Research article

Evaluating the effectiveness of a water conservation campaign: Combining experimental and field methods

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ARTICLE INFO

Article history:
Received 23 November 2015
Received in revised form 16 May 2016
Accepted 18 May 2016

Keywords:
Conservation campaigns
Demand management
Policy instruments
Water consumption
Environmental behavior
Controlled field experiment
Cost-effectiveness analysis

1. Introduction

Policymakers and social marketers use various policy instruments to influence behavior in order to enforce public policy and achieve social goals. A commonly used classification of policy instruments involves economic incentives, command and control type regulations, and social-marketing efforts that include informational and educational campaigns (Press and Arnould, 2009; Vedung, 1998; Weiss and Tschirhart, 1994). Incentives and regulations are widely used by public policymakers (Bemelmans-Videc et al., 2011; Stern and Dietz, 2002) and their various advantages over awareness-raising informational social-marketing-based efforts are often discussed in the public policy and economics literature. Specifically, it is suggested that policymakers typically employ informational campaigns during short and disruptive crises or when economic or regulatory instruments are not feasible (e.g., Stern and Dietz, 2002; Vedung, 1998). Still, despite their wide application, economic and regulatory instruments are not always effective (e.g., Press and Arnould, 2009; Wall, 2005) and suffer from serious limitations, such as imposing regressive cost burdens, being difficult to enforce, creating public antagonism, limiting people’s free choice, and encouraging free riders (see, for example, Allcott, 2011; May, 2005; Rothschild, 1999). Conversely, in terms of promoting conservation efforts, two key strengths of informational and social-marketing campaigns over traditional policy instruments are that they create less public reactance and that they may create a longer and deeper change in behavior due to their educational nature (Dietz et al., 2009; Rothschild, 1999). In addition, informational campaigns can be deployed quickly and are often cheaper to implement. Therefore, it is not surprising that conservation campaigns have become a critical part of many regulators’ arsenal of policy tools for natural resource management in general and water management in particular (March et al., 2015; Saurí, 2013).

Such conservation campaigns are often introduced or emphasized in times of shortages or crisis, along with other policy instruments, such as price increases, quotas, and other regulatory implements. This simultaneous use of multiple instruments is logical from the perspective of the regulator, as research confirms this strategy’s effectiveness in promoting socially desired behaviors relatively to a strategy involving a single type of policy instrument (Dietz et al., 2009). However, the concomitant use of campaigns together with a mix of other policies hinders the ability to determine the actual effectiveness of the campaigns as it becomes difficult to disentangle the relative impacts of each policy instrument used (Michelsen et al., 1999; Syme et al., 2000).

Interest in social-marketing campaigns to promote policy goals has grown over time (Lefebvre, 2013). There is some evidence that such campaigns can be effective in changing behavior, especially for short periods of time and at a relatively low cost (Dietz et al., 2009; Saurí, 2013), however research directly juxtaposing marketing and policy instruments is scarce. Further, relatively little research has looked at the effectiveness of such campaigns over time (Saurí,
Thus, more longitudinal assessments are warranted (Grinstein and Nisan, 2009). To contribute to this evolution, there is thus a need to provide rigorous evidence regarding the benefits of such informational, social-marketing tools in social contexts to enable policymakers to make better use of them, either alone or combined with traditional policy instruments.

In this work we conducted two complimentary studies in the field and online to shed light on the effectiveness of water conservation campaigns. We first conducted a large-scale longitudinal controlled field experiment, in which we monitored actual daily water conservation behavior among 1000 households over a period of six months in order to assess the long-term effect of conservation messages mailed to the customers. The intervention focused on water conservation in Israel, a country which suffers from chronic water scarcity. Importantly, the experiment took place at a time in which the country was suffering from an extended drought. Thus, the experiment measured the effect of the intervention above and beyond general water conservation campaigns and policy measures that were being implemented at the time. Using a difference-in-difference econometric model, we compared water consumption rates for households who received the marketing messages (a set of three mail messages as we detail below) to those from a control group who received no mailing.

Further, in order to evaluate the cost-effectiveness of the campaign, we compare our intervention to other possible policy instruments currently widely in use in Israel and in other countries: one demand management oriented — price increases, an instrument commonly recommended by economists, both in general and in the context of water demand management in particular (Dalhuisen et al., 2003; Olmstead and Stavins, 2009), and the other supply management, in this case the cost of supplying additional water via desalination, which has become Israel’s primary source of municipal water over the past decade.

Finally, the field experiment is complemented by an online two-stage experiment that replicates the findings in the field and sheds light on the underlying motivation for water conservation following the campaign. This experiment is also valuable in demonstrating the educational and longer-term value of campaigns relative to price increases, emphasizing that consumers are often unaware of price changes.

Overall, this paper makes three key contributions. First, we offer a longitudinal assessment of the effectiveness of a real-world water conservation campaign. This enables us to test the time boundaries of an effective campaign. Second, replicating the real-world findings in a clean setting sheds light on the underlying mechanism that drives the success of conservation campaigns. Finally, we compare the impact of our intervention with the effect of an alternative policy instrument, price increase, demonstrating the educational, economic and social advantages of campaigns as part of a conservation policy toolkit.

2. Literature review

2.1. Traditional policy instruments for water management

The depletion of water resources is an increasing concern for policymakers, given the critical role of water not only for provision of basic needs, but also for sustaining economic growth, political stability, and ecosystem health. Policymakers use a variety of instruments to address water resource scarcity, including both supply and demand management options.

Supply augmentation has been the traditionally preferred method of water managers for dealing with water shortages (Halich and Stephenson, 2009). However, demand management options are often viewed by policymakers and others as preferable to supply-side solutions for both economic and environmental reasons (Gleick, 2003). Command and control regulatory instruments to reduce consumption include restrictions on water use (e.g., limitations on lawn irrigation or car-washing) and mandating conservation technologies (e.g., low-flow taps and toilets or grey-water systems). Economic instruments generally focus on water pricing or comparable policies, such as rebates for conservation. Economists especially tend to recommend pricing tools, claiming that they require less monitoring and enforcement, offer more freedom of choice and tend to be more reliable and more cost-efficient. Other advantages include the possibility of better reflecting actual costs and providing finance for what is often a highly subsidized commodity (e.g., Olmstead and Stavins, 2009).

An extensive literature exists on economic instruments for water management, including incentivizing conservation (for a review see Worthington and Hoffman, 2008). Price increases are a commonly recommended tool, however, there are several limitations and obstacles to its implementation. For one, urban and residential water demand tends to be inelastic (Bauman et al., 1998; Dalhuisen et al., 2003; Espey et al., 1997). The main reasons suggested for low elasticity of water demand are lack of substitutes for water and the relatively small share of water usage in the overall expenses of a typical household. In a primary application of relativity, the inelastic demand is that price increases generally need to be substantial in order to achieve significant reductions in water: Consumers often do not respond to small changes in the price of water (Bauman et al., 1998). Large price increases, however, may reduce the political acceptability of such policies.

Equity concerns can also impede use of price mechanisms in the case of controlling water demand, especially given the perception of water as a human right. Price increases also tend to be regressive, meaning that poorer households bear a proportionally larger share of the cost burden (Olmstead and Stavins, 2009). Such distributional concerns can be remedied with instruments such as rebates, but these tend to be complicated. Block tariff rates are a common method of addressing distributional concerns. Incentivizing conservation by raising prices on upper tiered blocks has the advantage of reducing the impact on low-use consumers, and targeting high-use consumers, who often are both better able to pay for water and can more easily change consumption patterns. However, because such a policy only affects a segment of all users, it necessarily entails even higher price increases relative to price increases for all tariff levels in order to achieve the same quantity of water savings. Moreover, empirical evidence shows that the increasing block tariffs (IBT) structure can have unintended consequences that can erode its effectiveness as a means of addressing equity considerations (Dahan and Nisan, 2007).

An additional problem with using price instruments is that residential water is generally not purchased at the time of use. Rather, consumers receive a bill only after the consumption has taken place, often weeks later. This can result in a time lag between the impact of the price increase and the change in consumer behavior, often decreasing the effectiveness of the price instrument (Gaudin, 2006). In order to avoid this lag, water utilities will often embark on a campaign in advance of the price changes to inform consumers. Such actions can themselves be a type of awareness-raising informational campaign. In general, consumers often take time to adjust to price changes. Several studies have found that short-term demand tends to be significantly more inelastic than long-term demand (e.g., Espey et al., 1997; Dalhuisen et al., 2003). Furthermore, as prices for water are usually regulated, the bureaucratic process of changing prices can often be lengthy. Thus, these lag times can be a significant disadvantage if a rapid response is desired, as in the case of responding to a seasonal drought.

A growing body of research has attempted to assess the impact
of different non-price regulatory water demand management poli-
cies, such as use-restrictions, rationing, and mandating of various
water-saving technologies (e.g., Halich and Stephenson, 2009; Lee
and Tansel, 2013; Qaiser et al., 2011; for a review see Saurí, 2013).
A few studies have also compared price and non-price approaches
to water conservation (e.g., Michelsen et al., 1999; Wang et al., 1999;
Olmstead and Stavins, 2009; Reyna, 2012). However, relatively
few have attempted to assess the effectiveness of informational
campaigns.

2.2. Conservation campaigns

Environmental campaigns, especially those focusing on natural
resource conservation, are increasing in popularity (e.g., Abrahamse, et al., 2005; Abroms and Maibach, 2008; Kronrod et al., 2012; Peattie and Peattie, 2009; Pechmann et al., 2003; Wall, 2005).
Much of the literature on resource conservation campaigns focuses
on understanding consumer motivations and their sociodemographic
characteristics. Five hundred households were assigned to an
neighborhood with relatively homogenous socio-economic char-
acteristics. The study was conducted in Israel, a country that suffers from
chronic water scarcity (Lawrence et al., 2002), and regularly suffers
from extended droughts. Israel has long since utilized all of its
naturally occurring renewable freshwater sources, and policy-
makers have routinely promoted both supply and demand
management strategies to deal with shortages. As its primary supply
augmentation option, seawater desalination, is quite expensive,
policymakers, especially those at the Finance Ministry, have
encouraged the more cost-effective demand management options
(Katz, 2013). These include policies such as price increases, sub-
sidization of low-flow faucet attachments, seasonal use restrictions
and to some extent, informational campaigns. These policies tend
to be implemented concurrently and thus it is difficult to assess the
relative impact of any given policy. The current research therefore
attempts to evaluate the impact of a conservation campaign by
conducting one in a controlled experimental setting.

3. Empirical studies

This research includes two studies: a large-scale longitudinal
field experiment and an online experiment. The first study aims to
test the effectiveness of a campaign encouraging water conserva-
tion among 1000 households in a real-world context with actual
behavior and over time. The complementary online experiment
aims to replicate the real-world findings in a clean setting and
highlight the underlying mechanism.

3.1. Field experiment

3.1.1. Study context

The study was conducted in Israel, a country that suffers from
chronic water scarcity (Lawrence et al., 2002), and regularly suffers
from extended droughts. Israel has long since utilized all of its
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relative impact of any given policy. The current research therefore
attempts to evaluate the impact of a conservation campaign by
conducting one in a controlled experimental setting.

3.1.2. Sample and methodology

A controlled field experiment was conducted during a period of
six months (May–October), to evaluate the effectiveness of a spe-
cific intervention calling for water conservation. Jointly with a
municipal water utility in Petach Tikva, a typical city in the center of
Israel, a sample of 1000 households was randomly selected in a
neighborhood with relatively homogenous socio-economic char-
acteristics. Five hundred households were assigned to an
experimental group and another 500 households served as a control group. The choice of Petach Tikva as a sample site was important for a few reasons: a) socio-economically it is representative of the middle class in Israel, b) geographically and climatically, it is representative of the center of the country and its bulk of the populated area, and c) the city’s water utility installed advanced water meters, each with a unique household indicator, that automatically relay real-time online water consumption data to a central database, allowing for daily monitoring.

We received data from the water utility on household daily consumption for a total of 31 weeks, from March through October, such that measures of water consumption covered the hottest period of the year, which traditionally has the highest rates of consumption. Also, the experiment was done during a multi-year drought, in which various national level campaigns for water conservation were in place.

The experiment consisted of 3 mailings calling for water conservation. The mailings were sent only to the treatment group. The control group received no mailings. None of the households were aware that this was part of an experiment. The first mailing, sent in mid-May (during the 11th week of our data), was a postcard involving the conservation message (details below), inserted in a personally addressed and stamped formal envelope (by the water utility). Three weeks later, the second identical message was sent, but this time the message was printed on the water bill. A week after that, the third mailing was sent. It involved a 7 x 10 cm magnet, featuring the same message as in the previous mails. Thus, the whole experimental intervention lasted roughly one month. The decision about the number of mailings and timing was based on Municipal preferences and constraints.

3.1.3. Stimulus

Prior work in environmental marketing and health communication (Dillard and Shen, 2005; Kronrod et al., 2012; Quick and Considine, 2008) suggests that a forceful tone elicits resentment and reactance against the message, resulting in lower behavioral outcomes. Conversely, a gentler phrasing leads to greater compliance with the message. In constructing our stimulus we relied on prior empirically tested phrasing of messages encouraging water conservation (Kronrod et al., 2012). The mailing consisted of a single phrase: “It is worth conserving water”, inside a large green circle along with the logo of the water utility. The message had potential to be effective due to multiple possible interpretations of “worth”: (a) an environmental meaning — conserving water for environmental purposes (b) an economic meaning — saving costs on the water bill. As we later demonstrate in the description of the online experiment, the target audience associated “it is worth” with the civic, environmental duty of water saving rather than costs saving. The message was presented at the center of the postcard or magnet (first and third mailing wave) and near the amount to be paid on the water bill (the second mailing wave).

3.1.4. Analytical approach

During the period in which this study was undertaken, Israel was suffering from a multiyear drought and was implementing both price changes and a widely viewed national water conservation campaign. As these factors affected all households, this analysis analyzes only the additional conservation induced by the controlled intervention. We ran a difference-in-difference type analysis using panel data clustered at the household level and dummies to indicate whether households were in the treatment or control group (i.e., those receiving or not receiving mailings, respectively). As such, we account for the impact of other potentially confounding variables that may have affected water consumption among all users during the period in question.

The regressions were run according to Equation (1) below:

\[
\text{Consumption}_it = \beta_0 + \beta_1 \text{Treatment}_i + \sum_{t=1}^n \beta_{2t} \text{Time}_t + \sum_{t=1}^n \beta_{3t} \text{Time}_t \times \text{Treatment}_i + u_{it}
\]

Consumption = average daily household consumption during the period in question
Treatment = dummy variable indicating whether or not the household received the message (Control = 0. Received = 1)
Time = dummy variables indicating the time period in question
Time × Treatment = interaction variables for different time periods and whether or not the household received a message
\(\beta\) = parameters to be estimated
\(u\) = error term, clustered by household
\(i\) = household identifier
\(t\) = time period
\(n\) = total number of time periods

Consumption data was aggregated into weekly averages of daily consumption in order to account for periodicity in water use. Multiple regressions with varying time periods (weekly and biweekly) were run.

3.1.5. Descriptive data

Water consumption data was collected for 1000 households; however, some observations were dropped from the sample because of faulty meters, attrition (moving or going on extended vacations), returned mail, etc. The effective number of households included in the final sample analyzed totaled 934 observations: 472 treatment and 462 control households.

Fig. 1 presents a seven day running mean of household daily water consumption (measured in cubic meters (m³) per day). A running mean was used to smooth the data, as actual consumption on a given day was somewhat stochastic. Ideally in such policy analyses, populations differ based only on the intervention. Average daily consumption for the period prior to the first mailing seems to show little difference between households receiving mailings and those used as controls. Following the mailings, however, consumption in households not receiving the message grew significantly, while the change in consumption in households receiving the message was much less dramatic. The rise (and subsequent fall) in water consumption by the control group is due to rising early summer temperatures, followed by declining late summer and early fall temperatures. This seems to indicate that the treatment seems to have moderated seasonal peaks in consumption.

3.1.6. Estimated regression results

Average daily consumption for weeks 1–3 (March) was used as a base time period in all regressions. Thus, results are relative to consumption during this period. Values for the constant represent average daily consumption by the control group during the base period (weeks 1–3). Values for the variable treatment represent the difference in consumption between treatment and control groups during the base period. The time period dummy variables represent the mean change in consumption for the control group relative to the base period for the period in question. The time × treatment interaction variables indicate average daily consumption of treatment group relative to the control group during the time period.

For reasons of brevity, the primary regression shown below (Table 1) uses biweekly time periods well before and well after the
Table 1
Regression results for mean daily consumption (m³) — Bi-weekly data.

<table>
<thead>
<tr>
<th>Variable description</th>
<th>Variable</th>
<th>Coefficient</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption of control group during baseline period</td>
<td>Constant</td>
<td>0.399***</td>
<td>0.000</td>
</tr>
<tr>
<td>Additional consumption for treatment group during baseline period</td>
<td>Treatment</td>
<td>0.005</td>
<td>0.769</td>
</tr>
<tr>
<td>weeks4–5</td>
<td></td>
<td>0.036***</td>
<td>0.000</td>
</tr>
<tr>
<td>weeks6–7</td>
<td></td>
<td>0.025**</td>
<td>0.011</td>
</tr>
<tr>
<td>weeks8–9</td>
<td></td>
<td>0.066***</td>
<td>0.000</td>
</tr>
<tr>
<td>weeks10–11</td>
<td></td>
<td>0.016</td>
<td>0.127</td>
</tr>
<tr>
<td>weeks12–13</td>
<td></td>
<td>0.031***</td>
<td>0.006</td>
</tr>
<tr>
<td>weeks14–15</td>
<td></td>
<td>0.054****</td>
<td>0.005</td>
</tr>
<tr>
<td>weeks16–17</td>
<td></td>
<td>0.047***</td>
<td>0.000</td>
</tr>
<tr>
<td>weeks18–19</td>
<td></td>
<td>0.030**</td>
<td>0.026</td>
</tr>
<tr>
<td>weeks20–21</td>
<td></td>
<td>0.022*</td>
<td>0.059</td>
</tr>
<tr>
<td>weeks22–23</td>
<td></td>
<td>0.026**</td>
<td>0.035</td>
</tr>
<tr>
<td>weeks24–25</td>
<td></td>
<td>0.026*</td>
<td>0.060</td>
</tr>
<tr>
<td>weeks26–27</td>
<td></td>
<td>0.026*</td>
<td>0.055</td>
</tr>
<tr>
<td>weeks28–29</td>
<td></td>
<td>0.021*</td>
<td>0.053</td>
</tr>
<tr>
<td>weeks30–31</td>
<td></td>
<td>0.024**</td>
<td>0.048</td>
</tr>
<tr>
<td>weeks4–5*T</td>
<td></td>
<td>-0.001</td>
<td>0.894</td>
</tr>
<tr>
<td>weeks6–7*T</td>
<td></td>
<td>-0.015</td>
<td>0.192</td>
</tr>
<tr>
<td>weeks8–9*T</td>
<td></td>
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<td>0.526</td>
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<td>weeks10–11*T</td>
<td></td>
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<tr>
<td>weeks12–13*T</td>
<td></td>
<td>-0.027**</td>
<td>0.049</td>
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<tr>
<td>weeks14–15*T</td>
<td></td>
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<td>0.024</td>
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<td>weeks16–17*T</td>
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<td>weeks18–19*T</td>
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<td>0.360</td>
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<tr>
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<td>0.088</td>
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<td>0.413</td>
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<td>0.482</td>
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<tr>
<td>weeks28–29*T</td>
<td></td>
<td>-0.007</td>
<td>0.588</td>
</tr>
<tr>
<td>weeks30–31*T</td>
<td></td>
<td>-0.017</td>
<td>0.266</td>
</tr>
</tbody>
</table>

Note: ***, **, and * indicate significant at 1%, 5%, and 10% levels, respectively, based on robust standard errors clustered by household.
campaign. A regression using weekly data display the duration of the effectiveness of the campaign at a higher resolution. Because of limitations of space, the results are shown in Table 2 for the relevant time periods only. The qualitative implications do not differ between the regressions.

The coefficients on treatment and on the time-treatment interaction variables prior to week 12 — the first week following the first mailing — are not statistically significant, indicating that the control and treatment groups did not differ in terms of consumption prior to the initial mailings. The statistically significant values for the time period variables are consistent with the general trend of an increase in consumption during the early summer and a decrease in late summer. For weeks 12–16, however, treatment households consumed statistically significantly less water than control households (Table 2). (The biweekly regressions in Table 1 show consumption for weeks 16 and 17 aggregated, which is not statistically different from the base period, however, weekly regressions shown in Table 2 indicate that week 16 consumption was lower for treatment households than non-treatment ones at a 10% significance level (p = 0.089).) This trend of reduced consumption remained throughout the rest of the period of analysis as well, though the difference in consumption was not statistically significant (with the exception of weeks 22–23).

Taking the coefficients from the regression results in Table 2 it is possible to calculate the amount of water savings due to the campaign. Using the constant as the baseline consumption and adding the additional consumption per period for the control groups (the coefficients on the time-period dummies), average daily household consumption for the control group during the five week period (weeks 12–16) was 0.441 cubic meters. Subtracting from this the reduction in consumption of the treatment households (the coefficients on the time-period-treatment interaction dummies), average daily consumption of the treatment households during the period was 0.408 cubic meters, or roughly 7.6% less water than control households. This amounted to a savings of nearly 1.2 cubic meters per household for the five week period. In 2009, Israel had 2,139,300 households (CBS, 2010). Had all households responded as did those receiving the message, Israel would have conserved nearly 2.3 million cubic meters of water during the period in question.

3.1.7. Comparing the cost-effectiveness of the alternative policy instruments

We compared the costs of the intervention to one supply management option — desalination, which currently accounts for over half of Israel’s municipal water supply and serves as a measure of the marginal cost of supply — and one other demand management policy option — price increases — taking into account the price increases that would have been necessary to achieve an identical reduction in consumption.

The costs of the intervention were estimated at just under $0.28 per mailing household (using the exchange rate at the time of the first mailing of 1 US$ = 4.14 New Israeli Shekels (NIS)). These costs included printing and mailing the messages as well as a small fixed cost for design of the messages. This cost is relatively high, and it is assumed that with economies of scale these costs could be lowered somewhat, should the intervention be expanded. Each household received three messages; however, one was included with the water bill and thus the additional cost was negligible. Thus, the cost per treatment household was just under $0.56.

The average household receiving the message consumed 1.2 cubic meters less water over the course of the five weeks following the initiation of the intervention relative to the control group. The average cost of this conservation comes to $0.46 per cubic meter. However, the bulk of the statistically significant conservation was prior to week 16, the week following the third mailing. Thus, if one only calculates the cost of the first two mailings, the average cost of conservation was just $0.23 per cubic meter.

The cost of desalination represents the effective marginal supply cost in Israel, and currently supplies over half of the country’s municipal consumption. According to Becker et al. (2010), direct costs of desalination in Israel were estimated at $0.52 per cubic meter during the period in question, with a minimum cost of environmental externalities associated with desalination of $0.065 per cubic meter. In addition, costs associated with pumping and delivery are estimated at roughly $0.15 per cubic meter, giving a total of $0.70. This can be seen as a lower bound estimate, as it does not take into consideration the environmental impact on the marine ecosystem. Thus, the specific campaign was clearly more cost-efficient than supply augmentation, at least as a short term option.

Price elasticity of demand is measured as the percentage change in quantity relative to a percentage change in price. The calculation was limited to five weeks following campaign initiation, as this is the period for which the difference between intervention and control groups was statistically significant at the 10% level or higher. As mentioned, residential water demand tends to be inelastic, with most estimates falling in the −0.2 to −0.75 range (e.g., Dalhuisen et al., 2003; Espy et al., 1997; Worthington and Hoffman, 2008). Price elasticity for municipal water demand in Israel was estimated at −0.17 (Dahan and Nisan, 2007). This is a conservative estimate as both significant price increases and sustained national conservation campaign were implemented between the estimate of the elasticity and our intervention. Taking this as a conservative estimate, however, in order to achieve a 7.6% decrease in consumption the marginal tariff rate would have to have increased by 44.7%. This would have amounted to over $0.85 per cubic meter. Price rate increases of smaller proportions that were implemented during this period encountered stiff political resistance and were quickly rescinded (Lavee, 2009).

3.2. Online experiment

An online two-stage experiment complemented the field experiment. The aim of the experiment was to replicate the results of the field experiment in a controlled setting and to test reactance towards price increase as the underlying mechanism of response to messages. We supposed that messages create less antagonism than price increases, while potentially being more (or at least as) effective and bearing greater long-term educational benefits.

3.2.1. Participants and procedure

One hundred and forty participants from the Israeli population (M_{age} = 48, 70 women) were recruited by a market research company for payment. Participants were informed that this is a two-stage study, with a week time lag between the stages.

At the first stage, participants saw one of the following two messages, representing price increase or a persuasive message:

1. Price increase: “Imagine that you receive a formal letter from the Ministry of National Infrastructures, saying: To fight the drought conditions in Israel, it was decided to inaugurate

Between the running of the campaign and the writing of this article (September 2015), the marginal tariff for municipal water in Israel increased from $1.91 per cubic meter to $3.31 per cubic meter. Given current marginal tariff rates, prices would need to rise by $1.48 per cubic meter. Thus, the advantages of a similar campaign done today would likely be substantially greater than those reported above.
drought tax on household consumption. It is worth conserving water as much as possible.”

2. Message: “Imagine that you receive a formal letter from the Ministry of National Infrastructures, saying: ‘To fight the drought conditions in Israel, please join the cause and reduce your household water consumption. It is worth conserving water as much as possible.’”

Following the message, participants then answered a series of questions all measured on a 7-point scale. First, they answered 4 questions that gaged intentions to conserve water, adapted from Chandran and Morwitz (2005) (e.g., “following the message, how likely are you to make an effort to conserve water?”), Cronbach’s $\alpha = 0.98$). Next, they answered an additional 4 items measuring reactance, adapted from Kronrod et al. (2012) (e.g., “The message elevates a feeling of resistance in me”, $\alpha = 0.86$). Finally, participants answered 2 questions pertaining to the interpretation of the meaning of the message: “It is worth conserving water” to understand if the respondents understood “worth” to imply a sense of civic, environmental duty or the potential for personal economic savings.

A week later, the same participants answered a second set of questions. The campaign condition did not include a specific reminder about the message from last week but opted to be as general as possible: “This is the second part of the questionnaire regarding water that you filled out last week.” The price increase condition received the same introduction with the following addition: “Assume that the price for water consumption has indeed increased, as promised in the letter you received last week. Now, imagine that after a while you received another formal letter from the Ministry of National Infrastructures, which read, The Ministry of National Infrastructures has decided to cancel the drought taxes for the Ministry of National Infrastructures, saying: To increase, as promised in the letter you received last week. Now, (point scale items pertaining to their intention to conserve water once the pricing regulation is removed.

A week later, the same participants answered a second set of questions. The campaign condition did not include a specific reminder about the message from last week but opted to be as general as possible: “This is the second part of the questionnaire regarding water that you filled out last week.” The price increase condition received the same introduction with the following addition: “Assume that the price for water consumption has indeed increased, as promised in the letter you received last week. Now, imagine that after a while you received another formal letter from the Ministry of National Infrastructures, which read, The Ministry of National Infrastructures has decided to cancel the drought taxes for the Ministry of National Infrastructures, saying: To increase, as promised in the letter you received last week. Now, (point scale items pertaining to their intention to conserve water once the pricing regulation is removed.

After reading the introduction, participants then answered four 7 point scale items pertaining to their intention to conserve water now ($\alpha = 0.96$), a series of questions regarding their level of knowledge of changes in water prices over time, and several demographic items. Participants were then thanked and paid.

3.2.2. Results

10 participants did not take part in the second stage and 4 participants took less than 60 s to fill out the questionnaire in the first stage. These 14 participants were removed from the database. All results are based on n = 126.

2-way mixed Repeated Measures analysis with the two stages as a within subjects factor and the two conditions as a between subjects factor revealed a significant interaction (F(1, 124) = 9.97, $p = 0.002$). The analysis suggests that participants in the price change condition significantly decreased their intention to conserve water in the second stage, compared with the first stage ($M_{stage1} = 5.04, M_{stage2} = 4.19, F(1,124) = 9.4, p = 0.003$). Intentions of participants receiving the conservation message did not decrease, and in fact increased in the second stage, though this difference between the stages was not significant for this group ($M_{stage1} = 5.04, M_{stage2} = 5.3, F(1,124) = 1.9, p = 0.166$). We found no significant differences in intentions to conserve water in the first stage across the two groups ($M_{message} = 4.9, M_{price increase} = 5.04$, n.s.). However, reactance towards the message in the first stage was significantly higher for the price increase group ($M = 2.7$) than for the conservation message group ($M = 1.9$; t = 2.97, p = 0.004). This result suggests that, while price increases and campaigns may achieve similar levels of water conservation, price increases bring higher levels of reactance than campaigns do.

We also examined how respondents viewed the meaning of “It is worth conserving water” due to the potentially multiple meanings: Water saving or cost saving. A t-test analysis clearly reveals that participants viewed “worth” as associated much more with saving water as a sense of civic, environmental duty than with saving money ($M_{saving water} = 6.1, M_{saving costs} = 3.9, p < 0.001$).

Finally, to address the previously mentioned issue of consumer’s relative lack of responsiveness to small changes in water prices over time (Rauman et al., 1998), as well as the possibility of delayed behavioral response to price increases, we tested respondents’ knowledge of recent changes in prices of water over the short (one year) and medium (five year) terms. Although participants generally correctly identified that prices had increased over the past five years (79% responded “absolutely sure”), they were largely unsure or mistaken about the scale of the change: While the mean percent of price rise indicated by participants was 2.95% ($SD = 1.23$), actual prices more than doubled over this period. Further, only 11% of respondents correctly identified the real direction of change in price over the past year. Though in reality average prices declined by over 4%, well over half of respondents (72%) were reasonably confident or very confident that they had, in fact, risen.

4. Discussion

The online experiment generally replicates the field experiment. Our results imply that price increases may be effective in achieving...
water conservation, but are unlikely to have a long-term effect if the price is lowered. Conversely, conservation campaigns may be as effective as price increase in achieving water conservation, and may also have a longer-term effect: Participants in the conservation message condition indicated no less intention to conserve water a week after they read the message, even though they were not reminded of the message or its content. Further, it appears that policy instruments such as price increases elevate reactance significantly more than conservation campaigns, which may influence population cooperativeness both in the short and long run. The lack of knowledge regarding the price changes, especially in the short term, supports the notion that people are largely unaware of small changes in the price of water, and notice only when changes are substantial or emphasized through communications. This finding also suggests that there are likely to be time lags in consumer behavioral responsiveness to price changes.

4.1. Implications

The current work reports the effectiveness of a conservation campaign designed to reduce household water consumption. The use of actual behavior rather than only self-reported data, jointly with a large sample and a longitudinal controlled field experiment research design, made it possible to capture the effect of a conservation campaign in a relatively accurate way. In addition, we compared the impact of the intervention with alternative policy instruments, representing both supply and demand management, and conducted an online experiment that replicates the findings and sheds light on underlying motivations to conserve water.

Results indicate that the effectiveness of our campaign was relatively high – relative to the control group – an average reduction of 7.6% in water consumption per household, over a 5 week period, with a 10% reduction in demand at its peak. As this finding is based on a controlled field experiment, it provides a robust indication of the effectiveness of conservation campaigns in a resource scarcity context, at least in the short term. Importantly, at the time of the intervention, all households were concurrently experiencing significant price changes and a wide-spread national level water conservation campaign. As such, the results from our intervention are in addition to the effects of these other policy instruments, which are estimated together to have reduced consumption by roughly 20% (Hovel, 2010). This reinforces the effectiveness of our intervention. Moreover, it is plausible that a large scale nationwide campaign would show even higher impact due to the effects of social influence.

The intervention was very simple, relatively cheap, and could be easily and quickly implemented. The primary effect was actually reducing a spike in consumption relative to households not exposed to the campaign, during the hottest period of the year. Its impact could be traced in our data at least five weeks following its introduction. This suggests that the use of campaigns could be most effectively implemented in situations in which policymakers need to handle relatively short term supply shortages, such as those that occur during droughts or seasonal peak energy demand. It can also be of use in systems in which water is supplied by dams, in which a spike in consumption that occurred with the onset of summer, and thus, the timing of the intervention may have been significant. Researchers have found that willingness to conserve is highest during periods of scarcity (Aisbett and Steinhauser, 2014). Thus, further studies in varied contexts would be helpful before generalizing from our experiments, both regarding the potential for conservation and the relative cost-effectiveness of such measures.

Secondly, the message and format of the mailed messages used in the field experiment were very simple. As noted earlier, campaign effectiveness is related to both the design and the intensity of the campaign. Thus, more sophisticated messages, other materials and a more intense intervention may have much greater effects. In addition, based on prior pro-social persuasion research, various message types can be tested and compared.

Finally, like in most other studies, the duration of the campaign was limited. While there could be a natural decline in the campaign’s impact, some studies have found that longer duration resource conservation campaigns can have more persistent, long-lasting effects (e.g., Allcott and Rogers, 2014). Future research may tackle this topic more systematically. In addition, future research can further evaluate the relative cost-effectiveness of measures that are expected to be temporary, such as campaigns, relative to other policy measures that may have longer term impacts.

5. Conclusion

Overall, this research provides strong support for the benefits of conservation campaigns relative to traditional policy instruments. We hope that our findings will encourage policymakers and social marketers to use environmental campaigns to complement traditional policy instruments and to consider it as a viable tool when constructing policy packages.

Acknowledgement

The authors acknowledge Liza Teper and Ori Sharf for their excellent research assistance. They are grateful to Meitav Ltd. for collaboration in field experiment and data collection for this research project. They are also very grateful for the helpful comments of David Dery.

References


A study in Israel conducted around the time this experiment was being conducted found that 77% of those surveyed did not know the price they paid for water (Peled, 2009). A more recent study found that a nearly two-thirds of adults sampled indicated that they believed that prices had increased over the previous two years, despite continuous decreases in both average and marginal tariff rates (Katz, 2010).