

EXPERIMENTAL DEVELOPMENT AND EVALUATION OF A SHOP SAFETY ATTITUDE SCALE

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For centuries accidents have plagued man, and the costs of accidents are rising tremendously. Family goals and aspirations are interrupted when human resources are destroyed or disabled so as to be non-productive. According to the National Safety Council, the cost of accidents in the United States during 1970 was \$27, 000, 000, 000. This included wages lost, medical fees, insurance settlements, property damaged and property lost by fire. There was a 16 percent increase in death rates due to accidents in agricultural industries between 1960 and 1970.

These costs of accidents indicate a great need for ways to predict accidents. Probably the best predictor of accidents is the amount of time the individual is exposed to the hazard; however, it is detrimental to wait until accidents occur and then determine the cause.

Research revealed that personal characteristics which cause accidents can be inherited while others are learned early and these characteristics do play an important part in accidents. Some characteristics are physical such as poor hearing, eye sight, and nervousness. Others may be attitudes of recklessness, stubbornness, irritation, violent temper, excitability, inattention, inconsiderateness, and other undesirable traits.

The promise could be made that if attitudes could be tested or measured to see if they would predict whether one student may be prone to have more accidents than another student, then the possibility of preventing accidents would become a reality.

The Purposes

The major purpose of this study was to develop and evaluate a shop safety attitude scale to be administered at the beginning of the shop class. On this basis the instructor would be able to identify students who may be more prone to have accidents in the school shop.

The secondary purposes of the study were:

1. To determine the relationship between mechanical aptitude test scores and accident experience.

2. To determine the relationship between social desirability test score and accident experience.
3. To determine the relationship between high school rank, cumulative college grade-point average and ACT score and accident experience.
4. To determine the relationship between course enrolled in (Agricultural Engineering 254 or Agricultural Engineering 255) and accident experience.
5. To determine the relationship between age and accident experience.

Procedure

During the spring quarter of 1971, the author attempted to develop and test a semantic differential type attitude scale as a pilot study for this research. The test used 19 stimulus words or concepts and 9 opposing adjectives for each stimulus word. The nine pair of opposing adjectives represented the evaluative, activity, and potency factors.

An instruction sheet was attached which listed the procedure for completing the semantic differential-type test. An accident survey attached included questions concerning accident experience during the past five years. This first test was then administered to a small group of students to determine how they would react to this type of test and to obtain direction or indication of ways to improve the next test. After the data were tested with an inter-correlation matrix, it was evident that the stimulus words having a controversial or emotional connotation correlated significantly with accident experience.

During the fall quarter of 1971, a second semantic differential type attitude scale was constructed and administered to 262 students in several agricultural engineering classes. This test was an effort to improve upon the first test administered. The accident survey attached to this instrument included questions concerning the student's accident experience during the last three years. Stimulus words that did not have a significant correlation with criterion variables were eliminated. Five words were the same as the first test; blood, car races, war, revolt, and teacher. Five additional words; me, fire, dope, motorcycle and violence, were chosen to complete the ten stimulus words. Six opposing adjectives were used with each stimulus word. Good-bad and beautiful-ugly were used for the evaluative factor, active-passive and fast-slow were used for the activity factor and large-small and strong-weak were used for the potency factor.

Results of the second test were similar to the first test. Stimulus words with a controversial or emotional connotation were significantly correlated with accident experience. The word violence, teamed with the evaluative factor, produced the highest correlation. The construction and administration of the final test was influenced by the findings and experience with the pilot study.

The final test retained three stimulus words; war, violence, and me, from the pilot study because these words correlated significantly with accident experience. Iron, love and death were added to make six stimulus words for the final test. Five pair of adjectives represented the evaluative factor. These were: good-bad, clean-dirty, beautiful-ugly, fair-unfair, and kind-cruel. Four pair of adjectives were employed to represent the potency factor. These were: large-small, heavy-light, strong-weak, and rugged-delicate. Active-passive, fast-slow, sharp-dull, and hot-cold represented the activity factor. Review of literature revealed that stability or lack of stability seemed to be associated with accident experience. For this reason stability factor was included in the final test and represented by the adjectives, tame-wild, sober-drunk, and sane-insane.

Three tests were administered to 125 students during their regular one-hour class periods. An accident survey of the past three years was completed by each student after completion of the tests. The first test administered was the attitude scale consisting of the 96 responses to six stimulus words as described above. The second test was Edwards' Social Desirability Scale, a 39-item true-false questionnaire. The statements on this instrument, taken from the Minnesota Multiphasic Personality Inventory, described personal feelings. A mechanical aptitude test was also administered.

The cumulative college grade-point average, high school rank and ACT test scores were obtained from the student records in the Office of the Registrar at Iowa State University of Science and Technology.

Information from the semantic differential type attitude scale was combined to develop 12 of the 20 independent variables. The responses for the four stimulus words (war, iron, violence and death) were added together along each of the four factors (evaluative, activity, potency and stability) to make up four independent variables. The stimulus words, love and me were kept separate but the responses along each of the four factors were added together for each of these stimulus words to bring about eight other variables, four for love and four for me. Eight other independent variables were; mechanical aptitude test score, social desirability response score, American college test score, high school rank, cumulative college grade-point

average, year at Iowa State University, course (Agricultural Engineering 254 or Agricultural Engineering 255) and age. Information concerning accident experience was combined into 24 dependent variables. The data were then processed through the electronic computer to obtain intercorrelations among all 44 variables.

The Mouflon step-wise regression procedure was used with each of the 24 Y variables. For each Y variable an equation was originated giving co-efficients to be multiplied by selected X variables and added to a constant thus producing a predicted number of accident experiences for an individual subject during a three-year period of time. Some regression equations and their respective multiple R² are listed in Table 1.

TABLE 1

COMBINATION OF INDEPENDENT (X) VARIABLES TO PREDICT DEPENDENT (Y) VARIABLES WITH THE F LEVEL TO ENTER THE REGRESSION EQUATION SET AT 2

Variables	Multiple R ²
$\hat{Y}_{21} = 0.1198X_{11} + 0.2815X_{14} + 0.6777X_{16} - 1.0572X_{20} - 2.3491$	0.1568
$\hat{Y}_{22} = 0.4886X_{16} + 0.3793X_{18} - 0.7085X_{20} + 0.1599$	0.1461
$\hat{Y}_{23} = -3.0713X_7 + 0.1702X_{11} + 0.7482X_{16} - 1.1011X_{20} + 6.1772$	0.1325
$\hat{Y}_{10} = 0.2378X_{16} + 0.3141X_{18} - 0.4283X_{20} - 1.1771$	0.1130
$\hat{Y}_4 = 0.4781X_{16} + 0.3435X_{18} - 0.7104X_{20} + 0.7282$	0.1404
$\hat{Y}_6 = 0.0674X_1 - 0.2853X_3 + 0.87X_5 - 0.3496X_8 + 0.0525X_{10} + 0.0920X_{13} - 0.0927X_{17} + 3.7917$	0.2336

Conclusions

If an instructor were interested only in the number of property damage accidents for which the student was to blame, he could use the X variables in the regression equation, $\hat{Y}_6 = 3.792 + 0.067X_1 - 0.285X_3 + 0.009X_5 - 0.350X_8 + 0.053X_{10} + 0.092X_{13} - 0.093X_{17}$.

By using this equation, 23.36 percent of the variance could be accounted for in predicting an individual student's accident experience concerning property damage accidents for which he was to blame during a three-year period.

If a shop instructor were interested in predicting the number of injuries to his students requiring a doctor's treatment or first aid during a three-year period, he could administer the semantic differential attitude scale described in this study. Individual student's scores that can be combined to be included in the regression equation, $\hat{Y}_{21} = -2.35 + 0.12X_{11} + 0.28X_{14} + 0.68X_{16} - 1.06X_{20}$, constitute the following four variables: the activity factor with the concepts war, iron, violence and death; the potency factor with the concept love, the stability factor with the concept love, and the stability factor with the concept me. By using this equation, 15.68 percent of the variance may be accounted for in predicting an individual student's accident experience concerning the injuries to himself requiring a doctor's treatment or first aid.

The first variable selected to predict \hat{Y}_{21} , number of injuries to self requiring a doctor's treatment or first aid, was X_{20} , stability factor with the concept, me. This revealed that those students who scored the stability factor more toward the adjectives (drunk, insane and wild) had more injuries to self requiring a doctor's treatment or first aid. This indicated that the students who may have low opinions of themselves tended to have more accidents.

Therefore, the conclusion was made that there must be some relationship between a student's opinion of himself, his emotional stability, or his level of adjustment to his environment and his accident experience.

The following example will help to explain how the regression equation can be used to predict accident experience for individual students.

Student "number 001" reported very few accidents on the accident survey and none for \hat{Y}_{21} , number of injuries requiring a doctor's treatment or first aid during the past three years. The mean number of these types of accidents was 6.3 for all 125 students during a three-year period.

By taking selected scores provided by a student from the semantic differential attitude scale and inserting them into the regression equation, it is possible to predict his accident experience. Several individual scale scores were summed to be included in the four variables for each student.

The following key gives the item number of the semantic differential attitude scale to be scored from left to right, straight, and from right to left, reverse, for the four variables used in the regression equation.

Variable X_{11} , straight - 3, 14, 20, 23, 63, 65, 74, 79
reverse - 5, 10, 25, 28, 49, 55, 57, 68

Variable X_{14} , straight - none
reverse - 37, 39, 44, 47

Variable X_{16} , straight - 33
reverse - 38, 48

Variable X_{20} , straight - none
reverse - 82, 84, 87

Example: Scores for student "number 001" were:

Variable X_{11}		Variable X_{14}	Variable X_{16}		Variable X_{20}
<u>S</u>	<u>R</u>	<u>R</u>	S	<u>R</u>	<u>R</u>
6	4	7	8	3	8
6	7	2	—	<u>6</u>	7
2	8	8			
3	9	8	S=8	R=9	8
2	2				
9	2	—	<u>S + R = 17</u>		<u>R = 23</u>
2	1	R=25			
9	6				

S=39 R=39

S + R = 78

The regression equation to be used to predict injuries to self was:
 $\hat{Y}_{21} = -2.35 + 0.12X_{11} + 0.28X_{14} + 0.68X_{16} - 1.06X_{20}$

For student "number 001" the equation would be:

$$\hat{Y}_{21} = -2.35 + 0.12(78) + 0.28(25) + 0.68(17) - 1.06(23) = 1.24$$

Therefore, $\hat{Y}_{21} = 1.24$ injuries to himself requiring a doctor's treatment or first aid during a three-year period.

This example shows that the regression equation can be used to predict an individual's accident experience. Student "number 001" did not have this type of accident, but the equation predicted him to have 1.24 injuries, while the mean of the total group was 6.3.

Before an instructor decides to use this semantic differential attitude scale alone or in combination with other variables, he must weigh its value as an accident prediction instrument. In this study the author at best was able to account for a little less than one-fourth of the variance.

Based on the results of this study, it appears that accident experience consisting of injuries to self or damage to property can be predicted for students in shop classes with 15 to 23 percent of the variance being accounted for. Using the testing procedure described in the study, shop instructors could identify those students who may be involved in accidents. Students, once identified as being accident repeaters, could be given additional safety instruction or other attention as considered necessary by the instructor.

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UTILIZING RESEARCH FOR ADULT FARMER PROGRAMS

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The salvation of mankind may eventually depend on adult education. Infinite waste of human resources in an ultra-modern complex society may result in chaos, but adult education can help citizens maximum their contribution to society or minimize their contribution to society or minimize their contribution to its eventual destruction.