Study on Evaluation Model of Armored Vehicle Driving Training Based on Typical Tasks

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Abstract. The results of armored vehicle driving training are affected by many factors. In order to evaluate the driving level of drivers more comprehensively and accurately, this paper comprehensively considers many factors and carries out research on the evaluation of driver driving training. By comparing and analyzing various evaluation methods, the appropriate evaluation method is selected according to the characteristics of driving training evaluation. Then the single evaluation index is determined and the evaluation index system of driving training is established. The evaluation model of driving training is established according to the characteristics of evaluation index.

Keywords: Armored vehicles, Evaluation of driving training, Model study.

1. Evaluation objectives and methods of driving training

In order to give drivers more comprehensive and accurate driving training evaluation and give a true picture of the driving of the driver level, not only to judge whether the driver's driving behavior accurately, in order to complete in accordance with the requirements, but also consider whether the driver's psychological quality, qualified vehicle running status, engine work state whether meet the corresponding requirements, and many other factors. This chapter will carry out the evaluation research of driving training from many aspects. By constructing a reasonable and scientific evaluation index system, the evaluation results can reflect the real driving level of drivers more accurately and comprehensively.

Based on the analysis of the characteristics of armored vehicle driving training and the evaluation objectives of driving training, this section will analyze and select the evaluation methods of driving training. Modern comprehensive evaluation method, also known as multi-factor evaluation method, refers to a comprehensive quantitative and qualitative evaluation method for multiple objects in a complex system to give a good or bad grade. Modern comprehensive evaluation methods include deterministic index evaluation method and non-deterministic index evaluation method, the former includes conventional comprehensive evaluation method, principal component analysis method, cluster comprehensive evaluation method, data envelopment analysis method, etc. The latter includes fuzzy comprehensive evaluation method, grey correlation synthesis method and so on. By analyzing the evaluation methods, the method suitable for the evaluation of driving training is selected.

2. Evaluation index system of driving training

In order to reasonably and comprehensively evaluate the driving level of drivers, the evaluation of driving training should not only pay attention to the driver's driving behavior, but also consider the vehicle running state, the driver's physical quality and other factors. The selection of appropriate evaluation indicators can improve the accuracy of the evaluation of the driver's driving training results, and also improve the evaluation efficiency. Let the evaluation index set constructed in this section be U, which contains all the evaluation indexes of the evaluation index system. The evaluation index set U contains four first-level evaluation indicators: drivers' physiological and psychological state, vehicle running state, drivers' driving behavior and driving training data, which are respectively represented by U1, U2, U3 and U4. The first-level evaluation index set contains the second-level evaluation index uij (I =1,2... ,m; J = 1, 2,... N) The following is to analyze each first-level evaluation index, determine

the corresponding second-level evaluation index, and construct the evaluation index system of driving training.

2.1. Evaluation index of driver's physiological and psychological state

The physiological and psychological state of the driver has a great influence on the result of vehicle driving training, and the cultivation of calm driving has a positive effect on ensuring driving efficiency. The change of heart rate can reflect the change of driver's mental state before and after driving training. If the heart rate is stable, it means that the driver's mood is stable and there is no big fluctuation. If the heart rate increases too fast, it may be caused by excessive stress and mood swings during driving. Similarly, the change of body temperature can also reflect the change of the driver's mood to a certain extent, and also reflect the driver's physical quality. Therefore, in this section, heart rate and body temperature of drivers during driving are selected as the evaluation indexes of drivers' physical and psychological states. The physiological and psychological evaluation indexes were denoted by U1, and the heart rate was denoted by u11, and the body temperature was denoted by u12.

2.2. Evaluation index of driver's driving behavior

In this section, the evaluation index of driver's driving behavior is mainly determined for driving manipulation behavior. The driving training process contains a variety of driving behaviors, and the sequence of the combination of various driving behaviors should also be considered when driving on typical combined roads. The driver needs accurate control of the gas pedal, clutch pedal and gear switch. In the process of uniform speed driving, it is necessary to keep the speed of the vehicle stable, control the accelerator pedal at a certain position, without too much fluctuation, and do not change the position of gear, clutch and other devices. The shift process mainly involves the clutch pedal, the gas pedal and the shift control. The main operating object of deceleration and parking process is the brake pedal, in which the deceleration process should also consider the driving behavior of downshifting. Based on the project research requirements, this section also adopts the opinions of 8 expert group members to determine the evaluation indicators of drivers' driving behavior. The specific descriptions of each indicator are shown in Table 2-1.

Table 2-1 Evaluation index of driver's driving behavior

The evaluation object	The evaluation index	Description of Evaluation index
Gear shift	Shift timing u21	Whether the shift is performed at the correct time. The gear shifting speed with the best dynamic performance obtained in the previous study is the evaluation basis. It starts at the moment when the clutch pedal is pressed, which indicates the driver's intention to shift gears.
	The gear is u22	According to the driving road conditions and requirements, whether the driver through the shift up or down to choose the appropriate gear, so that the vehicle full play of power.
	Shift time u23	Whether the shift action is coherent and simply, not procrastinating, at the same time, the shift process can not be too hasty, affecting the stability of the vehicle, which needs to be evaluated by the shift time. The shift time is defined as starting from the moment when the clutch pedal is pressed, and then shifting operation is carried out, and ending at the moment when the clutch pedal is completely released.
Clutch pedal position u24		The proportion of the actual position of the clutch pedal to the position of the pedal at the end of trampling. Mainly reflected in the start and shift two processes, need to cut off power transmission clutch pedal step to 100%.
The clutch pedal	When starting to release the clutch pedal u25	In the starting process, the time consumed between the time when the clutch pedal is released 100% and the time when the clutch pedal is completely released. 。

2.3. Vehicle running status evaluation index

Drivers have their own driving habits and characteristics, and different driving habits will affect the driving conditions of vehicles. If only the driver's driving behavior is evaluated, the large gap with the action reference standard leads to a low evaluation result, but the actual operation of the vehicle is not considered to meet the driving requirements, such an evaluation result is not reasonable and practical, and the comprehensive evaluation should take into account the driving behavior and vehicle running state.

Vehicle running state mainly considers vehicle running state and engine working state. The evaluation indicators of vehicle running status are shown in Table 2-2. The evaluation index of vehicle running state is expressed as U3, then the number of engine stalling is expressed as u31, the instantaneous speed of vehicle is expressed as u32, the root mean square of weighted acceleration is expressed as u33, and the number of tail-slicing and skidding is expressed as u34.

Table 2-2 Evaluation index of driver's driving behavior

The evaluation object	The evaluation index	Description of Evaluation index
Condition of engine	Number of engine flameouts u31	Under normal circumstances, experienced drivers can reasonably complete driving related operations, and make the vehicle maintain a stable working condition; However, inexperienced drivers are prone to engine flameout due to unskilled operation or wrong operation, which will affect the stable operation of the vehicle. Therefore, the number of engine flameout was selected to evaluate the driver's driving proficiency. The more the number of engine flameout, the lower the evaluation of the driver's driving proficiency.
Instantaneous vehicle velocity u32		When comparing the actual driving speed of the driver with the evaluation reference, whether the actual speed of the vehicle reaches the ideal speed.
Running state of vehicle	Weighted root means square value of acceleration u33	Long-term in the bad driving environment, will have a large negative impact on the driver's health. In order to help drivers, maintain good driving habits and ensure basic driving comfort, it is necessary to limit the variation of vehicle longitudinal acceleration from being too drastic. The weighted root mean square value of acceleration is selected as the evaluation index to evaluate the comfort of drivers during driving, which helps drivers pay attention to driving operation, improve their comfort and ensure their health.
Tail flick, skid and other times u34		Reasonable operation of the driver can make the armored vehicle run stably. If the operation is not proper, the phenomenon of tail-slinging and skidding may occur in the process of driving the armored vehicle. Therefore, the number of times of unsteady driving such as tail-swinging and skidding is used to characterize the stable driving state in the driving process.

2.4. Evaluation index of training data

The driver's physiological and psychological state index, the driver's detailed driving behavior index, and the vehicle running state three categories of evaluation indicators, respectively from the perspective of the driver and vehicle, to evaluate the driving training, reflecting the driver's driving level from multiple perspectives.

In this section, the completion time of training is selected as a training data evaluation index. In addition, the parking position evaluation index is set for the training task with fixed parking item to evaluate the driver's fixed parking ability. Table 2-3 shows the evaluation index and description of training data.

Table 2-3 Evaluation index of driver's driving behavior

The evaluation object	The evaluation index	Description of Evaluation index
Training data	Completed training time u41	Evaluate whether the equipment dynamic performance meets the requirements during the whole training task.
	The car position u42	Used to judge the driver's ability to stop at fixed point. It mainly exists in the parking process when completing the driving route, and the tasks such as getting on the flat car need to stop smoothly at the designated position. By comparing the distance between the actual parking position and the calibration parking point, the evaluation is given. 。

3. Establishment of evaluation model for driving training

This section classifies the evaluation level based on the evaluation objective of driving training. Then, based on the selection of the evaluation index and the calculation of the index weight coefficient, the evaluation mathematical model and the comprehensive evaluation model of each driving training evaluation index will be established respectively, and the function of each evaluation model will be realized in MATLB. Based on the selected evaluation methods, this chapter constructs the evaluation index system of driving training, calculates and determines the weight coefficient of each evaluation index, and establishes the evaluation model of driving training.

3.1. Evaluation grade division

The set of evaluation grades can be expressed as follows:$V \quad V_{11}, V_{12}, V_{21}, ..., V_{ij}$, Among them, V_{ij} (i=1,2,3,4; j=1,2,…,n) denotes the evaluation level corresponding to the j th second-level index in the i th first-level index. This section is divided into five evaluation levels according to the evaluation objectives of driving training: excellent, good, qualified, pass and fail. The driver's driving training results were calculated and evaluated, and the driver's driving level was divided into corresponding grades according to the rating results. It is rated "excellent" when the total score is 90 or greater, "good" when the score is in the range of [80,90], "qualified" when the score is in the range of [70,80], "pass" when the score is in the range of [60,70], and "fail" when the score is less than 60.The evaluation level set is:V_0 excellent 90, 100 , good 80, 90 , qualified 70,80 , pass 60, 70 , fail 0, 60

3.2. Evaluation model of driving training

The comprehensive evaluation result of driver's driving training is represented by V, which is the sum of the product of the evaluation result corresponding to each evaluation index and the corresponding weight coefficient, calculated by the following formula:

$$V = \sum_{i=1}^{m} w_{ij} \cdot B_{ij}$$

$$\left(j = 1, 2, 3..., n \right)$$

Where, wij (I =1, 2..., m; J = 1, 2... N) is the weight of each index; Bij (I = 1, 2..., m; J = 1, 2... N) is the evaluation result of each indicator.

4. Conclusion

Based on the selected evaluation methods, the evaluation index system of driving training was constructed, the weight coefficients of each evaluation index were calculated and determined, and the evaluation model of driving training was established. Based on the project requirements, the evaluation objectives of driving training are analyzed and determined. The drivers' physical and psychological state, drivers' driving behavior, vehicle running state and training data were analyzed. To divide the evaluation level and establish a mathematical model.

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