The Educational Effectiveness of Fire Demonstrations

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WE IN PUBLIC HEALTH have long known that injuries and deaths from burns in the home are a major problem. Nationally among all accidental deaths, those from burns rank third with 7,700 deaths in 1964 (*1*). In the home, deaths from fires and burns rank second with 6,300 deaths in 1964 (*1a*). Data from studies in Tennessee show that 26.2 percent of all deaths from home accidents were caused by fires and burns (*2*) and that 87.2 percent of all fatal accidents due to fires and burns occurred at home (*3*). Data from another Tennessee study reveal that accidents resulting in burn injuries to children ranked second only to motor vehicle accidents in severity from the standpoint of medical prognosis, present impairment, cost of treatment, and amount of time incapacitated (*4*), but that burn accidents were the most avoidable from the standpoint of the child and his caretaker (*4a*).

Means of preventing the fires that result in injuries and loss of human life are constantly sought. In the past educational efforts have been mainly through campaigns: fire prevention weeks, Little Miss Spark and Miss Fire Prevention beauty pageants, parades, slogan and poster contests, and other gimmicks. Educators have long doubted the effectiveness of such approaches.

The Fire Demonstration

More recently, methods designed to teach rather than promote have been developed. One such method is the fire demonstration developed in Mississippi County, Ark., by a representative of the Division of Accident Prevention, Public Health Service. The demonstration has a standardized script.

The demonstration begins with an explanation of the three essential elements necessary to start a fire. A fire triangle is used to explain that air, heat, and fuel are needed to make a fire and that a fire may be controlled by removing any one of these. The demonstrator extinguishes a candle by placing a glass over the flame, and the fire dies after exhausting the oxygen. By removing excess fuel (paper) from a metal pan the remaining small amount of paper soon burns out. Heat of burning paper is reduced by sprinkling the flame with water.

The fact that practically everything will burn under the proper conditions is portrayed by igniting steel wool from a flame. To show that a flame is not the only source of heat, steel wool is also ignited by placing it across the terminals of a battery and producing heat from electrical energy.

To illustrate the proper method of extinguishing a grease fire, a skillet of simulated burning grease, carried by a cutout of a housewife, is smothered by sliding the lid onto the skillet beginning on the side closest to the housewife. The flame is also extinguished by using baking soda.

Gasoline is used to demonstrate the misuse of household petroleum. A clear plastic tube is

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used to show that petroleum vapors are invisible and heavier than air. When the demonstrator places gasoline-soaked rags in a box at the top of the tube, the vapors travel down the tube to a candle at the bottom. The ignited vapors then travel up the tube, igniting the rags in the box and making the heated vapors visible. A chamber equipped with spark plugs is used to demonstrate the explosive force of gasoline vapors in a confined area.

The flammability of various household products is illustrated by spraying the mist of aerosol sprays into a flame. The spray becomes a flaming torch. Various types of sprays, such as hair spray and bug bombs, are used.

A mockup of a house and its electrical system is used to show the danger of starting house fires by overloading electrical circuits. The proper size fuse in an electrical light circuit is blown by overloading the circuit with several small appliances. This safety factor is then negated by inserting a fuse of too large an amperage or placing a penny behind the blown fuse. As a result the insulation on the wires in the walls and ceilings burns, starting a fire in the attic.

In March 1967, 8 kits were being used by 12 health department teams in 20 counties in Tennessee. A reported 26,000 persons saw the demonstration during the 1966 fiscal year, and it is likely that not all showings were reported by the demonstrators.

An unknown number of the fire kits are being used by public health personnel, primarily in the Midwestern States, the Southeast, and the Southwest. The kits are used not only by public health personnel, but by agricultural extension workers, schools, industries, fire departments, and others as well.

The Study

A study was conducted in Tennessee during the fall and winter of 1964–65 (*5*) to determine if fire demonstrations, conducted by public health personnel, are effective in changing knowledge, attitudes, and practices related to fires. The researchers sought to answer if specific knowledge about cause and prevention of fires is acquired, opinions regarding the cause and prevention of fires become more realistic, and household practices related to fire causation become more preventive as a result of viewing a fire demonstration.

The design of the study included testing groups for knowledge, opinions, and practices; presenting the demonstration; retesting the groups with the same items reordered; and interviewing and surveying the homes of a subsample of those tested.

A test of knowledge, opinions, and practices was devised consisting of true-false and agree-disagree items, a checklist of flammable-nonflammable substances, and an inventory of practices. In the development of the tests 20 groups were used for pretesting to refine questions and testing procedure and to determine test reliability. In each case the pretest questionnaires were administered in the same manner as that used with the study population, except that the tests were given before and after each group's regular program, none of which was on accident prevention. Pretesting the final form of the test with eight groups resulted in an average reliability score of 90.3. Each of the reliability tests was significant at or below the 0.001 probability level.

Tests were administered to 1,707 persons in 47 groups who saw the fire demonstration. The groups included home demonstration clubs, community clubs, civic and service clubs, parent-teacher associations, industrial groups, and school classes. Each group served as its own control, with each person providing his own base for measuring change. It was recognized that learning might be influenced solely by people meeting together in a group and taking a test; however, it was felt that these influences were not great in this study and changes could be attributed to the demonstration.

A 20 percent random subsample was drawn of the adults who took both tests and saw the demonstration. Household inspections and interviews with these 192 persons were conducted to determine degree of retention of knowledge and opinions and to find out whether or not the practices recommended in the demonstration had been adopted.

Results

In the total study population of 1,707 persons an extremely significant (0.001 level) acquisition of information and change to more desirable opinions resulted from seeing the fire demstration.

Those groups with low initial scores made the greatest gain because they had the greatest opportunity for improvement. Initial knowledge and opinion levels were extremely significant in their relationship to overall improvement in scores. The higher a person's initial score, the less opportunity he had for improvement.

When correction was made for initial level of knowledge, certain variables contributed significantly to improvement in knowledge scores. These included type of group, size of group, race, age, educational level, and whether or not the viewer had seen a demonstration before (see table).

The white persons in the study population made greater knowledge gains than the nonwhites. Level of education was directly associated with improvement in knowledge scores, except that the college graduates made next to the poorest showing.

In order of greatest gain in knowledge, the groups were school groups, industrial groups, civic and service clubs, PTA groups, community clubs, and home demonstration clubs. The smaller the group, the greater the knowledge gain. Improvement in knowledge scores increased with age to age 40 and then declined. If a viewer had seen a demonstration more than 2 years before, he made greater knowledge gain than those who had not seen one or had seen it more recently.

When correction was made for initial level of opinion, certain variables including residence, race, educational level, and homeownership contributed significantly to the improvement in opinion scores (see table).

The white viewers in the study population made significantly greater gains in opinion scores than did the nonwhites, and homeowners made greater improvement than renters. Level of education was directly related to improvement in opinion scores, except that the high school graduates made greater improvement than the participants with 1 to 3 years of college. Urban residents improved their opinions significantly more than rural residents.

Knowledge and opinion scores fluctuated over time, with a slight loss in average knowledge and a slight improvement in average opinion in the total interview sample over a 24-week

Summary of hypotheses of selected variables related to knowledge and opinion scores of 1,382 [1] persons, with degrees of freedom, F-values, and significance levels

Hypothesis	Degree of freedom [2]	Knowledge		Opinion	
		F-value	*P*=	F-value	*P*=
Rural-urban residence	1	3.50	(3)	4.83	0.05
Type of group	5	3.70	0.01	1.32	(3)
Size of group	3	3.52	.05	1.73	(3)
Race	1	15.62	.001	18.97	.001
Age	2	4.07	.05	1.79	(3)
Sex	1	.04	(3)	.16	(3)
Educational level	5	5.30	.001	3.22	.01
Homeowner or renter	1	1.66	(3)	12.95	.001
Type of heating	1	.20	(3)	.10	(3)
How learned of demonstration	4	.69	(3)	1.15	(3)
Ever seen demonstration before	3	2.73	.05	1.17	(3)
Have questions about demonstration	2	2.09	(3)	.36	(3)
Race, education, homeownership	7	7.45	.001	8.51	.001
Race, sex, age	4	5.65	.001	5.50	.001
Type groups, residence	6	4.31	.001	2.58	.05
Race, type of heating	2	7.88	.001	9.64	.001
Residence, type of heating	2	1.76	(3)	2.42	(3)

[1] Only 1,382 of the 1,707 persons in the study are included because of difficulties encountered in programing certain items due to the manner of precoding.

[2] The numerator degrees of freedom for each hypothesis were the same for both knowledge and opinion and are the ones presented here. The denominator degrees of freedom were 1,381 for all hypotheses for both knowledge and opinion scores.

[3] Not significant.

period. The loss and improvement were so slight, however, as to be of little practical significance. Although there was a slight correlation (0.18) between knowledge and opinion scores, it was so slight as to be of little practical significance.

The demonstration was not effective in changing three practices—use of fuses larger than 15 amps in electric light circuits, use of kerosene by adults to start fires, and storing of kerosene and gasoline in unapproved containers.

The demonstration was more effective in changing the intentions of females than males and nonwhites than whites. Those who said they intended to change a practice usually carried out their intentions and made the change.

Measured by indicated practices and intentions to change practices, there was no statistically significant relationship between knowledge and practices scores, but there was a statistically significant relationship between opinion and practices scores.

Generally, the lower a person's knowledge and opinion scores, the more likely he was to live in a house in poor condition and the more hazardous were his practices.

People living in houses in poor condition were statistically more likely to use fuses of more than 15 amps in electric light circuits than those living in houses in good and excellent condition. A higher proportion of people living in houses in poor condition kept kerosene, and significantly more of them stored kerosene in glass jars or jugs and used it to start fires than those living in houses in average, good, or excellent condition.

Conclusions

There was significant improvement in knowledge and opinion in the total study population, but the demonstration was not equally effective with all groups. The greater gains were made by better educated, young, white, urban viewers in small groups. Demonstrators should realize that these persons will profit most from the demonstration.

The demonstration was less effective in changing knowledge and opinions of the older, rural, nonwhite, less educated persons who rented their homes. These persons are in the high-risk groups from the standpoint of fires and burns, and generally persons with these characteristics did not belong to organized groups. Means must be found to communicate with the high-risk groups and improve the demonstration for them.

Attitudes were more difficult to change than knowledge, but this change had greater effect in altering behavior. For this reason, the demonstrator should attempt to alter opinions directly.

The fire demonstration was not effective in changing the most frequently observed hazardous practices—use of fuses larger than 15 amps in electric light circuits, use of kerosene by adults to start fires, and storing of kerosene and gasoline in unapproved containers. This study showed that different groups have different problems and needs. More nonwhites and those living in houses in poor condition had a source of heat which required manual starting, kept kerosene unsafely stored, and used it to start fires. More whites than nonwhites kept gasoline and used it to start fires. Significantly more families living in houses in poor and extremely poor condition had fuses larger than 15 amps in electric light circuits than did people living in houses in good and excellent condition. The demonstration should be so designed that it can be adapted to fit the varied interests and values of target audiences and offer direct assistance in meeting their needs.

When people make a commitment to change, they are more likely to change. During the demonstration the demonstrator should attempt to get a verbal or show-of-hands response from the viewers to the effect that they will correct hazardous practices related to fires.

Summary

The study showed that the fire demonstration was effective in changing knowledge and opinions of the total study population, but that certain groups made significantly greater gains than other groups. Those making the least gain in knowledge and opinion were the older, rural, nonwhite, less educated persons who rented their homes. These persons were in the high-risk groups from the standpoint of fires and burns and are the groups for whom effective means of communication must be found.

Improvement in attitudes made the greatest contribution to improvements in practices, and when commitments were made to change practices they were usually carried out. The demonstration should attempt directly to alter attitudes and solicit commitments. It was found that the demonstration was not effective in altering the most hazardous practices, and these practices were the ones most frequently encountered. Since practices vary by group, the demonstration should be redesigned so that it can be adapted to fit specific needs of target audiences.

REFERENCES

(*1*) National Safety Council: Accident facts. Chicago, 1965, p. 6; (*a*) p. 82.

(*2*) Tennessee Department of Public Health: Tennessee vital statistics—1964. Nashville, Undated, p. 20.

(*3* Tennessee Department of Public Health: Facts for accident prevention in Tennessee—fire and burns. Nashville, Undated.

(*4*) Tennessee Department of Public Health: Accidental injuries to Tennessee children. Nashville, 1962, p. 53; (*a*) p. 57. Mimeographed.

(*5*) Hopkins, H. P.: The educational effectiveness of fire demonstrations. Thesis. University of North Carolina, Chapel Hill, 1966.

To Study Methods of Disposing of Old Boxcars

The Public Health Service is seeking new ways to dispose of old boxcars because the usual method, open burning, pollutes the air in many parts of the country. The Solid Wastes Program of the Service's National Center for Urban and Industrial Health has awarded a $50,000 contract to Booz-Allen Applied Research, Inc., Bethesda, Md., to carry out a comprehensive 6-month study of railroad car dismantling.

Under the contract, the firm will study current operating practices of railroad car dismantlers throughout this country, summarize information on proposed new techniques, conduct feasibility studies of new techniques that promise acceptable pollution control and economic practicality, and develop a system for rating cleanliness and economic practicality of proposed car dismantling systems.

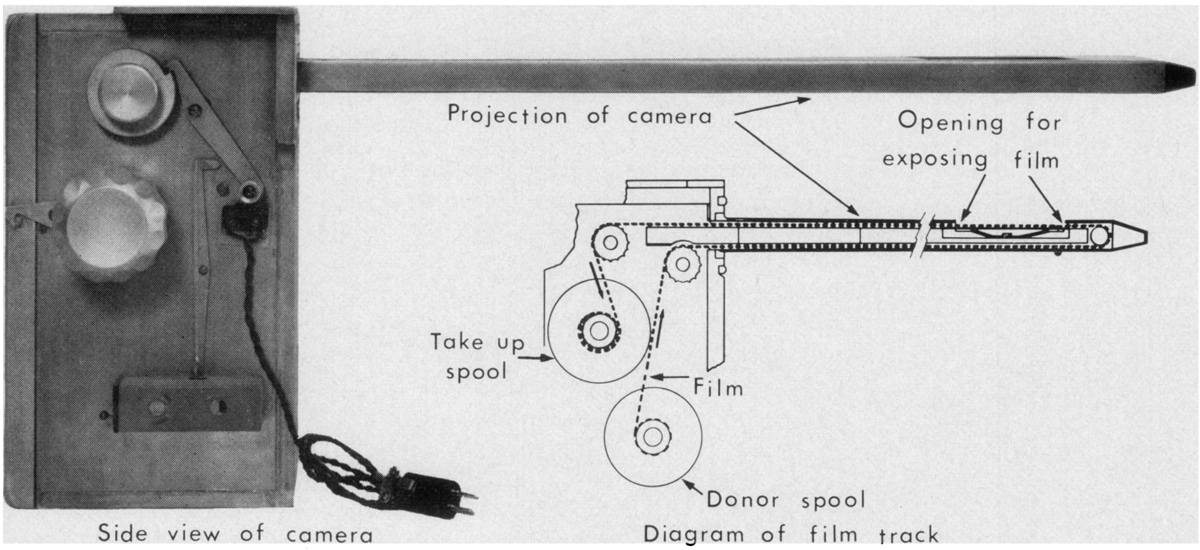
The Association of American Railroad Car Dismantlers asked the Solid Wastes Program to assist in devising better methods of salvaging scrap and reusable metal for the 100,000 freight cars that are taken out of service each year. It is hoped that the knowledge gained from the study may be applicable in the disposal of junk automobiles and other types of bulky wastes.

A 70 mm. Roll-Film Camera for Electron Microscopy

GRANTEE INVENTION

This easily removable camera permits exposure of several hundred micrographs, 2.9 inches long on 70 mm. perforated film, without breaking vacuum in RCA model EMU 3-B–H electron microscopes, as is now necessary after each five exposures. This camera will fit other microscopes after some changes.

The camera holds 60–100 feet of film, depending on the thickness of the film base. A projection of the camera replaces the cassette carrier in the photochamber and transports film to the exposure position and then to the takeup spool. Regular spacing of successively exposed portions of film is controlled by a film advance-knob and a frame-spacing cam and stop. Storing unexposed film under vacuum minimizes pump-down time in the microscope. Red-insensitive film can be removed under a safelight by withdrawing the film carrier sufficiently to permit removal of the takeup spool with exposed film. The free end of the unexposed film, or a new roll of film, can then be attached to a new takeup spool. Removal and installation of the original plate-carrier should first be done under the supervision of a microscope service man.—HIROSHI TONAKI, *senior electron microscope technician, department of biophysics, University of Chicago, at the time of this invention, now a research chemist in the Electron Microscope Laboratory, Edward Hines. Jr. Veterans Administration Hospital at Hines, Ill.*, JOHN HANACECK, *tool and instrument maker, Department of Biophysics, University of Chicago, and* WILLIAM BLOOM, M.D., D.H.C., *Charles H. Swift Distinguished Service Professor Emeritus of Anatomy, department of biophysics, University of Chicago. This apparatus was developed under Public Health Service grant No. 5RO1HDO1241–10.*



Side view of camera Diagram of film track