

# Tractor Operators' Perceptions of Farm Tractor Safety Issues and Implications to Agricultural and Extension Education

**Fokwa Ambe**, Graduate Assistant  
**Thomas H. Bruening**, Assistant Professor  
**Dennis J. Murphy**, Professor

Historically, the purpose of farm safety and health educational materials and programs has been to persuade, convince or educate farmers, members of their families, and hired employees to voluntarily engage in safe behavior during farm or nonfarm work activities (Murphy, 1992). Increasingly, authors have noted that traditional farm safety educational programs have been relatively ineffective (Aherin, Murphy, Westaby, 1992). According to Elkind (1993) assumptions that attitudes and behavior change can be accomplished through providing information is rather simplistic and perhaps invalid. Elkind (1993) found that among farmers who believed farming was the most hazardous occupation, approximately 90 percent of them would not discourage their children from farming. The generalized knowledge of hazards does not seem to translate into personal concern, on the part of farmers, for their own individual well being.

Witte, Peterson, Vallabhan, Stephenson, Plugge, Givens, Todd, Bechtold, Hyde and Jarrett (1992) found that in spite of farmers' beliefs that farm equipment accidents were severe, they believed themselves to be relatively invulnerable to such accidents. This false level of security is often transmitted to family members. Aherin and Todd (1989) reported that as children become older, their parents increasingly feel it is safe for the children to ride on farm tractors. For example, 87 percent of parents felt that it was safe for 10 to 12 year olds to ride, 95 percent felt it was safe for 13 to 15 year olds to ride.

Wilkinson, Schuler, and Skjolaas (1993), evaluated the Tractor Certification and Tractor and Machinery Certification Training Programs in Wisconsin comparing participant work practices and behaviors before the programs with their practices and behaviors after the programs. They concluded that the programs were not effective in changing unsafe work practices and behavior.

Robertson (1983) identified four assumptions of safety education that, when not met by a specific educational program, undermine the potential effectiveness of the training program. The assumptions state that:

Persons informed of risk will retain the information and take recommended action to reduce the risk.

Persons skilled in a given hazardous endeavor are less likely to be injured than those less skilled.

The educator has the means available to teach information or skill, and to cause behavioral change related to emotions, attitudes, and values.

The training of people to perform a hazardous activity to the point that any injury-reducing effect of the training is more than offset by increased injuries resulting from use of the new skill (p. 91-92).

Efforts aimed at reducing the level of risk associated with farm tractors need to start with farm tractor operators as active participants, advisors, and leaders in the endeavor. Witte et al. (1992) noted that major obstacles to the effectiveness of current intervention strategies include the lack of or little empirical evidence regarding what farmers think about farm equipment accidents and safety issues. According to Witte et al. (1992) present strategies are theoretical and focus on information exchange instead of persuasion.

Beginning from childhood, human beings gain knowledge, skill and understanding through education. Planning and developing safety educational programs should also begin with an understanding of how tractor operators learn and

what contributes to their learning. Brauer (1990) summarized a list of 14 principles of learning which may be considered when planning a safety education program. Among these are identifying the need for safety education, fitting program content to individual needs, organizing content logically, stimulating multiple senses, ensuring participation when performance is the goal, ensuring that simulations duplicate actual conditions, providing relearning to sustain knowledge and skill, and rewarding performance. Using a variety of approaches for safety training is essential for educating people to formulate safe decisions and to take safe actions. This is particularly crucial because it is through education and experience that people learn to minimize errors that lead to accidents and injuries (Brauer, 1990).

Developing an effective farm tractor safety education program to reduce tractor related injuries requires an understanding of the tractor operator's personal regard for farm tractor safety and related issues. Since it is increasingly important to involve the clientele group in the development of purposeful education programs, perceptions and beliefs were sought from tractor operators regarding life-threatening safety issues.

### **Purpose and Objectives**

The primary purpose of this study was to identify the perceptions of tractor operators by age groups. The secondary purpose was to identify implications of these perceptions to educational practice. Data collected was analyzed to establish descriptive characteristics of farm tractor operators and differences that may exist in the perceptions of aged, middle aged, and young adult tractor operators. The objectives of the study were as follows:

Identify perceptions of tractor operators in Pennsylvania regarding farm safety beliefs and behaviors.

Identify beliefs of tractor operators regarding farm tractor safety issues and their implications to educational practice.

### **Procedures**

To accomplish the objectives of the study, a sample of 557 tractor operators was randomly selected from the frame of farm tractor operators

(adult members of the Pennsylvania Farmers' Association) using random numbers generated by computer. The 557 individuals, who were stratified by age, were composed of a representative sample of 270 farm tractor operators between ages 18 and 64 and 287 farm tractor operators age 65 and older. Eligible farm tractor operators for the study were encouraged to participate voluntarily.

A questionnaire was developed and refined through consultation with an advisory committee consisting of land-grant university agricultural safety specialists, a product safety engineer, a National Institute for Occupational Safety and Health (NIOSH) safety specialist, and agricultural extension educators. The questionnaire was also field tested by tractor operators not included in the sample. Returns from the two mailings of the survey totaled 288 usable questionnaires, a 51.7 percent overall return. Cronbach alpha analysis established a minimum alpha coefficient of .66 and a maximum of .84 as the reliability of the subsections of the questionnaire. Twenty percent of the initial nonrespondents were contacted by telephone in a follow-up survey using randomly selected questions from the original questionnaire. A comparison of the telephone respondents with the mail respondents indicated no significant differences between the two groups.

The analysis of variance was used to evaluate differences between aged, middle aged, and young adult tractor operators. An alpha of .05 was established prior to the analysis of data. The probabilities reported were based on the analysis of variance.

### **Results**

The respondent groups were approximately equal in size. Thirty-four percent of the respondents were aged tractor operators, slightly more than 32 percent were middle-aged, and slightly more than 33 percent were young adult tractor operators. Aged tractor operators had an average age of 70.9 years, 48.8 years of experience operating farm tractors, and 11.5 years of formal education. Middle aged tractor operators had an average age of 54.4 years, 38.5 years of experience operating farm tractors, and 12.4 years of formal education. Young adult tractor operators had an average age of 35.3 years, 23.2 years of experience operating tractors, and 13.8 years of formal education.

Table 1. Means and Standard Deviations of Tractor Operator Responses Regarding Carrying Extra Riders by Age Group

Statement	n	All Respondents		Aged		Middle Aged		Young Adult	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
I allow extra riders age six years or less	279	1.32	0.56	1.19*	0.42	1.29*	0.55	1.49*	0.65
I allow extra riders between the ages of 7 and 13 years	277	1.47	0.60	1.40*	0.58	1.38*	0.53	1.63**	0.69
I allow extra riders between the ages of 14 and 17 years	278	1.56	0.64	1.58	0.67	1.51	0.55	1.62	0.71
I allow extra riders age 18 and over	275	1.78	0.71	1.75**	0.74	1.70*	0.55	1.94	0.79

A = Aged, M = Middle Aged, Y = Young Adult. A\*Y\* = Aged and Young Adult tractor operator means were significantly ( $p < .03$ ) different from each other at the  $\alpha = .05$  level of significance. Scale: 1=Never, 2=Occasionally, 3=Frequently, 4=Consistently.

In Table 1, tractor operators' behavior in the context of allowing extra riders on the most frequently operated farm tractor has been summarized in four categories of children's ages. Tractor operator respondents indicated a tendency to occasionally children to ride on tractors as children became older. Significant differences were noted by age groups for allowing extra riders age six years or less, riders between the ages of 7 to 13, and riders age 18 and over. No significant difference was noted by age group for occasionally allowing extra riders between the ages of 14 and 17 years. The differences among tractor operators relating to this behavior suggest that tractor operators do not experience the same temptation to allow extra riders on farm tractors across the three age groups as may be expected. Young adult tractor operators have a much higher temptation to allow an extra rider on farm tractors than all the other age groups. Aged tractor operators also have a much higher tendency to allow extra riders on farm tractors than middle aged tractor operators. These results confirmed the findings of Aherin and Todd (1989) indicating a sizeable percentage of parents who felt it was more acceptable to allow older children to be on tractors.

Selected farm tractor safety features were assessed to determine whether differences exist in tractor operators' perceptions of their usefulness when compared by the responses of the respective three groups. As indicated in Table 2, the highest mean score of 3.60 was for the statement, "the power-take off (PTO) guard is a useful safety feature," for which all age groups were also significantly ( $p < 0.03$ ) different at the  $\alpha = 0.05$  level of significance. When compared to other age

groups, aged tractor operators had a higher tendency to indicate that the PTO guard was a useful safety feature. Mean scores greater than three indicate that tractor operators perceived that the safety features indicated were either frequently or consistently useful. The notable finding in Table 2 is that farm tractor operators had very low mean scores regarding the use of the tractor seatbelt. This suggests that tractor operators in all three age groups do not perceive the tractor seatbelt as a useful safety feature.

Data reported in Table 3 shows that all tractor operators had a tendency to select the wrong tractor gear when in a hurry. Aged tractor operators had a higher tendency than the other two groups to indicate that locked brake pedals on their tractors did not transmit equal force to each rear wheel when pressed. All three groups tended to occasionally have problems with the tractor's levers when mounting and dismounting. All groups tended to occasionally have problems seeing the immediate surroundings of the farm tractor from the operator's seat. All of these conditions in critical situations could pose serious safety hazards to farm tractor operators.

Data summarized in Table 4 shows that tractor operators in all groups had a tendency to respond in a negative way regarding the retrofitting of all tractors manufactured between 1970 and 1985 without ROPS. Aged tractor operators had a lesser tendency to disagree with mandatory retrofitting of tractors manufactured between 1970 and 1985 than did the other groups. Tractor operators in all age groups had a tendency to be uncertain regarding an

Table 2. Means and Standard Deviations of Tractor Operator Responses Regarding Tractor Safety Features by Age Group

Statement	n	All Respondents		Aged		Middle Aged		Young Adult	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
The roll-over protective structure (ROPS) is a-useful safety feature	141	3.28	1.02	3.29	1.06	3.34	0.94	3.20	1.08
The enclosed cab with ROPS is a useful safety feature	139	3.37	0.96	3.40	0.97	3.39	1.00	3.31	0.93
The slow moving vehicle (SMV) emblem is a useful safety device	259	3.48	0.87	3.49	0.71	3.38	0.95	3.40	0.91
The tractor power-take off (PTO) guard is a useful safety device	244	3.60	0.84	3.66*	0.52	3.59*	0.81	3.40*	1.07
The work lights are a useful safety feature	245	3.36	0.86	3.83	0.85	3.37	0.82	3.33	0.91
The amber warning lights are a useful safety feature	224	3.41	0.88	3.38	0.81	3.43	0.77	3.26	1.03
I use the tractor's seatbelt	166	1.37	0.72	3.54	0.80	1.33	0.68	1.34	0.70

Note: A\*Y\* = Aged and Young Adult tractor operator means are significantly ( $p < .03$ ) different from each other at the alpha = .05 level of significance. Scale: 1=Never, 2=Occasionally, 3=Frequently, 4=Consistently.

Table 3. Means and Standard Deviations of Tractor Operator Frequency Levels Regarding Compatibility of Tractor Features

Statement	n	All Respondents		Aged		Middle Aged		Young Adult	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
When brake pedals that are locked together are pressed down, the brakes transmit an equal braking force to each rear wheel	252	3.44	0.89	3.40	0.92	3.39	0.91	3.56	0.82
I bump into/brush against levers/controls when getting on or off the tractor	264	1.72	0.69	1.70	0.63	1.64	0.66	1.83	0.77
The immediate surroundings are hard to see from the operator's seat because of the farm tractor's frame, cab or the rear wheels	236	1.69	0.69	1.71	0.78	1.67	0.77	1.71	0.65
I mistakenly select the wrong gear when in a hurry	266	1.54	0.53	1.62*	0.55	1.57*	0.52	1.42*	0.50

Note: A\*Y\* = Aged and Young Adult tractor operator means are significantly ( $p < .03$ ) different from each other at the alpha = .05 level of significance. Scale: 1=Never, 2=Occasionally, 3=Frequently, 4=Consistently.

annual safety inspection for tractors. They also had a tendency to strongly disagree to a government agency being allowed to certify tractors as being safe. Tractor operators also had a tendency to disagree regarding the issue of farmers bearing the major cost of retrofitting farm tractors if they were required.

The data in Table 4 shows that aged tractor operators tended to disagree less strongly with the statement suggesting that farm tractor operators should be required to have a tractor operator's license to operate a tractor on public roads. The aged group had a higher tendency to strongly disagree with being required to renew such a license every two years.

Table 4. Means and Standard Deviations with Regards to the Level of Agreement of Respondents Concerning Perceptions About Tractor Safety Issues.

Statement	n	All Respondents		Aged		Middle Aged		Young Adult	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
All farm tractors should be given safety inspection	279	2.80	1.22	2.74	1.20	2.72	1.22	2.88	1.24
Tractors should be certified as being safe before being sold or traded between farmers	275	2.98	1.21	2.93	1.27	3.02	1.18	2.95	1.20
If certification becomes mandatory, farmers should be allowed to certify their own tractors as being safe before selling/trading	276	3.16	1.18	3.19	1.14	3.10	1.25	3.15	1.17
If required, certification of tractors as being safe should be done by someone else (farm equipment dealers/insurance persons)	276	2.63	1.19	2.57	1.13	2.51	1.24	2.83	1.20
If required, certification of tractors as being safe should only be done by a government agency	274	1.49	0.80	1.56	0.80	1.41	0.85	1.47	0.79
If certification of tractors as being safe becomes mandatory, the cost should be shared by farmers and the government	273	2.54	1.31	2.55	1.20	2.60	1.37	2.40	1.35
It should be mandatory that tractors, except those used in low clearance situations, have ROPS and seatbelt	279	2.80	1.20	2.85	1.19	2.73	1.19	2.79	1.25
If a roll-over protective structure is not already in place, all tractors manufactured between 1970 and 1985 should be retrofitted	279	2.25	1.05	2.45 <sup>”</sup>	1.15	2.13	0.88	2.16*	1.09
If roll-over protective structures are required farmers should bear the major cost of retrofitting	276	2.09	1.12	2.27*	1.16	2.13	1.11	1.87*	1.07
If roll-over protective structures are required the government or tractor manufacturer should bear the major cost of retrofitting	272	3.33	1.19	3.20	1.21	3.43	1.17	3.33	1.22
Tractor operators should have a tractor operator’s license, similar to an automobile license, to operate a tractor on public roads	276	1.92	1.12	2.01	1.08	1.90	1.19	1.82	1.10
If the tractor operator’s license is required, it should be renewed every two years for operators over 65 years of age	274	1.97	1.00	1.87	0.88	2.00	1.12	2.05	1.02

Note\* A\*Y\* = Aged and Young Adults are significantly (p<.003) different. A\*M\*Y\* = All three groups are significantly (p<.008) different, at the alpha = .05 level of significance. Scale: 1=Strongly disagree, 2=Disagree, 3=Uncertain, 4=Agree, 5=Strongly agree.

## Conclusions

In spite of the efforts of safety specialists and other concerned groups to encourage farm families not to allow extra riders on farm tractors, tractor operators in this study indicated they occasionally allowed extra riders on tractors. This finding was corroborated by data from Aherin and Todd (1989) which indicated that parents had an increased tendency to allow children on farm tractors as their age increased. The persistent injury incident situation involving extra riders on tractors and the tendency for farm families to allow extra riders calls for a further indepth study of the behavior other than the current assumptions that tractor operators are too resistant to change their unsafe behavior. Literature suggests that adults believe they already are safety conscious. This explains why these adults have a mind set about safety education. Witte et al. (1992) found that farmers believed themselves invulnerable to farm equipment accidents. In view of the situation, multiple approaches to behavior modification are imperative to penetrate the existing adult mind-set which continues to be an impediment to the effectiveness of safety educational programs.

Of the several safety features assessed to identify differences in operator perceptions as to their usefulness as safety devices, the slow moving vehicle emblem (SMV) sign and power take off (PTO) guard were identified positively as useful safety devices as compared to the other devices. The tractor seatbelt was perceived as the least useful of all the safety features specified. There have been slow moving vehicle (SMV) emblems and PTO educational campaigns to inform farmers of their benefits. On the contrary, the importance and usefulness of rollover protective structures (ROPS) and tractor seatbelts have not been communicated effectively with the same tangible and persuasive experiences as the SMV emblem and the PTO.

Finally, all tractor operators had negative perceptions of all specified tractor safety issues regarding tractor safety inspection and certification, retrofitting tractors with ROPS and tractor operator licensure to operate tractors on public roads. However, all tractor operators' responses indicated that if the retrofitting of tractors with ROPS became mandatory government or tractor manufacturers should pay for the major part of the cost of retrofitting.

## Recommendations

Tractor safety education should involve tractor operators as active participants, advisors, and leaders. This is necessary because their needs and perceptions differ and it is through such active participation that the differences may be minimized. In addition, several authors suggest that farmers need to be actively involved in the learning process to enhance behavior modification regarding farm tractor safety on their part (Witte et al, (1992). According to Drawbaugh and Hull ( 197 1, p. 48-49), "Forgetting appears to be the result of recently learned material interfering with what the individual already knows. A person who has had only limited experience in a given area of work cannot remember learned details. As the amount of knowledge increases, the details become lost in configural storages they become subsumed by recent information and generalized principles."

This suggests that older learners may be having problems with incorporating new knowledge with experiential knowledge. In view of this fact, safety educational programming for aged tractor operators should include opportunities which enhance knowledge management and encourage relearning. The educational programs should include several educational approaches and learning opportunities to increase the tractor operator's chances of formulating safe decisions and to take safe action when required.

Tractors should be routinely inspected to insure that electronic and other tractor safety features have not been bypassed or disabled. The government, tractor manufacturers, safety specialists, county extension staff and tractor operators should work collaboratively in this effort to make tractor safety a success and Pennsylvania farms safe for all farm families.

### Implications for Agricultural and Extension Education

The results of this study suggest that past farm tractor safety education programs have had limited effectiveness. The job of the agricultural extension educator is to explore all the educational theories available when a particular combination of educational approaches do not work in a given situation. Tractor operators believed that the tractor power-take-off (PTO) guard and the SMV emblem are useful safety features principally because of

extensive and varied educational approaches in each of the situations. Allowing extra riders on farm tractors is an issue which still needs to be confronted with multiple behavior modification strategies one of which still requires educating the farming population involved.

Farm tractor manufacturers have in the past showered educational materials on users of farm tractors with the hope that such materials would be read, unsafe behavior would be modified and their legal responsibility sustained. The farm tractor industry needs to take the example of the automobile industry. Educational materials should be designed to purposefully stimulate more than one sense to motivate the learning of the materials. Farm tractor operators and extension educators must be involved in each stage of the design of the materials to facilitate their adoption.

The goal is to have safer farm tractors, safer farms, and healthful farm families in Pennsylvania. Agricultural and extension educators can accomplish this goal by incorporating teaching strategies that actively involve the learner and challenge manufacturers to develop learning opportunities for aged and other tractor operators.

## References

- Aherin, R.A., Murphy, D.J. & Westaby, J.D. (1992). Reducing farm injuries: Issues and methods. St. Joseph, MI: American Society of Agricultural Engineers.
- Aherin, R.A. & Todd, C.M. (1989). Accident risk taking behavior and injury experience of farm youth. Paper No. 89-5530. St. Joseph, MI: ASAE.
- Brauer, R.L. (1990). Safety and health for engineers. New York: Van Nostrand Reinhold.
- Drawbaugh, C.C. & Hull, W.L. (1971). Agricultural education: Approaches to learning and teaching. Columbus, OH: Charles E. Merrill Publishing Company.
- Elkind, P.D. (1993). Correspondence between knowledge, attitudes and behavior in farm health and safety practices. Journal of Safety Research, **24(3)**: 171-179.
- Murphy, D.J. (1992). Safety and health for production agriculture. St. Joseph, MI: American Society of Agricultural Engineers.
- Robertson, L.S. (1983). Injuries: Causes, control strategies, and public policy. Lexington, MA: Lexington Books, D.C. Heath and Company.
- Tevis, C. (1991). The mass media and agriculture. In Myers, M.L., Herrick, R.F., Olenchock, S.A., Myers, J.R., Hard, D.L., Wilson, K.W. (Eds.). Papers and Proceedings of the Surgeon General's Conference on Agricultural Safety and Health. 30-May 3, 1991, Des Moines, Iowa. Cincinnati, Ohio: Publication Dissemination, DSDTT National Institute of Occupational Health.
- Wilkinson, T.L., Schuler, R.T., Skjolaas, C.A. (1993). The effects of safety training and experience of youth tractor operators. Paper No. 93-6. Presented at the 1993 Summer Conference of the National Institute for Farm Safety, Inc., Coeur d'Alene, Idaho.
- Witte, K., Peterson, T.R., Vallabhan, S., Stephenson, M.T., Plugge, C.D., Givens, V.K., Todd, J.D., Bechtold, M.G., Hyde, M.K., & Jarrett, R. (1992). Preventing tractor related injuries and deaths in rural populations: Using a persuasive health message framework in formative evaluation research. College Station, TX: Texas A&M University System.