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THE DEVELOPMENT OF A BATTERY OF KNOWLEDGE TEST ITEMS FOR USE IN THE LICENSING OF MOTORCYCLE OPERATORS

By

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ABSTRACT

THE DEVELOPMENT OF A BATTERY OF KNOWLEDGE TEST ITEMS FOR USE IN THE LICENSING OF MOTORCYCLE OPERATORS

By

Richard Douglas Ashman

The number of motorcycles used in the United States has steadily increased over the past twenty years, and with the increase in demand, there have been deaths, injuries, and property damage associated with motorcycle accidents. Because of the increase in motorcycle accidents, many states have instituted some form of special motorcycle operator licensing procedure to help identify knowledgeable motorcycle operators.

This study was designed to develop motorcycle operator knowledge test items for licensing and program evaluations. The test items were based on the critical operation tasks needed for the safe operation of a motorcycle on the public streets and highways.

Description of the Methods, Techniques, and Data Used

A population of 322 Michigan motorcycle operators was included in the 1980-81 study period. Ten Secretary of State Branch offices were used in the State of Michigan.

A descriptive analysis of the data was made for particular information about the subjects as to age, sex, and motorcycle riding experience.

An analysis of the test items was conducted to indicate which items showed discriminating powers. The data were, also, analyzed statistically to determine the inter-relationships that existed between the variables and critical tasks for motorcycle operation.

Findings of the Study

1. The data indicated that over 60 percent of the test items had a discriminating power over .20. All of the critical tasks areas were represented within each of the four tests.
2. The different tests revealed strengths in one or more of the critical tasks related to motorcycle operation.
3. The statistical test, rotated factor analysis, suggested no clear pattern in the relationships with regard to the critical tasks as a whole.
4. A majority of the factors were coherent either on a single task or several tasks with similarities in the factors.
5. The rotated factor analysis was able to identify the conceptual variables for motorcycle operators tasks.

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Special appreciation is expressed to Dr. Robert E. Gustafson, major advisor, for his guidance and valuable direction.

The staff at Michigan Secretary of State office were extremely helpful in collecting data. Mr. Michael Rudisill's assistance in selecting branch offices and providing guidance relative to the subjects tested in this study were of utmost importance.

Appreciation is extended to the Nebraska Safety Center staff and Mrs. Shari Whalen for their valuable advice, encouragement, and cooperation during this study. Finally, a special appreciation is expressed to my wife, Sandie, for her love and devotion, and to our children, Mark and Nicole, for their inspiration, patience, and love.

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CHAPTER I

INTRODUCTION

The number of motorcycles in the United States has steadily increased from 660,400 in 1962 to over 5,800,000 in 1980.[1] Consequently, motorcycles have become an important mode of transportation in the highway transportation system.

With the increase in motorcycle usage since 1962, the number of deaths in motorcycle accidents has also increased. Motorcycle deaths increased from 759 in 1962 to 4,480 in 1980. There were some 52,600 motor vehicle fatalities in 1980 and of this number motorcycle deaths accounted for 4,480 of the fatalities.[2] Motorcycle deaths thus represented about 9 percent of the total number of motor vehicle deaths, but accounted for only about 4 percent of the registered vehicles.

When comparing death rates per 100 million miles drive for 1980, the motorcycle death rate was 21 compared

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[1] National Safety Council, Accident Facts: 1981 Edition (Chicago, Ill.: National Safety Council, 1981), p. 56.

[2] Ibid., pp. 40, 56.

to the overall motor vehicle death rate of 3.48; a rate over six times as high.[3] These statistics demonstrate that the motorcycle is over represented in motor vehicle fatalities regardless of whether one is looking at total fatalities or fatality rates.

The Problem

Because of the increase in motorcycle accidents and resulting deaths, injuries, and property damage, many states have instituted some form of special motorcycle operator licensing procedure. Forty-five states and the District of Columbia have a special motorcycle license required to drive on the streets and highways under their control.[4]

Forty-four states administered a special written knowledge examination and conducted vehicle inspections as part of the testing procedure. Forty states administered off-road skills tests, 26 had on-street tests, and 12 states required both.[5] However, there was no indication of uniformity throughout the states with regard to the content of the operators tests and/or licensing procedures.

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[3] Ibid., p. 56.

[4] American Automobile Association, Digest of Motor Laws, Forty-Seventh Edition (Falls Church, Vir.: January 1980), pp. 1-213.

[5] Motorcycle Safety Foundation, Cycle Safety Info: State Motorcycle Operator Licensing (1979), p. 1.

Statement of Problem

A review of the research indicated that minimal emphasis has been placed upon the desired content in licensing examinations. Research attempts in knowledge test items for motorcycles have been based on source documents of motor vehicle operator tasks and/or general information references. No evidence could be found where knowledge test items were documented by a task analysis of motorcycle operation.

McDole and Berger of the University of Michigan provided a motorcycle operators tasks guide based upon motor vehicle operator tasks source documents.[6] This research, and others prior to 1974, were founded on motor vehicle operator tasks sources for driver education and licensing. Prior to September, 1974, no motorcycle operator task analysis source documents were available. Blair Heywood and James McKnight, under contract for National Public Service Research Institute, developed the first true motorcyle task analysis in 1974.[7]

The Heywood and McKnight analysis applied to the performance, knowledge, and skills required in safe operation of motorcycles by novice and experience operators alike.

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[6]T. L. McDole and W. G. Berger, Item Writer's Guide For Motorcyle Riding: A Preliminary Outline, Prepared under contract FH-11-7616 for the National Highway Safety Administration, U.S. Dept. of Transportation, Washington, D.C. (Ann Arbor, Mich.: The Highway Safety Research Institute, August, 1971).

[7]H. Blair Heywood and A. James McKnight, Motorcycle Task Analysis, Prepared for the Motorcycle Safety Foundation by the National Public Service Research Institute of Central Missouri State University, September, 1974.

This document was prepared for use in developing instructional programs, materials, practices, and testing programs.[8] The program with the knowledge test items identified above is that they have not been documented by critical motorcycle operator tasks analysis.

Purpose of the Study

The primary purpose of this study was to develop valid and reliable motorcycle operator test items based upon the critical driver tasks for operation of a motorcycle. These test items could then be used for licensing and program evaluations.

Importance of the Study

This study was important for two reasons. First, a review of literature indicated there was a need for an evaluation instrument based upon critical tasks for safe motorcycle operation. This is not to imply that other tests and test items were not successful in testing motorcycle operators' performance. There were a number of test items developed over the years. The American Association of Motor Vehicle Administrators,[9] The Texas Licensing Program,[10] and

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[8] Ibid., pp. xi-xvi.

[9] American Association of Motor Vehicle Administrators, Suggested Questions for Motorcycle Licensing, A report prepared by the Motorcycle Industry Council in cooperation with the National Highway Safety Bureau (undated).

[10] Lewis A. Locke, Motorcycle Operator Licensing: Design, Analysis and Revision of The Texas Licensing Program, A research study jointly funded by the State of Texas and U.S. Department of Transportation, Conducted in cooperation with the Texas Department of Public Safety and Texas A & M University, 1968.

Pollock and McDole, to name just a few, have developed motorcycle operator test items.[11] However, no evidence could be found for motorcycle test items being based upon the critical tasks identified in a task analysis specifically for motorcycle operation. When Pollock and McDole developed their test item pool, a motorcycle task analysis had not been completed. Pollock and McDole did document their National Item Bank Tests of Driving Knowledge on the HumRRO Driver Education Task Analysis.[12] The HumRRO analysis, however, was primarily designed for use with motor vehicles and was relevant to the field of driver and traffic safety education.[13]

Second, the need to improve and update motorcycle operator licensing tests has become more critical with the increase in motorcycle operation and accidents. As a result, activity in this regard has become more prevalent. At the end of 1979, there were ten states, and several providencies of Canada involved in upgrading motorcycle operator licensing examinations with regards to knowledges and skills needed

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[11] W. T. Pollock and T. L. McDole, Development of a National Item Bank for Tests of Driving Knowledge, A report to the National Highway Traffic Safety Administration, Contract FH-11-7617, September, 1973.

[12] Ibid., p. 2.

[13] A. James McKnight, Driver Education Task Analysis, Vols. I-IV, Human Resources Research Organization, Final report on NHTSA Contract FH-11-7336, March, 1971.

for safe operations.[14] California is now in a federally funded demonstration project to evaluate the effectiveness of an improved licensing program to reduce motorcycle accidents and injuries.[15]

The staff of the Motorcycle Safety Foundation has helped nineteen states and two territories in the United States update their motorcycle licensing program by providing and adopting the Foundation's "Motorcycle Operator Manual."[16] These projects need a source document that is reliable and helpful in determining safe motorcycle operation.

Warren Quensel expressed the opinion that a task analysis is the "key" to the development of a valid instructional program.[17] An analysis of required tasks contributes to the development of instructional objectives for desired outcomes.[18] To evaluate the outcomes, an examination needs to be based upon the objectives indicated by the task analysis.

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[14]Motorcycle Safety Foundation, 1977 Annual Report (Linthicum, MD.: Motorcycles Safety Foundation, 1977).

[15]Ibid.

[16]Motorcycle Safety Foundation, On the Move, Vol. 6, No. 1 (Linthicum, MD.: Motorcycle Safety Foundation, January, 1980), p. 1.

[17]Warren P. Quensel, "Approaches to Traffic Safety Education Program Development," Journal of Traffic Safety Education (October, 1979), 6.

[18]Ibid.

There is reason to believe that there are applications of the study for state licensing agencies and instructional programs alike. Today, there is a task analysis available which will permit the identification and selection of content items that are vital to the successful operation of motorcycles.[19]

It must be noted, however, that the test items in this study are measuring only the necessary knowledge for on-the-roadway operations. There was no attempt to relate the test items to accidents and violations, but to make valid the critical task test items for motorcycle operation. Failure to comply with the necessary responses in a critical task may contribute to unwanted accidents. Pre-knowledge surely will help reduce or prevent the possibility of future accidents.

Procedures for the Study

The content areas used in writing the test items were selected from the Heywood and McKnight Motorcycle Task Analysis. Only those items receiving a critical index of "9" in overall criticality were used for the bases of the test items.[20] The overall criticality was determined by operator error probability, frequency of use, accident

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[19]Heywood and McKnight, Motorcycle Task Analysis, pp. 1-411.

[20]Ibid.

likelihood, and accident severity. A critical index of 1 to 9 was used and the high number indicated a high critical factor.

Test items from the Pollock and McDole National Item Bank of Driving Knowledge Tests were selected to cover the critical test items for motorcycle operators.[21] Additional test items were develop to cover adequately any task analysis content areas not selected from the National Item Bank Pool.

The item pool consisted of an evaluation of the items in the pool by prescreening, item analysis, pilot-testing, and pre-test item validation. Content validity was determined by having the test item pool evaluated by both Michigan Department of State personnel and ten motorcycle experts in the fields of motorcycling, education, administration, and licensing.

The data were collected by means of four separate tests given to motorcycle operators from the State of Michigan. The Michigan licenses examiners administered the voluntary test to the respondents, after their state licensing examination was completed. The completed tests were sent to the New Programs Division of the Secretary of State office in Michigan.

Definition of Terms

Behavior--Behavior refers to mental, emotional, and physical reactions.

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[21]Pollock and McDole, Development of a National Item Bank, pp. B5-53.

Critical Driver Tasks--The behavior in the task analysis was rated for its frequency, error probability, accident likelihood, and accident severity by ten experienced motorcycle operators.

Criticality Index Tasks--The criticality indexes ranged from 1 to 9 with only those tasks with this index 9 used as critical tasks for the study.[22]

Human Resources Research Organization--The Human Resources Research Organization (HumRRO) is a nonprofit behavioral research and development organization working to improve human behaviors in our society.

Knowledge Test or Examination--Generally a written evaluation covering the information in a state licensing manual on necessary motorcycle operator knowledge.

Licensing Agency--The state's governmental office that is empowered to test the knowledge and abilities of future and present motor-vehicle operators, and certify those individuals with some form of license that qualifies them to operate motor vehicles on the public highways in the state.

Motorcycle Safety Foundation--The Motorcycle Safety Foundation (MSF) is a national private, nonprofit organization whose goal is the reduction of motorcycle accidents and injuries.

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[22]Heywood and McKnight, Motorcycle Task Analysis, p. xv.

Reliability--Reliability is the consistency of the evaluation results.[23]

Task--Task "refers to a group of behaviors related to one another by having a common purpose or involving similar sets of behaviors."[24]

Tasks Analysis--Tasks analysis "describes the behaviors, knowledge, and skills required in the safe operation of motorcycles."[25]

Validity--Validity refers to how accurately a test measures what it is supposed to measure.[26]

Overview of the Study

Chapter II is a review of the research and other professional literature which pertains to the development of test items. The first section describes the research work done on motorcycle tasks analysis and knowledge test items. The final section discusses the procedures suggested for development of test items.

The research design and methodology of the study is presented in Chapter III. The major sections of this

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[23]Norman E. Gronlund, Measurement and Evaluation in Teaching, Third Edition (New York: Macmillan Publishing Co., 1976), p. 80.

[24]Heywood and McKnight, Motorcycle Task Analysis, p. xii.

[25]Ibid., p. xiii.

[26]Gronlund, Measurement and Evaluation in Teaching, p. 79.

chapter are the origin of test items, preparation of test items, data collection, and the analysis of the test models.

Chapter IV presents analysis of the data from the study. The chapter is divided into three sections: pertinent information about the respondents, descriptive analysis of the test items, and a statistical analysis of the relationships.

In Chapter V is found the summary of the study, conclusions, recommendations, recommendations for further research, and a discussion.

CHAPTER II

REVIEW OF LITERATURE

An extensive search of the literature was conducted to produce information related to the tasks involved in safe motorcycle operation, and the development of motorcycle knowledge tests. The first section of this chapter presents the literature pertinent to the practice and procedures employed in the development of motorcycle tasks and evaluations. The second section is devoted to the development procedures for test item construction.

Motorcycle Tasks and Tests

Since the Motorcycle Safety/Highway Safety Program Standard was issued in 1967, there has been a steady trend to require a special motorcycle operator's license or endorsement in the states. A survey conducted by the Motorcycle Safety Foundation, with endorsement by the American Association of Motor Vehicle Administrators, requested from the states and the District of Columbia detailed information concerning the licensing procedures for motorcycle operators. Results of the survey revealed that thirty-eight states had

a special written knowledge examination.[27] There were forty-five states and the District of Columbia which required a separate motorcycle license or endorsement.[28] Only states of Arkansas, Idaho, Indiana, Mississippi, and West Virginia did not require a special license for motorcycle operation in their state.[29]

The State of Texas conducted a study of its motorcycle licensing program which included a revision of its knowledge tests.[30] In 1977, the Motorcycle Safety Foundation assisted several states in providing workshops for licensing supervisors and helped in the review of state knowledge tests. Five states--Wyoming, Virginia, Pennsylvania, Illinois, and Louisiana--held licensing workshops with the Motorcycle Safety Foundation. During the same year, the Foundation assisted the Canada Ministry of Transportation in that country's licensing improvement project. The State of Tennessee adopted the model motorcycle manual and knowledge test developed by the Foundation in 1977. California was in the process of evaluating the federally funded

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[27]L. B. G. Nathan and P. F. Waller, State Procedures for the Licensing of Motorcycle Operators, A survey conducted as a contract for the Motorcycle Safety Foundation (Chapel Hill, N.C.: University of North Carolina, Highway Safety Research Center, June, 1974), p. 1.

[28]American Automobile Association, Digest of Motor Laws, pp. 1-213.

[29]Ibid., pp. 14, 52, 61, 104, 205.

[30]Locke, Motorcycle Operator Licensing, p. 1.

"motorcycle licensing improvement project" for effectiveness in the reduction of motorcycle accidents and injuries.[31]

The first step in developing a motorcycle knowledge test is to determine the necessary tasks involved in motorcycle operations. McDole and Berger developed the first set of riding task items for motorcycle operation in 1971.[32] The Item Writers' Guide was developed to assist in the identification of motorcycle riding tasks, and to be used as a source document for developing motorcycle examinations. The McDole and Berger task development was an extension of the "HumRRO Driver Education Task Analysis" completed by A. J. McKnight in August of 1970.

The HumRRO Task Analysis was the most extensive item bank used for upgrading driver licensing examinations for motor vehicle operations.[33] The Guide presented only those tasks in operating a motorcycle for on-road and off-road behaviors. The rider behaviors included the following tasks:

1. Basic Control Tasks
2. General Driving Tasks
3. Tasks Related To Traffic Conditions
4. Tasks Related To Roadway Characteristics
5. Tasks Related To the Environment

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[31]Motorcycle Safety Foundation, pp. 5-11.

[32]McDole and Berger, Item Writer's Guide For Motorcycle Riding, pp. 1-88.

[33]McKnight, Driver Education Task Analysis, Vol. 1.

6. Tasks Related To the Motorcycle
7. Pre-Trip Tasks
8. Maintenance
9. Legal Responsibilities[34]

Forbes indicated in his book on human factors that the driving task analysis by McKnight was a systematic search of the literature on driving behaviors organized in a formal scheme that provided trainable driver tasks in motor vehicle operation. The procedure was capable of ordering information for driving behavior and conditions that influenced behavior to develop the necessary objectives for test item construction.[35]

These tasks and others prior to 1974 were founded on some form of motor vehicle task analysis, but not on tasks necessarily in motorcycle operation. The Motorcycle Task Analysis conducted by Blair Heywood and James McKnight was the first to deal with the special tasks in motorcycle ridding. This study described the needed behaviors, knowledge, and skills in safe motorcycle operation. The content areas included in the tasks analysis were as follows:

1. Basic Control
2. Roadway Characteristics
3. Traffic Characteristics
4. Environmental Characteristics

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[34]McDole and Berger, Item Writer's Guide For Motorcycle Riding, pp. 1-88.

[35]T. W. Forbes, Human Factors In Highway Traffic Safety Research (New York: Wiley-Interscience, a Division of John Wiley & Sons, Inc., 1972), p. 266.

5. Off-Road Characteristics
6. Operator Characteristics
7. Motorcycle Characteristics
8. Passenger and Cargo Characteristics[36]

The first research in the area of motorcycle test items was conducted by the Motorcycle Industry Council which recommended questions for a motorcycle driver license examination. This report was prepared for the American Association of Motor Vehicle Administrators.[37] The study by Malany presented one of the first comprehensive programs for motorcycle driver's licensing and was a model for knowledge examinations.[38]

A test item evaluation by McDole produced two paralled test forms that measured the on-the-road knowledge of motorcycle operators. The McDole study recommended the following content areas for a motorcycle knowledge test pool:

1. Pre-operative Procedures
2. Basic Knowledge
3. Driving Situations
4. Vehicle and Driver
5. Vehicle Code--Laws and Regulations[39]

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[36]Heywood and McKnight, Motorcycle Task Analysis, pp. v-ix.

[37]American Association of Motor Vehicle Administrators, Suggested Questions for Motorcycle Licensing, p. 24.

[38]LeGrand L. Malany, A Report Developing a Comprehensive State Program of Motorcycle Driver's Licensing, No. 3 Highway Traffic Safety Center, 1969.

[39]Thomas L. McDole, "Development of a General Knowledge Test For Use In Motorcycle Operator Education and Evaluation Programs" (a Doctoral Dissertation, College of Education, Michigan State University, East Lansing, Michigan, 1973), p. 174.

Pollock and McDole developed a "National Item Bank" for knowledge test in 1973 which also included an item pool of questions related to motorcycle operation. Their report suggested that the content of a knowledge test should cover the following driving topics:

1. Pre-operation Procedures
2. Basic Control Procedures
3. Basic Maneuvers
4. Road and Weather Conditions
5. Emergencies
6. Driving Situations
7. Driver and Vehicle Conditions
8. Legal Requirements[40]

Test Construction

The first step in developing an evaluation tool is to determine the necessary outcomes to be expected of the respondents. These outcomes are determined by the kind of knowledge, understanding, and attitudes the individual should possess. The specific objectives should be stated in clear terms for a particular behavior desired of the respondent.[41]

Beggs and Lewis described in their book, Measurement and Evaluation In the Schools, the procedure for developing tests. The first process is the development of appropriate content areas to be covered and the nature of the group to

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[40]Pollock and McDole, Development of a National Item Bank, p. 7.

[41]Norman E. Gronlund, Measurement and Evaluation In Teaching, Third Edition (New York: Macmillan Publishing Co., Inc., 1976), p. 7.

whom the test is to be administered. The content needs to be assessed and weighted according to the cognitive domain levels of knowledge, comprehension, application, analysis, synthesis, and evaluation.[42]

To establish the needed behavioral objectives, one must analyze the nature of the tasks specific to the outcomes of the evaluation. The types of outcomes should be identified by a small number of topics or headings. Gronlund suggested the following categories as possible topic areas:

1. Knowledge--terminology, specific facts, concepts principles, methods, and procedures
2. Understanding--written materials and problem situations
3. Application--of factual information and problem solving skills
4. Thinking skills--critical and scientific
5. General skills--laboratory, performance, communication, computational and social
6. Attitudes--social and scientific
7. Interest--personal, educational and vocational
8. Appreciations--social and scientific
9. Adjustments--social and emotional[43]

To prepare a valid and useful test, Gronlund recommended that a series of basic steps be followed:

1. Determine the purpose
2. Construct a table of specifications
3. Select the item types
4. Prepare a set of test items
5. Assemble the test
6. Administration of the test

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[42]Donald L. Beggs and Ernest L. Lewis, Measurement and Evaluation In the Schools (Boston, Mass.: Houghton Mifflin Co., 1975), pp. 103-04.

[43]Gronlund, Measurement and Evaluation In Teaching, pp. 29, 37.

7. Analysis of the test
8. Results of the test project.[44]

Micheels and Karnes provided a list of necessary steps for building a test successfully which included:

1. Major objectives of course content--list, examine, analyze, and define according to expected outcomes
2. Develop a table of specifications
3. Construct test items based on objectives
4. Assemble items in test
5. Develop directions for test administration
6. Have experts analyze the test
7. Administer test to a group of subjects, and re-analyze the test and make necessary revisions as needed.[45]

A list of learning tasks specific to the behaviors are the basis for the content to be covered in a test. A representative sample of the tasks can be obtained by constructing four or five items for each task. However, if the domain of tasks is very limited, a table of specifications might not be necessary.[46]

A simple test of all the specific tasks and objectives within the behaviors will provide a table of specifications. The Beggs and Lewis, and Gronlund references in measurement and evaluation recommended similar formats in

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[44]Ibid., p. 136.

[45]W. J. Micheels and M. R. Karnes, Measuring Educational Achievement (New York: Macmillan Publishing Co., Inc., 1958), pp. 126-29.

[46]Gronlund, Measurement and Evaluation In Teaching, pp. 144-46.

generating a table of specifications represented in Figure 1.[47,48]

There were general agreement that objective test items present the pupil with a highly structured task that also limits the kind of responses they can make. The respondent must demonstrate the specific knowledge, understanding, and/or skills tested in each item. The multiple-choice form was recognized as the most widely applicable and useful type of objectives test item. It can measure both the simple and more complex learning outcomes and was especially useful for measuring outcomes that require the understanding, application, or interpretation of factual information.[49]

The basic learning outcomes measured by multiple-choice items from simple to complex was presented by Gronlund in Measurement and Evaluation In Teaching. He recommended that the items:

1. Cover knowledge of terminology
2. Cover knowledge of specific facts
3. Cover knowledge of principles
4. Cover knowledge of methods and procedures
5. Identify the correct application in a situation
6. Interpret various relationships between facts
7. Justify the use of a particular method of procedure.[50]

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[47]Beggs and Lewis, Measurement and Evaluation In the Schools, p. 104.

[48]Gronlund, Measurement and Evaluation In Teaching, p. 143.

[49]Ibid., pp. 188-90.

[50]Ibid., pp. 191-95.

Content Area	Tasks or Objectives			
Knowledge				
Understanding				
Skills				
Application				
Attitudes				
Appreciations				

Figure 1. Table of Specifications.

It was recommended by Beggs and Lewis that the construction of test items be assessed from the specialist point of view and possess content validity.[51]

There were several characteristics for good test construction recommended by experts in the area of measurement and evaluation. Berger summarized these characteristics in a federally funded project in 1971. The characteristics of a good test are that the test is reliable and valid and the test starts with good test items.[52]

There are three basic types of validity commonly used in measurement. Gronlund identified these as content validity, criterion-related validity, and construct validity. Gronlund defined them as follows:

1. Content validity--how well the test measures the subject matter content and behaviors under consideration.
2. Criterion--related validity--how well test performance predicts future performance or estimates current performance on some valued measure other than the test itself.
3. Construct validity--how test performance can be described psychologically.[53]

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[51]Beggs and Lewis, Measurement and Evaluation In the Schools, p. 104.

[52]G. W. Berger, Understanding Test Construction: The Design of License Knowledge Tests (Ann Arbor, Mich.: The Highway Safety Research Institute, prepared for inclusion in A Handbook for Driver Licensing Knowledge Testing, Under Contract PH-11-7616 for National Highway Safety Administration, U.S. Department of Transportation, 1971), p. 2.

[53]Gronlund, Measurement and Evaluation In Teaching, pp. 81-96.

The most important item to consider in constructing tests is validity. Validity refers to the extent the evaluation results serve its particular purpose.[54]

The next consideration should be the importance of reliability in the evaluation tool. The reliability of a test measurement refers to the consistency of the evaluation results. Test reliability is necessary, but not sufficient enough, for validity. The reliability simply provides the consistency necessary for possible validity.[55]

Usability of testing instruments is also an important consideration and should not be overlooked when constructing tests. The test developer needs to consider the cost of implementing the test, but this should be a minor consideration. More important than cost is the validity and reliability characteristics. One of the major considerations in the usability of a test is the ease of administration. The directions should be simple and clear so it can be administered by people with limited amounts of training. The length of time required for the test should be as short as possible. Gronlund further indicated that to be valid and reliable, a test should fall somewhere between 20 and 60 minutes.[56]

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[54]Ibid., p. 102.

[55]Ibid., pp. 105-07.

[56]Ibid., pp. 125-28.

Summary

This chapter included two sections. Section one was devoted to literature pertinent to motorcycle examinations and practices and procedures used in the development of motorcycle evaluations and tasks. The second section discussed the development procedures used for test construction.

The literature reviewed indicated that, prior to 1974, a motorcycle task analysis was not available and that source documents used for motorcycle examinations were primarily established from motor vehicle analysis. There was also a determination that a test construction procedure was a primary consideration for good tests; and a continuous evaluation process is required as indicated by the measurement and evaluation authorities. The two main considerations in the development of good tests were validity and reliability. To accomplish the needed validity and reliability, one must determine the content and specific tasks to be evaluated.

CHAPTER III

METHODOLOGY OF THE STUDY

Presented in this chapter of the study are the procedures employed and steps taken to develop motorcycle operator knowledge test items. The major sections include the origin of the test items, preparation of test items, data collection procedures, and data analysis methods.

Origin of Test Items

The content areas used to write the study test items were selected from the Heywood and McKnight Motorcycle Task Analysis prepared for the Motorcycle Safety Foundation. Heywood and McKnight used four critical factors to develop an index of criticality for a particular behavior in safe motorcycle operation. The operator behaviors (critical factors) were rated according to frequency, error probability, accident likelihood, and accident severity. The overall criticality was then determined by a critical index of 1 to 9 with the high number indicating a high critical behavioral factor.[57] Only those behaviors with an index of 9 were used in developing the test items for this study.

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[57]Heywood and McKnight, Motorcycle Task Analysis, pp. xiv-xvi.

Development of Source Document

The basic source documents used in developing the content of the Motorcycle Task Analysis were motorcycle publications such as textbooks, lesson plans, technical reports, periodicals, interviews, audio-visual material, and operator observations involving photographic analysis. McDole's and Berger's "Item Guide" was used as a foundation source for the motorcycle tasks analysis.[58] Other source documents, Thomas McDole dissertation, state examinations, Motorcycle Safety Foundation materials, and The Pollock and McDole Item Bank Pool, were used to generate test items for the study.

Content Areas and Behaviors

The content areas of the study were based on the Motorcycle Task Analysis critical indices with a value of 9. A table of specifications was constructed to indicate the learning tasks necessary for safe motorcycle operation behaviors as shown in Figure 2. The major areas of content with an index of 9 is shown on the left side of the figure and indicates the proportion of the test items that should be devoted to each of the behaviors. A test of general behaviors are across the top of the figure showing the knowledge and skills required for safe motorcycle operation.

The weighing of knowledge and skills made it possible to construct test items which measured a representative

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[58]Ibid., p. ii.

Content / Behaviors	Knows Procedures	Identification	Knows Characteristics of operator, vehicle, and environment	Knows concepts of operation	Perceptual skills	Manipulation skills	TOTAL
Basic Control	10	3	0	2	5	10	30
Roadway Characteristics	5	3	0	2	13	0	23
Traffic Characteristics	2	5	0	15	10	1	33
Environmental Characteristics	0	0	0	3	2	0	5
Operator Characteristics	0	0	9	0	0	0	9
Total	17	11	9	22	30	11	100

Figure 2. Table of Specifications for Motorcycle Critical Tasks (Percentages).

sample of the intended outcomes. The figure provided some assurance that the tasks would receive the necessary emphasis in the test. A representative sample of tasks could be obtained by constructing four or five items per task. This was accomplished by providing one item for each task in each of the four tests in the study.

Preparation of Test Items

The first procedure used in test item development was the selection of item format. The multiple-choice form was used to measure the outcomes of knowledge and skills as suggested by Gronlund.[59] The multiple-choice item can measure both simple and complex outcome of knowledge, understanding, and application tasks.

Test items from the Pollock and McDole National Item Bank were selected to cover the critical test items for motorcycle operators. Additional test items were developed to adequately cover any task analysis content areas not selected from the National Item Bank Pool, Thomas McDole Dissertation, and state motorcycle examinations.

The evaluation of items in the original item pool consisted of item analysis and pre-test item evaluation. The evaluations produced ninety-five items that covered the critical tasks for safe motorcycle operation. The content areas and number of items for each major task were:

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[59]Gronlund, Measurement and Evaluation In Teaching, p. 188.

		Number of Items
1.	Basic control tasks	30
2.	Tasks related to roadway characteristics	20
3.	Tasks related to traffic conditions	25
4.	Tasks related to the environment	10
5.	Tasks related to the operator	10

The test responses were scored and analyzed to identify any "poor" items. A "poor" item was identified by the criteria of item difficulty less than .20 and correlation of respondents less than .50. The criteria was applied to the test items and those that passed were included in the final test item pool. The final test pool consisted of eighty items for this study evaluation.

Evaluation of Item Content Validity

A group of motorcycle experts was used to determine if the items covered the critical task items in the Heywood and McKnight Task Analysis for motorcycle knowledge, skill, and application. Ten individuals identified with motorcycle licensing, instruction, programming, and operation reviewed the ninety-five items. These expert reviewers were used to modify the test items for the final pool (see Appendix A). After the modifications were completed, four tests with twenty items each were formulated for the testing.

Data Collection

One of the four final tests were given to 322 Michigan motorcycle operators after they had passed the Michigan Knowledge Test at one of the ten state branch

offices. These ten offices were selected from the 201 branch offices within the state on the basis that they had a high volume of motorcycle license applicants. Six branch offices were from region four, and the remaining four offices were from region five (see Appendix B).

The Michigan Secretary of State Office is assigned the responsibility of testing the knowledge and abilities of future and present motorcycle operators, and certify those individuals with some form of license that qualifies motor vehicle operators for the State of Michigan. Permission for the testing was obtained from Mr. Michael Rudisill, supervisor of New Programs Division, Bureau of Field Services, Department of State. Mr. Rudisill and his supervisors agreed to test the Michigan motorcycle operators at the selected branch offices.

The testing was conducted by branch examinors on consecutive office work days during the business years 1980 through 1981. The respondents were original or renewal motorcycle license applicants who passed the tests for a motorcycle license in Michigan during the study time period at the selected offices.

Data Analysis

Percentages and frequency distributions were utilized to show the responses regarding the variables of sex, age, and riding experience. Frequency distributions were developed on the individual responses for the eighty test items. A discrimination of powers test was conducted

comparing the means of the top one-fourth to the means of the bottom one-fourth to show the difference in mean scores. A factor analysis was used to establish which questions clustered together to form common factors. Tables were developed to illustrate the degree of relationships in the study.

The major sections presented in this chapter included the origins of test items, preparation of items, data collection procedures, and the data analysis methods used in developing the motorcycle operator knowledge test item pool.

The presentation and analysis of the data is found in Chapter IV.

CHAPTER IV

ANALYSIS OF THE DATA

In the preceding chapter, the design and methodology of the study was presented. In this chapter, the analysis of data may be found. The chapter is divided into three sections: pertinent information about the respondents, descriptive analysis of the test items, and a statistical analysis of the relationships.

Pertinent Information About the Respondent

This section presents information on the following characteristics of the respondents in the study groups:

1. Ages of the respondents in the study test groups.
2. Ratio of females and males in the study test groups.
3. Years of riding experience prior to taking the examination.

Four different tests were administered to Michigan motorcycle operators during the test period 1980-81. The total number of respondents was 322 including 107 with test A, 96 with test B, 65 with test C, and 54 with test D.

Age

The age range in test group A was 16 to 61 years of age. Test respondents in group B had a range in age from

17 years to 70, and test group C ranged from 16 to 60 years. Finally, Test D had a range in age from 17 to 49 years during the test period.

The data related to the number and percent of respondents in the test groups regarding age are presented in Table 1.

Sex

Test group A had a total of 107 respondents of which 87 percent were males, 6.5 percent females, and 6.5 percent did not respond to the sex factor.

It was revealed from the data that 80.2 percent of the subjects were male, 10.4 percent female, and 9.4 percent had no response in test group B of the study.

Eighty-one and six tenths percent of the subjects were male, 9.2 percent female, and 9.2 percent had no response in test group C.

The participants responding for test D reported that 92.5 percent were males, 5.6 percent females, and only 1.9 percent failed to respond to their sex.

The data concerning the sex of the motorcycle operators in the test groups are presented in Table 2.

Riding Experience

The data on the number of years motorcycle riding experience prior to taking the test are presented in this section.

Table 1.--Frequency Distribution of Subjects' Age.

Age In Years Response	Number from Samples*				Percent from Samples*			
	A	B	C	D	A	B	C	D
16-25	37	27	25	23	35	28	39	43
26-35	33	32	21	20	31	33	32	37
36-+	28	26	13	10	26	27	20	18
Other	9	11	6	1	8	12	9	2
TOTAL	107	96	65	54	100	100	100	100

* A-test A $\bar{X}$= 31.122 SD= 9.828 N= 98 , B-test B $\bar{X}$= 32.518 SD= 11.250 N= 85 , C-test C $\bar{X}$= 30.085 SD= 9.893 N= 59 , D-test D $\bar{X}$= 29.623 SD= 8.856 N= 53

Table 2.--Frequency Distribution of Subjects' Sex.

Sex Response	Number from Samples*				Percent from Samples*			
	A	B	C	D	A	B	C	D
Male	93	77	53	50	87	80.2	81.6	92.5
Female	7	10	6	3	6.5	10.4	9.2	5.6
Other	7	9	6	1	6.5	9.4	9.2	1.9
TOTAL	107	96	65	54	100	100	100	100

* A-test A $\bar{X}$= 1.070 SD= .256 N= 100 , B-test B $\bar{X}$= 1.115 SD= .321 N= 87 , C-test C $\bar{X}$= 1.102 SD= .305 N= 59 , D-test D $\bar{X}$= 1.057 SD= .233 N= 53

Test group A had 28 percent of the respondents with riding experience for three years or less, 29 percent had 4 to 9 years, and 33 percent had ridden for 10 years or more prior to taking the test.

Twenty-two percent of the respondents in test group B had 3 or less years experience, 24 percent had 4 to 9 years, and 32 percent had 10 or more years motorcycle riding experience.

The subjects in test C reported that only 19 percent had 3 years or less, 32 percent had 4 to 9 years, and 34 percent had 10 years or more experience prior to the examination.

The data revealed that 24 percent of the respondents had 3 years or less, 20 percent 4 to 9 years, and 43 percent had 10 or more years experience in test group D of the study.

A frequency distribution of the subjects' motorcycle riding experience in years is presented in Table 4.

Analysis of the Tests Items

This section presents the data analysis of the tests items. The test's item pool was arranged according to motorcycle operator tasks. The five critical tasks covered: (1) basic control tasks; (2) tasks related to roadway characteristics; (3) tasks related to traffic condition; (4) tasks related to the environment; and (5) tasks related to the operator.

The questions and correct answers are shown in the item index with associated statistics. Included in the statistics, is a frequency distributor, discriminating

Table 3.--Frequency Distribution of Subjects' Riding Experience.

Riding Experience Years	Number from Samples*				Percent from Samples*			
	A	B	C	D	A	B	C	D
1-3	30	21	12	13	28	22	19	24
4-9	31	23	21	11	29	24	32	20
10-+	35	31	22	23	33	32	34	43
Other	11	21	10	7	10	22	15	13
Total	107	96	65	54	100	100	100	100

* A= test A $\bar{X}$= 7.813 SD= 6.923 N= 96 , B= test B $\bar{X}$= 9.040 SD= 8.890 N= 75 , C= test C $\bar{X}$= 8.236 SD= 6.357 N= 55 , D= test D $\bar{X}$= 9.021 SD= 6.949 N= 47

powers, and the standard deviation for those items with a descriminate power over .20 as shown in Table 4.

Statistical Analysis

The statistical analysis of the relationships are presented in this section. All the test items with a discriminating power over .20 were given the factor analysis. The test items with a varimax rotated factor analysis of .40 or greater were then analyzed to identify interrelationships of the variables.

The rotated factor analysis of the test items did not indicate a clear pattern with regard to the different motorcycle tasks, but did identify all five tasks in the analysis. The tasks related to the environment were a weak

Table 4.--Final Test Item Pool.

Test-Item[a]	I. Basic Control Tasks A. Pre-Operative Procedures B. Preparing the Motorcycle for Riding	Freq. Dist.	Disc. Powers	SD[b]
A-1	Before mouting your motorcycle you should:		.43	.41
	a. Adjust the mirrors	2		
	b. Set the gear shift lever to neutral	15		
	c. Return the kickstand lever to storage	5		
	*d. Visually check the tires	85		
B-1	The condition of the tires should be checked for excessive wear or damage:		.30	.46
	a. Once a day	8		
	b. Every week	11		
	c. Once a month	9		
	*d. Before mounting your motorcycle	68		
C-1	In a pre-ride inspection you should:		.13	
	*a. Inspect the tires for wear or damage	30		
	b. Adjust the brake tension	3		
	c. Replace the spark plugs	0		
	d. Adjust the mirrors	32		
D-1	When performing the pre-ride inspection, you should:		.21	.54
	a. Check windshield and lights	8		
	*b. Inspect tires for wear or damage	23		
	c. Check signals	20		
	d. Remove motorcycle from sidestand	2		
	B. <u>Preparing the motorcycle for riding</u>			
A-2	After mounting the motorcycle, you should:		.35	.36
	a. Move the parking stand to the "Park" position	3		
	b. Push the motorcycle out into an open area before starting it	10		
	*c. Adjust the mirror(s) for a clear view of the road	93		
	d. Check the chain and cables for proper tension and lubrication	1		

Table 4.--continued.

Test-Item[a]	I. Basic Control Tasks B. Preparing the Motorcycle for Riding C. Maintaining Balance	Freq. Dist.	Disc. Powers	SD[b]
B-2	The following should be checked before you ride:		.19	
	*a. The headlights are on and working correctly	83		
	b. Depth of the tire tread	4		
	c. Clutch cable for proper tension	3		
	d. The gear selector lever is in park	6		
C-2	When riding an unfamiliar motorcycle you should:		.08	
	a. Check the gearshift pattern	6		
	b. Check the clutch friction point	2		
	*c. Know and practice with the motorcycle controls	55		
	d. Drive at low speeds and in first gear	1		
	C. Maintaining Balance			
A-3	For good steering control you should:		.002	
	*a. Grasp the handlebars firmsly	99		
	b. Lean heavily into the handlebars	0		
	c. Steer mostly by shifting your weight up and down	5		
	d. Hold loosely onto the ends of the handgrips	3		
B-3	To steer the motorcycle you should:		.22	.45
	a. Shift your weight to the right when making a left turn	15		
	*b. Make small steering corrections by putting pressure on the handlebars	70		
	c. Turn the handlebars more sharply the faster you are going	1		
	d. Hold the handlebars loosely at all times	10		
C-3	If your motorcycle begins to lean excessively when turning left, you should:		.65	.53
	*a. Apply pressure to handgrips to turn front wheel further in the direction of the turn	25		
	b. Turn the handlebars sharply to the right	10		
	c. Shift your weight to the left	15		
	d. Apply rear brake to straighten out	14		

Table 4.--continued.

Test-Item[a]	I. Basic Control Tasks C. Maintaining Balance D. When Changing Direction	Freq. Dist.	Disc. Powers	SD[b]
D-2	When making a gradual turn, you should:		.20	.32
	a. Turn the handlebars quickly	1		
	*b. Turn by leaning	48		
	c. Turn the handlebars quickly and lean	0		
	d. Lean the cycle more than your body	5		
	D. When Changing Direction			
A-4	Before changing directions, you should: (change of lanes, passing, etc.)		.04	
	a. Stop the motorcycle in your lane	0		
	*b. Signal in advance of the turn	106		
	c. Reduce speed	0		
	d. Lean into the direction of the turn	1		
B-4	The first thing to do before changing lanes is:		.48	.50
	a. Signal with your lights and hand	53		
	b. Slow down	0		
	*c. Check your mirrors and look over your shoulder	42		
	d. Move closer to the lane you want to be in	1		
C-4	When deciding to pass on a 2-lane road, it is most important to:		.07	
	*a. Focus your vision on the intended path of travel	50		
	b. Know the number of vehicles behind you	3		
	c. Know the type of vehicle you are passing	5		
	d. Know the amount of air pressure from vehicles like trucks	7		
C-6	When making a rapid stop you should apply:		.43	.49
	*a. The rear brake firmly and then the front brake just short of sliding the front wheel	26		
	b. The rear brake and then the front brake firmly and increase pressure on both	23		
	c. The rear brake firmly then downshift and avoid using the front brake	6		
	d. The rear brake gently then press the clutch lever and apply the front brake	10		

Table 4.--continued.

Test-Item[a]	I. Basic Control Tasks E. Reducing speed F. Skid Recovery	Freq. Dist.	Disc. Powers	SD[b]
	E. Reducing Speed			
A-5	If making an emergency stop on a dry road, you should apply the:		.008	
	a. Front brake only	0		
	b. Rear brake only	10		
	*c. Front and rear brakes together	93		
	d. Front brake and then rear brake	4		
B-5	When making an emergency stop on a slippery road or on loose gravel, you should:		.33	.49
	*a. Apply the rear brake only	36		
	b. Use the front and rear brakes together	41		
	c. Apply the front brake when the rear wheel begins to slide	9		
	d. Use the throttle and clutch and avoid using the brake	10		
C-5	When coming to an area where loose sand covers the roadway surface, you should:		.08	
	*a. Slow down before reaching the area	62		
	b. Slow down in the area	1		
	c. Maintain speed in the area	2		
	d. Raise up on the footpegs before reaching the area	0		
D-3	When reducing speed, you should:		.09	
	*a. Observe road surfaces ahead	13		
	b. Focus eyes directly ahead at all times	0		
	c. Move eyes more frequently from side to side	3		
	d. Check mirrors for following vehicles	38		
	F. Skid Recovery			
A-6	If your rear wheel has skidded out-of-line when making a rapid stop, you should:		.32	.41
	a. Apply more pressure on the front brake and less on the rear brake	50		
	b. Release both brakes and press the clutch lever	29		
	c. Open the throttle, release both brakes and lean	5		
	*d. Maintain rear brake pressure	23		

Table 4.--continued.

Test-Item[a]	I. Basic Control Tasks F. Skid Recovery II. Tasks Related to Roadway Characteristics A. Roadway Vision B. Intersections	Freq. Dist.	Disc. Powers	SD[b]
B-6	When your rear wheel begins to skid, you should:		.30	.50
	*a. Maintain or reduce the power to the rear wheel	50		
	b. Put feet on the footpegs	0		
	c. Pump the front brake	14		
	d. Hold the front wheel as straight as possible	32		
	A. Roadway Vision			
A-8	When riding you should continually:		.43	.38
	*a. Check areas on and off roadway, well ahead, to the sides, and behind	88		
	b. Check the speedometer	2		
	c. Check pavement markings and signs	3		
	d. Shift your eyes every 10 seconds	14		
B-7	If you have to change speed or direction because of something in the roadway, you should:		.48	.46
	a. Press in the clutch lever	1		
	*b. Check for vehicles behind and around you	68		
	c. Apply both brakes lightly and signal	27		
	d. Take both feet off the footpegs for balance	0		
C-7	When driving a motorcycle rather than a car, it is more important to:		.57	.50
	a. Know the rules of the road	6		
	b. Keep a safe following distance	27		
	*c. Watch for objects on the roadway	32		
	d. Adjust the mirror(s) carefully	0		
	B. Intersections			
A-9	When approaching an intersection it is most important to:		.38	.53
	a. Stay in the right lane	29		
	b. Watch for traffic making right turns	11		
	c. Watch for large puddles on the road	7		
	*d. Watch for traffic making left turns	58		

Table 4.--continued.

Test-Item[a]	II. Tasks Related to Roadway Characteristics B. Intersections	Freq. Dist.	Disc. Powers	SD[b]
B-8	When driving your motorcycle near an intersection, you should:		.00	
	a. Keep in the left lane	2		
	*b. Pay more attention to the traffic and roadway ahead	93		
	c. Speed up to get away from the intersection quickly	1		
	d. Brake hard when stopping to avoid a loss of traction	0		
C-8	When on a main road at an intersection and a vehicle is approaching from the left, you should:		.35	.35
	a. Stop; he always has the right-of-way	5		
	b. Speed up to make sure he knows you're there	0		
	*c. Yield if he does not slow down	56		
	d. Slow down immediately and blow your horn	4		
D-4	If you are going straight through the intersection and see a vehicle to your left:		0	
	a. Drive partially into the intersection	0		
	*b. Prepare to yield right-of-way	54		
	c. Speed up to get through the intersection before the other vehicle	0		
	d. Pull off the road until the vehicle gets through the intersections	0		
D-19	When riding a motorcycle near intersections, you should:		.07	
	a. Not pace your speed to the traffic lights	2		
	b. Change your speed every few moments so as not to stall	0		
	*c. Stay in the lane which offers the best movement and vision	52		
	d. Take advantage of your motorcycle and weave in and out of traffic	0		

Table 4.--continued.

Test-Item[a]	II. Tasks Related to Borad Characteristics C. Lane Selection D. Special Areas	Freq. Dist.	Disc. Powers	SD[b]
	C. Lane Selection			
A-10	When you pass oncoming traffic on a 2-lane road, you should:		.32	.49
	a. Keep your eyes focused straight ahead	31		
	b. Trn on the lights and blow the horn	9		
	*c. Prepare to move to the right side of your lane	66		
	d. Steer in a zig-zag fashion	4		
B-9	When driving on the right-hand lane on a 4-lane road, you should usually ride:		.45	.49
	a. In the center of the lane	38		
	*b. In the left wheel track	57		
	c. On the line dividing the lanes	1		
	d. In a slight zig-zag pattern	0		
C-9	When you approach a long line of oncoming vehicles, you should:		.18	
	*a. Move to the right side of your lane	32		
	b. Stay in the left part of the lane	33		
	c. Flash your lights and slow down	0		
	d. Drive in a zig-zag manner to attract attention	0		
D-5	When you drive into the left lane of a 4-lane highway to pass another vehicle, you should:		.24	.50
	a. Drive in the right wheel track	16		
	b. Stay in the center of the lane	16		
	*c. Drive near the left wheel track	22		
	d. Drive in a zig-zag manner	0		
	D. Special Areas			
A-11	When on a right-hand entrance to a freeway, you should:		.27	.34
	*a. Look back over your left shoulder and into the left rear view mirror	93		
	b. Only look straight ahead at the roadway	1		
	c. Not speed up until you are on the main road	5		
	d. Assume the right-of-way when merging with freeway traffic	8		

Table 4.--continued.

Test-Item[a]	II. Tasks Related to Roadway Characteristics D. Special Areas III. Tasks Related to Traffic Conditions A. Following	Freq. Dist.	Disc. Powers	SD[b]
B-10	When entering the roadway, you should:		.33	.39
	*a. Check roadway to the left and right	78		
	b. Push the motorcycle forwards with both feet	0		
	c. Cancel turn signal	0		
	d. Turn into the nearest lane	18		
C-10	When turning left onto a two-way street, you should:		.44	.53
	*a. Go straight across roadway and turn left upon reaching the nearest left lane	32		
	b. Turn left into the first lane	9		
	c. Start your left turn half-way in the first lane	11		
	d. Lean your motorcycle to the left a little	12		
D-6	When crossing a two-way street, you should:		.33	.39
	*a. Look to the left then right and finally left	44		
	b. Look first in the direction from which traffic is coming			
	c. Look at the direction you intend to go before entering the intersection	1		
	d. Stop before going through the intersection	4		
	A. Following			
A-12	To maintain an adequate following distance, you should:		.29	.38
	a. Follow one car length for every 10 mph you are going	86		
	*b. Follow at least two seconds behind the vehicle ahead of you	18		
	c. Reduce speed 5-10 mph less then the vehicle ahead of you	2		
	d. Use only the rear brake to slow	1		
B-11	Generally your following speed should be determined by:		.26	.32
	a. The speed of the fastest vehicle on the road	0		
	*b. The speed of the vehicle ahead of you	85		
	c. The speed of the vehicle behind you	2		
	d. The power of your engine	9		

Table 4.--continued.

Test-a Item	III. Tasks Related to Traffic Conditions B. Following C. Passing or Changes Lane	Freq. Dist.	Disc. Powers	SD[b]
C-11	If the vehicle in front of you suddenly stops, the safest thing to do is:		.70	.48
	a. Slide your motorcycle to a stop and jump off	0		
	*b. Slow down and take evasive action	42		
	c. Brake hard and try to stay behind the vehicle	20		
	d. Continue at the speed and try to drive around the vehicle	3		
D-7	When the vehicle ahead of you indicates he is going to turn, you should first:		.29	.42
	a. Slow down and steer around him	13		
	b. Stop until he is completely finished	28		
	*c. Look to see if his turn can be made safely	12		
	d. Speed up to pass him as soon as possible	1		
	B. Passing or Changes Lane			
A-13	If you are being passed you should:		.26	.44
	a. Move to the right	76		
	b. Increase your speed slightly	0		
	c. Signal the other driver when it is safe for them to pass	12		
	*d. Look over your shoulder to check the vehicle that is passing you	17		
B-12	When being passed you should move to the right:		.52	.50
	*a. When being crowded by the passing vehicle	46		
	b. Whenever it is possible to do so	45		
	c. Only on undivided roads	2		
	d. Only if you are going below the speed limit	3		
C-12	When passing another vehicle you should:		.52	.48
	a. Drive alongside the vehicle until you are sure that the driver sees you	8		
	b. Move to the far right of the passing lane	14		
	*c. Not be in the same lane as the vehicle you are passing	42		
	d. Pass between two lanes of moving traffic	1		

Table 4.--continued.

Test-Item[a]	III. Tasks Related to Traffic Conditions C. Passing or Changes Lanes D. Left Turning Vehicles	Freq. Dist.	Disc. Powers	SD[b]
D-8	If you are passing a vehicle that starts to drift toward you, blow your horn and:		.65	.50
	a. Speed up to pass	8		
	*b. Watch to see if the driver hears you	23		
	c. Apply your brakes and pull over to the right	17		
	D. Pull into the lane to the left or into the median	6		
D-17	Just before you pass another vehicle, you should:		.53	.47
	a. Signal with your lights and hand	13		
	b. Slow down	0		
	*c. Check your mirrors and look over your shoulder	37		
	d. Move closer to the lane you want to be in	4		
	D. Left Turning Vehicles			
A-14	When you are nearing an intersection and a left turning vehicle approaches, you should:		.49	.47
	a. Look for oncoming drivers' indication of left turn	15		
	b. Reduce speed	52		
	*c. Look for oncoming drivers' indication of yielding to you	35		
	d. Cover brake and shift to a lower gear	5		
B-13	Before yielding to a vehicle which is turning left in front of you:		.22	.50
	a. Move into the right lane	27		
	b. Move to the left so you can pass when he starts to turn	8		
	c. Signal the vehicle that he should turn	8		
	*d. Check the vehicles behind you	53		
C-13	When other drivers should yield before making a left turn, the motorcyclist should:		.05	
	a. Change lane positions to improve visibility to vehicle turning	5		
	b. Change lane position away from intersecting vehicle	4		
	*c. Reduce speed and decide if vehicle will yield	56		
	d. Turn left to avoid him	0		

Table 4.--continued.

Test-Item[a]	III. Tasks Related to Traffic Conditions D. Left Turning Vehicles E. Vehicles From the Side	Freq. Dist.	Disc. Powers	SD[b]
D-9	If an oncoming vehicle is preparing to turn left at an intersection, you should:		.31	.50
	a. Drive to the left to get around it	2		
	b. Speed up and continue straight before he completes his turn	7		
	c. Stop and let him turn	13		
	*d. Lag slightly behind other vehicles going in your direction	32		
D-18	When another vehicle is approaching an intersection it is important to:		.20	.34
	a. Drive in the right wheel track of your lane	6		
	*b. Watch for vehicle indicating a left turn	47		
	c. Signal and blow your horn	1		
	d. Turn your headlights on and stop	0		
	E. Vehicles From the Side			
A-15	A special danger of city rather than country driving is:		.15	
	*a. Vehicles coming out from alleys and parking spaces	102		
	b. The speed of traffic	3		
	c. Animals crossing the road	1		
	d. Road surfaces you drive on	1		
B-14	When you ride by parked cars, you should:		.15	
	a. Move to the right side of the lane	2		
	*b. Slow down and stay in the left tire track of lane	92		
	c. Blow your horn or flash your lights	2		
	d. Speed up and drive in the lane farthest away from the parked cars	0		
C-14	When in the residential area of a city, you should:		.00	
	a. Try to go at a constant speed of 35 mph	0		
	*b. Watch for pedestrians, especially children	64		
	c. Slow down if you want to drive through a "play street:	1		
	d. Do not use your horn	0		

Table 4.--continued.

Test-Item[a]	III. Tasks Related to Traffic Conditions E. Vehicles From the Side F. Interacting with Vehicles	Freq. Dist.	Disc. Powers	SD[b]
D-10	When passing playground and recreational areas, you should:		.29	.43
	*a. Watch both sides of the street for children	13		
	b. Reduce speed	33		
	c. Watch between vehicles for pedestrians	7		
	d. Ride in a zig-zag pattern for visibility	1		
	F. Interacting with Vehicles			
A-16	When riding a motorcycle you should:		.35	.39
	a. Ask the passenger to give hand signals	1		
	b. Ignore the vehicles moving in the same direction as you	0		
	c. Drive in the center of your lane	19		
	*d. Assume that other drivers do not see you	87		
B-15	If you are being passed on a multiple lane street, and a conflict exists, you should:		.15	
	*a. Change lanes, if safe	37		
	b. Slow down	42		
	c. Increase your speed	1		
	d. Look for indication that vehicle will respond to your motorcycle	16		
C-15	A safe motorcycle driver will:		.42	.33
	*a. Give the other driver the right-of-way	57		
	b. Only use the right-hand traffic lane	5		
	c. Not make right turns at busy intersections	0		
	d. Change lanes rather than change speed	3		
D-11	When parking close to parked vehicles, you should:		.04	
	a. Lean the motorcycle on its side	0		
	*b. Allow sufficient distance for other vehicles to enter and exit parking spaces	31		
	c. Park the motorcycle with both wheels against the curb and in the center of the space	7		
	d. Park the motorcycle with the front wheel touching the curb	16		

Table 4.--continued.

Test-Item[a]	IV. Tasks Related to the Environment A. Conditions of Limited Visibility B. Conditions of the Roadway Limitations	Freq. Dist.	Disc. Powers	SD[b]
A-17	To help others see you at night, you should:		.12	
	*a. Wear bright or light-colored clothing	99		
	b. Keep your headlights on high beam	4		
	c. Ride in the center of the roadway	2		
	d. Move back and forth in your lane	2		
B-16	When you ride a motorcycle during the day:		.04	
	*a. Turn your headlights on	92		
	b. Use only hand signals instead of signal lights	0		
	c. You need not wear goggles	2		
	d. Increase your following distance over that used at night	2		
C-16	When you approach the top of a hill, you should <u>not</u>:		.53	.47
	a. Slow down slightly	11		
	b. Stand up on footpegs to see over the top	30		
	*c. Drift toward the center line	20		
	d. Dim your lights	4		
D-12	As you enter a tunnel you should:		.60	.50
	a. Move closer to the center of the road	19		
	b. Increase your speed a bit	0		
	*c. Remove your sunglasses	32		
	d. Turn off your headlights	3		
	B. <u>Conditions of the Roadway Limitations</u>			
A-18	The most slippery place to ride on a wet road is:		.40	.49
	a. The right wheel track	13		
	*b. The center on the lane	63		
	c. The left wheel track	3		
	d. Near the shoulder or the curb	28		
B-17	When driving on a wet or slippery road, it is best to:		.52	.46
	a. Put more weight on the front wheel	7		
	b. Reduce your tire pressure	21		
	*c. Avoid pavement markings or metal surfaces	68		
	d. Lean the motorcycle more than usual when turning	0		

Table 4.--continued.

Test-Item[a]	IV. Tasks Related to the Environment B. Conditions of the Roadway Limitations V. Tasks Related to the Operator A. Drugs and Alcohol	Freq. Dist.	Disc. Powers	SD[b]
C-17	On a mountain road, you should:		.37	.43
	*a. Stay just to the right of the center of the lane except when meeting traffic	49		
	b. Keep your brakes on when going downhill	5		
	c. Ride on the right shoulder, if possible	9		
	d. Move from one side of the lane to the other	2		
D-13	When coming to a railroad crossing without warning signals, you should:		.06	
	a. Stop even if you don't see any trains coming	5		
	b. Speed up and look quickly both directions	1		
	*c. Slow down and look before crossing the tracks	48		
	d. Signal other vehicles to pass you	0		
	A. Drugs and Alcohol			
A-19	When operating a motorcycle after drinking alcohol, you should:		.35	.36
	*a. Increase separation with others	91		
	b. Increase speed, get where you are going	0		
	c. Use only your rear brake	3		
	d. Drive in the right wheel tracks of your lane	13		
B-18	If operating a motorcycle after drinking:		.15	
	a. Drive in one gear lower than normal	1		
	*b. Operate the motorcycle at lower speeds	88		
	c. Signal 200 feet from a turn	0		
	d. Drive in the center of your lane	7		
C-18	When operating a motorcycle after taking drugs and medication:		.52	.49
	a. Drive only in residential or city areas	4		
	*b. Increase your separation with other vehicles by lane positions	41		
	c. Drive in the center of your lane for protection	12		
	d. Brake slower and use only the rear brake	8		

Table 4.--continued.

Test-Item[a]	V. Tasks Related to the Operator A. Drugs and Alcohol B. Emotional and Physical Conditions	Freq. Dist.	Disc. Powers	SD[b]
D-16	If you operate a motorcycle after taking drugs, you should:		.13	
	*a. Operate the motorcycle at reduced speeds	51		
	b. Follow what other drivers are doing at signals	2		
	c. Increase your speed and brake hard	0		
	d. Drive in first gear only	1		
D-14	After drinking alcohol or taking drugs, you should:		.07	
	a. Eat candy before driving a motorcycle	0		
	b. Rest one hour before driving	3		
	c. Drink coffee before driving	1		
	*d. Avoid operating a motorcycle	50		
	B. Emotional and Physical Conditions			
A-20	To help prevent fatigue you should:		.39	.44
	a. Maintain a safe constant speed	35		
	b. Have a passenger with you on long trips	33		
	*c. Wear good windproof clothing	28		
	d. Grasp the handlebars firmly	11		
B-19	If you are tired and cannot stop to sleep, you should:		.19	
	a. Drive at a constant speed	1		
	b. Drive as fast as permitted	1		
	*c. Stop and rest at least every hour	83		
	d. Drive as slow as possible	11		
C-19	If you are experiencing strong emotions, you should:		.08	
	*a. Avoid operating a motorcycle	58		
	b. Increase your speed	0		
	c. Increase your separation from other vehicles	6		
	d. Vary speed regularly	1		
D-15	You should avoid operating a motorcycle if:		.51	.50
	*a. You are experiencing strong emotional feelings	22		
	b. The tires are low on air pressure	14		
	c. The turn signals are not operating properly	3		
	d. You need to carry packages on the motorcycle	15		

Table 4.--continued.

Test-Item[a]	V. Tasks Related to the Operator B. Emotional and Physical Conditions	Freq. Dist.	Disc. Powers	SD[b]
A-7	A good motorcycle rider should:		.04	
	a. Increase separation when fatigued or drowsy	35		
	*b. Avoid operating a motorcycle when experiencing strong emotions	33		
	c. Operate motorcycle at slower speeds when drowsy	28		
	d. Change clothing, if wet	11		
B-20	A good motorcycle rider should:		.22	.50
	a. Increase separation when fatigued or drowsy	24		
	*b. Avoid operating a motorcycle when experiencing strong emotions	45		
	c. Operate motorcycle at slower speeds when drowsy	26		
	d. Change clothing, if wet	1		
C-20	A good motorcycle rider should:		.27	.48
	a. Increase separation when fatigued or drowsy	11		
	*b. Avoid operating a motorcycle when experiencing strong emotions	45		
	c. Operate motorcycle at slower speeds when drowsy	8		
	d. Change clothing, if wet	0		
D-20	A good motorcycle rider should:		.38	.50
	a. Increase separation when fatigued or drowsy	13		
	*b. Avoid operating a motorcycle when experiencing strong emotions	24		
	c. Operate motorcycle at slower speeds when drowsy	17		
	d. Change clothing, if wet	0		

[a]Refers to specific test and item as shown in Appendices C, D, E, and F.

[b]Standard Deviation--Factor analysis variable indicated for questions over .2 Discriminating Power.

factor with only three variables from a possible thirty-six having a rotated factor .40 or greater items.

There were nine questions in test A that indicated interrelationships with six clustered factors through the factor analysis. Three of the nine questions covered the tasks related to roadway characteristics and had most of the highest relationships. The next major relationship was with the tasks related to the traffic and operator. The tasks related to the environment and basic control tasks were represented by only one factor as shown in Table 5.

Seven questions in test B indicated relationships, and the three questions covering tasks related to the roadway characteristics was most noted in this test. The traffic condition tasks had two questions with relationship, whereas, basic control and operator tasks was indicated by one question in the test as presented in Table 6.

Test C had the most questions with interrelations from the factor analysis. The tasks related to traffic conditions was dominate in test C. Questions concerning basic control, operators, and roadway tasks was represented by three or less relevant questions each. The tasks related to the environment was also represented in test C. These data are summarized in Table 7.

Test D consisted of nine interrelated factor questions with loadings greater than .40. The greatest number of questions were related to the critical tasks for safe operation in traffic conditions. Two questions covered

Table 5.--Rotated Factor Analysis for Test A Items.[a]

A Variables	Factors*					
	I'	II'	III'	IV'	V'	VI'
RWQA1	(.49422)	.13747	.14609	-.03562	-.00153	.14380
RWQA2	.14100	.37468	.23891	-.13545	-.01862	.27648
RWQA6	.30682	.10953	.03148	.05104	-.17520	-.16847
RWQA8	.15550	-.00947	(.69468)	-.16416	.10813	.10606
RWQA9	.14397	.01361	.21238	-.11860	-.06099	.06518
RWQA10	.02675	.00250	.04501	-.03683	-.00447	(.45892)
RWQA11	-.09180	(.79534)	.04849	.09951	-.00948	-.03380
RWQA12	.32298	.29638	-.03394	.34746	.10846	-.14450
RWQA13	.17287	.06605	-.07754	(.71157)	.05552	-.13077
RWQA14	.09649	.00944	.11916	-.09893	.28795	.11556
RWQA16	(.45838)	-.09811	.12024	.00480	.15076	-.00854
RWQA18	(.43922)	-.20609	-.14638	.15346	.08117	.10733
RWQA19	-.00012	-.00320	-.01868	.15734	(.71269)	-.13173
RWQA20	-.08328	.12047	(.43611)	.18121	.06857	-.02808

[a]Loadings $\geq$.40 shown in parentheses.

*I' = Basic Control, Traffic, and Environment, II' = Roadway, III = Roadway and Operator, IV = Traffic, V = Operator, VI = Roadway.

Table 6.--Rotated Factor Analysis for Test B Items.[a]

B Variables	Factors*					
	I'	II'	III'	IV'	V'	VI'
RWQB1	.00618	-.09311	.17462	(.45421)	.16637	.02752
RWQB3	.02705	-.01817	-.16779	.02098	.35591	.06023
RWQB4	.09408	.32984	.35162	-.22020	.10625	-.02686
RWQB5	.07210	.09088	-.17226	.05271	.02647	.16162
RWQB6	-.14184	-.15214	.06723	.10018	.06857	.32619
RWQB7	.00269	.16068	(.70802)	.07183	-.08867	.07300
RWQB9	(.87315)	.01525	-.01573	-.03995	-.01799	.13202
RWQB10	.05702	.03841	.13144	.14297	(.71037)	.10040
RWQB11	.21392	.16336	-.02406	-.04300	.09000	(.71235)
RWQB12	.25265	-.01472	-.00123	-.01031	.18700	-.02294
RWQB13	-.23514	(.68392)	-.00538	-.14583	.01214	-.01155
RWQB17	.17804	.37437	.13115	.06337	-.03709	.07317
RWQB20	-.04035	.00102	-.18016	(.67540)	.00731	.05469

[a]Loadings $\geq$.40 shown in parentheses.

*I' = Roadway, II' = Traffic, III' = Roadway, IV' = Basic Control and Operator, V' = Roadway, VI' = Traffic.

Table 7.--Rotated Factor Analysis for Test C Items.[a]

C Variables	Factors*					
	I'	II'	III'	IV'	V'	VI'
RWQC3	.30908	.15719	.13031	.11333	.04000	.07471
RWQC6	.05769	.08796	-.04685	(.67264)	.10462	.07411
RWQC7	-.05113	.01532	(.67066)	.07927	-.01699	-.02909
RWQC8	.27951	.11602	(.49167)	-.20705	-.02027	.03916
RWQC10	.13457	.31940	.23877	.19966	-.01355	(.49862)
RWQC11	.16406	.11955	.10587	.20586	.03181	(.49389)
RWQC12	(.56365)	-(.42486)	.10572	.35107	-.14354	-.08183
RWQC15	.15058	(.71256)	.08634	.08288	.02956	-.01290
RWQC16	(.59398)	.10210	-.03736	-.05341	-.07370	.036663
RWQC17	-.00559	-.02352	.09099	.14990	.27874	.00494
RWQC18	.24646	.07657	.10430	.09568	-(.58563)	.11835
RWQC20	.08847	.18476	-.06997	.03984	(.48524)	.14534

[a]Loading $\geq$.40 shown in parentheses.

*I' = Traffic and Environment, II' = Traffic, III' = Roadway, IV' = Basic Control, V' = Operator, VI' = Roadway and Traffic.

tasks associated with roadway characteristics. Tasks associated with the operator, environment, and basic control were each represented once in the test. These data were presented in Table 4.8.

A summary of statistics for the motorcycle operator tests including the mean, standard deviation, item difficulty, item discrimination, and the Kuder-Richardson Formula 20 alpha reliability coefficent are presented in Table 9.

The four tests had means ranging from a 63 in test D to a mean score 69 for test B. There were two different range scores in the study. Tests A and C had a range of 55 and tests B and D indicated a range of 45.

The lowest standard deviation in the tests was 10.25 for test D and the highest deviation was found in test C of the study with 11.53.

There was only six one-hundredths percent difference in the mean item difficulty scores for the test groups; and, the mean item discrimination indicated a range of .07 in the four tests.

The Kuder-Richardson reliability coefficient alpha and standardized item alpha were very similar in each test. Test B had .31 for both the coefficient alpha and standardized alpha.

Table 8.--Rotated Factor Analysis for Test D Items.[a]

D Variables	Factors*					
	I'	II'	III'	IV'	V'	VI'
RWQD1	.00555	-.00095	.01847	.00697	(.65473)	-.06042
RWQD2	-.34198	.07225	.33223	.08967	.07343	.04159
RWQD5	.15253	(.47357)	-.07903	-.06530	.04208	.09220
RWQD6	-.01019	-.02253	.14441	(.85969)	.05600	.04751
RWQD7	.09660	.16040	-.19067	0.4615	-.30106	.38745
RWQD8	.08300	.02819	(.58210)	.15482	-.02117	-.20134
RWQD9	-.13442	(.76895)	.19675	.08948	-.08893	-.05815
RWQD10	.01211	-.00674	.02422	.00857	-.00310	(.64339)
RWQD12	.32213	.02673	-.15177	.22712	(.41693)	.02109
RWQD15	.31286	-.00758	.15514	.08462	.01569	.01068
RWQD17	.28709	.23051	.39497	.05039	.08485	.08198
RWQD18	.04844	-.21616	(.41815)	-.27075	-.20476	.14429
RWQD20	(.62815)	.08928	.06099	-.06190	.07088	.06568

[a]Loadings $\geq$.40 shown in parentheses.

*I' = Operator, II' = Roadway and Traffic, III' = Traffic, IV' = Roadway, V' = Basic Control and Environment, and VI' = Traffic.

Table 9.--Summary Statistics for Motorcycle Operator Tests.

	Test			
	A	B	C	D
Mean	65	69	67	63
Range	55	45	45	55
SD	10.49	11.09	11.53	10.25
$\bar{X}$ Item Difficulty	.64	.69	.67	.63
$\bar{X}$ Item Discrimination	.25	.28	.32	.26
KR20*				
Alpha	.32	.31	.32	.22
Standardized Item Alpha	.29	.31	.30	.17

*Covariance matrix analysis for reliability coefficient of 20 items based on the right answer.

Summary

In this chapter the analysis of the data was presented. The chapter was divided into three sections: pertinent information about the respondent, analysis of the test items, and statistical analysis of the relationships. Tables were presented in each of the respective sections to help describe these data.

In the following chapter the summary, findings, conclusion, and recommendations may be found. A discussion section was provided with the author's personal comments about the study.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Presented in the preceding chapter was the analysis of the data. In this chapter may be found: (1) a summary of the study; (2) major findings; (3) conclusions of the study based upon the data; (4) recommendations; (5) recommendations for further study; and (6) a discussion.

Summary

The purpose of this study was to develop motorcycle operator knowledge test items for licensing and program evaluations. The test items were based on critical driver tasks needed for the safe operation of motorcycles on the streets and highways of this nation.

Michigan motorcycle operators applying for a motorcycle license during the 1980-81 testing period were defined as the population. Three hundred and twenty-two subjects were ultimately used in the study. The geographical area included ten high volume branch offices of the Michigan Secretary of State offices.

The collecting of data was done by means of four separate tests designed specifically for each of the four

test groups. The tests were designed to provide information concerning three specific areas: (1) information about the respondents; (2) identifying good test items; and (3) interrelationships of the variables and factors.

The four separate tests were developed and sent to the New Programs Division for the Michigan Department of State. The tests were then distributed to the ten branch offices in the State of Michigan. The tests returned were tallied and a total of 322 respondents were included in the study. The responses were hand coded, key punched, and placed on disks for statistical analysis after errors were corrected. The statistical analysis was conducted with the Kearney State College, Kearney, Nebraska, computer linked to the University of Nebraska, Lincoln, Nebraska, computer system.

A description analysis of the data was made for pertinent information about the subjects on age, sex, and motorcycle riding experience.

The data was also analyzed statistically to determine good test items through discriminating powers testing. A rotated factor analysis was then employed to determine the interrelationships among the variables being tested.

The Major Findings

The following is a summary of the major findings:

1. The data indicated that each test had at least 60 percent of its test items with acceptable discriminating powers.

2. All four tests showed at least one item in each of the five critical tasks areas which received a discriminating power greater than .20.
3. The factor analysis indicated that 64 percent of the items tested covered tasks related to roadway and/or traffic conditions for safe motorcycle operation.
4. Fifty-eight percent of the factors were coherent for a single motorcycle operator task.
5. Variables with similar tasks were found in 13.9 percent of the factors.
6. The factor analysis indicated that 16.7 percent of the items had more than one variable with the same factor or tasks.
7. Only 19 percent of the variables indicated more than one task was associated with the factor, but further investigation of the variables revealed interrelationships by actions, identifications, and/or changes performed by the motorcycle operator.
8. The data revealed that there was no significant difference between the four tests on the critical tasks areas acceptable for testing.

Conclusions

The conclusions based upon the findings of the study indicated:

1. The items and tests in their present form are valid and reliable for testing motorcycle operator knowledge covering critical operator tasks.

2. The tests have different emphasis on the five critical operator tasks.
3. The four tests showed no clear pattern of interrelationships to the critical tasks for motorcycle knowledge items.
4. The tests can identify factors or tasks associated with the five critical tasks for measuring motorcycle operation.
5. The individual test items can be recombined as a valid and reliable, comprehensive examination for a motorcycle rider education class or motorcycle operator license examination.

Recommendations

The motorcycle operator knowledge test items and tests are suitable as an instrument for evaluating the critical operator tasks in safe motorcycle operation. It is recommended that the tests or items be selected according to the specific task or tasks to achieve the desired objectives in an examination.

The user could recombine the test items into a new testing instrument. The new instrument should be selected from the 52 discriminating items and specifically the 34 items with factor analysis loadings of .40. The common items in the test forms need to be evaluated and selected to eliminate duplication of those items. Care should be taken to include items for each of the five critical operator tasks important to safe motorcycle operation.

Recommendations for Further Research

On the basis of the findings from the study, it is recommended that:

1. The test items be researched for their relationship to a driver performance measurement tool as a predictor of safe motorcycle operation.
2. A study be conducted at regular intervals to help update knowledge test examinations for future motorcycle operators.
3. Research be conducted to evaluate the effectiveness of future motorcycle operator licensing and evaluation instruments.
4. The tests be further developed to establish norms and guidelines for final examinations or motorcycle operator license evaluations.
5. The tests and items be further validated by motorcycle experts with highly developed operator skills.

Discussion

The test forms and their items are one of the most comprehensive motorcycle knowledge test pools developed and based on critical motorcycle operator tasks. The content areas used to write the study test items were selected from a source document providing a task analysis for safe motorcycle operation. The content of the source document covered the tasks of basic control, roadway, traffic, environmental, and operator characteristics. The source document was a task

analysis that described the behaviors, knowledges, and skills required in the safe operation of motorcycles.

However, the items were evaluated on a small sample population and thus the sample only represents that population, not the total motorcycle operator population.

The author suggests that any duplication of the study be conducted with a larger sample population in other geographic locations. It is recommended that additional studies be conducted on samples of inexperienced and experienced operators of high school ages. This type of study would allow for additional statistical testing and re-testing of different treatment.

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APPENDICES

APPENDIX A

ITEM EVALUATORS

APPENDIX A

ITEM EVALUATORS

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APPENDIX B

MICHIGAN LICENSING BRANCH OFFICES

APPENDIX B

MICHIGAN LICENSING BRANCH OFFICES

(USED FOR THE STUDY)

Region four:

1. Flint--Bristol
2. Jackson North
3. Lansing South
4. Lansing West
5. Mason
6. Owosso

Region five:

1. Battle Creek South
2. Grand Rapids Northeast
3. Grand Rapids Northwest
4. Grand Rapids South

APPENDIX C

MOTORCYCLE KNOWLEDGE TEST A

APPENDIX C

MOTORCYCLE KNOWLEDGE TEST A

Age_____
Sex_____
Riding Experience_____

1. Before mounting your motorcycle you should:

   a. Adjust the mirrors
   b. Set the gear shift lever to neutral
   c. Return the kickstand lever to storage
   d. Visually check the tires

2. After mounting the motorcycle you should:

   a. Move the parking stand to the "Park" position
   b. Push the motorcycle out into an open area before starting it
   c. Adjust the mirror(s) for a clear view of the road
   d. Check the chain and cables for proper tension and lubrication

3. For good steering control you should:

   a. Grasp the handlebars firmly
   b. Lean heavily into the handlebars
   c. Steer mostly by shifting your weight up and down
   d. Hold loosely onto the ends of the handgrips

4. Before changing directions, you should: (change of lanes, passing, etc.)

   a. Stop the motorcycle in your lane
   b. Signal in advance of the turn
   c. Reduce speed
   d. Lean into the direction of the turn

5. If making an emergency stop on a dry road, you should apply the:

   a. Front brake only
   b. Rear brake only
   c. Front and rear brakes together
   d. Front brake and then rear brake

6. If your rear wheel has skidded out-of-line when making a rapid stop, you should:

   a. Apply more pressure on the front brake and less on the rear brake
   b. Release both brakes and press the clutch lever
   c. Open the throttle, release both brakes and lean
   d. Maintain rear brake pressure

7. A good motorcycle rider should:

   a. Increase separation when fatigued or drowsy
   b. Avoid operating a motorcycle when experiencing strong emotions
   c. Operate motorcycle at slower speeds when drowsy
   d. Change clothing, if wet

8. When riding you should continually:

   a. Check areas on and off roadway, well ahead, to the sides and behind
   b. Check the speedometer
   c. Check pavement markings and signs
   d. Shift your eyes every 10 seconds

9. When approaching an intersection it is most important to:

   a. Stay in the right lane
   b. Watch for traffic making right turns
   c. Watch for traffic going straight
   d. Watch for traffic making left turns

10. When you pass oncoming traffic on a 2-lane road, you should:

   a. Keep your eyes focused straight ahead
   b. Turn on the lights and blow the horn
   c. Prepare to move to the right side of your lane
   d. Steer in a zig-zag fashion

11. When on a right-hand entrance to a freeway, you should:

   a. Look back over your left shoulder and into the left rearview mirror
   b. Only look straight ahead at the roadway
   c. Not speed up until you are on the main road
   d. Assume the right-of-way when merging with freeway traffic

12. To maintain an adequate following distance, you should:

    a. Follow one car length for every 10 mph you are going
    b. Follow at least two seconds behind the vehicle ahead of you
    c. Reduce speed 5-10 mph less than the vehicle ahead of you
    d. Use only the rear brake to slow

13. If you are being passed you should:

    a. Move to the right
    b. Increase your speed slightly
    c. Signal the other driver when it is safe for them to pass
    d. Look over your shoulder to check the vehicle that is passing you

14. When you are nearing an intersection and a left turning vehicle approaches, you should:

    a. Look for oncoming drivers' indication of left turn
    b. Reduce speed
    c. Look for oncoming drivers' indication of yielding to you
    d. Cover brake and shift to a lower brake

15. A special danger of city rather than country driving is:

    a. Vehicles coming out from alleys and parking spaces
    b. The speed of traffic
    c. Animals crossing the road
    d. Road surfaces you drive on

16. When riding a motorcycle you should:

    a. Ask the passenger to give hand signals
    b. Ignore vehicles moving in the same direction as you
    c. Drive in the center of your lane
    d. Assume that other drivers do not see you

17. To help others see you at night, you should:

    a. Wear bright or light-colored clothing
    b. Keep your headlights on high beam
    c. Ride in the center of the roadway
    d. Move back and forth in your lane

18. The most slippery place to ride on a wet road is:

    a. The right wheel track
    b. The center of the lane
    c. The left wheel track
    d. Near the shoulder or the curb

19. When operating a motorcycle after drinking alcohol, you should:

    a. Increase separation with others
    b. Increase speed, get where you are going
    c. Use only your rear brake
    d. Drive in the right wheel track of your lane

20. To help prevent fatigue you should:

    a. Maintain a safe constant speed
    b. Have a passenger with you on long trips
    c. Wear good windproof clothing
    d. Grasp the handlebars firmly

APPENDIX D

MOTORCYCLE KNOWLEDGE TEST B

APPENDIX D

MOTORCYCLE KNOWLEDGE TEST B

Age_____
Sex_____
Riding Experience_____

1. The condition of the tires should be checked for excessive wear or damage:

   a. Once a day
   b. Every week
   c. Once a month
   d. Before mounting your motorcycle

2. The following should be checked before you ride:

   a. The headlights are on and working correctly
   b. The depth of the tire tread
   c. The clutch cable for proper tension
   d. The gear selector lever is in park

3. To steer the motorcycle you should:

   a. Shift your weight to the right when making a left turn
   b. Make small steering corrections by putting pressure on the handlebars
   c. Turn the handlebars more sharply the faster you are going
   d. Hold the handlebars loosely at all times

4. The <u>first</u> thing to do before changing lanes is:

   a. Signal with your lights and hand
   b. Slow down
   c. Check your mirror(s) and look over your shoulder
   d. Move closer to the lane you want to be in

5. When making an emergency stop on a slippery road or on loose gravel, you should:

   a. Apply the rear brake only
   b. Use the front and rear brakes together
   c. Apply the front brake when the rear wheel begins to slide
   d. Use the throttle and clutch and avoid using the brake

6. When your rear wheel begins to skid, you should:

   a. Maintain or reduce the power to the rear
   b. Put feet on the footpegs
   c. Pump the front brake
   d. Hold the front wheel as straight as possible

7. If you have to change speed or direction because of something in the roadway, you should:

   a. Press in the clutch lever
   b. Check for vehicles behind and around you
   c. Apply both brakes lightly and signal
   d. Take both feet off the footpegs for balance

8. When driving your motorcycle near an intersection, you should:

   a. Keep in the left lane
   b. Pay more attention to the traffic and roadway ahead
   c. Speed up to get away from the intersection quickly
   d. Brake hard when stopping to avoid a loss of traction

9. When driving in the right-hand lane on a 4-lane road, you should usually ride:

   a. In the center of the lane
   b. In the left wheel track
   c. On the line dividing the lanes
   d. In a slight zig-zag pattern

10. When entering the roadway, you should:

   a. Check roadway to the left and right
   b. Push the motorcycle forwards with both feet
   c. Cancel the turn signal
   d. Turn into the nearest lane

11. Generally your following speed should be determined by:

   a. The speed of the fastest vehicle on the road
   b. The speed of the vehicle ahead of you
   c. The speed of the vehicle behind you
   d. The power of your engine

12. When being passed you should move to the right:

    a. When being crowded by the passing vehicle
    b. Whenever it is possible to do so
    c. Only on undivided roadways
    d. Only if you are going below the speed limit

13. Before yielding to a vehicle which is turning left in front of you:

    a. Move into the right lane
    b. Move to the left so you can pass when he starts to turn
    c. Signal the vehicle that he should turn
    d. Check the vehicle behind you.

14. When you ride by parked cars, you should:

    a. Move to the right side of the lane
    b. Slow down and stay in the left tire track of your lane
    c. Blow your horn or flash your lights
    d. Speed up and drive in the lane farthest away from the parked cars

15. If you are being passed on a multiple-lane street, and a conflict exists, you should:

    a. Change lane, if safe
    b. Slow down
    c. Increase your speed
    d. Look for indication that the vehicle will respond to your motorcycle

16. When you ride a motorcycle during the day:

    a. Turn your headlights on
    b. Use only hand signals instead of signal lights
    c. You need not wear goggles
    d. Increase your following distance over that used at night

17. When driving on a wet or slippery road, it is best to:

    a. Put more weight on the front wheel
    b. Reduce your tire pressure
    c. Avoid pavement markings or metal surfaces
    d. Lean the motorcycle more than usual when turning

18. If operating a motorcycle after drinking alcohol:

    a. Drive in one gear lower than normal
    b. Operate the motorcycle at lower speeds
    c. Signal 200 feet from a turn
    d. Drive in the center of your lane

19. If you are tired and cannot stop to sleep, you should:

    a. Drive at a constant speed
    b. Drive as fast as permitted
    c. Stop and rest at least every hour
    d. Drive as slow as possible

20. A good motorcycle rider should:

    a. Increase separation when fatigued or drowsy
    b. Avoid operating a motorcycle when experiencing strong emotions
    c. Operate motorcycle at slower speeds when drowsy
    d. Change clothing, if wet

APPENDIX E

MOTORCYCLE KNOWLEDGE TEST C

APPENDIX E

MOTORCYCLE KNOWLEDGE TEST C

Age_____
Sex_____
Riding Experience_____

1. In a pre-ride inspection you should:

   a. Inspect the tires for wear or damage
   b. Adjust the brake tension
   c. Replace the spark plugs
   d. Adjust the mirror(s)

2. When riding an unfamiliar motorcycle you should:

   a. Check the gearshift pattern
   b. Check the clutch friction points
   c. Know and practice with the motorcycle controls
   d. Drive at low speeds and in first gear

3. If your motorcycle begins to lean excessively when turning left, you should:

   a. Apply pressure to handgrips to turn front wheel further in the direction of the turn
   b. Turn the handlebars sharply to the right
   c. Shift your weight to the left
   d. Apply rear brake to straighten out

4. When deciding to pass on a 2-lane road, it is <u>most</u> important to:

   a. Focus your vision on the intended path of travel
   b. Know the number of vehicles behind you
   c. Know the type of vehicles you are passing
   d. Know the amount of air pressure from larger vehicles like trucks

5. When coming to an area where loose sand covers the roadway surface, you should:

   a. Slow down before reaching the area
   b. Slow down in the area
   c. Maintain speed in the area
   d. Raise up on the footpegs before reaching the area

6. When making a rapid stop you should apply:

   a. The rear brake firmly and then the front brake just short of sliding the front wheel
   b. The rear brake and then the front brake firmly and increase pressure on both
   c. The rear brake firmly then downshift and avoid using the front brake
   d. The rear brake gently then press the clutch lever and apply the front brake

7. When driving a motorcycle rather than a car, it is more important to:

   a. Know the rules of the road
   b. Keep a safe following distance
   c. Watch for objects on the roadway
   d. Adjust the mirror(s) carefully

8. When on a main road at an intersection and a vehicle is approaching from the left, you should:

   a. Stop; he always has the right-of-way
   b. Speed up to make sure he knows you're there
   c. Yield if he does not slow down
   d. Slow down immediately and blow your horn

9. When you approach a long line of oncoming vehicles, you should:

   a. Move to the right side of your lane
   b. Stay in the left part of the lane
   c. Flash your lights and slow down
   d. Drive in a zig-zag manner to attract attention

10. When turning left onto a 2-way street, you should:

   a. Go straight across the roadway and turn left upon reaching the nearest lane
   b. Turn left into the first lane
   c. Start your left turn half-way in the first lane
   d. Lean your motorcycle to the left a little

11. If the vehicle in front of you suddenly stops, the safest thing to do is:

   a. Slide your motorcycle to a stop and jump off
   b. Slow down and take evasive action
   c. Brake hard and try to stay behind the vehicle
   d. Continue at the speed and try to drive around the vehicle

12. When passing another vehicle you should:

    a. Drive alongside the vehicle until you are sure that the driver sees you
    b. Move to the far right of the passing lane
    c. Not be in the same lane as the vehicle you are passing
    d. Pass between two lanes of moving traffic

13. When other drivers should yield before making a left turn, the motorcyclist should:

    a. Change lane positions to improve visibility to the vehicle turning
    b. Change lane position away from the intersecting vehicle
    c. Reduce speed and decide if the vehicle will yield
    d. Turn left to avoid the other vehicle

14. When in the residential area of a city, you should:

    a. Try to go at a constant speed of 35 mph
    b. Watch for pedestrians, especially children
    c. Slow down if you want to drive through a "Play Street"
    d. Do not use your horn

15. A safe motorcycle driver will:

    a. Give the other driver the right-of-way
    b. Only use the right-hand traffic lane
    c. Not make right turns at busy intersections
    d. Change lanes rather than change speed

16. When you approach the top of a hill, you should <u>not</u>:

    a. Slow down slightly
    b. Stand up on footpegs to see over the top
    c. Drift toward the center line
    d. Dim your lights

17. On a mountain road, you should:

    a. Stay just to the right of the center of the lane except when meeting traffic
    b. Keep your brakes on when going downhill
    c. Ride on the right shoulder, if possible
    d. Move from one side of the lane to the other

18. If operating a motorcycle after taking drugs and medication:

    a. Drive only in residential or city areas
    b. Increase your separation with other vehicles by lane positions
    c. Drive in the center of your lane for protection
    d. Brake slower and use only the rear brake

19. If you are experiencing strong emotions you should:

    a. Avoid operating a motorcycle
    b. Increase your speed
    c. Increase your separation from other vehicles
    d. Vary your speed regularly

20. A good motorcycle rider should:

    a. Increase separation when fatigued or drowsy
    b. Avoid operating a motorcycle when experiencing strong emotions
    c. Operate motorcycle at slower speeds when drowsy
    d. Change clothing, if wet

APPENDIX F

MOTORCYCLE KNOWLEDGE TEST D

APPENDIX F

MOTORCYCLE KNOWLEDGE TEST D

Age_____
Sex_____
Riding Experience_____

1. When performing the pre-riding inspection, you should:

   a. Check windshield and lights
   b. Inspect tires for wear or damage
   c. Check signals
   d. Remove motorcycle from sidestand

2. When making a gradual turn, you should:

   a. Turn the handlebars quickly
   b. Turn by leaning
   c. Turn the handlebars quickly and lean
   d. Lean the motorcycle more than your body

3. When reducing speed, you should:

   a. Observe road surfaces ahead
   b. Focus eyes directly ahead at all times
   c. Move eyes more frequently from side to side
   d. Check mirror(s) for following vehicles

4. If you are going straight through the intersection and see a vehicle to your left:

   a. Drive partially into the intersection to warn the other vehicle
   b. Prepare to yield the right-of-way
   c. Speed up to get through the intersection before the other vehicle
   d. Pull off the road until the vehicle gets through the intersection

5. When you drive into the left lane of a 4-lane highway to pass another vehicle, you should:

   a. Drive in the right wheel track
   b. Stay in the center of the lane
   c. Drive near the left wheel track
   d. Drive in a zig-zag manner

6. When crossing a 2-way street, you should:

   a. Look to the left then right and finally left
   b. Look first in the direction from which traffic is coming
   c. Look at the direction you intend to go before entering the intersection
   d. Stop before going through the intersection

7. When the vehicle ahead of you indicates he is going to turn, you should first:

   a. Slow down and steer around him
   b. Stop until he is completely finished turning
   c. Look to see if his turn can be made safely
   d. Speed up to pass him as soon as possible

8. If you are passing a vehicle that starts to drift toward you, blow your horn and:

   a. Speed up to pass
   b. Watch to see if the driver hears you
   c. Apply your brakes and pull over to the right
   d. Pull into the lane to the left or into the median

9. If an oncoming vehicle is preparing to turn left at intersection, you should:

   a. Drive to the left to get around it
   b. Speed up and continue straight before he completes his turn
   c. Stop and let him turn
   d. Lag slightly behind other vehicles going in your direction

10. When passing playground and recreational areas, you should:

   a. Watch both sides of the street for children
   b. Reduce speed
   c. Watch between vehicles for pedestrians
   d. Ride in a zig-zag pattern for visibility

11. When parking close to parked vehicles, you should:

   a. Lean the motorcycle on its side
   b. Allow sufficient distance for other vehicles to enter and exit the parking spaces
   c. Park the motorcycle with wheels against the curb and in the center of the space
   d. Park the motorcycle with the front wheel touching the curb

12. As you enter a tunnel you should:

    a. Move closer to the center of the road
    b. Increase your speed a bit
    c. Remove your sunglasses
    d. Turn off your headlight

13. When coming to a railroad crossing without warning signals, you should:

    a. Stop even if you don't see any trains coming
    b. Speed up and look quickly both directions
    c. Slow down and look before crossing the tracks
    d. Turn off your headlight

14. After drinking alcohol or taking drugs, you should:

    a. Eat candy before driving a motorcycle
    b. Rest one hour before driving
    c. Drink coffee before driving
    d. Avoid operating a motorcycle

15. You should avoid operating a motorcycle if:

    a. You are experiencing strong emotional feelings
    b. The tires are low on air pressure
    c. The turn signals are not operating properly
    d. You need to carry packages on the motorcycle

16. If you operate a motorcycle after taking drugs, you should:

    a. Operate the motorcycle at reduced speeds
    b. Follow what other drivers are doing at signals
    c. Increase your speed and brake hard
    d. Drive in first gear only

17. Just before you pass another vehicle, you should:

    a. Signal with your lights and hand
    b. Slow down
    c. Check your mirror(s) and look over your shoulders
    d. Move closer to the lane you want to be in

18. When another vehicle is approaching an intersection it is important to:

    a. Drive in the right wheel track of your lane
    b. Watch for vehicles indicating a left turn
    c. Signal and blow your horn
    d. Turn your headlights on and stop

19. When riding a motorcycle near intersections, you should:

    a. Not pace your speed to the traffic lights
    b. Change your speed every few moments so as not to stall
    c. Stay in the lane which offers the best movement and vision
    d. Take advantage of your motorcycle and weave in and out of traffic

20. A good motorcycle rider should:

    a. Increase separation when fatigued or drowsy
    b. Avoid operating a motorcycle when experiencing strong emotions
    c. Operate the motorcycle at slower speeds when drowsy
    d. Change clothing, if wet