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Driver Education for Stress Conditions

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A set of driver performance training activities has been developed to prepare drivers to handle a vehicle under such stress conditions as tire failure, skid situations, off-road recovery when one or more wheels drop off pavement, and to properly steer vehicle, to evade sudden impending dangers, and to brake the vehicle without losing control. As this paper points out, when these activities are learned and practiced, improvements occur in a driver's ability to operate a vehicle and to respond to stress conditions with a high degree of success. In addition, reductions in accidents and property damage have also taken place.

The program described in this paper was developed from information obtained through a search of the literature and through experiences gained by participating in training programs previously developed by such organizations as Liberty Mutual Insurance Company, General Motors Proving Ground, and the National Safety Council.

For many years, the Liberty Mutual Insurance Company has provided information via films and workshops concerning the ability to control a vehicle in various skid situations (1). General Motors Proving Ground first developed a series of activities that were aimed at improving skills of drivers in handling emergencies (2). The National Safety Council has for many years conducted Winter Driving Techniques Workshops at Stevens Point, Wisconsin (3).

Others have conducted training programs that have

incorporated these and similar activities. The Bob Bondurant School of High Performance Driving provides a program and helped with the production of a film by the Chevrolet Division of the General Motors Corporation (4). The National Park Service and several state highway patrols have produced programs to develop driver skills in responding to emergency situations.

The program discussed here was developed by the Safety Department at Central Missouri State University and is a composite of many ideas. The course centers around three important elements in the driving task—the driver, the vehicle, and the environment.

CLASSROOM ACTIVITIES

Classroom activities involved the following:

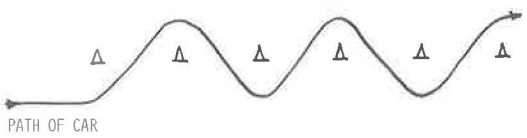
1. Course orientation;
2. A simplified approach to tire interaction with the surface and traction (braking traction and cornering traction);
3. Differences in the coefficient of friction among dry, wet, and ice-covered surfaces;
4. Comparative stopping distances of new tires versus worn tires on various surfaces;
5. Relation of friction to cornering, stopping, and driving;
6. Centrifugal force related to vehicle control;
7. Understanding of the fact that all four wheels help steer and control the vehicle path;
8. Visual perception pretest, improvement exercise, and posttest; and
9. An introductory description and discussion of each in-car exercise including serpentine steering, evasive maneuvering, controlled braking, off-road recovery, skid control, and blow-out simulation.

Following discussion, a fixed-base simulator presentation is used to prepare drivers for the type of actions they will be required to perform in the car.

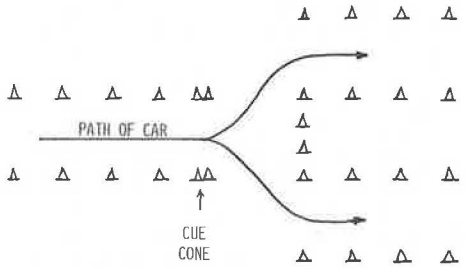
LABORATORY IN-CAR EXERCISES

The in-car phase of the course includes hands-on experience to develop skill in performing the exercises accurately and skillfully. Each exercise is demonstrated, and the student is allowed to practice the exercises under direct supervision of the instructor.

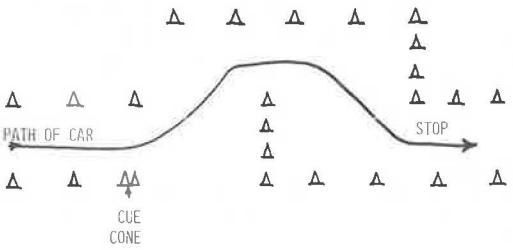
Serpentine Steering. The purpose or objective of this exercise is to develop proper timing of steering input, judging the relationship of fixed objects to the vehicle.



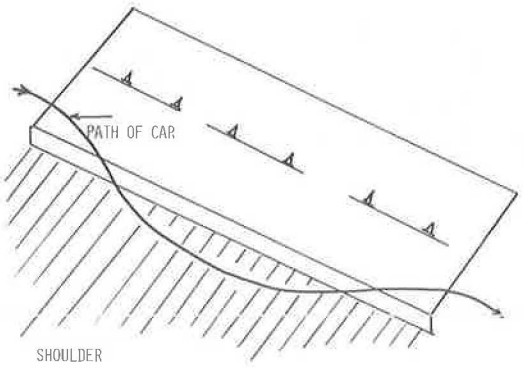
Evasive Maneuver. This exercise allows students to discover that the evasive capabilities far exceed the stopping capabilities. A car can evade an object in a shorter distance than the driver can stop the vehicle.



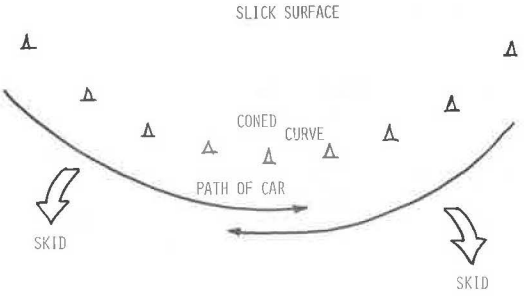
Controlled Braking. This exercise allows students to master the skill of being able to use maximum braking force to stop a vehicle in the shortest distance possible, while retaining steering control of the vehicle.



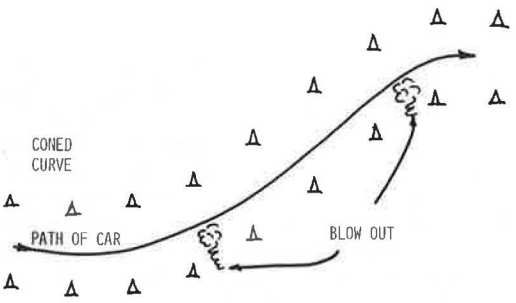
Off-Road Recovery. This exercise develops skill in getting a vehicle back onto the pavement at highway speed when either two or four wheels drop off the pavement onto the shoulder. This is used only in unusual situations, where there is neither time nor space in which to slow down.



Skid Control. This exercise allows students to sense the feel of a vehicle in a skid and to develop proper driving techniques to control the vehicle.



Blowouts. This exercise allows students to develop skills of vehicle control in the event of front or rear blowout and to control the car either in a straight line or curve.



Blowout is induced somewhere within the coned course. A mechanical device (blowout simulator) is used to suddenly remove air from tire in approximately one-quarter of a second.

PROGRAM EVALUATION

The Advanced Driving Techniques Programs have received a high degree of acceptance by professionals in the traffic safety field. These programs have also been deemed of great value by those who have been trained in these activities. However, little has been done to evaluate the programs as to their long-range effectiveness in reducing accidents and violations.

A small study, conducted by the General Motors Proving Ground in 1969, to validate its training program did provide indications of very satisfying results (5). The study involved 60 police officers. Matched groups were selected, and one group was given the training program. After 18 months, these data showed that the trained group had only half as many accidents; a record of one-tenth the total costs in terms of injuries, days lost, lost wages and vehicle damage; and an average cost per accident of 20 percent of that of the untrained group (5). Although General Motors did not feel that this small study was an adequate validation of the course, it did provide promising results (5).

The Safety Department at Central Missouri State University has conducted several programs of this nature and, while data regarding long-range results are not yet available, primary indications from change in ability to operate a vehicle under emergency conditions following the instructional program lead us to believe that results similar to those in the General Motors study may be in the offing. Groups trained included adult drivers, student drivers, U.S. Air Force personnel, AT&T instructor personnel, and fleet operators.

The Missouri Safety Center, in cooperation with the Missouri Division of Highway Safety, has conducted a pilot program for the training of emergency vehicle operators in advanced driver education. The Greater St. Louis Training Academy agreed to serve as the study group for this project.

Material reported in this paper concerning this study has been taken from The Evaluation of a Curriculum on Advanced Driver Education for Emergency Vehicle Operators in Missouri, an unpublished doctoral dissertation by Fredrick W. Reuter (1977). The purpose of the project was to evaluate the long-range benefits that may be derived from a curriculum in advanced driver education specially designed for operators of emergency vehicles throughout the state of Missouri.

The hypotheses to be tested in this study were

1. H_o1: There is no difference in performance on pretests of knowledge, low speed skill, and increased speed skill between the advanced driver education group and the control group, which does not receive advanced driver education.
2. H_o2: There is no difference in performance on posttests of knowledge, low speed skill, and increased speed skill between the advanced driver education group and the control group, which does not receive advanced driver education.
3. H_o3: There is no difference in learning between the group receiving advanced driver education and the control group, which did not receive advanced driver education, as measured by differences in pretest and posttest knowledge, low speed skill, and increased speed skill scores achieved by persons in either of the groups.

A literature review indicated that a wide variety of training programs of this type are being conducted across the nation. Few programs are the product of a strong statistical analysis to ensure continued program evaluation and development. Information available at the local, state, and national levels readily attests to the need for a comprehensive and concise education program for emergency vehicle operators. As an example, information from the National Safety Council's Fleet Safety Contest shows accident rates (per 1.6 million vehicle-kilometers) for municipal patrol cars are 31.33, compared to 8.32 for passenger cars and 11.4 average for all vehicles in fleet use (6).

CURRICULUM DEVELOPMENT

Contributions to the curriculum, which was developed over a 4-month period, came from a review of the literature and a study of the Driving Task Analysis conducted by the Human Resources Research Organization on driver and traffic safety education (7). Major elements in the curriculum were the National Safety Council's defensive driving course, the Maryland State Department of Education's system of perceptual driving, and the General Motors Proving Ground's evasive maneuvers course.

The curriculum stressed a systems approach to understanding the driving task, a visual perception improvement program to upgrade the driver's visual habits, and a series of advanced driver education off-street range exercises designed to improve driver skills. Materials developed included the following:

1. Instructor manual—a two-phase supplement to the student manual—with pretests and posttests for both knowledge and skill; and
2. Student manuals for each phase: phase 1 (classroom), 6 hours of modular classroom study with visuals; phase 2 (range exercises), performance objectives for skill evaluations.

Ten hours of advanced range activities were also included in the program.

The curriculum was reviewed by 16 practicing professionals in the field of driver and traffic safety education. Each was given a complete set of curriculum materials and asked to make comments, corrections, and suggestions regarding the curriculum. In addition, a reading specialist was asked to correct the curriculum materials for sentence structure and readability. The operator's manual (phase 1) had a 12th grade reading level.

Instructor Training

Central Missouri State University personnel trained six St. Louis Police Academy officers at their Highway Safety Instructional Park. A 24-h classroom and range study program was given to these instructors who, in

turn, would be instructing trainees. The instructors had an opportunity to familiarize themselves with the curriculum materials, and worked with some Air Force recruits to master teaching techniques for the program.

Figure 1. Driver evaluation form number 1.

EXERCISE 1 - SERPENTINE - LOW SPEED			OPERATOR ID._____	
ATTEMPTS: 1 2 3 4 5 6 7 8 9 10		SPEED: 20	28	
SKILLS	VALUE	FIRST TRIAL	MIDDLE TRIAL	FINAL TRIAL
9-3 HAND POSITION	5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5
CLOSE CONE APPROACH	5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5
MAINTAINS SPEED	5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5
GOOD STEERING INPUTS	10	0 2 4 6 8 10	0 2 4 6 8 10	0 2 4 6 8 10
CLEAR RIGHT SIDE VEHICLE	5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5
CLEAR LEFT SIDE VEHICLE	5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5
CLEARS ALL CONES	5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5
GOOD VISUAL PROCEDURE	10	0 2 4 6 8 10	0 2 4 6 8 10	0 2 4 6 8 10
GOOD RANGE SAFETY PROCEDURES	R*	. . . . .	. . . . .	. . . . .
COMPLETES PRE-DRIVING CHECK	R*	a b c d e f g	a b c d e f g	a b c d e f g
INSTRUCTOR'S COMMENTS:				
TOTAL POINTS	50			

* REQUIRED

Figure 2. Driver evaluation form number 2.

EXERCISE 2 - SKID CONTROL - LOW SPEED			OPERATOR ID._____	
ATTEMPS: 1 2 3 4 5 6 7 8 9 10		SPEED: 25	30	
SKILLS	VALUE	FIRST TRIAL	MIDDLE TRIAL	FINAL TRIAL
CONTROLS VEHICLE	5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5
MAINTAINS COURSE	5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5
GOOD RESPONSE TO SKID	5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5
GOOD STEERING INPUTS	10	0 2 4 6 8 10	0 2 4 6 8 10	0 2 4 6 8 10
GOOD COUNTERSTEER	5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5
GOOD HAND TECHNIQUE	5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5
CLEARS ALL CONES	5	0 1 2 3 4 5	0 1 2 3 4 5	0 1 2 3 4 5
GOOD VISUAL PROCEDURE	10	0 2 4 6 8 10	0 2 4 6 8 10	0 2 4 6 8 10
GOOD RANGE SAFETY PROCEDURE	R*	. . . . .	. . . . .	. . . . .
COMPLETES PRE-DRIVING CHECK	R*	a b c d e f g	a b c d e f g	a b c d e f g
INSTRUCTOR'S COMMENTS:				
TOTAL POINTS	50			

* REQUIRED

Study Group

The study group consisted of 24 persons chosen from a group of 38 recruits in training during March and April 1976 at the Greater St. Louis Police Academy. A choice of groups was available according to the academy-scheduled time of training. This group of 24 was chosen because they appeared to represent a more heterogeneous cross section from the greater metropolitan area of St. Louis. The recruits were divided into two groups of 12 by the academy driver training coordinator. One group was to remain untrained. Both groups were given the same pretests and posttests on knowledge and skill performance.

Not all of the skill exercises in the original curriculum could be tested due to the physical character of the driving facility available. Off-road recovery and tire failure exercises were deleted in this study.

Evaluation Team

An evaluation team, consisting of three professional driver educators on the Missouri Safety Center staff, conducted evaluations of program operation and administered both pretests and posttests to cadets in the Academy Advanced Driving Project.

The evaluation team received training in the use of the skill rating form developed for the curriculum prior to reaching St. Louis. The evaluation team had an opportunity to familiarize themselves with the St. Louis range and to practice the rating procedure.

Evaluation team members assumed the "primary rater" position in the right front seat. Academy instructors assisted and rated from the "secondary rater" position in the right rear seat. No conversation was permitted between raters during testing times. This process allowed a check of objectivity and reliability of the test instruments. Samples of the evaluation instruments (Figures 1 and 2) are included here.

ANALYSIS OF DATA

Data from the study received statistical treatment via a t-test to determine if a significant difference existed at the 0.05 level of significance. Analysis of data gathering from pretests and posttests showed the following:

1. H_o1 stated, "There is no difference in performance on pretests of knowledge, low speed skill, and increased speed skill between the advanced driver education group and the control group, which does not receive advanced driver education." This hypothesis was rejected because in each pretest (knowledge, low speed, and increased speed) the data showed a significant difference between the groups. The data showed that a difference did exist between the trained group and the untrained group before the study began.
2. H_o2 stated, "There is no difference in performance on posttests of knowledge, low speed skill, and increased speed skill between the advanced driver education group and the control group, which does not receive advanced driver education." This hypothesis was rejected because the data showed that a significant difference existed in performance between the trained group and the untrained group on posttest scores of knowledge, low speed skill, and increased speed skill. The trained group had received the curriculum materials before the posttest, while the untrained group had not.
3. H_o3 stated, "There is no difference in learning between the group receiving advanced driver education and the control group, which did not receive advanced

driver education, as measured by differences in pretest and posttest knowledge, low speed skill, and increased speed skill scores achieved by persons in either of the groups." This hypothesis was rejected because there was a significant difference in learning between the trained group and the untrained group as measured by the differences in pretest and posttest scores on knowledge and increased speed skill tests. The trained group significantly improved their pretest and posttest scores on low speed skill. The hypothesized difference between the groups was shown by the difference in the scores on low speed skill tests. The trained group significantly improved their scores on pretests and posttests on increased speed skill. The untrained group showed no significant improvement in these scores.

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions are warranted by the data gathered in this study:

1. The subjects were not homogeneous before the study began. Selection of recruits for this study was not done randomly. Therefore, the results can be applied only to study groups.
2. The untrained group was apparently able to significantly increase their test scores on low speed skill by skills learned in the performance of the pretest.
3. The untrained group was not able in most cases to significantly improve their test scores in knowledge and skill. This was most apparent in posttest increased speed skill, where the greatest difference in mean scores appeared.
4. The trained group was able to improve their scores as measured by the differences between pretest and posttests of knowledge and skill. This is most apparent on the posttest of increased speed skill. The degree of difficulty was highest for this skill, and the trained group showed significant improvement for this skill.
5. The curriculum was considered successful because the trained group significantly increased their posttest mean scores, while the untrained group did not (with the exception of the low speed skill testing).
6. The development and evaluation of this curriculum are considered successfully accomplished.

Because of the experience gained by the development and evaluation of this curriculum for advanced driver education for emergency vehicle operators, the following recommendations are made:

1. Urban police, fire, and rescue vehicle operators throughout the state of Missouri should be given the opportunity to be trained in this curriculum.
2. Rural police, fire, and rescue vehicle operators throughout the state of Missouri should be given the opportunity to be trained in this curriculum.
3. The Missouri State Highway Patrol should give each of its patrol officers the opportunity to be trained in this curriculum as part of their basic training program.
4. A task analysis for police officers on patrol should be developed in order to identify the interrelationships of driving and patrol duties (e.g., surveillance and radio operation).
5. More emphasis should be placed on the perceptual skills part of the classroom information as it relates to driving in the skill exercises.
6. As this curriculum is used, it should be continuously evaluated and judiciously abridged when needed.

The following recommendations for future research are made:

1. In order to ensure homogeneity of the subjects in each group, there should be random selection of subjects for both the study and control groups.
2. Further research is needed to establish validity and reliability for the study's evaluation instruments. Special attention should be given to the low speed skill test so that an instrument capable of discrimination can be developed despite the elementary level of skills involved.
3. A follow-up study comparing accident records of the two groups should be conducted to determine if the curriculum had any long-range effect on accident rates of the study group members.
4. Further statistical analysis of the study group through accident records should be conducted and compared against the results of this present study.
5. The need for an adequate driving range facility should be recognized so that a complete program can be conducted (including all exercises provided for in the curriculum).
6. All future instructors of this curriculum should be trained in the same manner as in this study, in order to ensure a consistently high program level.
7. The need for adequate funding for classroom and range facilities should be recognized in advance of implementation of the curriculum program so that a complete and comprehensive application of the curriculum may be made.

DISCUSSION

Although the accepted method of randomization was not used for the selection of the study group, it was my observation that the study groups were not visibly different. Also, the evaluation procedure in skill exercises was considered to be a necessarily fatiguing experience for the raters. Consideration should be given to providing a longer time period in which to complete these skill exercise evaluations. Some raters, including secondary raters, became ill due to the rough maneuvers required.

One of the strong features of this curriculum which was not measured by the evaluation was the enthusiasm of the subjects in the trained group for both the classroom and the range programs. The prospect of the challenge in actual behind-the-wheel experience at skill exercises seemed to gain the interest of the most skeptical participant.

Unsolicited responses from the subjects who had completed the curriculum indicated numerous opportunities for practical application of the curriculum information. In these cases, the subjects expressed the opinion that their training had resulted in improved ability in accident avoidance.

The reason for the untrained group's significant improvement on low speed skill posttest scores is difficult to identify. One should consider that the basic level of skill required and the speed used is low enough that the testing procedure alone could cause enough increase in learning to allow a significant improvement in posttest scores. It should be noted that when a higher order of skill and speed was needed, as in the increased speed skill exercises, the trained group showed a large and significant improvement, while the untrained group showed only slight improvement.

Two other projects have been conducted by the Missouri Safety Center and the Safety Department. One project was to conduct workshops for emergency vehicle operators throughout the state of Missouri. A sec-

ond project was conducted by the Safety Department at Central Missouri State University and involved the use of the same curriculum materials as described in this paper, but was designed for operators of U.S. Air Force military vehicles at Whiteman Air Force Base, Missouri. This project sought to teach young military driver's license holders 24 years of age and under.

The purpose of these projects was to evaluate the long-range benefits that may be derived from a curriculum in advanced driver education specially designed for operators of emergency vehicles throughout the state of Missouri.

Instructor Training

Central Missouri State University trained instructors conducted the workshops throughout the state of Missouri. Also, the university trained six Air Force persons at its Highway Safety Instructional Park. Instructors who would, in turn, be instructing trainees participated in a 24-h classroom and range study program.

Missouri Statewide Project

To date, the statewide project has conducted 23 instructional workshops in Rolla, Poplar Bluff, Kirksville, Clinton, St. Louis (for fire personnel only), Kirkwood, Neosho, Liberty, and Cape Girardeau. A total of 443 drivers of police, fire, and ambulance type vehicles participated.

At the beginning of each workshop, a film is used to help demonstrate the need for the program. An attempt is made to match the film to the majority of participants. Films used included "Ambulance Run" (for emergency medical groups), "Police Pursuit" (for police personnel), "Defensive Driving III" (for police personnel), "Fire Truck" (for fire personnel), and "GM Emergency Driving" (for general purposes).

USAF - Whiteman AFB Project

This project has been in operation approximately 6 months. To date, 325 drivers (24 years of age and under) have been trained. The project is designed to provide training for all drivers of military vehicles on an annual basis.

Driver and accident records are kept and will be reviewed every 6 months throughout the project. Since the program is just beginning, no follow-up data are available. However, to date no person trained has had any kind of accident. Several trained persons have sought out instructors to relate experiences where their training has prevented an accident in their privately owned vehicles. Further, one trained driver stated that his training had prevented an accident while he was operating an Air Force vehicle.

Conclusions

Although no formal statistical follow-up data are available yet from either of these studies, the experience of those trained and their enthusiasm for the program have been significant enough to have funding continued for another year. Also, the Air Force wing and base commanders have given the project approval to continue as planned.

Follow-up data may be obtained, when available, from the Missouri Safety Center, Central Missouri State University, Warrensburg, MO 64093; or Dr. Robert A. Ulrich, head, Safety Department, Central Missouri State University, Warrensburg, MO 64093.

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