

Installation and Reliability of a Free Smoke Detector

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ABSTRACT

The present study reports 832 telephone interviews during the spring of 1984 with persons from two insurance companies in the same geographical area. In the fall of 1982 one of the insurance companies started to distribute a free smoke detector to all of its customers. The other insurance company served as a control and comparison group for studying the effects of a free smoke detector on installation and reliability.

The population in each insurance company was stratified into two insurance policy groups, and crossed with three age groups. Random samples of approx equal sizes were drawn. Around 94 percent of the persons in the samples were actually reached, and the interview about installation and reliability ended with a request to press the test button of the smoke detector.

The net effect of sending out a free smoke detector is more pronounced with household policy holders, although home policy holders more often have a smoke detector installed.

There is no general tendency that people who have bought a smoke detector take better care of it, maintain it better, install it in the right place more often, check it more often, or make it operate properly more often than those who have got a free smoke detector. However, for old people the free smoke detector has been out of working order more often than for young people.

Any such effect of a free smoke detector is not more pronounced with those who have a household insurance policy than with those who have a home insurance policy. Nor is there any such effect of age group.

It should be noted that around 16 percent of the smoke detectors that are reported by their owners to be in working condition, do not respond to the test-button being pressed.

INTRODUCTION

In the fall of 1982, a local insurance company in Sweden (Länsförsäkringar, Gästrikland, LFG) began distribution of a free smoke detector to all its customers with a policy including fire liability. Around 21.000 policy holders with a household (rental units or condominiums) or home (privately owned single-family homes) insurance policy received their detectors by mail before Christmas 1982, and some hundreds more after that time.

Very little is known about the installation and reliability of smoke detectors in general in Sweden. SMI [1] reported from a telephone survey in February 1984, that the average proportion of detectors had tripled (from 16 to 45 percent) from 1981 to 1984, and that 88 percent of those who had a detector were sure that it was in working order. The same study also reported the proportion of smoke detectors in apartments or small homes and across a few age strata.

Two mail surveys, which among other things addressed the installation and reliability of the free smoke detectors, have been carried out among the LFG policy holders (Blom et al, [2]; Eriksson et al, [3]). In the first of these two studies it was reported that on the average 79 percent had installed the free smoke detector, and that the proportion varied with age and kind of insurance policy. The second study reported that 86 percent of the free smoke detectors were said to work.

None of the above three studies have deliberately been designed to test hypotheses about installation and reliability of smoke detectors in various layers of the population. None of the two surveys on the free LFG smoke detectors made any attempt to evaluate whether there was any difference in these respects between free smoke detectors and smoke detectors that people have paid for. None of the three studies made any attempt to find a more valid measure of whether the detectors were in working order, than merely a report from the person interviewed.

The figures for the U.S. are higher than in Sweden for smoke detector installation. Gancarski and Timoney [4] reported that by 1982 two out of three U.S. homes had detector coverage. Their paper references three survey reports [5, 6, 7] and four field research projects [8, 9, 10, 11, 12] addressed to the effectiveness of home smoke detectors. It is interesting to note that one of surveys [7] gathered data by means of actual home visits rather than telephone interviews. It is also noteworthy that in [7] 30 percent reported never having tested their detectors, and in [12] only 38 percent of the detectors had been tested during the last month.

The study presented here tested a number of explicit hypotheses related to the fact the the LFG smoke detectors were free, and what effect this had on where the detector was put up, how it was maintained and checked. Of particular interest was to find out whether there was any variation in reliability and maintenance due to type of policy and age of policy holder. Comparisons were therefore made with another insurance company (Folksam, FO) in the same geographical area.

Another objective of the study was to find out whether or not the smoke detectors actually responded to the test button. This was a strong reason for employing telephone interviews.

The more general hypotheses can be phrased in the following way:

I. Those who have received a free smoke detector do not take as good care of it, do not maintain it, do not install it in the right place, and do not make it operate properly to the same extent as those who bought it themselves.

Ia. This effect of a free smoke detector is more pronounced with those who have a household insurance policy than with those who have a home insurance policy.

Ib. This effect of a free smoke detector is more pronounced with older people than with young and middle aged people.

With regard to the installation of free detectors the following hypotheses were formulated:

II. Those who have been sent a free smoke detector more often have an installed smoke detector than those who have bought one themselves.

Iia. This effect of a free smoke detector is less pronounced with those who have a household insurance policy than with those who have a home insurance policy.

Iib. This effect of a free smoke detector is less pronounced with older people than with young and middle aged people.

Note that Ia, Ib, Iia, and Iib are formulated as the interactions of the effects of a free smokedetector with insurance policy and with age group. That is, the effects of policy form and age groups in the company that did not give out a free smoke detector will be compared to the effects observed within the company who did.

METHOD

A total of twelve random samples of approx 75 persons each were taken from the two insurance companies. Stratifying variables were age (61+, 42-60, -41) and type of insurance policy (household, home). In March 1984 all of the persons in the sample were mailed a letter, saying they would be contacted over the phone for an interview. Nothing was however mentioned about smoke detectors being the subject of the interview.

From March through August 1984 842 telephone interviews were made, reaching 93.8 percent of the original net sample of 898 persons (see Table 1). Persons with non listed phone numbers were contacted by mail up to three times and asked to call back.

All of the interviewed were asked about whether they had or had had a smoke or fire detector installed, when they installed it, whether it was operative or not, in what room and where in the room it was put up, whether it had been in order all the time, how often and in what way they tested the smoke detector, whether it had given an alarm signal at any other time than during testing and the cause for that. At the end of the interview all those who said they had a smoke detector installed were asked to press the test button so the interviewer could hear the signal over the phone. Those who tried but did not succeed the first time were asked to try again and to keep the button pressed for 20 sec. Arguments for refusing were recorded, and later scored into "good" and "bad" arguments. Only arguments stating lack of will, but not lack of capability were scored as "bad".

RESULTS

In order to test the above hypotheses a saturated logit analysis (SPSS-X) was made, followed by successive eliminations of non-significant terms, employing the likelihood ratio chi square statistic for testing the remaining model against observed frequencies. (See [13,14] for more information about the statistical methods)

TABLE 1. The sample divided by insurance policy and age groups

	Household		Home	
	FO	LFG	FO	LFG
61+				
Net sample	70	76	76	72
Not reached	3	4	2	4
Interviewed	<u>67</u>	<u>72</u>	<u>74</u>	<u>68</u>
42-60				
	73	76	74	73
	9	13	3	0
	<u>64</u>	<u>63</u>	<u>71</u>	<u>73</u>
-41				
	81	75	75	77
	5	7	3	3
	<u>76</u>	<u>68</u>	<u>72</u>	<u>74</u>

Percent Smoke Detectors Installed Across Years

Figure 1 shows the cumulative percent of smoke detectors across years. There is no difference between the two insurance companies within the two policy forms before the fall of 1982 when LFG started to distribute the free detector.

Also, there is virtually no difference between age groups in adoption of smoke detectors.

The proportions of policy holders in the various sub-strata who report they had a smoke detector installed at the time of the interview are shown in Figure 2. For FO the average is 32 percent and for LFG 71 percent, a highly significant difference.

The significant effects of company (C) ($z = -11.01$) and the interaction C x policy (P) ($z = -2.05$), means that the effect of a free detector is different for the two policy forms. As can be seen in Figure 2 (row 3, col 1), there is a greater difference between the companies for the household insurance, which is contrarary to hypothesis IIa.

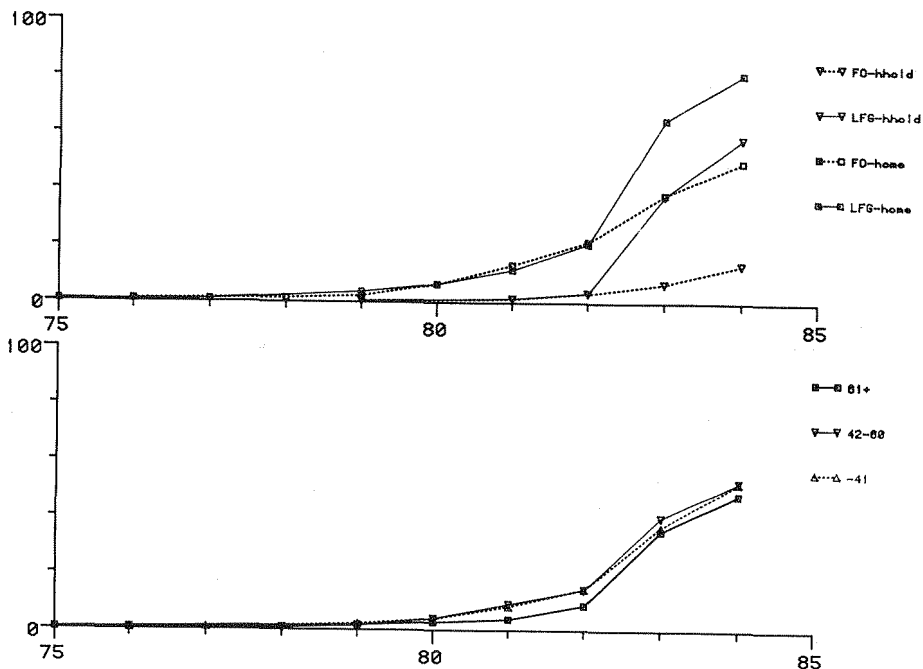


FIGURE 1. Cumulative percentage smoke detectors by year

The interaction C x age group (A) ($z = -2.50, 2.11$) indicates different age effects for the two insurance companies. In Figure 2 it can be seen that the difference is largest for the oldest group, which is contrary to hypothesis IIb. The significant interaction P x A ($z = .86, 2.41$) means that for the youngest group, there is the largest difference between policy forms.

Thus, the following conclusions can be drawn with regard to the hypotheses:

II. Yes, sending out a free smoke detector has increased the number of installed smoke detectors.

IIa. No, the effect of a free smoke detector is not less pronounced with those who have a household insurance policy than with those who have a home insurance policy.

IIb. No, the effect of a free smoke detector is not less pronounced with older people than with young and middle-aged people.

Operating All the Time

The percent of respondents with a smoke detector who said "yes" to the question whether their smoke detector had been operating all the time, are shown in Figure 3.

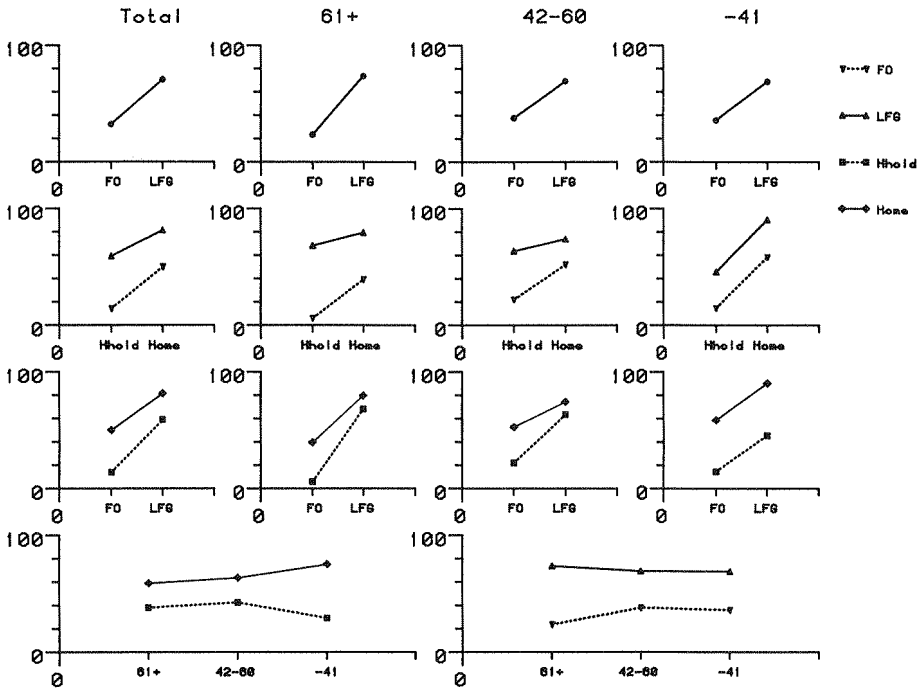


FIGURE 2. Percentage installed smoke detectors

Hypothesis I is supported, since there is a significant average difference between companies ($z = 7.37$).

The expectation inherent in hypothesis Ia, that a difference between the companies should be more pronounced for household policy holders than for home policy holders, is not borne out, since there is no significant interaction $C \times P$.

Concerning hypothesis Ib about the effect of age on the difference between the companies, there is an interaction $C \times A$ ($z = 12.97, -$). This means that the smoke detector has more often been in working order for F0 than for LFG for older and middle age people, while the reverse is true for young people. Hypothesis Ib therefore receives partial support.

Placement, Checks and False Alarms

In what room or where in the room the smoke detector is put up, whether the detector is checked at least once a month, and the number of false alarms did not significantly differ between groups in the way hypotheses I - Ib suggest.

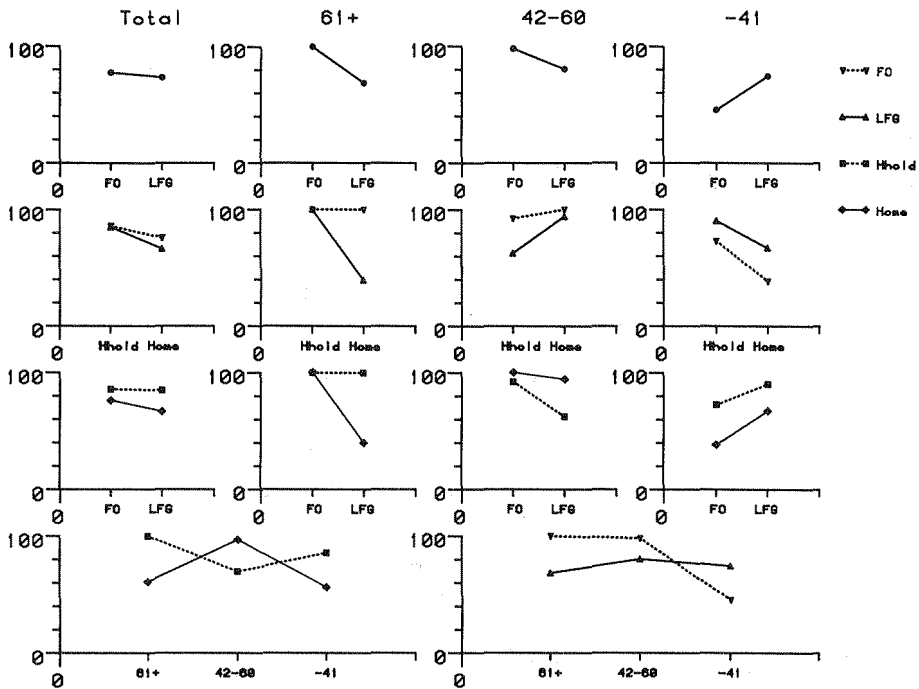


FIGURE 3. The smoke detector has been in working order all the time

Is the Smoke Detector in Operation?; Verbal Response

On the average 91 percent of the installed smoke detectors are verbally reported to be in working order. This figure does not significantly differ between subgroups in the ways stated by the hypotheses.

Is the Smoke Detector in Operation?; Button Press

Of those who reported that they had an operating smoke detector, and who agreed to press the test button (approx 17 percent did not press the test button for good or bad reasons), 84 percent of the smoke detectors responded. Thus, as shown in Figure 4, on the average 16 percent of the smoke detectors which are reported to be in working order did not react to pressing the test button. (If it is assumed that all of those who refused to press the button for bad reasons, have an installed but non-responding detector, this figure is doubled.)

In terms of hypotheses I - Ib there is no indication that the differences shown in Figure 4 reach significance.

Thus, hypotheses I - Ib are not supported.

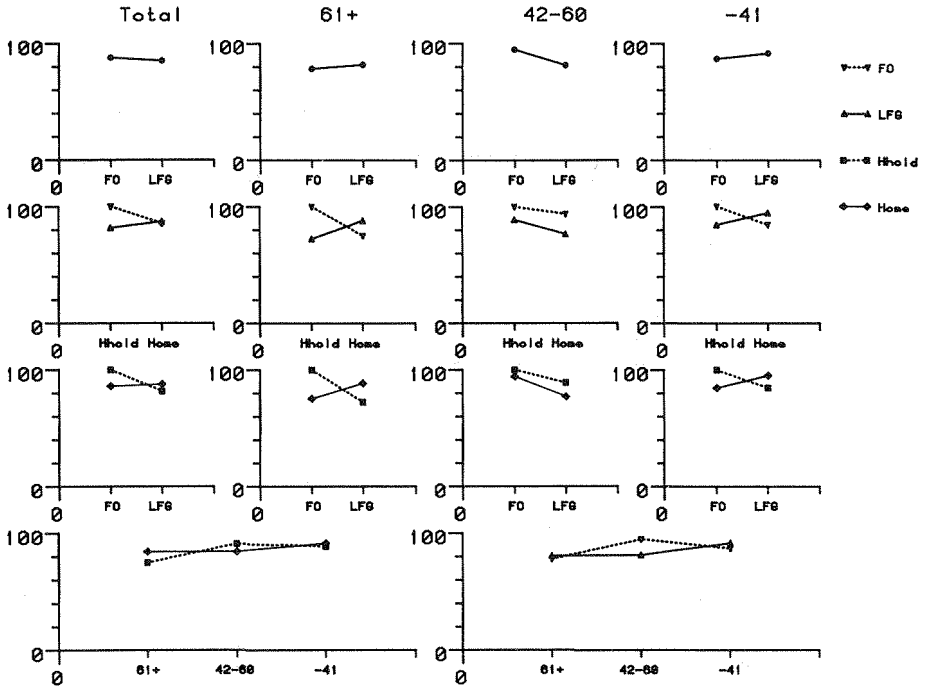


FIGURE 4. Smoke detector's response to pressing the test button

Refusals To Press the Test Button

The percentages who refused to press the test button are shown in Figure 5. There is no indication of an average difference between companies, and hypothesis I is not supported.

Also, there is no support for hypothesis Ia and Ib, since there are no indications of an interaction $C \times P$ or $C \times A$.

There is an effect of age ($z = -2.77, -2.17$) and of policy form ($z = -3.06$).

DISCUSSION AND CONCLUSIONS

Household policy holder do install their free smoke detector to a larger extent than do home policy holders. However, this may be a ceiling effect attributable to the fact that there was a higher percent smoke detectors in homes than in households before the free smoke detector was given out.

Older people do not differ from other age groups in how often they install a free smoke detector.

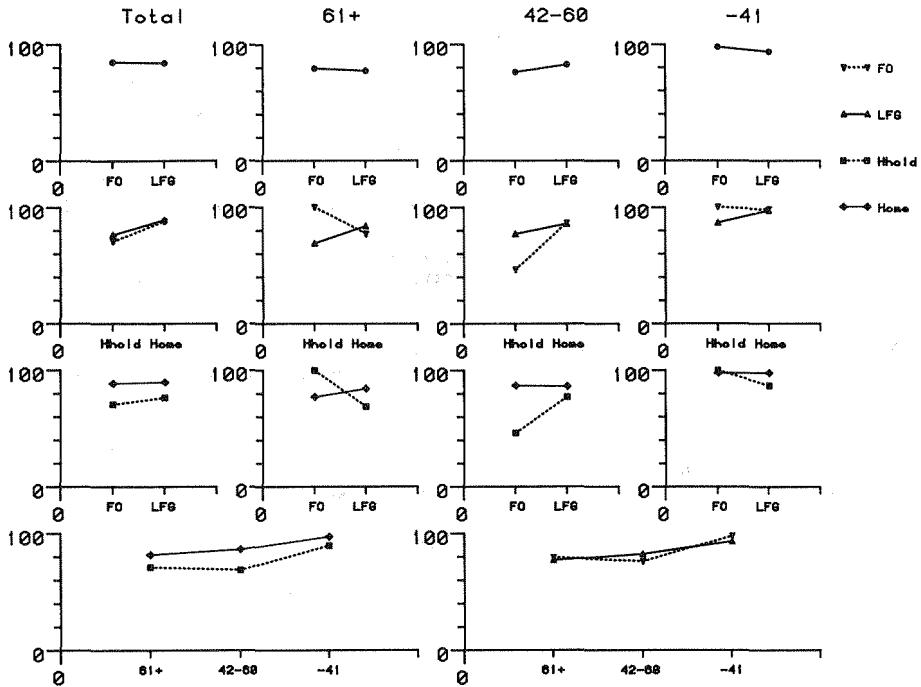


FIGURE 5. Pressed vs refused to press test button

There is no general tendency that people who have bought a smoke detector take better care of it, maintain it better, install it in the right place more often, check it more often, or make it operate properly more often than those who have got a free smoke detector.

Nor is any such effect of a free smoke detector generally more pronounced with those who have a household insurance policy than with those who have a home insurance policy, or for any age-group.

It should be noted that approx 16 percent of the smoke detectors that are reported by their owners to be in working condition, do not respond to pressing the test-button.

REFERENCES

1. Skandinaviska Marknadsinstitutet, SMI. "Telefonintervjuer - brandkunskap hos allmänheten," (Telephone Interviews - The Public's Knowledge About Fire). Skandinaviska Marknadsinstitutet, Stockholm, 1984.
2. Blom, R., Hällberg, K., Johansson, L., and Maikulangara, V. "Ingen rök utan eld - en undersökning av brandvarnare i Gästrikland," (No Smoke Without a Fire - A Study of Smoke Detectors in Gästrikland). Department of Statistics, University of Uppsala, 1983.

3. Eriksson, M., Natvig, H., Jansson, T., and Berge, K. "Brandsläckare - en vän i nöden," (Fire Extinguisher - a Friend in Need). Department of Statistics, University of Uppsala, 1984.
4. Gancarski J.L. and Timoney, T. "Home Smoke Detector Effectiveness," Fire Technology, 20: 4, 57-62, 1984
5. "Residential Smoke and Fire Detector Coverage in the U.S.: Findings from a 1982 Study," Federal Emergency Management Agency, Washington, DC, 1982.
6. "Survey and Analysis of Occupant-Installable Smoke Detectors: A Summary," Report prepared by the Aerospace Corporation, U.S. Fire Administration, Washington, DC, 1978.
7. "Pilot Study Designed to Test Effectiveness of Smoke Detection Devices in Private Dwellings," prepared by L.N. Moyer and S.E. Miller, U.S. Fire Administration, Washington DC, 1978.
8. "Detector Sensitivity and Siting Requirements for Dwellings (a report of the "Indiana Dunes Tests")," prepared by R.W. Bukowski, W.J. Christian and T.E. Waterman, Center for Fire Research, Washington, DC, 1975.
9. "Detector Sensitivity and Siting Requirements for Dwellings: Phase 2 (part 2 of a report on the "Indiana Dunes Tests")," prepared by S.W. Harpe, T.E. Waterman and W.J. Christie, Center for Fire Research, Washington, DC, 1976.
10. "Fire Statistics for 1980 and the Role of Smoe Detectors," prepared by J.H. Darge, Ontario Housing Corporation, Maintenance Engineering Branch, Toronto, Ont., Can., 1981.
11. Moore, D.A. "Remote Detection and Alarm for Residences: The Woodlands System," Fire Journal, 74, 1, 1980.
12. "An Evaluation of Residential Smoke Detectors under Actual Field Conditions: Final Report," prepared by the International Association of Fire Chiefs Foundation, U.S. Fire Administration, Washington, DC, 1982.
13. SPSS-X. User's Guide. New York: McGraw Hill 1983.
14. Haberman, S.J. Analysis of Qualitative Data. Volume 1. New York: Academic Press 1978.