CHAPTER NINE

Customizing Social Norm Nudges by Format and Reference Group to Reduce Water Consumption among Israeli Households

Eyal Pe'er

AT A GLANCE

- **Our Goal:** To identify the most effective manner to customize social norm nudges, by format and reference group, to reduce water consumption among Israeli households.
- **The Intervention:** Social norm nudge comparing bimonthly household water consumption to the median of a selected reference group (entire city vs. similar households) in a specific format (graph, percent, or cost).
- **The Results:** The nudges decreased water consumption among those that had higher-than-median consumption in previous periods, and the nudges were most effective to smaller households and when the nudge was in graphical format using the similar households as the reference group.
- **Lesson Learned:** Social norm nudges can be effective to reduce water consumption but heterogeneity among households significantly impacts effectiveness.

Motivation and Objective

Using social norms has come, in the last decade, to be one of the common tools used by many organizations to nudge consumers toward

more efficient and less wasteful consumption. The use of social norms, typically providing consumers with comparison values of their peers, neighbors, or other referent group, has been found to be generally effective, and thus advocated for as a nonrestrictive and unobtrusive means to curb consumption. Most of the studies examined the effects of social norms on electricity usage, while several others focused on water consumption or other types of energy conservation (e.g., towel reuse in hotels).

The motivation behind the current study was several years of drought that were experienced in Israel, roughly from 2010 to 2019, which spurred the Water Authority to seek out solutions, including behavioral ones, that could aid their efforts to curb water consumption among Israeli residents. The Water Authority issued a call for proposals to conduct an experiment that would test and evaluate different implementations of a behaviorally informed intervention in consumers' water bills. I responded to that call and proposed, after reviewing findings of previous studies on the topic, to implement and examine nudges that utilize social norms to curb water consumption.

Inspiration

In a famous experiment in California, 290 households received messages encouraging reduced energy use using descriptive norms (average energy consumption by participating households), with or without an injunctive norm icon (smiley J or frowny L), stating whether they were below or above average consumption. Results showed that, for both short term (after two weeks) and longer term (three weeks later), both descriptive and injunctive social norms reduced the consumption of consumers who were above average consumption in the preceding period. Moreover, under the injunctive norm message (smiley/frowny), consumers who were above average reduced their consumption while those who were below average did not increase their consumption. This experiment spurred a wave of field studies in the US and elsewhere that showed how social norm messaging can reduce consumption of electricity.[1]

Focusing on water consumption, Ferraro and Price used a similar paradigm to encourage residents of a large county in the US to reduce their household water consumption.[2] They appended to a certain month's water bill one of three messages including either technical advice on how to save water, an appeal to pro-social preferences, or a social norm message comparing the consumer's consumption to average (median) consumption in the past months. They found that,

compared to the control group, consumers who received the social norm message showed the highest reduction in water consumption (4.8 percent vs. 2.7 percent in pro-social appeal, and a null effect for the technical advice) in the subsequent period. This effect was, as expected, more pronounced for consumers who had a higher-than-median consumption level pre-treatment, but no boomerang effect was found for consumers who had a lower-than-median consumption level. When measured again about three months after, the size of the effect (on all experimental groups) was reduced by about a third but remained significant. Interestingly, the reduction in effect size over time was largest among higher-than-median users who received the social norm comparison messages.

Bernedo, Ferrero, and Price revisited the same sample several years after the initial intervention to investigate the potential long-term effect of the social norm nudge.[3] They found that the initial effect size reduced by half after four years but remained statistically significant and practically considerable even four years after the initial treatment. By analyzing the effects observed among households that changed owners during that period, the researchers were able to conclude that most of the effect can be attributed to behavioral changes in consumption habits, rather than to physical changes in capital stock of the home, consistent with other research.[4] Additionally, they found that homeowners are more affected by the social norm message compared to renters. Based on the observed effect sizes over seven summers, the authors estimate that the cost-effectiveness of the social norm nudge, had it been applied to the entire population, would have been $0.24 per 1,000 gallons saved.

Interventions and Method

As part of a policy initiative of the Israeli Water Authority, I partnered with a large water cooperation and examined the effect of displaying social norms on consumers' water bills (distributed bimonthly).[5] The intervention varied on the **format** of the social norm nudge and on the **reference** group it used: the versions included comparing consumers' water consumption to their peers either using graphical information only, or with accompanying textual information highlighting the differences in percentages (e.g., 50 percent above/below the median consumption) or in monetary terms (e.g., 100 NIS above/below the median bill). The social norm used for comparison was either based on the entire city's median consumption or the median of similar consumers (i.e., with the same household characteristics).

The Format of the Social Norm Nudge

In almost all the reported studies that used social norm nudges to curb electricity or water consumption, the comparison has been expressed in absolute or relative terms. For example, the Home Energy Report (HER) displays the individual's consumption as above, at, or below the average consumption, and the consumer can infer how much more electricity they used, compared to the average.[6] Some studies used percentages to directly inform consumers how much above or below the average (or median) their consumption is.[7] Brent and his colleagues also compared the absolute to relative formats in one study, and they found no clear difference in their effectiveness.[8] In none of the cases, however, was the value of the social norm nudge expressed in monetary terms (e.g., the relative added cost/savings compared to the average). This is inconsistent with a body of research that has already shown that converting efficiency or consumption metrics into cost metrics leads to better outcomes. For example, people were found more likely to prefer more fuel-efficient vehicles when fuel economy was presented in terms of fuel costs (estimated dollars per year) than in fuel efficiency (miles per gallon).[9] Similarly, people prefer more energy-efficient refrigerators when their energy efficiency is presented as cost per year,[10] and the same was found for washing machines.[11] Hardisty and colleagues also found that framing energy levels as annual costs nudged consumers to buy more electricity-saving light bulbs.[12] In other domains, Read, Frederick & Scholten showed that under-savings (e.g., for pension) can be moderated if annual interest is displayed as money earned and not as a percent interest rate, if the amount to be saved is large.[13]

Aside from being a more intuitive and familiar metric, monetary costs can also help aid decisions because they can be easily compared to other expenses. For example, spending twenty dollars on your water bills can be easily compared to how much you spend on other utilities, whereas consuming fifty gallons of water a month cannot be easily compared to how much electricity (or any other product or service)you consumed in the same month. Thus, our study also included a version of the social norm nudge that used the average (median) cost and how much the target consumer was above or below that norm. By this, we also test the monetary version of social norm nudge in a manner that is more straightforward than was previously tested by Brent, which only displayed costs in terms of relative savings compared to a 10 percent reduction benchmark and did not include a comparison to the median consumer.[14]

Reference Group

A key component of the social norm nudge is that it compares individual-level behavior to a group-level norm. Thus, setting the group-level norm could be critical for its success. When trying to curb water (or other resource) consumption, individual-level consumption could be compared to several different norms, including people living in the same neighborhood, people living in the same town, city, or county, or to people who are otherwise similar, in some sense, to the individual. The common perception is that the more specific and similar a group is to the individual, the more the individual will be affected by the norm. For example, Goldstein, Cialdini, & Griskevicius found that telling hotel guests that the majority of guests in their particular room reuse towels is more effective in persuading them to do the same, and such a "provincial" social norm is more effective than a descriptive social norm or other pro-social appeals.[15]

Probably because of these reasons, previous studies that used social norm nudges acted under the assumption that showing a comparison to consumers' neighbors would be more effective than comparing to a larger referent group (e.g., all city residents). However, from a policy perspective, comparisons to smaller groups could be more difficult to achieve, would require the collection and usage of consumers' personal information, and might not be feasible or sensible in all cases (e.g., in less habituated rural areas). If comparing to one's neighbors is indeed more effective, then it is important to estimate that effect's size, so it can be used to inform policy decisions within a cost-benefit analysis. On the other hand, if it is found that such personalization does not carry with it a marginal benefit, policymakers could do better to suffice with a coarser but less costly and more privacy-preserving comparison to a larger referent group such as the entire city, county, etc.

However, similarity must not be only local. In fact, when it comes to water consumption, it is not necessarily best to compare individuals' behavior to people who only live nearby. For example, a neighborhood could be diverse and include both apartment buildings, which have a smaller size and less water-consuming facilities, next to townhouses, which take up a larger piece of land and use much more water for irrigation and landscaping, as well as for recreational uses such as an outdoor pool or hot tub. Thus, when it comes to nudging water consumption, it might be more effective to compare to a group of consumers who use water similarly. For instance, individuals' water consumption could be compared to the average (or median) consumption of other consumers with similar characteristics (e.g., who live in the same type of residence

with a similar number of inhabitants). Thus, in the current study we tested whether making comparisons based on the type of residence and number of inhabitants in the residence could prove to be more effective than comparing to a more general norm available (e.g., the city level).

To summarize, our field study provided us with the ability to test for the effects of the format of the comparison (percent above/below median consumption vs. cost above/below median bill), and the reference group (the entire city vs. only consumers with same residency attributes).

Method

Our sample originally included 23,132 households in a mid-size city in the center of Israel: 76.9 percent of participants lived in apartments and 23.1 percent resided in houses. Family size ranged from zero (unknown but assumed to be one or two)[16] to ten, with a median of three persons.Out of the total sample, 3,067 were excluded because a leak was reported on their household either before, during, or after the treatment period. Also, 199 households were excluded for not showing any water consumption (zero) in any of the experiment periods. The final sample included 18,819 households of which 80 percent resided in apartments and the rest resided in houses.

Design

Participants were randomly allocated to one of seven groups, which included the control (N=3,116, 14.2 percent) that received the same bills as before. All the other six experimental groups received a modified bill that included a new graph that compared their consumption in the last six billing periods (twelve months) to the social norm. For half of these groups, the values used for the social norm were the median consumption levels among all city residents ("general referent group" conditions), and for the other half it was the median consumption of households similar to them in both type of house and family size ("similar referent group"). A third of the experimental groups only saw the graph with a sentence explaining what is shown on the new line ("descriptive norms only" conditions). For another third of the groups, the graph was accompanied by the difference (in percentages) between the consumers' consumption and the referent median consumption in the current billing period.

If the difference was positive (i.e., the consumer used more water than the norm), it was accompanied by a frowny face L, and if it was

negative it was accompanied by a smiley face J ("injunctive norms"). The last third of the groups had the difference in consumption presented in difference in costs above or below the norm median. Allocation to conditions was made randomly at the consumer level based on the list of consumers who received a water bill in the period right before the first treatment.

Procedure

The experimental messages were added to the bimonthly bills of participants with the help of the water corporation personnel in two bimonthly bills consecutively. Participants were allocated to the same condition in all bills and received the same type of message on all bills. However, the specific values on the graph and the respective text varied according to the specific bill's consumption values.

Results

Table 9.2 shows the average weekly consumption pre-treatment (in thousands of liters) by the condition of treatment (format and reference group) and the percent change in water consumption in the first and second post-treatment, in relative terms compared to last years' difference in consumption in the respective time periods. That is, the difference between the two time periods (pre- vs. post-treatment) is subtracted from the respective difference in consumption that was measured in the same time periods last year (as was done in Ferraro and Price's study).[17] For example, in the control group, water consumption between pre- and post-treatment decreased by 8.23 percent compared to the same difference in the previous year. This means that conditions in which the percent change was larger (in size) than that of the control condition show an effect of the treatment. The last column in Table 9.2 shows the relative effect size by comparing the percent change of each treatment to that found in the control. For example, the treatment that showed a graph comparing to the general city level led to a decrease in water consumption in a degree that was 183 percent (almost triple) the size of the change found in the control group. Overall, the treated households showed a larger percent change in water consumption compared to the control (-13.45 percent vs. -8.23 percent) but this difference was not statistically significant, t (2616.4) = 0.45, p = 0.65.

Comparing between treatments, ANOVA showed that while the format of the nudge (graph, percent, or cost) did not show a significant effect, F (3, 15744) = 0.79, p = 0.49, the reference group did show a

Figure 9.1. CONSORT flow diagram for the intervention

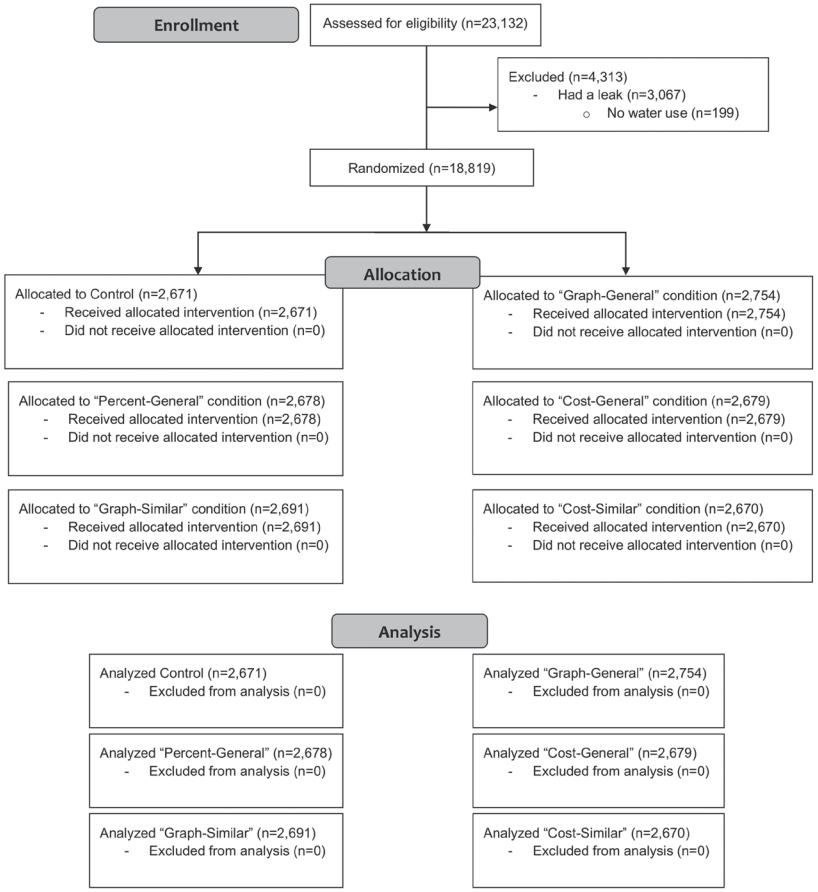


Table 9.1. Similarities and differences between current study and Ferraro & Price's (2013) study

Similarities	Differences
Uses similar intervention (social norm nudge in water bills) as previous studies	Experimental design includes variations of the social norm nudge (by format and reference group)
Uses similar procedure and implementation (nudges added to water bills)	Sample size is smaller (18,300 in the current research vs. 106,669 households in Ferraro & Price [2013])
Uses similar measure (change in actual water consumption between conditions and households)	

Table 9.2. Mean effects of nudges on water consumption

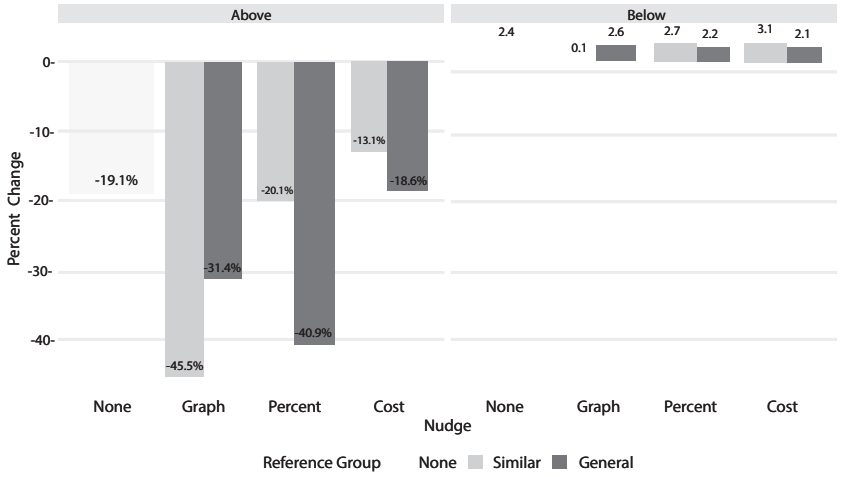
Format	Reference group	N	Average difference in liters (trimmed)	Percent Change relative to last year	Relative effect size
Control		2,671	–254.41	–8.23%	
Graph	General	2,754	–331.87	–23.33%	–183%
Percent	General	2,678	–267.24	–9.07%	–10%
Cost	General	2,679	–320.72	–5.12%	38%
Graph	Similar	2,691	–62.97	–14.98%	–82%
Percent	Similar	2,675	121.59	–19.65%	–139%
Cost	Similar	2,670	–16.45	–8.17%	1%

significant effect, F (1, 15744) = 4.29, p = 0.03. The interaction between the type of nudge and reference group was also not significant, F (2, 15744) = 0.6, p = 0.55. Additionally, the type of residence (house vs. apartment) and the size of the household[18] did not show significant effects, $F < 1$, $p > .05$.

Nudging Those Who Matter

More important, however, are the results of the effects of the nudges among consumers who showed an above-than-median consumption in the previous period, and thus were expected to decrease their consumption following the nudge, compared to those that already consumed below the median. As Figure 9.2 shows, the percent change among those who had an above-than-median consumption was much more pronounced than their counterparts, who did not show any significant change from the previous period. ANOVA showed that in addition to the significant effect of the level of previous consumption (above or below median), F (1, 15737) = 78.79, $p < .001$, there was a significant effect for the reference group, F (1, 15737) = 4.31, p = .03. This effect showed that the group that received a nudge with a reference to the general norm (the entire city) reduced their water consumption a little less than those who received a reference to similar other consumers. ANOVA between treatment conditions only (without control) of consumers in the "Above" group showed significant effects for both nudge and reference group, F (1, 6895) = 4.1, 5.49, p = 0.04, 0.02, but no significant interaction, F (1, 6895) = 0.01, p = 0.92. These effects showed

Figure 9.2. Percent change of water consumption between consumers who had above vs. below median consumption in previous period, between the different nudges

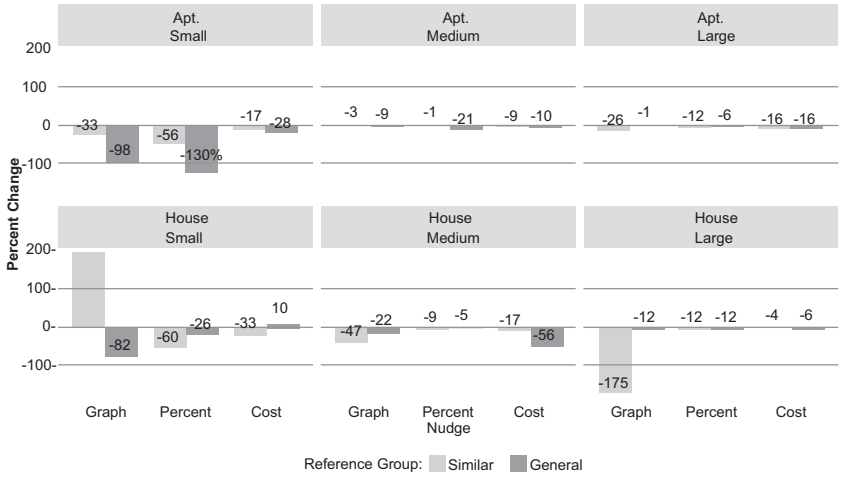


that the change in water consumption was higher when the nudge only included a graph (mean change of –38.48 percent), followed by the percent (-30.43 percent), and the cost (-15.8 percent). As seen in Figure 9.2, the highest percent change was when the nudge included a graph with reference to the similar group of other consumers (-45.5 percent).

Heterogeneity in Effects

Further analyzing the households that were above the median in previous period also showed differences depending on the household characteristics. The difference between houses and apartments was significant, F (1, 6863) = 13.89, $p < .01$, as houses showed a larger percent change compared to apartments (-32.8 percent vs. –27.01 percent on average). There was also a significant interaction between the type of residence and the type of nudge, F (2, 6863) = 3.01, $p = 0.049$, and between the type of residence and the reference group, F (1, 6863) = 3.82, $p = 0.05$. Moreover, there was a significant four-way interaction between the type of nudge, reference group, type of residence, and household size, F (4, 6863) = 3.63, $p < .01$. As Figure 9.3 shows, the effects of the nudges were more pronounced among small houses and small apartments. Surprisingly, there was a counter-effect (increase in consumption) among small houses that received a graph with reference to

Figure 9.3. Percent change in water consumption between types of nudges and households



similar consumers. Other than that, though, the effects of the nudges were in the expected direction.

Reconciliation

Our efforts at replication of a previous social norms intervention yielded mixed results. The overall effect of the nudge was not significant when analyzed in aggregate, which is different from previous results. This is because there were significant differences between the types of nudges, which differed both in their format and the reference group used. Additionally, previous research did not measure or consider household characteristics – such as type of residence and household size – which appear to also matter significantly in moderating the effects of the nudges. Another finding that was consistent with previous literature is that consumers who were already below median consumption did not significantly alter their behavior (down or up) following the treatment.

Discussion and Prescriptive Advice

From this research, two major lessons should be learned. First, while social norm nudges can impact households' consumption, the method of implementation is key. Thus, researchers and practitioners should

carefully consider how to best tailor and design the social norm nudge to impact water consumption behavior. Second, individual differences matter too. The effects of the nudges were most pronounced among smaller households and also more effective among houses compared to apartments. This finding was made possible in this research due to the existing data in the participating water corporation. If such data is also available in future settings, it should be taken into account when designing the specific implementation of this behavioral policy.

NOTES

1 See for examples Costa, D.L., & Kahn, M.E. (2013a). Energy conservation "nudges" and environmentalist ideology: Evidence from a randomized residential electricity field experiment. *Journal of the European Economic Association*, *11*(3), 680–702. https://doi.org/10.3386/w15939; Costa, D.L., & Kahn, M.E. (2013b). Do liberal homeowners consume less electricity? A test of the voluntary restraint hypothesis. *Economics Letters*, *119*(2), 210–12. https://doi.org/10.1016/j.econlet.2013.02.020; Allcott, H. (2011). Social norms and energy conservation. *Journal of Public Economics*, *95*(9–10), 1082–95. https://doi.org/10.1016/j.jpubeco.2011.03.003; Ayres, I., Raseman, S., & Shih, A. (2013). Evidence from two large field experiments that peer comparison feedback can reduce residential energy usage. *The Journal of Law, Economics, and Organization*, *29*(5), 992–1022. https://www.jstor.org/stable/43774381; and Kim, J.H., & Kaemingk, M. (2021). Persisting effects of social norm feedback letters in reducing household electricity usage in Post-Soviet Eastern Europe: A randomized controlled trial. *Journal of Economic Behavior & Organization*, *191*, 153–61. https://doi.org/10.1016/j.jebo.2021.08.032.

2 Ferraro, P.J., & Price, M.K. (2013). Using nonpecuniary strategies to influence behavior: Evidence from a large-scale field experiment. *Review of Economics and Statistics*, *95*(1), 64–73. https://doi.org/10.3386/w17189.

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5 I would like to thank the invaluable contributions to the research design, implementation, and analyses by Dr. Itay Sisso.

6 See Costa & Kahn (2013a); and Costa & Kahn (2013b).
7 Ferraro & Price (2013).
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16 The water corporation assigns a value of zero to household who have not recently reported the number of persons that occupy the household. However, these are assumed to contain one or two persons at the most because (a) the long-term consumption patterns of these groups are highly similar and (b) consumers have an incentive to report the number of persons in the household only if that is above two, in order to get the discounted base fare.
17 Ferraro & Price (2013).
18 Household size was categorized by number of residents as small (up to two residents, 38.6 percent), medium (three to four residents, 31 percent) or large (five or more, 30.4 percent).