016, Editorial Department of Journal of Tongji University. All right reserved.
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