

# Making Pro-Social Social: The Effectiveness of Online and Offline Social Communication

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## Abstract

The popularity of social media as a tool to influence behavior has exploded in recent years. Targeted behaviors include product purchases, charitable donations, network formation, and the sharing of word-of-mouth. However, the effectiveness of firm social media activity on consumer actions is often unclear, due to the role other communication channels have in influencing the effectiveness of these activities. We find that in the realm of pro-social behaviors, social media messages shared via affiliate groups to which recipients belong are ten times as effective as non-affiliate messages. However, they are only effective when coupled with offline, in-person communication. Possible explanations include the signaling value that messages through affiliates have indicating the worthiness of the cause, the role of social norms, and the value of public identity signaling.

**Keywords:** social media; marketing interactions; grassroots marketing; pro-social marketing; energy efficiency.

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# 1 Introduction

Social media has become a popular tool for firms wishing to influence consumer behavior. However, measuring the impact of social media exposures is a challenge, especially since they often occur in concert with other interactions, both firm-to-consumer and consumer-to-consumer. There is also substantial heterogeneity in their effectiveness due to factors such as the identify of the sender (Gong et al., 2017), the identity of the recipient (Lambrecht et al., 2018), and the timing of the communication relative to the purchase or consumption occasion (Seiler et al., 2017).

In this paper, we study the impact of social media (Facebook and Twitter) as part of a novel energy efficiency campaign that targets individuals through their affiliate group in order to encourage them to commit to save energy, as part of the Rhode Island Energy Challenge (RIEC) “Find Your Four” program. This allows us to assess 1) the impact of the sending organization and 2) interaction effects with other communication channels. A unique aspect of grassroots marketing is the use of affiliate groups (as the sending organizations) in reaching their members. These affiliate groups can include municipal communities, places of work, churches, schools, etc. Using affiliate groups as the channel of messaging may have multiple benefits: it may increase the likelihood that a message is consumed, lead to the creation of a shared goal within the affiliate group, leverage descriptive norms (by referencing the behavior of others within the group), and increase the credibility of the message.

In addition to communications sent via the affiliate groups, we also have data on communications from non-affiliate sources such as the electric utility, the non-profit organization helping to organize the campaign (SmartPower), and non-local newspapers. Thus we can directly compare the effectiveness of information source, i.e. whether the information came from an affiliate, for any specific type of communication (social media, newsletters, newspaper articles for municipal affiliates, etc.), acknowledging that the content of the messages may differ due to the ability of affiliate groups to reference descriptive norms (describing what *is* done by others), a shared goal, or affiliate-specific events. We find that on average,

affiliate social media and newspaper articles are an order of magnitude more effective coming from the affiliate groups as when they come from the non-affiliate groups (the electric utility and Smartpower in the case of social media, the state newspaper instead of local papers for newspaper).

An additional component of the campaigns is the use of face-to-face interactions at events, particularly for the municipal affiliate groups. Goldfarb et al. (2015) and Uetake and Yang (2018) both show the great extent to which in-person communications can have on consumer behaviors. In the context of charitable donations, Ariely et al. (2009) demonstrated that image is indeed an important part of the motivation to behave pro-socially. Meer (2011) likewise find that university alumni are more likely to give and give larger amounts when they are solicited by someone with whom they have social ties, or with whom they share characteristics, and Castillo et al. (2014) find that notifications about peer donations on Facebook increase the likelihood of donating. Barton et al. (2014) offer a different explanation in a related context, the effectiveness of candidate canvassing on voter turnout, namely that such behavior is a costly signal of quality – in our context, affiliate participation and event tabling may signal the importance of the desired behavior change. Finally, it could be that in-person communications provide evidence for *inductive* norms, i.e. what *ought* to be done by individuals (Cialdini et al., 1990). For all these reasons, we would expect that face-to-face communications would be effective in spurring energy savings commitments.<sup>1</sup>

The expected interaction between social media and the other marketing tools is not clear a priori. Each instrument may serve as substitutes or complements to the others. If the marketing communication is merely informative, we might expect there to be a negative interaction effect. However, if the value of messages from affiliate groups and/or in person communication at events serve a social signaling purpose, reinforce social norms, or provide a signal of importance as proposed above, then we might instead see evidence of a positive complementarity. Indeed, we do find a positive interaction between affiliate group social

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<sup>1</sup>In the Batra and Keller (2016) integrated marketing communications framework, we expect the in-person interactions to both build trust and elicit emotions, moving people down the purchase funnel.

media messages and in-person communication at events, in contrast to the negative interactions we find between some of the other marketing instruments. Furthermore, we find no significant increase in the effectiveness of social media messages coming from affiliate groups (relative to those coming from non-affiliates) unless paired with events. Supporting the aforementioned behavioral explanations of social norms in energy conservation, we find that the most effective social media messages all reference the affiliate organization and/or social norms in the content of the social media post. The positive complementarity between affiliate group social media messages and events has implications for improving the effectiveness of grassroots marketing campaigns in pro-social applications.

## 2 Background

### 2.1 Empirical Setting: The Rhode Island Energy Challenge

The RIEC is a partnership between SmartPower and National Grid to “create a high visibility, community-based, on-the-ground campaign to increase energy efficiency” (SmartPower 2014).<sup>2</sup> SmartPower is a leading non-profit marketing firm dedicated to promoting clean, renewable energy and energy efficiency and National Grid is the electric utility. The program challenges Rhode Islanders to change their energy behavior by committing to four concrete actions that will reduce their energy use and/or improve energy efficiency. The four “easy” actions listed on the Find-Your-Four website are using energy-efficient bulbs, regulating house temperatures while away, using a powerstrip, and getting a home energy assessment.<sup>3</sup>

The RIEC program provides Rhode Island-wide communications to build awareness

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<sup>2</sup>The utility customer engagement platform, Opower, was involved as well in an early stage.

<sup>3</sup> A more comprehensive list of other activities is provided on the website (with information about the number of people who committed to each) and are listed in Table A.1 in Appendix A. In addition, another goal of the program is to increase awareness and participation in National Grid’s energy efficiency programs (e.g., the EnergyWise in-home energy assessment, refrigerator recycling, and lighting promotions) and reduce peak-period electricity demand.

through traditional media (e.g., press releases and inviting reporters to events) and social media (e.g., Twitter). There is also a website, [www.findyourfour.com](http://www.findyourfour.com), where participants sign up with their four committed actions and join the communications list. These participants then receive regular e-mails with energy tips and links to National Grid's energy efficiency programs.

To reach Rhode Islanders, the program partners with local municipalities, businesses, non-profits, and faith-based organizations, which we refer to as program affiliates. The affiliates commit to a participation rate between five and ten percent of all affiliated households. To attain these goals, individuals are reached through a variety of channels. SmartPower identifies enthusiastic program participants as "energy ambassadors" who help the community or organization reach the stated goal through outreach to colleagues, neighbors, and other affiliated members. SmartPower also hosts community or organization events and meetings about the RIEC program to spread the word.<sup>4</sup> Another element of the program is fostering competition between different municipalities and non-profit organizations by rewarding the best performers with recognition, award plaques/signs, and a monetary grant from National Grid that can be used for energy efficiency improvements on the organization or municipality's building of choice.<sup>5</sup>

The intensive community and organization-based grassroots outreach programs began with one municipality<sup>6</sup> and three organizations in May 2013, at the same time as the broader kick-off of the state-wide communications effort. From there it expanded to further municipalities and organizations. Thus, from an analysis perspective, there are really two programs: the affiliate (municipality and organization-based) intensive grassroots efforts and the broader communications effort across Rhode Island. The official state-wide kickoff was on May 29, 2013.

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<sup>4</sup>In addition, there is the "Find Your Four Video Challenge" to harness Rhode Island residents' creativity in promoting the program, as well as a partnership with [www.ReNewableNow.biz](http://www.ReNewableNow.biz) to increase publicity for the program.

<sup>5</sup>Almost all towns and organizations "won" in actuality

<sup>6</sup>A second municipality had a kick-off but then expended no effort of any kind to get commitments.

It should be noted that contexts such as these differ from situations in which firms and other organizations attempt to account for social spillovers between consumers when determining the targeting and intensity of marketing activity, or even create exogenous word-of-mouth by compensating consumers or external agents when they promote a product to their peers, as in Godes and Mayzlin (2009). The goal (energy savings commitments) is unrelated to the affiliate groups' main objectives (profits for businesses, religious teaching for churches, etc.). This helps avoid the issue that social interactions may be less effective if consumers perceive an ulterior motive (Verlegh et al., 2004). People might still question the motive behind SmartPower's direct messaging, despite the social goal, but people would have no reason to believe that the affiliate groups have any motives besides the pro-social motive in our context.

## **2.2 Related Literature**

Prosocial marketing was first studied in the 1970s (Fox and Kotler, 1980), and recently there has been considerable research on pro-social behavior, including blood donations (Aravindakshan et al., 2015), charitable giving (Dube et al., 2016), HIV prevention (Ashraf et al., 2014), and environmental donations (List et al., 2004). However, nearly all of this research has focused on the incentives rather than on the combination of marketing instruments used to obtain these goals (Ariely et al., 2009). Grassroots marketing is one approach that can be used, and often incorporates less conventional marketing tools, relying on social influence and earned media, in addition to efforts coordinated by the organization, which have been shown to be more effective in affecting behavior in some contexts (Lovett and Staelin, 2016). Such tactics have been used for new product launches to reduce the barriers of adoption, and have also been used recently in a variety of environmental marketing campaigns, including a community-based campaign to encourage recycling (Haldeman and Turner, 2009) and the Solarize program to increase residential adoption of solar photovoltaic panels (Gillingham and Bollinger, 2017).

Measuring the effectiveness of marketing activities can of course be a challenge. Recently, there have been several papers measuring causal effects of marketing instruments using non-experimental, plausibly exogenous variation. Shapiro (2015) uses geographic variation in TV ad exposures along TV market borders to identify the effect of pharmaceutical ads. Hartmann and Klapper (2015) use the variation in the ad exposures across TV markets from the increased ratings if the market’s team is playing in the Super Bowl and find that Super Bowl ads can generate significant increases in revenue per household.<sup>7</sup> Finally, Lewis and Reiley (2013) use the exact timing of Super Bowl ads to assess their effect on online search behavior.

Social media touches in particular are often absent in analyses of marketing effectiveness, with a few exceptions. Seiler et al. (2017) leverage a temporal shock disallowing comments on tweets during a three day period in China on Sina Weibo to measure tweet elasticity. Lambrecht et al. (2018) explored the role of the recipient in explaining differences in tweet effectiveness on Twitter, exploiting day-level variation for inference (as we do), and find that early propagators of trends are less responsive to advertising than consumers who embrace trends later. Finally, Lovett and Staelin (2016) show that earned media (including word-of-mouth and online social media) can be more effective than paid and owned media, per exposure.

Attribution is much harder in contexts in which multiple marketing instruments are used in concert, but it is essential to study such examples if we are to measure the degree to which one marketing tool influences the effectiveness of another. None of these aforementioned papers identify causal interaction effects across marketing touches. This is partly due to data limitations; it is unusual to know the universe of all marketing touches in a campaign, as we do in our context, and even more unusual to have sufficient variation to identify causal interaction effects. Onishi and Manchanda (2012) explores one relationship between blog

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<sup>7</sup>Field experiments have also been used to measure the effect of banner ads (Sahni, 2015, 2016), sponsored search advertising (Blake et al., 2015), direct mail advertising (Bertrand et al., 2010), and tweets (Gong et al., 2017).

activity and movie demand, but the two are assumed to be outcomes that both result from television advertising, rather than blog activity affecting demand.

The integrated marketing communications literature has previously shown “complementarities” in marketing instruments, but this literature tends to use more descriptive approaches that cannot account for endogeneity of advertising and earned/social media (Batra and Keller, 2016). For example, Stephen and Galak (2012) study the interaction between traditional and social earned media (news mentions and blog activity) in driving participation in micro-financing, using a multivariate autoregressive double Poisson model, but they are unable to rule out unobservable demand shocks leading to both.<sup>8</sup> In a notable exception, Kumar et al. (2017) uses a difference-in-difference strategy to help identify causal interactions, but inference depends on the ability to match consumers who did and did not opt into receiving firm social media communications. Those that did receive the social media communications exhibit greater response to other marketing instruments such as TV advertising, as may occur either from complementarities or if consumers opted in because they simply have greater utility for the brand/product.

### 3 Data

The source of the data used in this study is SmartPower and their affiliate partners. The data begins on May 9, 2013 when the [www.findyourfour.com](http://www.findyourfour.com) website became active and the first sign-up occurred, and it extends through June 14, 2015. The dataset includes the following:

1. Program commitments - These data include the individual’s name, e-mail address, time and date of the commitment, the referrer (how the person learned about Find-Your-Four), IP address, location down to the zip code level, and affiliate group. As described above, the affiliate is the organization, which is the municipality, employer,

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<sup>8</sup>Even here, the authors are restricted to look at just two types of media for they do not have the full set of marketing interventions and earned media.



or local group (such as a church). We have the data on both completed and started but not completed commitments.

2. Web data - These data list the daily number of web sessions by town. We also have referral traffic aggregated across towns.
3. Events and Meetings - These data include the date of the event, target audience, attendance, and number of interactions with SmartPower (i.e., marketing touches).
4. E-mail and Newsletters - These data include the sending organization (e.g., SmartPower or another partner) and the number of recipients. For SmartPower e-mails, we have the bounce rate, open rate, and click-through rate.
5. Media - These data include the date of the event or media coverage, links to the creative/article, and the circulation. For social media, we have the number of followers.

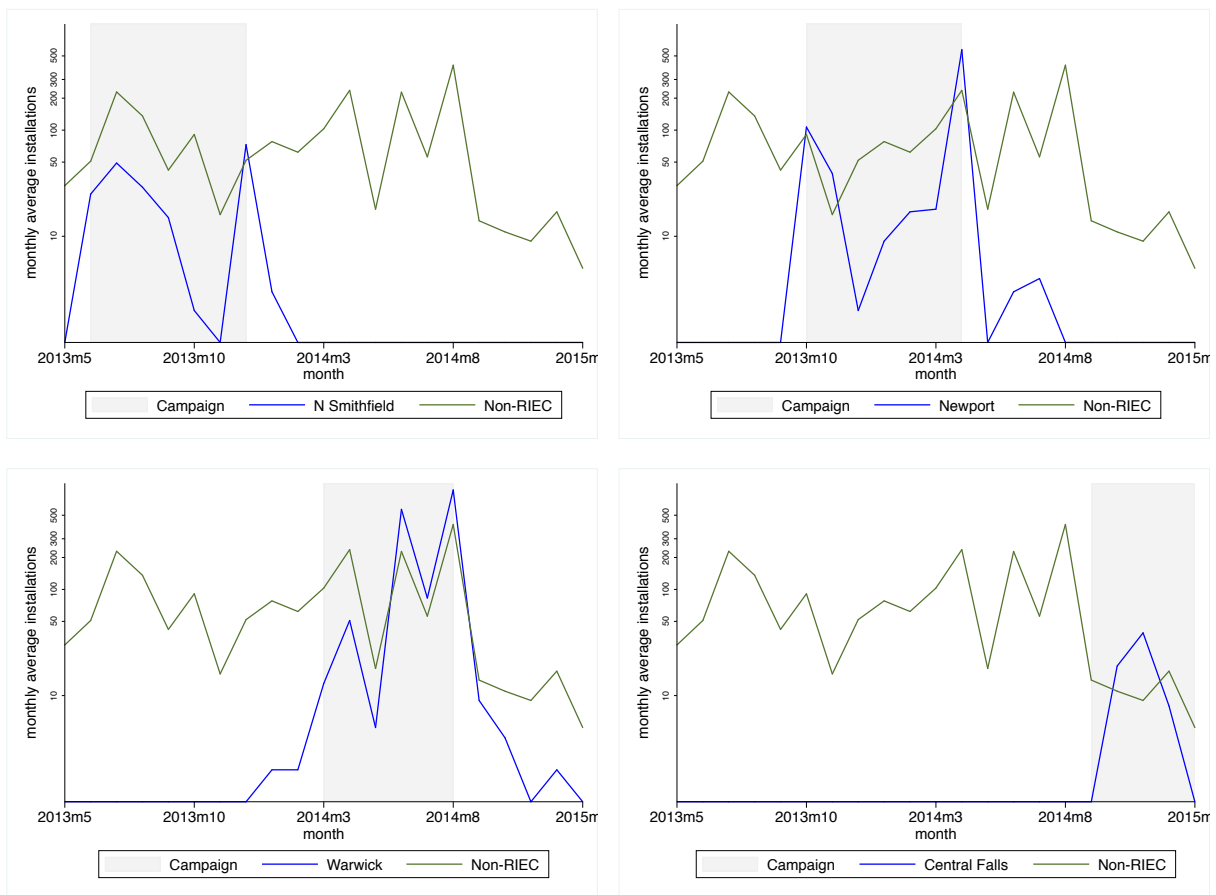
Details of the campaigns can be found in Appendix A, including a map of the municipality affiliates, the timing of all campaigns, the number of marketing touches by type, and the content of the social media messages. Across all affiliate groups, we observe a total of 92 events, 41 newsletters sent, 480 social media messages sent, 14 local (town) newspaper articles and 11 non-local articles, nine web articles, two TV segments, and one radio story. During the campaigns, our data indicate tens of thousands of marketing touches and 6,234 total commitments, 4,525 through the affiliate groups (Table A.4). The commitments can happen either at events or online. The top referral site is the non-profit Energyfed-eration.org, followed by Facebook.com. Municipal and organization sites also are featured highly in this list, providing further evidence of the causal effect of RIEC-affiliate messaging on commitments (see Table A.6 in Appendix A for the list).

## 4 Municipal Program Effectiveness

Before moving to evidence regarding the effectiveness of social marketing and marketing complementarities, we begin by examining the overall effectiveness of the focused municipal

campaigns. This analysis sets the stage for the analysis of different marketing touches by confirming that these integrated marketing campaigns were successful. Given that the broader Rhode Island Energy Challenge is a state-wide program, this is an investigation into the additional commitments in the treated municipalities relative to elsewhere in Rhode Island. In other words, we are interested in quantifying the additional lift above the base level in Rhode Island from the state-wide program. Towns that participated were ones approached by National Grid’s Jurisdictional Team, and were selected based on whether there was a personal relationship with a town leader (such as the mayor) indicating that they might be supportive. The selection of towns had nothing to do with the demographics of these towns, and an effort was made to include towns across the state.<sup>9</sup>

Figure 1: Signups in participating municipalities versus all other commitments



Note: Blue line - municipality. Green line - all others commitments. Campaign period - gray shaded area.

<sup>9</sup>A list of all municipalities is shown in the Appendix.

Initial evidence of the effect of the campaigns can be seen in the data descriptives. In Figure 1 we plot the number of monthly commitments in the participating municipalities against the *total* number of monthly commitments elsewhere in Rhode Island. We plot the total commitments elsewhere rather than per-capita commitments, since other areas had so few commitments on a per-capita basis (making it tough to see the variation in the graphs). The figure shows clear spikes in commitments in each town during the campaigns relative to the total commitments elsewhere. For each campaign we even see that there are campaign weeks with more commitments from that municipality than everywhere else in Rhode Island combined. A notable feature in the graphs is that prior to the municipal campaigns, there were extremely few commitments in any of the treated municipalities. This provides descriptive evidence that these municipalities would not have had many commitments without the campaigns. But other events may have occurred state-wide during the campaigns, so we use a difference-in-differences specification to compare the trends in the treated municipalities to the trends in all other municipalities in Rhode Island.

To estimate the treatment effect of the municipality campaigns, we model the number of commitments in municipality  $m$  in month  $t$  with the following linear model:

$$Y_{mt} = \beta T_{mt} + \mu_m + \delta_t + \epsilon_{mt}, \tag{1}$$

where  $T_{mt}$  is an indicator variable indicating that the municipality is participating in the program in month  $t$ . We use a linear model for the count of commitments in our primary specification because we are merely trying to capture the average effectiveness of the town campaigns.

The control group in this specification is all other towns and cities in Rhode Island. While the graphs alone provide convincing evidence that we would see very few commitments without the campaigns, it is worth examining how similar the treatment municipalities are to others in Rhode Island. The four municipalities range from a population of 11,967 in North

Smithfield to 82,672 in Warwick based on the 2010 Census. The remainder of the state has some very small, rural towns, with the smallest being New Shoreham (1,051 people) at one end of the population spectrum, and Providence, with 178,042 people, at the other end. Most towns in Rhode Island are of similar size to the treated municipalities. The median population in the treated municipalities is 24,672, while the median in the remainder of the state is 16,240. Similarly, the mean population in the treated municipalities (with the mean taken over municipalities) is 43,815 and in the remainder of Rhode Island is 24,515. These indicate that our treated municipalities are larger than the average town in Rhode Island, although this smaller average is due to 10 non-treated towns in Rhode Island which have less than 10,000 in population. Without these small towns, the average municipality sizes are comparable. We find that our results are very robust to removing these towns, removing Providence, and in general to the choice of the treatment group, since the pre-treatment commitments are so small (we satisfy the parallel trends assumption since pre-treatment trends are near zero adoptions per month).<sup>10</sup>

The results from estimating (1) with different combinations of municipality and month fixed effects are shown in Table 1. We find a statistically significant treatment effect, which is robust across all specifications. In the final specification with all fixed effects included, we find that the campaigns lead to an average of 124 additional commitments per month.<sup>11</sup> For a typical six-month campaign, this would imply 744 additional commitments. This shows clear evidence of the effectiveness of the municipality campaigns for inducing commitments. Of course, the campaigns consist of multiple marketing vehicles, which we will explore in the next section

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<sup>10</sup>We also look at median household income using the 2009-2013 American Community Survey. We find that due to Central Falls being a lower-income city (median household income of \$27,993), the median household income is actually lower on average in the treated municipalities than in the remainder of Rhode Island (\$57,696 versus \$70,050 with the average taken across municipalities). Assuming income is positive correlated with commitments, this implies that if anything we underestimate our treatment effect.

<sup>11</sup>Our robustness check using a negative binomial model shows a marginal effect of 132 additional commitments per month, which is very highly statistically significant (at the 0.1 percent level).

Table 1: Municipality Effectiveness Regression Results

	(1)	(2)	(3)	(4)
treatment	126.46*	124.01*	126.51*	124.04*
	(57.73)	(60.49)	(56.95)	(59.14)
municipality indicators	N	Y	N	Y
month indicators	N	N	Y	Y
R-squared	0.200	0.235	0.229	0.264
N	693	693	693	693

Notes: The treated municipalities are North Smithfield, Newport, Warwick, and Central Falls. All other municipalities in Rhode Island are included, with the exception of Cranston, which is dropped. The dependent variable is commitments. An observation is a municipality-month. Municipality-clustered standard errors in parentheses. \*\*\* indicates significant at the 0.1% level, \*\* at the 1% level, \* at the 5% level.

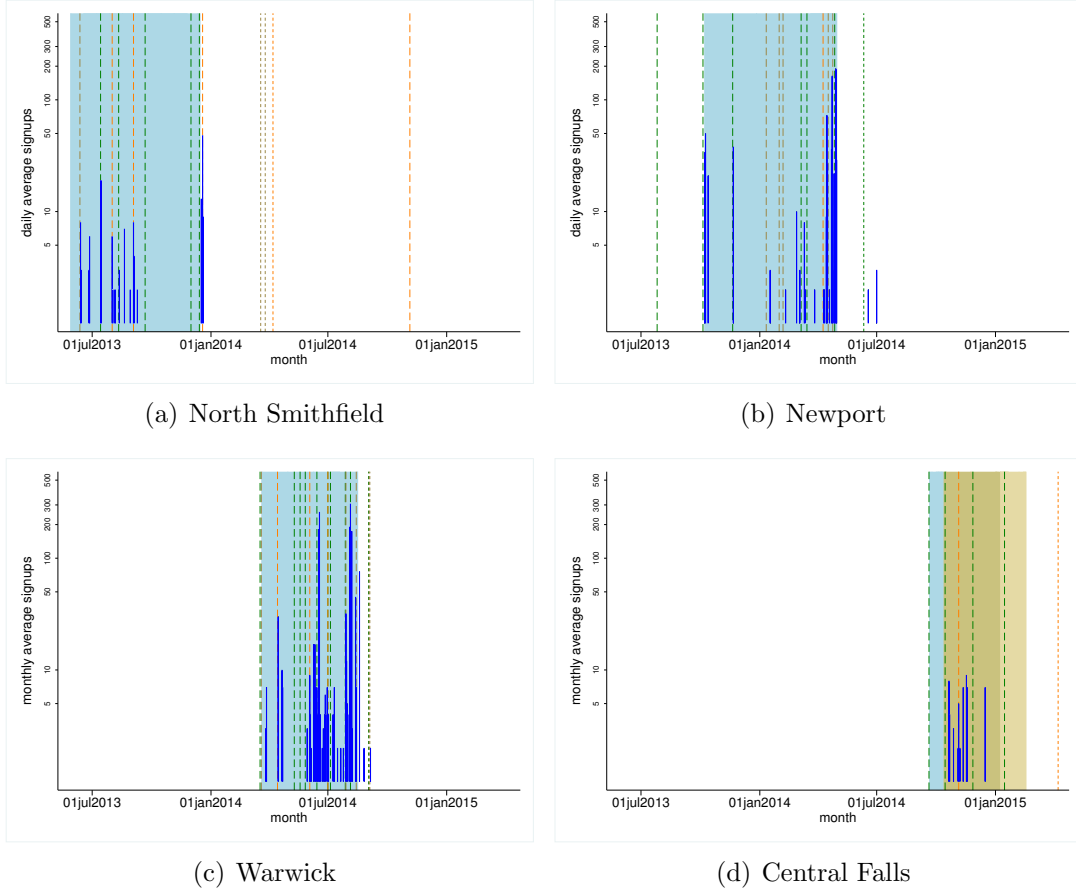
## 5 The Effectiveness of Different Marketing Vehicles

### 5.1 Graphical Evidence

To examine the effectiveness of social media and other marketing interventions, we exploit the exact timing of the marketing touches and commitments, in a research design that is similar in spirit to an event study design and is the same identification strategy used in Lewis and Reiley (2013). The underlying assumption behind this approach is that the different interventions that make up the program have an immediate or almost immediate effect on commitments. This empirical design is particularly appropriate for our setting because many of the interventions, such as events, social media, and e-mail interventions, facilitate immediate commitments. We can also use this empirical approach for marketing touches associated with the non-municipality campaigns as well as the municipality campaigns.

In Figure 2, we use data visualization to examine the timing of commitments and marketing touches by graphing the commitments over time with color-coded marketing communications, for each of the municipal campaigns, to ensure this is a reasonable assumption. Taking North Smithfield as an example, we see nine commitments on the day of the first

Figure 2: Intervention and Signup Timing in Municipal Campaigns

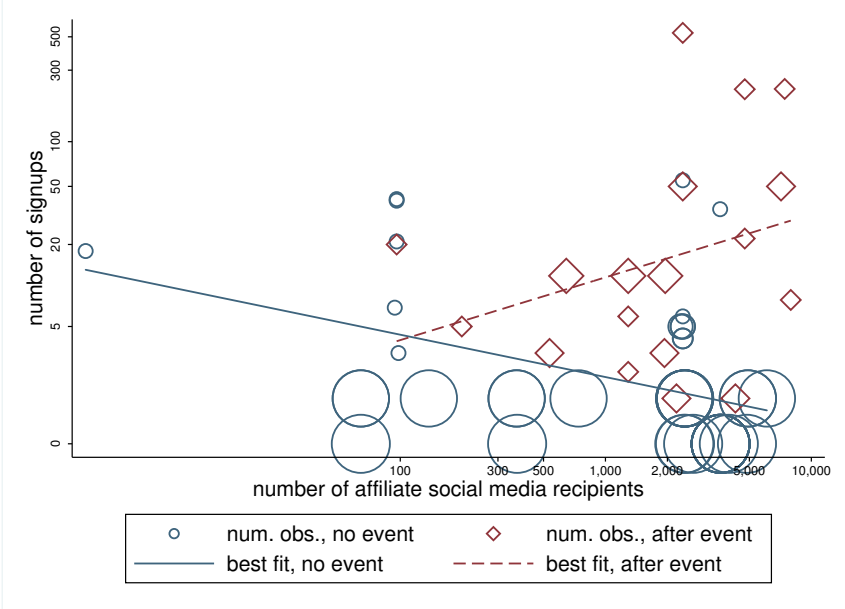


In these figures, the x-axis is a day and the vertical lines indicate each intervention. Green lines indicate town events such as concerts, parades, baseball games, etc. Orange lines indicate newsletters. Brown lines indicate earned newspaper media (with the thin dashed lines indicating reporting on past success). Pink lines refer to web media specific to the town. The campaign period is shown in the blue shaded area. The tan shaded area shown in the Central Falls figure indicates the period of the video challenge, which overlapped with the campaign.

intervention, which is the publication of the article in “The Valley Breeze” which describes how North Smithfield was pitted against Cranston in a challenge to save energy (Cranston started a municipal campaign but did not follow through with it). There are no commitments in the following days until the date when the REIC sent its June newsletter, when there is another mass of commitments. The next shock of commitments occurs on the same day of the North Smithfield concert kickoff, with no commitments in the following days. This pattern is reflected in all four towns and in all affiliates: most marketing interventions lead to an immediate shock, with little carryover effect beyond a few days. This contrasts with brand advertising, in which it is not often possible to make a purchase at the time of

brand advertising exposure, so the time of exposure is often very different from the time of purchase. In this marketing program, it is usually very easy to sign up immediately upon receiving a marketing touch. This fact, coupled with the fact that we see *all* of the marketing touches associated with the campaigns, enables us to use the timing of interventions and commitments in our empirical analysis.

Figure 3: Affiliate Social Media Signups with and without an Event



Note: Bubble size indicates number of observations. Red dotted line is best fit line after/during events. Blue line is best fit without events.

In this study, we are particularly interested in evidence for complementarities between social media and other marketing touches. We find these complementarities easiest to first visualize in a bubble plot. Figure 3 presents a bubble plot for the number of affiliate signups in the five-day period after each affiliate social media message (including the current day) as a function of the number of affiliate social media interactions (Twitter and Facebook). The data are plotted separately based on whether there was an event immediately preceding or on the same day as the social media communication.<sup>12</sup> The size of the bubble indicates the number of observations for each signups-social media newsletter recipient pair.

<sup>12</sup>We include bubble plots for each of the other main marketing instruments used in Appendix B for reference.

Table 2: Top Affiliate Social Media Messages

Message	Organization	Signups
The Preservation Society is supporting the efforts of the city of Newport and the RI Energy Challenge to help us all become more energy efficient	Preservation Society of Newport County	225
Energy saving tip: talk w your friends & neighbors about how they save energy & save \$310/yr	SmartPower, Warwick	224*
Councilwoman Camille Vella-Wilkinson takes a break from gathering Energy Challenge pledges at Warwick's National Night Out for a photo and some fun with Lt. Gilbert.	SmartPower, Warwick	224*
Thank you to everyone at Westbay Community Action for supporting the #RI #Energy Challenge!	SmartPower, Warwick	178
Join @URIOutreach for the University of #RI 1st Renewable #Energy School this Saturday 8/16 at 9am <a href="http://ow.ly/Af23q">http://ow.ly/Af23q</a>	Smartpower	55
Heritage Day and free Coffee promo	No. Smithfield	41
Heritage Day and free Coffee promo	No. Smithfield	40
Thanks to Warwick Parks & Recreation, the Norwood Association and The Jesse Liam Band for supporting the Warwick Energy Challenge at the concert Wednesday evening! Left to right: Jesse Liam Gauthier leader of The Jesse Liam Band and Jeff Baker of the Norwood Association at the Warwick Parks & Recreation summer concert - Norwood Gazebo on Pawtuxet Avenue.	SmartPower, Warwick	35

\* indicates that the last two were on the same day so we cannot separate their effects.



In general, Figure 3 shows that affiliate social media touches lead to many more signups when concurrent with an event, providing our first evidence of marketing complementarities. Table 2 lists the eight social media messages which coincided with the most subsequent signups in the following five days. All explicitly leveraged the affiliate, an event, or social norms. Examples of utilizing norms include thanking those people who had signed up and suggesting people ask friends and neighbors about how they save energy. When referring the event, it may be simply referring to the event (and the free coffee promotion) or combining social norms with the event reference, such as the reference to the Councilwoman soliciting signups at Warwick’s National Night Out.

In order to identify interaction effects across different communication channels, we must have sufficient observations in which these marketing touches co-occur and occur alone. Figure 2 showed that these affiliate communications do not all happen concurrently, and that the events and newsletters are fairly evenly spaced throughout the campaigns (as are social media messages). The correlation between the number of event interactions, the number of newsletter recipients, the number of affiliate social media recipients, and the number of newspaper recipients is essentially zero. The correlation matrix is shown in Appendix B.

## 6 Econometric Evidence

In our more formal analysis of the effect of marketing touches, we use a standard OLS fixed effects estimator, using  $\log(1 + Y_{it})$  (where  $Y_{it}$  is the number of signups) as the dependent variable due to the long right tail of the distribution:

$$\log(1 + Y_{it}) = \sum_{\tau=t-4}^t X_{i\tau}\beta + \mu_i + \delta_t + \epsilon_{it}. \quad (2)$$

We include all marketing touches over the four days preceding and the current day (a five day period), which are contained in the  $X_{i\tau}$ .<sup>13</sup> The  $\mu_i$  are affiliate fixed effects and the  $\delta_t$  are time fixed effects.  $\epsilon_{it}$  is an affiliate-day unobservable which we cluster at the affiliate-group level.

Coefficient estimates are shown in Table 3. We show the results with and without interactions. We first estimate the model with a dummy variable for each month in the data, which allows us to compare affiliate and non-affiliate messaging using daily variation. The results are in columns (1) – (3). With the log specification, we can interpret the coefficients as the effect on the percentage of signups per day (above a baseline of one since we add 1 before taking the log to prevent logs of zeros). In columns (4) – (6) we repeat these analysis including a dummy variable for every day in the data in order to capture all time varying factors we do not observe, above and beyond all the marketing interventions which we do observe. We can no longer identify the effect of non-affiliate touches since the identifying variation was at the daily level across all affiliates. However, we can still leverage the variation across affiliates to see if our affiliate results still hold.

In column (1), we see a statistically significant effect of event interactions, such that for every 100 interactions, we expect a 20% percent increase in signups per day in the five days after and including the event. For every thousand affiliate social media recipients, there is a 3.0% increase in signups. In contrast, for non-affiliate social media messages, there is only an increase of 0.3% for every 1000 recipients. Newspaper recipients exhibit the same pattern: the effect of affiliate newspapers per subscriber (the local papers) is 50 times larger than for non-affiliate newspapers.

When we include an interaction between affiliate social media and events, it is clear that the reason for the effectiveness of affiliate social media messages is due to the interactions at events. The effect of affiliate social media messages is not significantly different than zero and not significantly different than the effect of non-affiliate social media when not paired

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<sup>13</sup>We also tested just the current day, a three day period, and a seven day period. Our results are robust to changing the duration over which the marketing touches have impact.

Table 3: Estimated Effects

	(1)	(2)	(3)	(4)	(5)	(6)
interactions at event	0.0021*** (0.0006)	0.0018*** (0.0006)	0.0017*** (0.0006)	0.0020*** (0.0005)	0.0017*** (0.0006)	0.0016*** (0.0006)
affiliate newsletter recipients	0.0005 (0.0005)	0.0006 (0.0005)	-0.0925 (0.0777)	0.1526*** (0.0407)	0.1528*** (0.0408)	0.1019 (0.0685)
newsletter recipients	0.0068* (0.0041)	0.0069* (0.0041)	0.0063 (0.0040)			
affiliate social media recipients	0.0385*** (0.0129)	0.0129 (0.0131)	0.0239 (0.0162)	0.0380*** (0.0122)	0.0130 (0.0125)	0.0246 (0.0155)
social media recipients	0.0030*** (0.0010)	0.0026*** (0.0010)	0.0020* (0.0011)			
affiliate newspaper recipients	0.0336** (0.0145)	0.0276* (0.0148)	0.0377** (0.0181)	0.0359** (0.0141)	0.0298** (0.0144)	0.0399** (0.0175)
newspaper recipients	0.0007*** (0.0003)	0.0004* (0.0003)	0.0006*** (0.0002)			
affiliate social media		0.0033** (0.0014)	0.0057** (0.0024)		0.0032** (0.0013)	0.0055** (0.0022)
X interactions at event						
social media		-0.0001 (0.0003)	-0.0001 (0.0003)		-0.0000 (0.0003)	-0.0001 (0.0003)
affiliate social media						
X interactions at event						
affiliate social media						
X affiliate newsletter recipients						
social media						
X affiliate newsletter recipients						
affiliate social media						
X newsletter recipients						
social media						
X newsletter recipients						
affiliate social media						
X affiliate newspaper recipients						
social media						
X affiliate newspaper recipients						
affiliate social media						
X newspaper recipients						
social media						
X newspaper recipients						
affiliate newsletter recipients						
X interactions at event						
newsletter recipients						
X interactions at event						
email recipients						
	-0.0001** (0.0000)	-0.0001** (0.0000)	-0.0001** (0.0000)			
number of web articles	0.0023 (0.0096)	0.0045 (0.0096)	0.0003 (0.0092)			
TV	-0.0421 (0.0287)	-0.0185 (0.0279)	-0.0254 (0.0255)			
radio	0.0037 (0.0286)	-0.0002 (0.0286)	0.0046 (0.0283)			
video challenge	0.0098** (0.0042)	0.0084** (0.0041)	0.0080* (0.0041)			
video challenge	0.0613*** (0.0129)	0.0611*** (0.0128)	0.0605*** (0.0126)	0.0559*** (0.0121)	0.0557*** (0.0121)	0.0554*** (0.0121)
X during town campaign						
affiliate dummy variables	Y	Y	Y	Y	Y	Y
month dummy variables	Y	Y	Y	N	N	N
day dummy variables	N	N	N	Y	Y	Y
R-squared	0.141	0.152	0.163	0.211	0.222	0.231
Log-L	-3608.636	-3534.667	-3462.876	-3134.141	-3058.419	-2996.842
N	11016	11016	11016	11016	11016	11016

Notes: An observation is a campaign-day. The marginal effect is taken at the mean. Affiliate-clustered standard errors in parentheses. \*\*\* indicates significant at the 01% level, \*\* at the 5% level, \* at the 10% level.

with an event. This does not mean the same individuals need to both be at the event and receive the social media message. The occurrence of the event and the source of the social media message (the affiliate group) can serve as signals regarding the importance of energy conservation.

This effect is even stronger when we include other interactions. Two of the other interaction effects we see are between affiliate social media and non-affiliate newsletter recipients, and also between newsletter recipients and event interactions, but the interactions are negative. This indicates that these marketing instruments are serving instead as substitutes. There is one other positive interaction effect between non-affiliate social media and non-affiliate newsletters, but we do not want to over interpretive this result because it could be explained by an idiosyncratic shock on that day - this effect cannot be identified with the inclusion of the day fixed effects. The interaction between affiliate social media and events is unaffected by the inclusion of the day fixed effects.

Part of the explanation for the much larger effectiveness of affiliate social media is due to the fact that some are designed to leverage the event interactions. Note that this does not violate exogeneity. We would be worried about incorrect inference if both instruments were used due to an unobserved demand shock. The even spacing of the events make this highly unlikely, and anecdotal evidence in our conversations with SmartPower and the affiliate groups confirms this is not the case. Sending marketing communications in anticipation of an unobserved demand shock is very different than designing the content of the social media message based on whether an event is also going to occur, which is exactly the effect we want to estimate.

All of these results are also robust to restricting the analysis to just municipal campaigns. We also run the model using only same-day effects of all marketing touches. We report those results in [Table A.10](#) in Appendix C. Without allowing events to have effects in the several days afterwards, the significance of the main effect of events goes away, indicating that many of the signups actually occur in the several days following the event, rather than at the event

itself. The interaction effects between event interactions and affiliate social media touches is still positive and significant at 1%.

We also explored a zero-inflated Poisson (ZIP) model, using the regressors in specifications shown in Table 3 in columns (1) and (2), to account for the count nature of the data and for the large number of zeros (we can only include month fixed effects in this specification, not day fixed effects).<sup>14</sup> The results are qualitatively the same across all specifications – affiliate messaging is an order of magnitude more effective per touch, for both social media and newspaper, and there is a positive complementarity between event interactions and affiliate social media touches (see Appendix C).

## Cost-effectiveness

In terms of the cost effectiveness of interventions, we focus on the affiliate social media messaging and events of different sizes because we want to demonstrate the effect of designing a marketing strategy that leverages the positive interaction effect. The costs of using affiliate groups to use social media consist of the labor costs Smartpower incurs for the affiliate visit (Smartpower costs for each activity are shown in Appendix D). We assume that each visit then results in seven social media messages, the average in the data. The costs per signup for affiliate social media messaging and events are shown in Table 4. We show the costs based on the number of event interactions to show how larger events lead to lower costs, emphasizing the importance of the complementarities.

The cost per commitment when using events in conjunction with affiliate social media messaging decline from \$11.76 to \$2.42 with events between 100 and 5000 people. This includes the cost of the event and the costs of generating and sending the social media message in row 1. In row 2, we show the incremental cost per commitment if the event is already being held. If no event is held, the cost per acquisition using affiliate social media is \$68.74 per commitment, and thus it is much more cost effective to pair affiliate social media

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<sup>14</sup>The disadvantage of the ZIP model is that its structure assumes interaction effects, and it permits fewer fixed effects.

Table 4: affiliate Social Media &amp; Event Cost per Signup

	Number of event interactions					
	0	100	200	300	400	500
cost per commitment		\$11.76	\$5.99	\$4.02	\$3.02	\$2.42
added cost per comm. from social	\$ 68.74	\$2.77	\$1.41	\$0.94	\$0.71	\$0.57

Notes: Costs for affiliate social includes costs for the affiliate and the cost to Smartpower to meet with the business (or town). The calculations assume 7 social media messages by the affiliate (the mean in the data) and include costs of Smartpower visiting the affiliate, the costs of generating the content, and in row 2, the costs of tabling at an event.

messaging with events. For comparison, the cost of non-affiliate social media messages (which are half expensive because they include the cost of generating content but no costs of visiting the affiliate) are much less cost effective, at \$33.37 per commitment. Incremental costs per commitment via affiliate social media if an event with 500 interactions are only \$0.57 per commitment.

## 7 Discussion

Our first main finding that communications coming from affiliate groups are much more effective than communications coming from non-affiliates when using the same marketing channel can be explained in several ways. First, it could be that affiliate groups are able to leverage descriptive norms in their communications. Previous papers have explored how social norm messages aimed at energy conservation reduces energy use (e.g., Allcott, 2011; Allcott and Rogers, 2014; Ayres et al., 2012; Costa and Kahn, 2013; Dolan and Metcalfe, 2015; Ferraro and Price, 2013; Gillingham and Tsvetanov, 2017) or how prosocial appeals influence energy use relative to economic incentives (e.g., Reiss and White, 2008; Ito et al., 2017; Burkhardt et al., 2017). The content of the social media messages sent by affiliates confirm the social norms are referenced, although we cannot conclusively say this is the reason for the increased effectiveness.

Another explanation is that message recipients weigh information more when coming

from affiliates because the affiliate groups includes their peers. The value of social learning has been demonstrated in similar pro-social contexts including fundraising for public radio (Shang and Croson, 2009), solar adoption (Gillingham and Tsvetanov, 2017; Bollinger et al., 2018b), and water conservation Bollinger et al. (2018a).

The large effect of face-to-face communication at events is also not surprising given the pro-social context because of the signaling value associated with these interactions (Ashraf et al., 2014; List, 2006; Berman et al., 2015; Gneezy et al., 2012; Dube et al., 2016). Because contributing to a public good can signal information about ones' identity, the public nature of events can facilitate the role of injunctive norms in getting people to commit to save energy. Previous behavioral research has shown that social identity and utility from social interactions affect choices (Berger et al., 2011; Berger and Rand, 2008).

It is less clear why there is a positive spillover effect between the events and affiliate social media. However, prior energy savings commitments by others can signal the value of the goal (Kerr, 1983; Kerr and Bruun, 1983; Fishbach et al., 2011), who is also consistent with the cultural evolutionary theory of credibility-enhancing displays (Kraft-Todd et al., 2018). Furthermore, tabling at events and affiliate participation can both provide costly signals regarding the importance of the activity Barton et al. (2014). Because the social media messages that are most effective refer to either the affiliate group of the event, we think the most likely explanation of the spillover effect is that the signaling quality from the communication in one channel is being leveraged in both channels.

## 8 Conclusions

In this paper, we study marketing instrument effectiveness, including interaction effects, within the context of a pro-social grassroots marketing campaign. The Rhode Island Energy Challenge "Find Your Four" program uses an integrated communications approach to reach a broad audience by building campaigns around pre-existing communities, such as municipi-

palities, churches, businesses, and universities. The marketing instruments include events, social media, a video challenge, newsletters, earned newspaper articles and TV/radio spots, and e-mails. A distinguishing characteristic of this grassroots program is that commitments can often happen immediately after the marketing touch, which contrasts with other campaigns, such as those to encourage purchases in retail shopping categories. This allows us to use the timing of touches and commitments to establish causality.

Consistent with the consumer behavior literature, we find that affiliate touches are much more effective at getting energy savings commitments than non-affiliate messaging. But most importantly, we find clear evidence for a complementarity between face-to-face interactions at events and affiliate social media, whereby greater in-person interactions lead to increased effectiveness of social media. We further find that the most effective social media messages are ones that refer to on-the-ground campaigns and/or the event, constant with the highlighting of social norms and signaling the importance of the behavior. This provides evidence on the importance of designing the content of the social media messages carefully to gain the fullest advantage of the complementarities offered being these messages and in-person interactions.

Signups were a key goal of the program. Of course, the broader objective of the program is to save energy and thus reduce greenhouse gas and local air pollutant emissions from electricity generation. One limitation of this study is that we were not provided the data to examine the energy savings from the program. However, according to a report issued by National Grid, in a follow-up survey sent to all program participants in January 2014, over 90% reported following through with at least one activity, and 64% reported taking all four actions to which they had committed.<sup>15</sup> 85% of households replaced their lighting with CFLs and LEDs (National Grid provided discounts), and 69% installed high-efficiency HVAC equipment, a smart thermostat, or recycled a second refrigerator or freezer. A notable feature of these actions is that they will result in both short and long-term response in energy response. The LED energy savings alone that result from the municipal campaigns will save

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<sup>15</sup>The survey response rate was 15%, resulting in over 160 survey responses. [https://rpsc.energy.gov/sites/default/files/publication/c-945\\_RIEC%20Survey%20Results.pdf](https://rpsc.energy.gov/sites/default/files/publication/c-945_RIEC%20Survey%20Results.pdf).



over a thousand megawatts-hours of electricity per year, equivalent to installing 25 residential solar systems (at 5 kW each) but at much lower cost.<sup>16</sup>

One substantive takeaway from this study is that grassroots marketing campaigns have real potential to increase pro-social behaviors due to their ability to leverage affiliate-group communications. Over 70% of the National Grid survey respondents reported that it was encouraging to hear about the Challenge from local community members serving as advocates for energy conservation. We provide empirical evidence for this in the fact that affiliate communications are an order of magnitude more effective than non-affiliate communications. A second key takeaway is that the complementarities between marketing instruments suggests that an integrated communications approach will have greater success in similar pro-social contexts than a stand-alone marketing communications strategy.

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<sup>16</sup>The calculation uses our Table 1 column 4 results of a 124 installation per month treatment effect, assumes no rebound effect, and uses an 85% LED adoption rate for those who commit, consistent with the survey.

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# Appendix A: Program Details

Figure A.1: Map of Rhode Island illustrating the four municipal campaigns

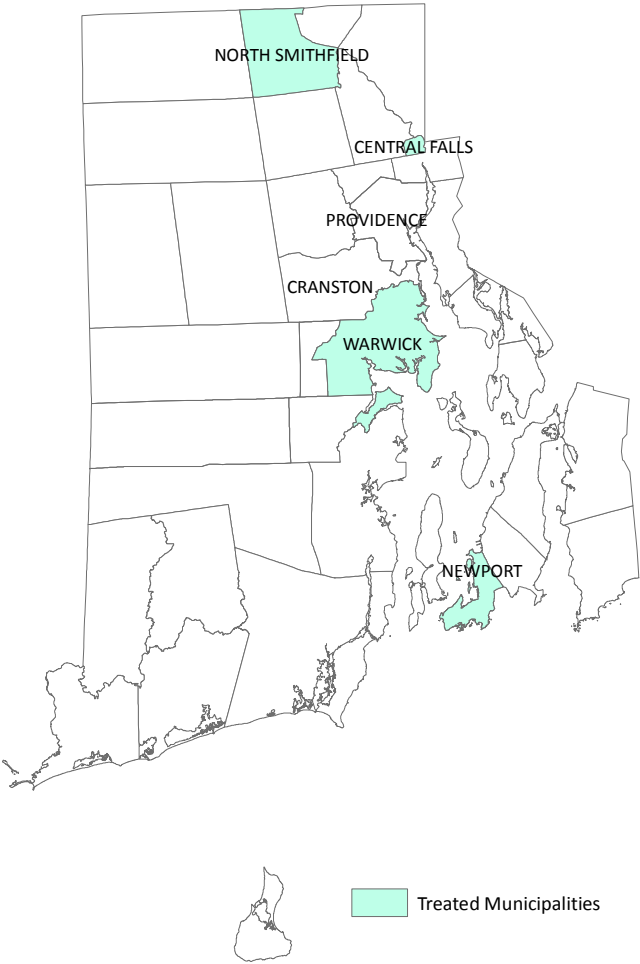


Table A.1: List of Energy Saving Activities

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Lower your thermostat a few degrees in the winter
Raise your thermostat a few degrees in the summer
Hang laundry to dry
Use computer power-saving modes
Unplug electronics when they're not in use
Zone heat with baseboard heaters
Turn off your computer at night
Wash clothes with cold water
Power down your cable or DVR box when it's not in use
Turn off lights when not needed
Ask your property owner to make energy-saving upgrades
Reduce pool temperature
Plan for a year of savings
Talk about savings
Reduce pool pump run time
Adjust the display on your television
Be smart about dishwashing
Reduce your water heater's temperature
Close your shades in the summer
Open your shades on winter days
Turn your water heater off or down when you're away
Avoid over-drying clothes
Clear the area around baseboard heaters
Turn down your thermostat when using your fireplace
Shave a minute off shower time
Set your refrigerator's temperature to 38F
Spotlight your work spaces
Clear the area around your AC
Clear area around vents
Clean your refrigerator coils
Use heated blankets and turn down the thermostat
Block drafts of cold air

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Table A.2: Timeline of Municipal Campaigns

Challenge	Total Signups	Start Date	End Date
North Smithfield	189	5/29/13	12/13/13
Newport	762	10/7/13	4/30/14
Warwick	1593	4/1/14	8/18/14
Central Falls	63	9/21/14	1/21/15

Notes: Cranston did not have the engagement of the municipal leaders and did not fully get off the ground, so is not included.

Table A.3: Timing of Non-Municipal Campaigns

Challenge	Total Signups	Type	Date
URI	0	University	3/8/14
UPS	117	Business	7/10/14
Blue Cross Blue Shield of RI	173	Business	8/5/13, 4/25/14, 9/5/14, 4/22/15
Fidelity	275	Business	6/10/14-6/12/14
GTECH	104	Business	5/1/14, 8/26/14-8/28/14
Citizen	144	Business	8/16/13
St. Peter's by-the-Sea	0	Faith	8/24/14
Emmanuel Church	19	Faith	3/23/14
Channing Memorial Church	29	Faith	4/27/14
St. James	0	Faith	9/21/14
Concordia Spiritual Center	0	Faith	6/22/14
Newman Congregational	3	Faith	2/16/14
Kings Cathedral	0	Faith	11/14
Video Challenge	NA	Contest	10/15/14-2/15/15

Table A.4: Total Marketing Touches

	Number Reached
Direct Interaction	11,250
Video Challenge Pageviews	13,452
Newspaper Article Circulation	308,664
Newsletter Viewers	74,529
Social Media Follower Interactions	893,926
Total Affiliate Signups	4,525
Total Signups	6,234

Table A.5: Average Marketing Touches

Activity	Obs	Mean	Std. Dev.	Min	Max
event	47	101.0709	104.5771	10	500
newsletter	20	1596.6	1487.723	100	4991
affiliate newsletter	221	2319.538	2986.552	43	9000
tax letter	1	80000	.	80000	80000
social	30	2154.367	2245.717	2	7945
affiliate social	4828	2531.641	1354.53	7	14416
newsletter	9	11511.11	3447.624	7900	15000
affiliate newsletter	136	48540.5	36767.24	7062	85000
videochallenge	1564	1	0	1	1

Table A.6: Top Referral Websites

Site	Type	Sessions	Unique Users
energyfederation.org	Non-profit	510	371
facebook.com	Social media	328	144
m.facebook.com	Social media	290	233
smartpower.org	SmartPower	255	124
semalt.semalt.com	Analytics Tool	228	228
intranet.corp.internal.citizensbank.com	Corporate Affiliate	182	170
insideblue	Not Sure	146	136
l.facebook.com	Social media	138	74
us7.campaign-archive1.com	e-mail marketing service (Mail Chimp)	125	15
buttons-for-website.com	Web share tool	97	97
cranstonri.com	Town Affiliate	95	51
ripower.org	Non-profit Affilaite	70	54
lm.facebook.com	Social media	69	36
t.co	Social Media	69	52
warwickri.gov	Town affiliate	43	42
cardis.com	Corporate Affiliate	30	13
nsmithfieldri.org	Town affiliate	30	27
makemoneyonline.7makemoneyonline.com	Other	27	27
turnto10.com	Media	27	26
us7.campaign-archive2.com	e-mail marketing service (Mail Chimp)	27	4
edline.net	Learning Community (Blackboard)	23	6
us-mg6.mail.yahoo.com	Not sure	23	23
10.254.254.4:81	Not sure	19	17
ri-ipl.org	Church Affiliate	19	12
valleybreeze.com	Media	19	18
cranstonlibrary.org	Town affiliate	18	17
smartpower.wpengine.com	SmartPower	17	1
studio.stupeflix.com	Video Site	16	0
nationalgridus.com	Utility	13	9
efi.org	Non-profit (Energy Federation)	12	12
smartpress.tumblr.com	SmartPower	12	8
us-mg5.mail.yahoo.com	Not Sure	11	9
pbn.com	Media	10	8

Table A.7: Municipalities in Rhode Island

Name	Type	County	Population
Barrington	Town	Bristol	16,310
Bristol	Town	Bristol	22,954
Burrillville	Town	Providence	15,955
<b>Central Falls</b>	City	Providence	19,376
Charlestown	Town	Washington	7,827
Coventry	Town	Kent	35,014
Cranston	City	Providence	80,387
Cumberland	Town	Providence	33,506
East Greenwich	Town	Kent	13,146
East Providence	City	Providence	47,037
Exeter	Town	Washington	6,425
Foster	Town	Providence	4,606
Glocester	Town	Providence	9,746
Hopkinton	Town	Washington	8,188
Jamestown	Town	Newport	5,405
Johnston	Town	Providence	28,769
Lincoln	Town	Providence	21,105
Little Compton	Town	Newport	3,492
Middletown	Town	Newport	16,150
Narragansett	Town	Washington	15,868
New Shoreham (Block Island)	Town	Washington	1,051
<b>Newport</b>	City	Newport	24,672
North Kingstown	Town	Washington	26,486
North Providence	Town	Providence	32,078
<b>North Smithfield</b>	Town	Providence	11,967
Pawtucket	City	Providence	71,148
Portsmouth	Town	Newport	17,389
Providence	City	Providence	178,042
Richmond	Town	Washington	7,708
Scituate	Town	Providence	10,329
Smithfield	Town	Providence	21,430
South Kingstown	Town	Washington	30,639
Tiverton	Town	Newport	15,780
Warren	Town	Bristol	10,611
<b>Warwick</b>	City	Kent	82,672
West Greenwich	Town	Kent	6,135
West Warwick	Town	Kent	29,191
Westerly	Town	Washington	22,787
Woonsocket	City	Providence	41,186

Notes: The treated municipalities are in bold: North Smithfield, Newport, Warwick, and Central Falls.

## Appendix B: Daily Data Descriptive Analyses

In this Appendix, we provide summary statistics of the daily affiliate panel data. In Table A.8, we show the basic summary statistics. In Table A.9, we show the correlation between affiliate marketing touches, and Figure A.2 shows the histogram of signups.

Table A.8: Daily Summary Statistics

Variable	Mean	Std. Dev.
event occurs	0.004	0.067
interactions at event	0.454	9.679
affiliate newsletter sent	0.002	0.045
affiliate newsletter recipients (1000s)	0.011	0.787
newsletter sent	0.021	0.144
newsletter recipients (1000s)	0.049	0.546
affiliate social media sent	0.003	0.053
affiliate social media recipients (1000s)	0.006	0.165
affiliate social media sent x other affiliate	0.044	0.206
social media sent	0.461	0.499
social media recipients (1000s)	1.167	1.562
affiliate newspaper article	0.001	0.029
affiliate newspaper recipients (1000s)	0.01	0.351
newspaper article	0.013	0.113
newspaper recipients (1000s)	0.63	6.902
e-mail sent	0.026	0.159
e-mail recipients (1000s)	7.000	57.602
web article	0.015	0.12
number of web articles (1000s)	0.016	0.139
TV (1000s)	0.003	0.057
radio (1000s)	0.002	0.04
video challenge indicator	0.149	0.356
video challenge x during town campaign	0.009	0.093
Observations		10,472

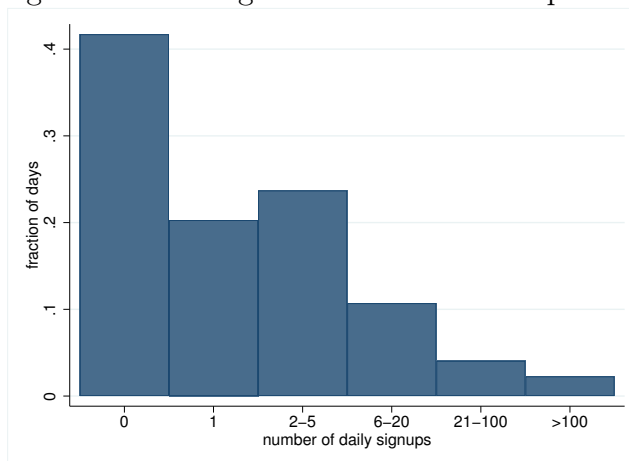
Notes: An observation is a day-campaign. There are four municipal campaigns and 14 affiliate campaigns. The dataset runs from 5/9/2013 to 1/14/2015.

Figure A.3 shows a bubble plot for events. It demonstrates that events are more effective at increasing commitments with more consumer interactions (note the log scale). To give some examples of these events, the most successful event was Warwick’s “National Night Out” which had 150 interactions and 531 observed commitments in the five day period fol-

Table A.9: Affiliate Marketing Touch Correlations

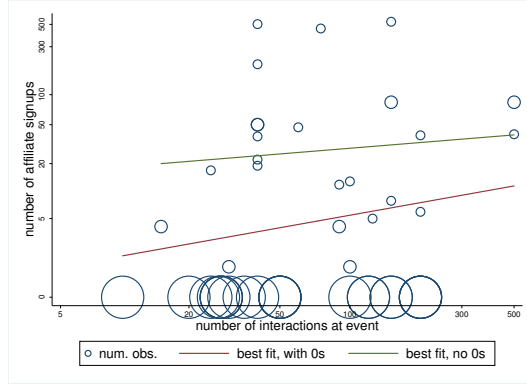
interactions at event	1			
affiliate newsletter recipients (1000s)	-0.0013	1.0000		
affiliate social media recipients (1000s)	0.0621	-0.0015	1.0000	
affiliate newspaper recipients (1000s)	0.0076	-0.0012	0.0919	1.0000

Figure A.2: Histogram of commitments per day



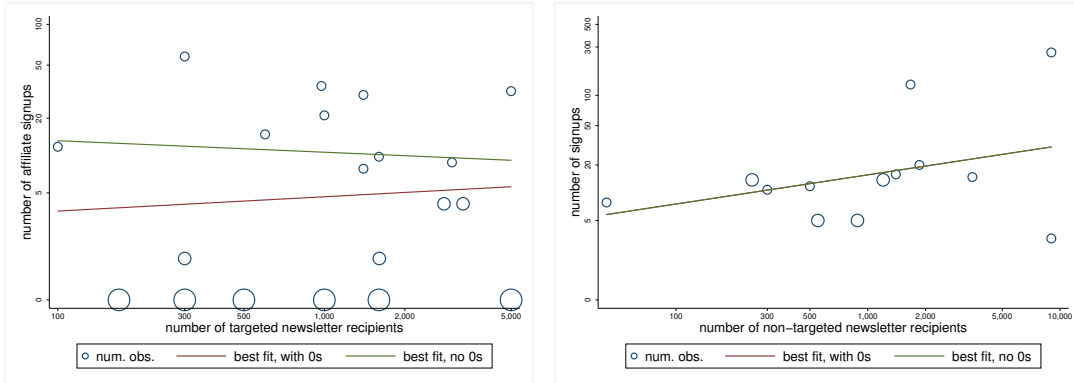
lowing and including the event. Warwick’s Little League tournament was second with 40 interactions and 503 commitments, followed by the Warwick Library Event with 455 commitments (75 interactions) and Newport’s Harvest fair with 84 commitments (650 interactions). The most successful non-municipality campaign events were the Westbay Community Action Program kickoff, with 47 commitments, and the Newport Beach Recycling Day, with 40 commitments. However, the largest bubbles fall on the x-axis—in total, 49% of events yield zero commitments in the five period day following (and including) the event day. This highlights an important feature in our data: a relatively large number of events led to zero commitments. This descriptive finding will motivate further empirical analysis that accounts for the zeros. The fact that more touches at events leads to a greater likelihood of non-zero commitments and the linear relationship between the number of commitments and number of touches conditional on having positive commitments indicate that interactions at events affect commitments on both the intensive and extensive margins, consistent with Hypothesis

Figure A.3: Bubble plot and histogram of commitments from events



Note: Bubble size indicates number of observations. Red line is best fit line. Green line is best fit conditional on positive commitments. 49% of events have zero signups in the following five days.

Figure A.4: Bubble plot and histogram of commitments from newsletters



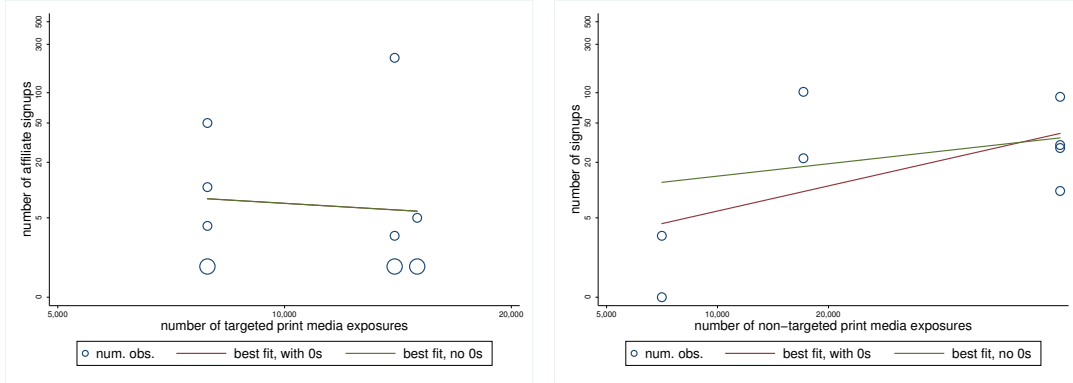
Note: Bubble size indicates number of observations. Red line is best fit line. Green line is best fit conditional on positive commitments. 30% of affiliate newsletters have zero signups in the following five days. 0% of non-affiliate newsletters have zero signups in the following five days.

2.

Figure A.4 provides a similar bubble plot and histogram for RIEC-affiliate newsletters (left panel) and non-affiliate newsletters (right panel).<sup>17</sup> Examples of the most successful of such newsletters include North Smithfield, which had 48 same-day commitments (58 commitments over the same day and the following four days) after sending out 300 newsletters, and Blue Cross & Blue Shield, which had 35 commitments out of 975 newsletters sent. This was the second newsletter for North Smithfield; the first had 21 commitments out of 1,000

<sup>17</sup>We do not include the zeros for the non-affiliate newsletters since it is difficult to determine if they covered the relevant population.

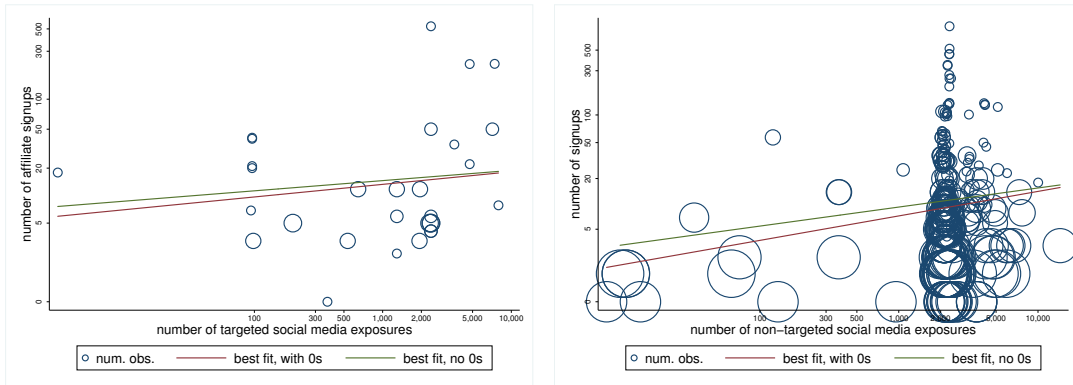
Figure A.5: Bubble plot and histogram of commitments from print media



Note:

Bubble size indicates number of observations. Red line is best fit line. Green line is best fit conditional on positive commitments. 0% of affiliate print articles have zero signups in the following five days. 13% of non-affiliate print articles have zero signups in the following five days.

Figure A.6: Bubble plot and histogram of commitments from social media



Note:

Bubble size indicates number of observations. Red line is best fit line. Green line is best fit conditional on positive commitments. 3% of affiliate social media messages have zero signups in the following five days. 7% of non-affiliate social media messages have zero signups in the following five days.

newsletters sent. The most effective non-affiliate newsletters were the Office of Energy Resources' newsletter on the Rhode Island governor's remarks on the RIEC. This newsletter led to 24 commitments over five days.<sup>18</sup> Just as in the event figures, a significant fraction of newsletters led to zero affiliate commitments. The best-fit lines for the RIEC-affiliate newsletters again show that the number of commitments is significantly lower when the zero commitment newsletters are excluded (red line) than when they are included (green line).

Figure A.5 shows a bubble plot diagram and histogram for affiliate and non-affiliate print

<sup>18</sup>Other successful non-affiliate newsletters were one of Smartpower's newsletters that led to 13 commitments and a newsletter from the North Rhode Island Chamber of Commerce that brought in 12.



media. The most successful local article was a feature piece by the Newport Daily News, which was followed by 221 commitments in the five day window. The Warwick Beacon’s “Avedisian Encourages Residents and Businesses to take part in Warwick Energy Challenge” had 50 commitments in the following days, 32 of which were on the same day. The most successful non-affiliate articles were the Valley Breeze’s “National Grid Names North Smithfield Energy Champion,” which had 70 commitments in the five day window; Providence Journal’s “National Grid Energy Saving Program is Making a Mark in Cranston,” which had 30 commitments; and Providence Journal’s “Energy Challenge Kicks off Ready,” which had 28 commitments.<sup>19</sup> We again see some print media interventions with zero commitments, but the percentage is relatively small. Just over 10 percent of the non-affiliate print media led to zero commitments, and none of the affiliate print media led to zero commitments.

Finally, Figure A.6 shows the bubble plot diagram and histogram for social media messages. The top panel shows the bubble plot and histogram for affiliate social media exposures. Only a very small percentage of these are zero, and some of these social media exposures were highly successful, with over 100 commitments. For non-affiliate social media exposures, there is a very clear positive relationship between the number of commitments and the number of touches. Some of the messages reached a very large number of households. Just over seven percent of these non-affiliate social media exposures led to zero commitments, and there is a wide dispersion in how many recipients there were of these unsuccessful exposures. Some of the unsuccessful exposures only went to a small number of residents, but some went to as many as 2,000 residents. In general, the best-fit line indicates that the more residents reached, the more commitments occur.

For newsletters, print media, and social media, there appears to be a clear linear relationship between the number of marketing touches and the number of signups, both unconditional and conditional on positive signups. The same is not true for affiliate touches.

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<sup>19</sup>For comparison, the top web articles not coinciding with print articles and events were on [renewablenow.biz](http://renewablenow.biz), [ecori.org](http://ecori.org), [banneker.com](http://banneker.com) and [cranston.patch.com](http://cranston.patch.com) with 70, 30, 28 and 28 commitments respectively. Unfortunately, we do not know the readership of the web articles.

Affiliate touches appear to lead to non-zero signups, but there is no clear linear relationship, with the possible exception for social media. Thus, the affiliate messaging appears to affect the extensive margin, whereas the non-affiliate messaging affects the intensive margin. This is consistent with Hypothesis 1.

# Appendix C: Robustness Checks

## Daily Effects Only

### ZIP model

The ZIP model assumes a two-part data generating process. The first part is a binary distribution that captures whether an intervention has enough influence to generate positive commitments. This is a behaviorally different process than the second part, which is governed by a Poisson distribution to model the count data process conditional on having positive commitments. The two-part data generating process can be viewed as a mixture distribution between a Poisson and a degenerate component with all of its mass at zero. There is a clear intuition for this model in our setting for one would expect that a significant number of interventions will simply not gain any traction due to weather or a variety of other conditions, and thus would lead to zero commitments. In grassroots marketing it is often important to have a critical mass of individuals who receive marketing touches to create the social spillovers necessary for a non-zero response. This process is distinctly different than the process than a standard count data process, such as a Poisson process.

Let the number of commitments in each campaign  $i$  in a day  $t$  be given by  $Y_{it}$ . Our specification thus models the number of commitments  $Y_{it}$  with the following probability mass function:

$$\begin{aligned} Pr[Y_{it} = 0 | \lambda_{it}] &= \phi + (1 - \phi)e^{-\lambda_{it}} \\ Pr[Y_{it} = y | \lambda_{it}] &= (1 - \phi) \frac{\lambda_{it}^y e^{-\lambda_{it}}}{y!}, \text{ where } y = 1, 2, \dots, \infty. \end{aligned}$$

In this model  $\lambda_{it} > 0$  is the Poisson parameter (i.e., the expected Poisson count) and  $\phi \in (0, 1)$  is the probability zeros will be generated.

Following the standard Poisson approach, we model parameter  $\lambda$  as an exponential function of the marketing interventions  $X_{it}$ , indicator (i.e., zero-one) variables for campaigns  $\mu_i$ ,

Table A.10: Estimated One-Day Effects

	(1)	(2)	(3)	(4)	(5)	(6)
interactions at event	0.0015 (0.0010)	0.0007 (0.0007)	0.0007 (0.0007)	0.0015 (0.0010)	0.0008 (0.0007)	0.0007 (0.0007)
affiliate newsletter recipients		0.0001 (0.0007)	-0.3745** (0.1775)	0.3065** (0.1410)	0.3120** (0.1413)	-0.0196 (0.1455)
newsletter recipients	0.0023 (0.0062)	0.0029 (0.0061)	-0.0013 (0.0059)			
affiliate social media recipients	0.1349** (0.0556)	0.0575 (0.0563)	0.0765 (0.0622)	0.1359*** (0.0523)	0.0590 (0.0522)	0.0794 (0.0575)
social media recipients	0.0154*** (0.0028)	0.0151*** (0.0028)	0.0138*** (0.0028)			
affiliate newspaper recipients	0.0291 (0.0186)	0.0140 (0.0148)	0.0250 (0.0179)	0.0293* (0.0170)	0.0139 (0.0130)	0.0234 (0.0155)
newspaper recipients	0.0015* (0.0008)	0.0010 (0.0007)	0.0011 (0.0007)			
affiliate social media		0.0108*** (0.0023)	0.0114*** (0.0026)		0.0109*** (0.0022)	0.0114*** (0.0025)
social media		-0.0001 (0.0004)	-0.0003 (0.0003)		-0.0003 (0.0003)	-0.0004 (0.0003)
X interactions at event						
affiliate social media			-1.0723** (0.4650)			-0.9510*** (0.1722)
X affiliate newsletter recipients						
social media			0.1847** (0.0875)			0.1456*** (0.0341)
X affiliate newsletter recipients						
affiliate social media			-0.1117** (0.0449)			-0.1003** (0.0408)
X newsletter recipients						
social media			0.0313** (0.0151)			
X newsletter recipients						
affiliate social media			0.1275* (0.0744)			0.1209* (0.0668)
X affiliate newspaper recipients						
social media			-0.0170** (0.0083)			-0.0151** (0.0072)
X affiliate newspaper recipients						
affiliate social media			-0.0116 (0.0071)			-0.0112* (0.0064)
X newspaper recipients						
social media			0.0001 (0.0003)			
X newspaper recipients						
affiliate newsletter recipients			0.0040*** (0.0004)			0.0018** (0.0009)
X interactions at event						
newsletter recipients			-0.0002* (0.0001)			-0.0002 (0.0001)
X interactions at event						
email recipients	0.0000 (0.0001)	0.0000 (0.0001)	0.0000 (0.0001)			
number of web articles	0.0074 (0.0225)	0.0133 (0.0218)	0.0156 (0.0197)			
TV	-0.1229*** (0.0474)	-0.1016** (0.0410)	-0.1075** (0.0435)			
radio	0.0397 (0.0590)	0.0395 (0.0588)	0.0404 (0.0587)			
video challenge	0.0264* (0.0149)	0.0273* (0.0140)	0.0264* (0.0141)			
video challenge x during town campaign	0.3224*** (0.0608)	0.3220*** (0.0607)	0.3197*** (0.0590)	0.3117*** (0.0578)	0.3121*** (0.0575)	0.3111*** (0.0572)
affiliate dummy variables	Y	Y	Y	Y		
month dummy variables	Y	Y	N	N		
day dummy variables	N	N	Y	Y		
R-squared	0.118	0.137	0.144	0.187	0.205	0.208
N	11,088	11,088	11,088	11,088	11,088	11,088

Notes: An observation is a campaign-day. The marginal effect is taken at the mean. Affiliate-clustered standard errors in parentheses. \*\*\* indicates significant at the 1% level, \*\* at the 5% level, \* at the 10% level.

and year-month indicator variables  $\delta_t$ :

$$\lambda_{it} = e^{\mathbf{X}'_{it}\boldsymbol{\Theta} + \mu_i + \delta_t}. \quad (3)$$

A convenient feature of this model is that  $\mathbb{E}[Y_{it}] = (1 - \phi)\lambda_{it}$  and  $\text{Var}(Y_{it}) = \mathbb{E}[Y_{it}] + \mathbb{E}[Y_{it}](\lambda_{it} - \mathbb{E}[Y_{it}])$ . Thus, the model does not impose equidispersion (i.e., the conditional mean equals the conditional variance) and allows for a greater variance than the Poisson model. Other models, such as the negative binomial model, also relax the equidispersion assumption, but this is only a side benefit of ZIP model. The primary motivation for using the ZIP model is to best reflect the process generating the observed consumer behavior.

The log-likelihood function is given by:

$$l(\phi, \boldsymbol{\Theta}; \mathbf{y}) = \sum_{i=1}^I \sum_{t=1}^T \{I(y_{it} = 0) \ln(\phi + (1 - \phi)e^{-\lambda_{it}(\boldsymbol{\Theta})}) \\ I(y_{it} > 0) [\ln(1 - \phi) - \lambda_{it}(\boldsymbol{\Theta}) + y_{it} \ln(\lambda_{it}(\boldsymbol{\Theta}) - \ln(y_{it}!))]\}$$

We thus solve the model using maximum likelihood estimation to recover the coefficients of interest  $\boldsymbol{\Theta}$ . Results are shown in Table [A.11](#).

Table A.11: ZIP Regressions

	ZIP 1			ZIP 2		
	commitments	inflation	marg. effect	commitments	inflation	marg. effect
interactions at event	0.0023 (0.0022)	-0.0046*** (0.0013)	0.0021* (0.0012)	0.0019 (0.0017)	-0.0047*** (0.0013)	0.0019* (0.0011)
affiliate newsletter recipients	-0.0033 (0.0109)	-0.0154** (0.0061)	0.0025 (0.0036)	-0.0038 (0.0114)	-0.0158** (0.0064)	0.0024 (0.0037)
newsletter recipients	0.0976 (0.0641)	-0.0476 (0.0616)	0.0522** (0.0219)	0.0833 (0.0639)	-0.0503 (0.0613)	0.0465** (0.0214)
affiliate social media recipients	0.0424 (0.0557)	-0.2742*** (0.0770)	0.0864** (0.0372)	-0.0533 (0.1548)	-0.2939*** (0.0583)	0.0515 (0.0718)
social media recipients	0.0759** (0.0344)	-0.0359** (0.0165)	0.0403*** (0.0136)	0.0694** (0.0331)	-0.0381** (0.0155)	0.0378*** (0.0126)
affiliate newspaper recipients	-0.0815** (0.0367)	-0.2153*** (0.0550)	0.0205*** (0.0053)	-0.0753** (0.0350)	-0.2110*** (0.0506)	0.0219*** (0.0046)
newspaper recipients	0.0171*** (0.0052)	0.0030 (0.0057)	0.0063*** (0.0019)	0.0173*** (0.0036)	0.0031 (0.0055)	0.0063*** (0.0013)
interactions at event						
X affiliate social media recipients						
email recipients	-0.0027*** (0.0004)	-0.0007 (0.0005)	-0.0009*** (0.0003)	(0.0015) (0.0007)	(0.0007) (0.0005)	(0.0007) (0.0004)
number of web articles	0.1220 (0.4373)	0.0028 (0.2794)	0.0496 (0.1303)	0.1367 (0.4186)	0.0015 (0.2778)	0.0554 (0.1234)
TV	-2.1118*** (0.5642)	-0.9122 (0.7192)	-0.6412*** (0.1627)	-2.1457*** (0.6331)	-0.9406 (0.7356)	-0.6410*** (0.1310)
radio	-1.8879*** (0.5551)	-1.5509** (0.7166)	-0.3884** (0.1893)	-1.9910*** (0.4928)	-1.6166** (0.6554)	-0.4094* (0.2153)
video challenge	0.2477*** (0.0940)	0.1961*** (0.0604)	0.0528 (0.0382)	0.2314** (0.0946)	0.1852*** (0.0624)	0.0483 (0.0368)
video challenge x during town campaign	0.3256** (0.1503)	-8.8758*** (1.3641)	2.3639*** (0.4967)	0.3327** (0.1466)	-8.8660*** (1.3815)	2.3461*** (0.5108)
affiliate indicator variables		Y			Y	
month indicator variables		Y			Y	
R-squared						
Log-L		-6,493.422			-6,361.253	
N		10,404			10,404	

Notes: An observation is a campaign-day. The marginal effect is taken at the mean. Affiliate-clustered errors in parentheses. \*\*\* indicates significant at the 1% level, \*\* at the 5% level, \* at the 10% level.

## Appendix D: Intervention Costs

Costs per activity are shown in Table A.12. In order to work through affiliates, SmartPower bears a cost to present to the affiliate group, and we assume that the cost to draft and post a social media message for the affiliate is the same as it is for SmartPower. Costs are based on labor and travel. For affiliate social media, we assume that each visit leads to seven social media messages (the average observed value in the data).

Table A.12: Costs of Interventions

Activity	Total Cost
Tabling at an event	\$77.64
Sending out tweets	\$9.71
Posting on Facebook	\$9.71
Giving a presentation to a group	\$38.82
Partner/supporter email	\$38.82
Draft Press Release	\$77.64
Business visits	\$77.64
Elected Official/Opinion Leader	\$19.41

Notes: Costs are based on hourly and fixed costs, including time and travel.