

PUBLIC BENEFITS TO A SMOKE ALARM PERFORMANCE EVALUATION SCHEME

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Based on original research by Everett Baker, Tyler Bennett, Jimmy Mosteller, and John Williams (WPI)²

ABSTRACT ● **Objective** The study conducted by WPI researchers examined whether additional performance information on smoke alarm packaging would be beneficial to the consumer and the public in making a decision on which type of alarm to select. ● **Setting** Investigators conducted in-person interviews at a local hardware store and collected online surveys during November and December 2015. ● **Participants** Forty-five in-person interviews and 479 online surveys were conducted. ● **Intervention** Consumers were interviewed at a local hardware store. Additional interviews were with Purdue University faculty members and personal acquaintances of the investigators. An online survey was developed and distributed by faculty members, family, and personal acquaintances. ● **Main outcome measures** Information that provided insight into consumer choices for smoke alarms and consumers' knowledge and understanding of smoke alarms. ● **Results** Almost all, 95.6 percent (43/45), of the in-person respondents who participated, were certain that they have a smoke alarm in their residence, but only 14.4 percent (6.5/45) were aware that different types of smoke alarms respond to different types of fires. Sixty percent (27/45) responded that the smoke alarm near or in the kitchen goes off often (nuisance alarms). Most respondents interviewed, 93.3 percent (42/45), would find it beneficial to have a smoke alarm performance rating system. ● **Conclusions** The data collected cannot be generalized, but they showed that respondents care about the performance of a smoke alarm in a fire, but it was not a major factor when purchasing a smoke alarm. This could be for two reasons: (1) lack of awareness of the variation in smoke alarm detection capabilities; and (2) performance specifications are not clearly specified on packaging. Additional information on a smoke alarm's capabilities, such as a rating system that is readily understandable and visible on the packaging, could be beneficial to raising consumer awareness that performance differences exist, and to assist them in making a more-informed decision in the selection of these important life safety devices.

A MAJORITY OF CONSUMERS use online reviews and additional information in making their purchases.^{3,4}

The buying process for a product begins anywhere along a typical six-stage buying process.⁵ The six stages are 1. Recognition of Need; 2. Search for Information; 3. Product Evaluation; 4. Product Choice and Purchase; 5. Post Purchase Use and Evaluation, and 6. Disposal of the Product. Consumers considering purchases could be thinking about the different features they want or need in the near- or far-term; how they are going to find the best item at the best price, and where and how will they buy it. Meanwhile, consumers may be subconsciously re-evaluating products they already own, possibly considering whether there are other products better than the item they own; how to discard their product when they replace it; and which item to purchase as a replacement. Depending on the product, consumers may not use or may skip some of the stages when

purchasing a product, especially a low-involvement product, such as a smoke alarm.

Generally, low-involvement products are inexpensive and are perceived to pose a low risk to buyers if they make a mistake purchasing them.⁶ For many consumers, smoke alarm purchases fit the characteristics of a low-involvement purchase. Consumers may understand that they should have smoke alarms but may not understand the differences in performance or features relative to their needs. Therefore, having low interest in selecting the alarm, these consumers will put little thought into its purchase. For these low-involvement products, consumers may perceive that the smoke alarms available are the same or perform similarly. A 2015 survey conducted by ORC International on behalf of Kidde Fire Safety found that 44 percent of respondents correctly identified 45 days as the shelf life of a Twinkie™; while only 9 percent correctly noted 10 years as a smoke alarm's operating life.⁷ The survey also found that nearly 50 percent of Americans spend 15 minutes or less shopping for new smoke alarms.

A smoke alarm is critical for the early detection of a fire in your home and could mean the difference between life and death. All listed residential smoke alarms sold in the United

³ KIELER, A. (2015, June 3). Nearly 70% of Consumers Rely on Online Reviews Before Making a Purchase. Retrieved January 27, 2016, from <http://consumerist.com/2015/06/03/nearly-70-of-consumers-rely-on-online-reviews-before-making-a-purchase/>.

⁴ ANDERSON, M. (2014, July 7). 88% of Consumers Trust Online Reviews as Much As Personal Recommendations. Retrieved January 27, 2016, from <http://searchengineland.com/88-consumers-trust-online-reviews-much-personal-recommendations-195803>.

⁵ TANNER, J., & RAYMOND, M. (2012). Market Principles (Vol. 1).

¹The views expressed in this report are the CPSC staff analysis of independent work conducted by WPI researchers² and have not been reviewed or approved by, and may not necessarily reflect the views of, the Commission. This document was prepared in the authors' official capacities and may be freely copied.

² Bennett, T; Mosteller, J.; Baker, E, and Williams, J. (December 17th, 2015), *Need for a Consumer Focused Smoke Alarm Performance System*, Worcester Polytechnic Institute, MA.

⁶ TANNER, J.; RAYMOND, M.A.; Market Principles v. 1.0, 2012

⁷ Survey: Consumers Know More About Snack Cakes than Smoke Alarms. (2015, October 15). Retrieved January 27, 2016, from <http://www.prnewswire.com/>.

States meet the minimum voluntary standard performance requirements of UL 217 Smoke Alarms.⁸ Even though listed smoke alarms meet UL 217, some smoke alarms exceed this minimum requirement; that is, they may respond faster and/or more selectively to different kinds of smoke that occur in fires. Because UL 217 does not distinguish performance levels beyond the minimum thresholds, consumers have no means to compare smoke alarm performance when deciding which alarm to buy.

During their practicum at the Consumer Products Safety Commission (CPSC), as part of their curriculum, a group of students from Worcester Polytechnic Institute (WPI) conducted a study to determine if additional performance information on the packaging would be beneficial to a consumer in their decision making. The study focused on the following topics:

- What important smoke alarm measures, such as detection time, nuisance alarming resistance, or installation features may affect the selection of a smoke alarm by consumers?
- How much do the advantages and disadvantages of smoke alarm performance affect the selection of a smoke alarm?
- Are consumers aware that smoke alarms perform differently?
- How can information about smoke alarms (packaging and labeling) better inform consumers about what they are purchasing?

The 2015 WPI team of Everett Baker, James Mosteller, Tyler Bennett and John Williams conducted their Interactive Qualifying Project (IQP) on examining the public benefits of performance information for smoke alarms. The IQP is not organized as a course, nor is it related to any particular major. Instead, the students work under the guidance of faculty members to conduct research, using social science methods directed at a specific problem or need. Students deliver findings and recommendations through a formal report and oral presentation to project sponsors and their faculty advisor. The team spent 6 weeks working with CPSC National Product Testing and Evaluating Center staff in Rockville, MD. The final report, *Evaluating the Need for a Consumer Focused Smoke Alarm Performance System*, contains their research and was submitted to the WPI advisors on December 17, 2015. This paper is a summary and analysis of their findings.

METHODS AND RESULTS

The WPI students used a combination of in-person interviews and online surveys for the study. They conducted limited in-person interviews, and achieved a high response rate with the online version of surveys. The first data collection effort was to gain information on how much consumers know about smoke alarms and what consumers look for when purchasing a smoke alarm. The second data collection effort was to gain information on the benefits to consumers of additional performance information on smoke alarm packaging.

The students visited 11 stores that sell smoke alarms in the Washington, D.C., metropolitan area. Only one local hardware store agreed to allow the students to conduct consumer surveys on its premises. Additional interviews were conducted with Purdue University faculty members and personal acquaintances. There were a total of 45 in-person interviews. Twenty-nine interviews were with customers at the local hardware store, four

with Purdue University faculty, and the remaining 12 with personal acquaintances of the students.

The interviews and surveys discussed below represented limited convenience samples that provide information without being extendable to the general population. The interviews revealed that 95 percent of the responding consumers had at least one smoke alarm. Slightly less than half of the respondents had ever purchased a smoke alarm, and only 14.4 percent of the respondents were aware that different smoke alarms respond differently to different types of fire. This supports findings in a report by the National Fire Protection Association (NFPA), indicating that consumers typically do not know what type, ionization or photoelectric, smoke alarm they have or own.⁹ The student's survey showed that of the respondents that have ever purchased a smoke alarm, 27.5 percent of the respondents knew smoke alarm performance varied with fire types. This is almost twice than the overall (27.5% vs. 14.4%) number of respondents who were aware of smoke alarm performance. This may suggest that performance of smoke alarms is filtered by consumers until needed, such that consumers may not seek additional information on smoke alarms until when it's time to purchase a

Question	Percent "Yes"
Do you have a smoke alarm in your home?	95.6
Have you ever purchased a smoke alarm?	44.4
Were you aware that some smoke alarms respond faster to certain fires?	14.4
Are you aware of the locations in your home where smoke alarms should be installed?	56.7
Do you have a smoke alarm inside or near your kitchen that goes off often?	60.0
Would a smoke alarm performance rating system, much like that of the 5 star crash test safety rating system for cars, influence your decision on which smoke alarm you would purchase?	93.3

smoke alarm. Overwhelmingly, 70 percent of the respondents who have ever purchased a smoke alarm did not know that smoke alarms perform differently to fire types; this supports a hypothesis that the majority of consumers may view smoke alarms as low-involvement purchases. Also important to consumer safety, 93 percent of the respondents positively answered that a smoke alarm performance rating system would influence their buying decision.

Students included one open-ended interview question, to which respondents were encouraged to list as many answers as they could. The question was "What do you look for when purchasing a smoke alarm?" Responses were categorized so that they could be quantified. Seven of the 45 respondents listed nothing for this question. The top response was reliability, but it is possible that reliability did not have the same meaning to all respondents. Respondents may have used reliability to mean "reliable in a fire," "reliable for the expected life of the product," or something else. The respondents were not asked to elaborate on reliability. Battery life, ease of installation, and price were also top responses. None of the consumers used the words "performance" or "respond quickly" in a fire, but nuisance resistance was mentioned by five of the 45 respondents.

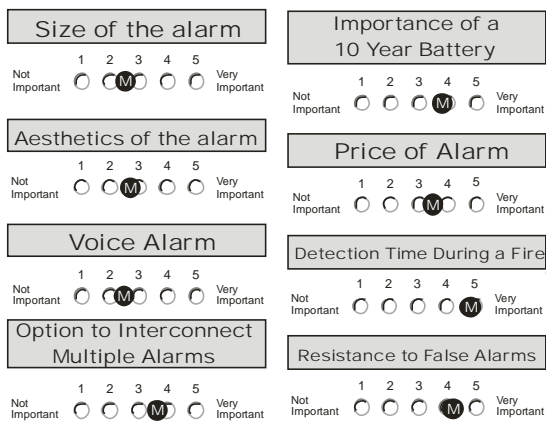
Reliability of a smoke alarm may convey the concept of dependability, successful operation or performance and/or the

⁸ UL 217, Standard for Safety Smoke Alarms (8th ed.). (2015). Northbrook, IL: Underwriters Laboratories.

⁹ AHERN, M. (2015, September). Home Structure Fires. Boston, MA. National Fire Protection Association.

absence of failures. Unreliability (or lack of reliability) conveys the opposite and this may arise from the consumer’s experience with smoke alarm, such as chirping in the middle of night, nuisance alarming when cooking, or failure to sound when the test button is pressed.

After the interview, 35 of the respondents filled out a survey that had them rate the level of importance (1 - not important to 5 – very important) for specific topics. A link to an online version of the survey was sent to WPI faculty, the students’ parents, and acquaintances. The online survey received 206 responses. Most of the online respondents listed detection time and nuisance resistance as important features for a smoke alarm. The importance of smoke alarm cost was rated slightly above average, which was fifth in the ranking and similar to “option to connect multiple alarms.” The size of the alarm, aesthetics of the alarm, and voice alarm ranked the lowest in importance in the survey.



M= mean

In the second survey, the students had interviewees look at various generic smoke alarm packaging that contained different information on the packaging. The same local hardware store for the interviews used previously was used during this survey. An online survey was also made available. A link to the online survey was distributed to WPI faculty staff, student families, and their acquaintances. There were 97 respondents from the online version of the second survey and 22 respondents at the local hardware store.

Respondents were first presented with three smoke alarms and asked to select the smoke alarm in order of preference. All the alarms were priced the same, but contained different levels of information on the packaging. One smoke alarm contained minimum information. Another smoke alarm contained a features list. The third smoke alarm contained a performance rating for fires and resistance to nuisance alarms.



Most of the respondents selected the smoke alarm with the features list (44%) or the smoke alarm with the performance

rating (35%) as their first choice. The smoke alarm with the minimum information was selected by 20 percent of the respondents. Similar results were for the respondents’ second choice. Fifty-six percent of the respondents selected the minimum information smoke alarm as their third choice.

The respondents were then presented with two smoke alarms that contained the same amount of information on the packaging but were priced drastically differently, about \$20 and \$35.



Overwhelmingly, 93 percent of respondents selected the smoke alarm with the lower cost. The respondents commented that because the smoke alarms appeared the same, they selected the lower cost alarm. A couple of respondents selected the higher cost alarm assuming that it performed better even though there were no markings to indicate such a claim.

The last set of smoke alarms presented to the respondents was two smoke alarms with different performance ratings and prices.



Overwhelmingly, 81 percent of respondents selected the smoke alarm that had the higher rating and cost. Some of respondents that selected the higher rating and cost felt it was “worth” the extra cost for the additional performance. Some of the respondents that selected the lower rating and cost stated that they did not believe that the rating was genuine and, therefore, chose the less expensive alarm.

The understandability of the rating system was also evaluated. Both an icon- and text-based rating system were presented to the consumers. The respondents were presented with a series of questions to select which rating (A or B) for an alarm would perform better in a flaming fire, perform better in a smoldering fire, and be less likely to trigger during normal cooking.



For the icon-based rating system, respondents correctly identified the flaming and smoldering icons 98 percent and 97 percent of the time, respectively. Only 68 percent of the consumers identified B as being better to “less likely to trigger during normal cooking.”

Similarly, respondents were presented with the text-based rating system and asked a series of questions. Similar to the

icon-based rating system, the respondents correctly identified the flaming and smoldering text 96 percent and 95 percent of the time, respectively. Only 75 percent of consumers identified B as being better to “less likely to trigger during normal cooking.”



DISCUSSION

Consistent with other studies on the number of homes with smoke alarms,¹⁰ the WPI data showed that most consumers (95%) have a smoke alarm in their home, but only 50 percent have ever purchased a smoke alarm. Even fewer respondents (14.4%) are aware that smoke alarms can perform differently for different fire types. Slightly above 50 percent of the respondents knew where smoke alarms should be installed or had a smoke alarm near or in their kitchen. This suggests that consumers understand the importance of having a smoke alarm but may not understand the characteristics and installation requirement for a smoke alarm, which would best protect them in a fire and prevent nuisance alarms.

Ninety-three percent of respondents believed that a performance rating system would be beneficial to making smoke alarm purchase decisions. This parallels the finding of the respondents selecting the smoke alarm packaging with more information on performance and features.

Respondents believed that detection time in a fire and resistance to nuisance alarm are important features in a smoke alarm. This conclusion is supported by the respondents selecting a more expensive smoke alarm that had a higher performance rating than a smoke alarm that had a lower cost and rating. This type of behavior has been seen in other situations; for example, in another study that looked at smart grids for customers, researchers found that for all customer segments, “grid reliability is extremely important, with many consumers willing to pay higher monthly fees in exchange for increased reliability.”¹¹

Respondents largely understood that the icon with more stars for flaming and smoldering indicated a better-performing smoke alarm for that type of fire. The same was not true for the nuisance-resistance icon. Even though more than 50 percent of respondents selected the correct icon or text, the understandability was much less than for the flaming and smoldering icons and texts. The nuisance-resistance icon and text may have confused some respondents into believing that a lower rating meant that it was less likely to nuisance alarm. The interviews during the study showed that respondents had a desire for smoke alarms that did not false alarm, but clearer language to convey the performance of this information would need to be further explored.

CONCLUSIONS

The students developed conclusions from the survey data. The students concluded that while consumers care about detection, when actually purchasing a smoke alarm, consumers do not primarily consider performance. According to the WPI students, this could be for two reasons: (1) lack of awareness of the variation in smoke alarm detection capabilities; and (2) performance specifications are not clearly specified on packaging.

The study indicated that consumers surveyed value detection time and nuisance resistance as important smoke alarm features. Even though respondents did not know that there was a difference in smoke alarm performance for different types of fires, these consumers expressed interest in additional information to help them select a smoke alarm. In the limited scope of this study, it is nice to know that most consumers will likely choose performance over price if given enough information to make an informed decision.

¹⁰ AHERN, M. (2015, September). Smoke Alarms in U.S. Home Fires. Boston, MA. National Fire Protection Association.

¹¹ Smart grid study: Reliability important to all consumers. (2012, May 7). Retrieved on January 21, 2016 from <http://simpleenergy.com/smart-grid-study-reliability-important-to-all-consumers/>.