Developing an Instrument to Assess Attitudes of Agricultural Employers and Employees Toward Farm Safety

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Abstract

Many research studies are concerned about measuring individuals' attitudes toward farm safety. However, valid and reliable measurement instruments are not readily available. Instruments for assessing attitudes toward farm safety were developed for both farm employers and farm employees. Four subscales were identified for use in the assessment: 1) General Farm Safety; 2) Personal Protective Equipment; 3) Shielding and Guarding of Tractors and Machinery; and 4) the Farm Shop. Items within each subscale were evaluated on content validity using a panel of experts. Readability was tested with three different statistical measurements and a sixth-grade class. Reliability was validated using test-retest and Cronbach's alpha. The final instruments were designed for administration in 10 to 15 min and the reliabilities for each subscale range from 0.61 to 0.83.

Keywords. Farm safety, Attitudes, Employers, Employees, Measurement instrument, Assessment.

Attitudes are an individual's "predisposition to act in a certain way toward or feel a particular way toward a person or thing" (Kerby, 1975). Attitudes are formed by one's experiences (Engel, Kollat and Blackwell, 1973; Kerby, 1975), through communications and persuasions from external sources, and by one's perception of the attitudes to achieve personal goals (Kerby, 1975). Attitudes are also ". . . a function of one's beliefs that their behavior will lead to certain consequences and their evaluation of these consequences" (Aherin and Baker, 1987). Several authors indicate attitudes contain three major domains: cognitive (perception and knowledge), affective (feelings and beliefs), and behavior (actions) or the tendency to behave (Engel, Kollat and Blackwell, 1973; Mueller, 1986; Pride and Ferrell, 1995). The cognitive component refers to the knowledge and information one has about the object or idea; the affective component relates to feelings, emotions, and unsubstantiated beliefs; the behavioral component pertains to the tendency to act toward the object or idea (Mueller, 1986; Pride and Ferrell, 1995). Knowledge about an object, feelings toward it, and behavioral tendencies are highly related. Therefore, knowledge, feelings, and behaviors are studied in an effort to draw inferences about attitudes (Mueller, 1986). One measure of the strength of commitment to an attitude is the amount of behavior performed because of this attitude; another

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measure is the public stance one has taken on a topic relevant to that attitude (Aherin, Murphy and Westaby, 1992).

Predicting behavior from one's attitude is not an exact science. The researcher needs to ask questions regarding a specific behavior in order to assess the attitude toward that behavior. However, attitude toward a general concept is not a good predictor of an intended behavior (Aherin, Murphy and Westaby, 1990; Aherin et al., 1992). Fishbein and Ajzen, as reported in Aherin et al. (1990 and 1992) and Aherin and Baker (1987), developed the Theory of Reasoned Action that states that behavior can be better predicted from one's intention to behave. This intention to behave is responsive to one's behavioral beliefs and one's normative beliefs. Behavioral beliefs help determine a person's attitude and are an indirect measure of that attitude. Normative beliefs are those that individuals feel are expected of them by society in general or by a particular reference group. In order to change behaviors, it is necessary to change one's intention to behave. Intentions to behave are changed by changing behavioral beliefs (Aherin et al., 1990; Aherin et al., 1992).

Triandis' Theory of Interpersonal Behavior (as reported in Aherin et al., 1992) also has intention as a determinant of behavior but includes habit and facilitating conditions as well. In this theory, intention to behave arises from three arenas: perceived consequences, affect (emotional reactions), and social factors. Habit, "behavior occurring without awareness", explained a large portion of behavioral variance in a study by Mittal (as cited in Aherin et al., 1992); facilitating conditions are those that enable the behavior to be carried out.

As part of a National Institute of Occupational Safety and Health (NIOSH)-funded project, the project staff was faced with measuring attitudes toward farm safety. There was a need to measure attitudes of farm employers and employees before treatment (safety training) to establish a baseline and after the treatment in order to show any change. These measurements were to be made at farms with employees and were to take only 10 to 15 min to complete.

The study population included farms from across Ohio which were enrolled in Workers' Compensation Group Rating Plans of cooperating organizations (Ohio Farm Bureau Federation, Ohio Pork Producers Council, National Federation of Independent Business). There was no attempt to control type of operation, number of employees, etc. Among those included in the sample could be greenhouse operations, cash grain farms, vegetable operations relying on migrant labor, livestock operations, large corporate farms, partnerships among family members, and smaller farms using seasonal part-time labor.

The staff identified four key areas of subject matter emphasis for which attitudes needed to be measured: general farm safety, personal protective equipment, shielding and guarding of tractors and machinery, and the farm shop. The four subscales were identified as being common to all types of farming operations: some type of personal protective equipment is needed whether one has field crops, livestock, greenhouses, orchards, or nurseries; tractors and some type of powered equipment are found on most, if not all, locations of agricultural production and, therefore, shielding and guarding are important; most farms have some equipment for maintenance and repair, including welders and power tools and some area designated for this work to be done; general farm safety covers those things not specifically found in the aforementioned subscales, including slips and falls, sun exposure, heat exhaustion, safety on the farm, and safety in general.

Materials and Methods

Because social concepts such as attitudes are abstract, the measurement process can be extremely prone to error. Therefore, it is essential that the measuring instrument is valid and reliable. An instrument is said to be valid if it is measuring the right things; reliable if its measurements are consistent and accurate (Mueller, 1986). The steps taken to ensure the validity and reliability of the instruments follow.

Validity

The first step in developing the instrument was to develop a pool of questions for measuring attitudes. The initial pool of questions came from a review of literature dealing with safety in agriculture and personal experiences of various project members. There were 84 individual items initially identified for inclusion based upon the four subscales of general farm safety, personal protective equipment, shielding and guarding of tractors and machinery, and the farm shop.

The 84 items were presented to a panel of experts for review. This panel consisted of nine specialists in farm safety, social science research, and educational program planning and evaluation. Validity was checked by this panel of experts as an on-going process throughout the development of the instrument. The panel members were asked to review the items for content validity: "Can this question be used to measure attitude, as it relates to each subscale category?". Re-wordings, eliminations, and item combinations were suggested. Based on this input, the number of questions was narrowed from 84 to 40. It was at the panel's recommendation that two separate instruments evolved, one for employees and one for employers. Items such as "I encourage my employees to act/work safely." were inappropriate for employees to address; the statement was modified to "I encourage my fellow employees to act/work safely.". Likewise, "One (1) rider at a time when driving a tractor is the rule on my farm." did not apply to an employee, but more directly reflected the employer's beliefs and practices toward this item of safety.

The 40 items were then reworded so that all were short, concise statements pertaining to safety. Some items measured the cognitive ("Taking regular breaks when operating equipment tends to reduce accidents.") and affective ("Wearing hearing protection makes it difficult to hear problems when operating equipment.") domains; others reflected the respondent's behavior ("I unplug power cords when servicing electrical equipment."). In addition, about half the items were stated positively and half were stated negatively to reduce response set. A five-point Likert scale was used for each question. The response categories were 1 = Strongly Disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, and 5 = Strongly Agree. The panel was again asked to review the revised questions and make additional suggestions. In the final instrument the subscale headings were removed and the items randomly arranged without regard to category.

As the instrument development process continued, the panel of experts provided comments and suggestions regarding the format (face validity) of the final questionnaire.

Readability

Because of the diversity of the farming operations in the population and their employees, it was essential to develop an instrument that could be easily read. Three different readability tests were used: Flesch Reading Ease, Dale-Chall Readability Formula, and the Fog Index. Additionally, it was tested with a sixth grade class.

The Flesch Reading Ease score used average sentence length and the average number of syllables per word to determine the reading ease score (Flesch, 1951). These scores were calculated through the Word Perfect 6.0a word processing program. The scores for the employer and employee instruments were 75 and 74, respectively. These scores translated into a seventh-grade reading level.

As a second and third check, the Dale-Chall Readability Formula (Dale-Chall, 1948) and Gunning's Fog Index (Londoner, 1967) were calculated. Both used an average sentence length and set multipliers to determine reading level. In addition, a table of "familiar" words was used in the Dale-Chall method against which terms were matched. Words in a document not appearing on the list were considered "unfamiliar" and added points to the total score. The Fog Index used a syllable count of words. Words with three or more syllables added to the score.

The Dale-Chall and the Fog Index were calculated by treating each subscale as a section. Both of these measures were scored by physically counting words, syllables, sentences, matching words, etc. The scores were Dale-Chall, 7.04 (9th/10th grade level) for the employee questionnaire and 7.37 (9th/10th grade level) for the employer questionnaire. The Fog Index was 11.14 (11th grade level) for the employee questionnaire, and 11.59 (11th grade level) for the employer questionnaire. Limitations of these methods and possible explanations for their higher scores included: (a) both were designed to be used with passages in written material where one identifies typical paragraphs on which to do the calculations; (b) common agricultural words (tractor, machinery, equipment, seatbelt, welding, respirators, etc) did not appear on the Dale-Chall list, therefore increasing the scores; and (c) words such as machinery, equipment, respirators, and agriculture containing three and more syllables also increased the Fog Index score.

Because of the incongruence of the three formal tests, the instruments were taken to a rural public school in Fairfield County, Ohio. Eighteen, sixth grade students were asked to read the instruments and to circle any words they did not understand. The words circled by the sixth grade class and their frequencies are shown in table 1. A thesaurus was used to change those words circled most often that were not inherently a part of the agricultural environment. For example, gauntlet, impractical, reflect, seminars, emphasizes/emphasized and respondent were changed; respirators,

Table 1. Words not familiar to 6th graders

Word	No. Times Circled	Word	No. Times Circled
Respirators	22	Gauntlet	17
Emphasized	15	Impractical	13
Ventilation	9	PTO	9
Reflect	7	Arc	7
Emphasizes	6	Seminars	5
Ground plugs	5	Gauntlet-type	4
Precautions	4	Guards	3
SMV	3	Degree	2
Respondent	2	Questionnaire	2
Step/rung	2	Rung	2
Vehicles	2	Prohibited	2
Immediately	2	Torn/baggy	1
Servicing	1	Accidents	1
Practices	1	Talk	1
Plugs	1	Individual	1
Concern	1	Restricted	1
Cords	1	Guards/shields	1
Baggy	1	Re-fueling	1
Manufactures	1		

arc, PTO, ventilation, guards, and SMV were not. Flesch, Dale-Chall, and Fog Index were recalculated. Both Flesch and Dale-Chall scores remained at their previous levels of seventh and ninth/tenth grade, respectively. The Fog Index was lowered to tenth-grade status.

Reliability

Reliability was measured two ways: (1) test-retest, and (2) internal consistency. Reliability coefficients show the extent to which an instrument is dependable and consistent. A coefficient of 1.0 indicates a perfect reliability; scores below 1.0 have lower reliability. Nunnally (1972) noted that the desired magnitude of the coefficient can vary depending on the circumstances: 0.80 is a commonly used goal but 0.50 to 0.60 may be sufficient in the early stages of research. Mueller (1986) noted that a list of few items tends to result in lower reliability coefficients. A reliability coefficient of 0.6 was the goal for this instrument development process.

The instruments were tested for stability over time by test-retest reliability. A college class of juniors and seniors studying agricultural safety and health was asked to complete both questionnaires in February and again two weeks later in March. Thirteen students completed questionnaires on both days. The responses of each student were compared item by item from the first test to the retest. Agreement was said to exist if a respondent marked either a 4 (agree) or a 5 (strongly agree) both times. Likewise, answers of 1 (strongly disagree) or 2 (disagree) were considered as a match. Finally, responses of 3 (undecided) were considered a match if answered the same both times. All the matches for an individual item were totaled and a proportion of the possible matches (13) calculated to give a reliability coefficient for each item. The coefficients for the items within each subscale were then averaged to yield a reliability coefficient for each of the four subscales. These overall figures are shown in table 2.

As part of the overall project, three focus group interviews were held in various parts of Ohio. Twenty-five farm employers participated in these focus groups. At the conclusion of the focus group, each farmer was asked to complete a farm employer questionnaire. Copies of the farm employee questionnaires and self-addressed, stamped envelopes were also given to those willing to have their employee(s) complete them. The employees who completed the questionnaires were selected by the employers, not the coordinators of the project. The purpose of pilot testing the instruments in this way was to get responses from people most like those who would be using the final instrument. In all, 25 employers and 28 employees completed questionnaires.

The responses to the items in each of the four subscales were analyzed using SPSS PC+ for Windows. Item-mean substitution was used if missing values occurred. Cronbach's alpha was calculated for each subscale on the employer and employee instruments to determine internal consistency. The results are shown in table 3.

Inter-item correlations show how each item (in this case, each question) discriminates among respondents. Each item must contribute to the measurement of a construct such as attitude. High total scorers on a subscale should also have a

Table 2. Test-retest reliability using college juniors and seniors

Subscale	Employer Instrument	Employee Instrument
General	0.84	0.76
Personal protective equipment	0.80	0.76
Shields and guards	0.75	0.70
Farm shop	0.76	0.76

Table 3. Initial internal consistency reliabilities (pilot test)

Subscale	Employer Instrument	Employee Instrument
General	0.66	0.68
Personal protective equipment	0.39	0.74
Shields and guards	0.72	0.73
Farm shop	0.43	0.59

high score on individual items. Likewise, low total scorers on a subscale should have a low score on individual items. This statistical process measures how each item contributes to the total score measurement. Items that do not discriminate among respondents are rejected. The result is a more homogeneous instrument (Mueller, 1986).

Using these inter-item correlations, items in each subscale were deleted until the highest coefficient was reached for each subscale. This effectively reduced the size of each of the attitude measurement instruments while increasing their reliabilities. The final employer and employee instruments had a total of 25 and 24 items, respectively. The final subscales contained from five to eight items. The number of items and the final alpha for each subscale, by instrument, is shown in table 4. A listing of the final items for each instrument, by subscale, is included in tables 5 and 6.

Summary and Conclusions

Measuring attitudes toward farm safety was one of the major problems facing the staff of a NIOSH-funded project. Attitudes toward a concept such as safety were comprised of cognitive (one's knowledge about the topic), affective (one's feelings and beliefs), and behavior (one's tendency to act). Few short, tested scales to measure this concept were found; none that addressed the areas of concern to the study. Instruments were developed to measure attitudes toward safety of both farm employers and farm employees.

A variety of methods was used to develop these instruments and to assure their validity, reliability, and readability. Eight steps were used to develop the employer and employee instruments to measure attitudes toward farm safety: (1) determined initial ideas for items, (2) conducted a review by a panel of experts to assess content and face validity and reduce the number of items, (3) determined readability scores, (4) established test-retest reliability, (5) conducted a pilot test with individuals similar to those for whom the instruments were being developed, (6) calculated reliability coefficients to determine internal consistency, (7) used inter-item correlations to identify items that weakened the instruments and removed those items, (8) limited the number of items to a length that could be completed in 10 to 15 min.

These instruments should be further tested to establish their use in various farm populations, therefore making them more applicable to other areas. Farm safety

Table 4. Number of items and reliability coefficients for final products

	Employer Instrument		Employee Instrument	
Subscale	No. of Items	Alpha	No. of Items	Alpha
General	5	0.75	5	0.77
Personal protective equipment	7	0.61	8	0.78
Shields and guards	7	0.72	6	0.83
Farm shop	6	0.67	5	0.66

Table 5. Final items by subscale for employee instrument

General:	Most workplace safety practices are unrealistic.
	The safety risks of farming concern me quite a bit.
	Safety should be stressed on the farm.
	I encourage my fellow employees to act/work safely.
	My employer emphasizes the need for safety.
PPE:	Short-sleeved shirts should be worn when working with chemicals.
	Safety glasses/goggles should be worn when using any type of machinery.
	Leather gloves with long cuffs should be worn when arc welding.
	Wearing hearing protection makes it difficult to hear problems when operating equipment.
	Precautions should be taken to protect the skin when working outdoors
	Torn/baggy clothing should be worn when operating machinery.
	Everyone who handles restricted-use chemicals should wear gloves.
	A shower should be taken immediately after working with chemicals.
Tractors:	Studying the manufacturers' equipment manuals increases safety in the workplace.
	Engines should be running when re-fueling equipment.
	Vehicles with “slow moving vehicle” (SMV) signs should not exceed 25 mph.
	It is safe to step over a moving PTO if done carefully.
	I ignore the safety stickers on equipment.
	The use of tractor seat belts should be left up to each individual.
Farm Shop:	I unplug power cords when servicing electrical equipment.
	It is OK to remove the ground plugs on tools.
	An engine should not be running in the shop without proper ventilation.
	I often play pranks on my co-workers when they are working with shop equipment.
	I usually bend over at the waist to pick up heavy objects.

Table 6. Final items by subscale for employer instrument

General:	I encourage my employees to act/work safely.
	Safety should be stressed on the farm.
	Safety is not as important as getting the job done.
	Most accidents are not preventable.
	I require the use of safe practices on my farm.
PPE:	Eye protection should be worn when handling chemicals.
	Respirators protect you from too much dust in a shop.
	A shower should be taken immediately after working with chemicals.
	Precautions should be taken to protect the skin when working outdoors.
	Respirators should be used to filter out toxic substances.
	Torn/baggy clothing should be worn when operating machinery.
	Safety glasses/goggles should be worn when using any type of machinery.
Tractors:	“One (1) rider at a time” when driving a tractor is the rule on my farm.
	A tractor is the most dangerous piece of equipment.
	The use of tractor seat belts should be left up to each individual.
	Studying the manufacturers' equipment manuals increases safety in the workplace.
	Engines should be running when re-fueling equipment.
	Guards are replaced after servicing machinery.
	Vehicles with “slow moving vehicle” (SMV) signs should not exceed 25 mph.
Farm Shop:	It is OK to stand on the top step/rung of a ladder when needed.
	I allow talk with others when someone is operating machinery/equipment.
	An engine should not be running in the shop without proper ventilation.
	The guards/shields of shop equipment should be removed to make the equipment easier to use.
	I allow pranks among my employees when they are working with shop equipment.
	I unplug power cords when servicing electrical equipment.

researchers interested in using attitude surveys may want to use these instruments as short, effective measurements.

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