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Persistence of behavioral programs: New information and implications for program optimization

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ABSTRACT

More studies on retention of impacts from increasingly popular behavioral energy efficiency programs are needed to allow programs to be credited with all their attributable effects, accurately assess cost-effectiveness, and optimize program design and delivery. This study reviews recent retention results for home-energy report-type (HER) programs, examines technical degradation function (TDF) and falloff, and provides sample calculations on program cycling for improved cost-effectiveness.

1. Introduction

Social marketing, feedback, and other behavioral programs are becoming increasingly popular in the energy efficiency sphere, and there is intense interest in performance statistics for these initiatives. Although there is quantitative information on impacts for many behavioral programs at the immediate conclusion of the treatments, few programs have allocated the budget to conduct the follow-up analysis needed to assess the full kWh savings associated with the program – that is, the savings in future years that are attributable to the program's intervention. As a consequence:

- The programs are not treated as seriously as "measure" programs,
- The programs' savings are certainly understated,
- The cost-effectiveness of the programs cannot be accurately calculated, and
- The allocation of funds among programs is not optimal.

We identify two elements of retention, or lifetime, for behavior programs: technical (or behavioral) degradation, and the number of years any attributable savings remain. The product of the two can be used to identify a proxy median lifetime, or a multiple of the savings that can represent the full attributable savings.

It is critical to allocate budget to retention work for the programs as part of routine evaluation work, at least until a sufficient literature on behavior retention patterns (if such patterns are identified) are demonstrated. And because some (but not all) behavioral program impacts are measured via survey, the follow-up evaluations will need to be planned for several years until the impacts disappear. For programs whose total impacts are measurable via billing analysis, a later-year evaluation may be able to identify the pattern for the interim period. Finally, we also illustrate the usefulness of retention results in program design and optimization.

2. Background

Perhaps the single biggest gap in both the lifetime literature and the behavioral program literature is the scarcity of studies examining the retention of education, training, social marketing, and behavioral interventions. Certainly the literature is growing, but in a review of well more than 150 studies in the behavioral sphere, we found that most examined savings for the first year of the program, but only a few before 2009, even mentioned retention

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Table 1
Post-treatment savings from HER programs (adapted from Illume et al., 2015).

Study	Service area	Treatment Months	Post-treatment savings analysis months	Savings Decay results
Allcott and Rogers (2014)	Upper Midwest	24–25	26	Annual average savings decay of 21%
Allcott and Rogers (2014)	West Coast	24	29	Annual average savings decay of 18%
Allcott and Rogers (2014)	West Coast	25–28	34	Annual average savings decay of 15%
Integral Analytics (2012)	SMUD	27	12	Savings decay of 32% one-year after treatment stopped
DNV-GL (2014)	PSE	24	36	Annual average savings decay of 11%
ODC (2014)	NGRID-MA	12–24	10	Reduced treatment led to reduced observed savings, with sharper effect for gas cohorts.

Note: All HER reports were delivered monthly and quarterly except the ODC study, which were bi-monthly and quarterly.

(Skumatz et al., 2009).[1] This makes it hard for potentially important and dynamic education programs to receive high benefit/cost ratios, reducing the likelihood of appropriate funding levels (Skumatz et al., 2009).

Two early studies addressed retention of educational messages and installation of low-cost energy-efficiency measures delivered through energy education programs. The Energy Smart Program conducted in Oregon with low-income households found strong to mild retention (about 40% after three years) of behavioral changes. Especially successful have been those energy education efforts that provide quality education over a longer period of time. Three energy education programs delivered in schools: the Kentucky NEED Program, the Iowa Living Wise Program, and the Washington Energy Education in Schools Program show the importance of quality education and reinforcement of behavioral change messages over time. Of these three programs, the highest institution of behavioral changes are found from the Washington program, where teachers conduct at least three different classroom sessions and one assembly with kids over the course of an entire school year. These efforts, along with an early study by Harrigan and Gregory (1994), which found 85–90% of the savings from the education portion of a weatherization program was retained after three years, few studies have conducted primary data analysis of the topic. Even well-funded, multiyear statewide outreach programs have not examined the persistence of behavior change (Skumatz et al., 2009).

3. Persistence studies on HER programs

Funding has been a challenge. Retention studies of behavioral programs are still relatively scarce, with the very visible recent exception of well-funded home-energy report-type (HER) or bill feedback programs offered to single-family households. These behavioral programs send households a report identifying their energy use, providing comparisons to other households, and suggesting ways to save energy. As many of these programs are "pilot" programs (even though they are often very large, covering many thousands of households), they use an experimental design to provide reports to a sample of households, but do not provide reports to a specially selected "control group" facilitating comparisons and impact measurements. These programs are designed to achieve residential electricity savings and customer value to utilities through delivery of a two-page report (printed front and back). Relying on a randomized control design, these reports present a treatment group with feedback on their electricity use and compare that use to a group of similar households, referred to as "neighbors," which are defined as 100 occupied households similar in size and paying the same rate code as the participating home. They also provide lists of energy-saving tips that differ from month to month and year to year. The implementer then compares the energy savings of the treatment group to a control group that did not receive the HERs. The pilot program uses an "opt-out" design (very few opt out), so the design does not suffer from the self-selection bias that often plagues other energy efficiency program evaluations.[2]

Early retention studies of these evaluations were reviewed in 2014 (Skumatz, 2014). A 2012 study (Integral Analytics) on SMUD's HER program examined the savings that were retained one year after the program had been delivered for about two years. The study found that savings decayed about 32% one year after the treatment stopped. A study on Puget Sound Energy's HER program (Smith, 2013) examined savings retained one year after a sample of HER reports were suspended, and found that savings decayed about 39%. This review also examined early results from the Cadmus Study (Khawaja and Stewart, 2014).

The final Cadmus Study assembled research from five programs: three from Alcott and Rogers, one from SMUD and an updated PSE study by DNV-GL. These were then incorporated, along with a study by ODC on National Grid-Massachusetts,[3] into a literature review for the Minnesota Department of Commerce, Division of Energy Resources (Illume et al., 2015). The Study presented a table of post-treatment savings estimates for HER programs (Table 1).

The decay rates in the table average roughly 20%. Khawaja and Stewart (2014) suggest that a measure of effective useful life from these programs can be estimated using these types of results, arguing that EUL = lifetime savings divided by first-year savings, with lifetime savings calculated using the decay rate and an attrition rate factor.[4] Using the data from these programs (20% savings and assumed 7% attrition rate) implies an EUL of 3.9 years. This is considerably longer than the one-year lifetimes that are conservatively used, and even the three-year savings used under more generous circumstances.

4. Technical degradation

Until sufficient studies are conducted that show when significant savings cease, this formula is a good approximation.

[1] Following up on a similar review conducted in Skumatz and Green (2000). This lack of retention results was reconfirmed by Mazur-Strammen and Farley, ACEEE, 2013.

[2] Description from NMR Group, Inc. (2016).

[3] From Illume Minnesota Study, but cites source as Arnold, H., Massachusetts Cross-Cutting Evaluation: Home Energy Report Savings Decay Analysis. Opinion Dynamics. September 2014 (Arnold, 2014).

[4] Calculated as first year savings/$(d + a - d^*a)$ where d = annual decay rate and a = annual attrition rate.