Harries, Tim, Rettie, Ruth, Studley, Matthew, Burchell, Kevin and Chambers, Simon (2013) Is social norms marketing effective? A case study in domestic electricity consumption. European Journal of Marketing, 47(9), pp. 1458-1475. ISSN (online) 0309-0566

Is social norms marketing effective? A case study in domestic electricity consumption

Introduction

Ever since the foundational work of social psychologists Asch (1987) and Milgram (1974) there has been a great deal of interest in the influence on behaviour of perceptions of 'normal'. In social marketing, this has led to the development of the *social norms approach* (Cialdini and Goldstein, 2004), a marketing technique that attempts to influence behaviour by changing perceptions of what is normal (Lewis and Neighbors, 2006; Neighbors *et al.,* 2010; Burchell et al forthcoming). According to the literature, this approach has proven successful in influencing bullying (Perkins *et al.*, 2009), substance abuse amongst students (Perkins, 2003; Bosari and Carey, 2003; Berkowitz, 2005; McAlaney and McMahon, 2007; Neighbors *et al.*, 2008; Moreira *et al.*, 2009), household recycling (Shultz, 1999; Nomura *et al.*, 2011), hotel towel re-use (Goldstein *et al.*, 2008), the payment of tax debts (Cabinet Office, 2012) and domestic electricity consumption (Allcott, 2011; Ayres *et al.*, 2009).

Funded by the Research Council UK Digital Economy Programme, and part of the suite of research projects known collectively as *CHARM*, this study set out to question the validity of these case studies and to assess the value of the social norms approach as a tool in the armoury of the social marketing practitioner. The field of domestic electricity was selected because the impact of social norms information is contested in this area and because the reduction of domestic consumption is an important social policy goal. The research aimed to ascertain whether social norms add significantly to the persuasive power of social marketing messages and to consider whether previous research on electricity consumption confounded the effects of the approach with those of feedback that only includes information on a household's own consumption.

The reduction of electricity consumption for the mitigation of climate change has a central place in policy discourse (Defra, 2006; DECC, 2010; HM Government, 2009) and has become a key social marketing objective (Hargreaves, 2011; Collier *et al.,* 2010; Whitmarsh *et al.,* 2011). The 2008 Climate Act committed the UK to reduce its 2050 carbon emissions to 80% of 1990 levels. Domestic consumption constitutes 31% of the UK's electricity demand (DECC, 2011). However, driven in part by the growth in consumer electronics and domestic appliances, it increased by 0.1% in 2010 (Firth *et al.*, 2008) and is not currently expected to fall sufficiently for the UK to achieve this target (Chitnis and Hunt, 2012). The use of the social norms approach on this issue is currently endorsed by the UK Government (Cabinet Office, 2011) and has already been adopted by the UK electricity provider First Utility (Solon, 2011).

Theoretical background and hypotheses

In applying the social norms approach to electricity consumption, it is important to consider how electricity differs from other types of consumer product. Electricity is abstract, invisible, intangible and only consumed indirectly and as a by-product of other practices (Fischer 2008). Furthermore, there is no clear link to cost or the level of spend relative to the norm; indeed, electricity consumption has been compared to shopping in a store where none of the products have price labels and the customer only receives a quarterly bill (Kempton and Lane, 1994). Finally, because the invisibility of electricity inhibits emotional attachments between customer and product, consumption patterns are rarely perceived as lifestyle statements (Birzle-Harder and Götz, 2001).

Feedback about consumption can address some of these differences and expose electricity consumption to the same norm-transforming influences experienced by other products. Established behavioural norms are challenged when there is increased awareness, motivation to change, realisation that a person's behaviour can have an impact and a belief that it is within a person's power to change that behaviour (Fischer, 2008). By facilitating progress through these stages, feedback about levels and patterns of consumption can lead to reductions of 5%-15% (Fischer, 2008; Darby, 2006). It does this by increasing householders' awareness of the amount of electricity they consume, alerting them to undesirable aspects of that consumption (such as waste or cost) and highlighting particular areas of consumption that, if changed, would reduce the undesirable elements of the overall outcome. Hypothesis H1 is designed to test whether feedback does, indeed, reduce electricity consumption:

H1. Changes in electricity consumption during the study will be positively related to the receipt of feedback on electricity consumption.

The *social norms approach* contends that the impact of feedback will be greater if it includes information about what is normal behaviour because such information can simplify or bypass decision-making by acting as a heuristic short-cut or 'nudge' (see Thaler and Sunstein, 2008). The approach provides individuals with information about the average behaviours of a group of salient others and assumes that the inclination to conformity will encourage them to try to emulate that norm.

In social norms marketing campaigns, these *descriptive norms* are sometimes combined with a second kind of norm more familiar to social marketers: the *injunctive norm*. Whereas descriptive norms describe what most people *actually* do, injunctive norms communicate what they *ought* to do. Although known by a variety of names, injunctive norms occur in many behaviour change models, including the *norm-activation model* and the *theory of planned behaviour* (Bamberg and Möser, 2007; White *et al.*, 2009; Carus *et al.*, 2008). Like proponents of social norms theory, supporters of these models now argue that injunctive norms are an essential theoretical and practical complement to descriptive norms (Fishbein and Yzer, 2003), which by themselves have insufficient predictive power (Armitage and Connor, 2001).

However, not all commentators consider social norms an essential element of feedback. Fischer (2008) argues that effective feedback on electricity consumption must be frequent, appliance-specific, and long-term, include historic

comparisons and be understandable and engaging. Conspicuous by their absence from this list are normative comparisons. Of the twelve studies in her meta-analysis that included normative comparisons, Fischer reports that none showed any evidence that normative information affected consumption. Similarly, Darby (2006) concluded that normative feedback was less effective than feedback relating to a household's own consumption. These conclusions are difficult to verify. Although Fischer claims that she reviewed twelve studies that used normative feedback, only three of these can be identified from her paper and of these, one (Garay and Lindblom, 1995) did not analyse the impacts of feedback on consumption and one (Wilhite *et al.*, 1999) relied on self-reported consumption change, which is not reliable. A study by Dünnhoff and Dusche (2008) reported a reduction of 8% in actual consumption, but this was the result of a range of measures, not only usage feedback. Similarly, of the two studies identified by Darby (2006) as employing comparative feedback, one was the paper by Garay and Lindblom (1995), mentioned above, and the other (Brandon and Lewis, 1999) had a sample of just sixteen.

In sharp contrast to Darby and Fischer, the authors of four US studies report the social norms approach to be effective in reducing domestic electricity consumption. The first of these (Schultz *et al.,* 2007) can be dismissed, for although social norms were used, the primary aim was not to test their impact on consumption and no control group was involved. The second, Nolan *et al.,* (2008), found that after one month social norms messages (N = 46) had reduced consumption by 11% more than the other types of feedback and after two months by 7% more. Most recently, two studies looked at the impact of a programme implemented by Opower, a US company that partners with utility companies to help them promote energy efficiency. This programme posts reports containing social norms with households' bimonthly/quarterly electricity bills. With samples of 85,000 (Ayres *et al.*, 2009) and 600,000 (Allcott, 2011) and intervention periods of one year and two years, respectively, these evaluations identified reductions of 2%-2.35%. However, they failed to distinguish the impact of social norms feedback from that of feedback of a household's own consumption for social norms feedback was presented to participants alongside their own household's data.

This study aimed to ascertain whether the use of social norms data adds significantly to the impact of consumption feedback. To avoid the mistake made by the US studies, a second control condition was included in which participants received feedback on their own consumption but not on the consumption of others. Hypothesis *H2* is designed, therefore, to test the additional impact of social norms feedback:

H2. Participants that receive feedback on both their own consumption and that of others will reduce their electricity usage more than those that receive feedback on their own consumption only.

Finally, prompted by a suggestion in the interview data that social norms information made the feedback more engaging for participants, it was hypothesised that social norms information might encourage participants to read feedback more assiduously. Mass marketing normally only gains the attention of small percentages of its intended audience. (In the UK only 18.35% of recipients open marketing emails

sent by SMEs and only 31.17% open those sent by government – McNeill, 2012). We tested the impact of social norms data on engagement levels with the following hypothesis:

H3. Amongst those participants that receive feedback, frequency of engagement with the feedback will be positively related to receipt of social norms feedback.

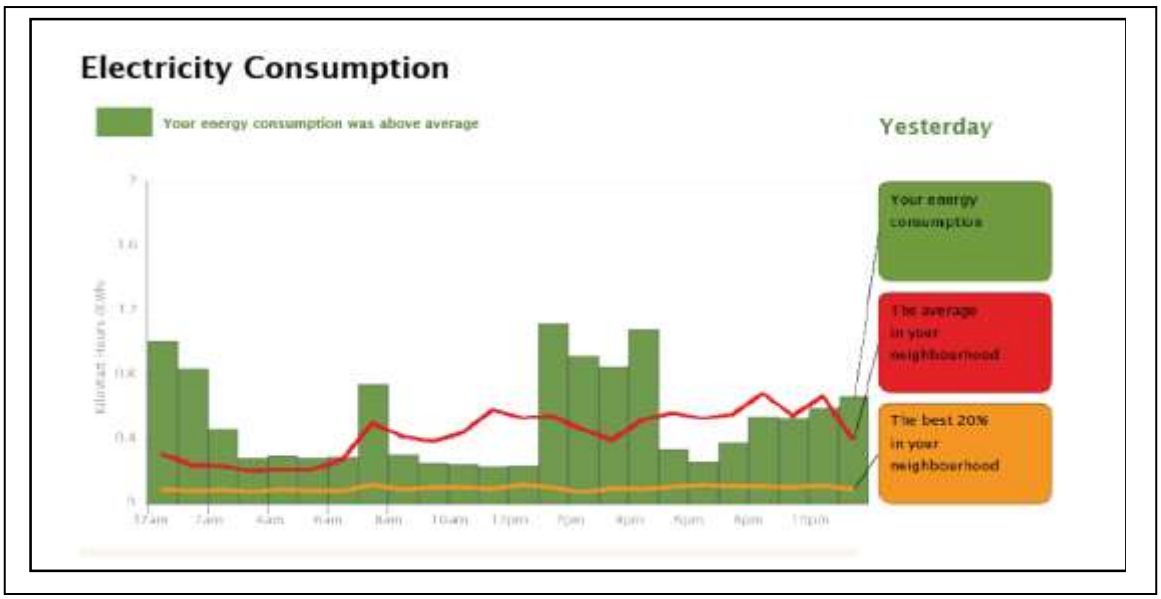
Methods

Consumption data was collected from participants using purpose-built monitoring devices capable of measuring consumption changes of 1 Watt or more, which sent hourly-usage data to the study server via a mobile telephony service. Participants were randomly allocated to either a condition in which they were given no feedback on their electricity consumption (the control condition), a condition in which they received feedback on their own household's consumption (the individual condition) or a condition in which feedback also included the consumption levels of other households in their locality (the social norms condition). After a two-week baseline period during which no participants received any feedback, measurement and feedback occurred for a period of sixteen weeks. During this time, data was collected on the number of times participants downloaded their feedback graphs. Furthermore, to allow for the control of factors such as household structure, the study used pre- and post-experiment participant questionnaires to collect data on demographics and the response to the interventions. An example of *partially-mixed* research (Leech and Onwuegbuzie, 2009), the study also included in-depth interviews and focus groups, which were used to explore the reasons for participants' responses to the feedback.

The experiment

Consumption data was provided to those in the two feedback conditions in the form of bar graphs depicting different views of electricity consumption. Four types of graph were made available to participants: the current day's usage; the previous day's usage; the previous seven days' usage, and daily usage since the start of the study. For those in the social norms condition (see Figure 1), these also included information on average electricity consumption levels of other households in the locality (the higher of the two lines; originally in red) and the consumption of the lowest consuming 20% (the lower line; originally in orange). Graphs provided for the social norms condition also included statements reflecting the relative level of consumption (see Appendix 1).

Figure 1: Example of a graph sent to a participant in the social norms condition



Participants were able to access all four types of graph at any time during the study on personalised password-protected websites and were sent weekly marketing emails containing one recent graph. The websites and emails also contained generic tips on household energy saving. Fortnightly mobile phone text messages reminded participants to read their emails and access their web pages.

Measures

The first of two key measures in the analysis was the proportional change in consumption between the two-week baseline period and the period spanning week 8 of the study and the close of the study in week 17. Week 8 was chosen for the start of the comparison period because the process of participating in a trial can itself cause participants to change their behaviour and any resulting behaviour change amongst the control group might have obscured the impact of the feedback.

The second key measure was the number of times participants downloaded the feedback graphs, which was a proxy for the number of times they engaged with the feedback. Downloads were recorded automatically, with the running total increasing each time an email was opened or a graph was viewed on the Internet. If participants forwarded emails to family members, opened the same email repeatedly or viewed the same web-graph more than, the count would be increased accordingly. As this variable was not normally distributed (k = 4.12), a logistic transformation was applied prior to analysis.

To make it possible to control for the impact of demographics, the pre-study survey collected participant data on a range of variables considered most likely to be significant; namely, number of adults and children in the household and household income. Data on respondent age, gender and social class was also collected.

In addition to the quantitative data collection, 22 depth-interviews and two focus groups were conducted to illuminate responses to the feedback and perceptions of impact on energy consumption. These involved a total of 33 participants, five of whom were interviewed at both the start and end of the study.

Sampling and recruitment

Following a pilot (*N* = 10), participants for the experiment were recruited door-to-door in two residential areas of Bristol, UK, by a professional marketing fieldwork company. Recruitment criteria included home access to the Internet and weekly use of email. Furthermore, blocks of flats were excluded from the study because of technical issues relating to electricity-monitoring and transmission technology, and shared student accommodation and homes with electric heating were excluded to ensure sample homogeneity. The demographic makeup of the 316 participants that provided electricity data for the full 18 weeks of the study is shown in Table 1.

Table 1: Demographic characteristics of the experiment sample (%)

The seventeen interview participants were chosen to ensure a balanced distribution across the characteristics considered most likely to influence the impacts of the interventions – i.e. overall level of electricity consumption, social class and household structure. As the main aim was to understand and compare the influence of individual and social norms feedback, most were recruited from the social norms condition (*N* = 13), only one from the control condition and three from the individual condition. The sixteen participants for the two focus groups were recruited at random from those in the social norms condition.

Analysis

To combine the strengths of ANOVA with the ability to easily control for more than one independent variable, the analytical method of multiple linear regression was adopted (Field, 2005). Although it had been intended to include income as an independent variable, 24% of the sample had refused to provide income data and as an initial set of analyses showed no correlation with consumption change, the income variable was omitted from the analyses. Collinearity levels were assumed to be within acceptable levels if they did not lead to over-inflation of the standard error (i.e. average VIF close to 1.00) and the tolerance of each variable was greater than .2 (see Field, 2005).

Qualitative analysis was conducted using the data management and coding package, *Atlas-ti*. Initially a coding framework was derived from the key themes identified in the literature and by the interviewer. Subsequently, a small number of transcripts were independently coded by two of the research team, who then compared their analyses, refined the coding frame and added new codes that had emerged. This final coding frame was applied to the remaining transcripts.

Findings

Impact of the feedback on changes in electricity consumption (H1)

Compared to the control group (SD = .19; *N* = 121), the reduction in consumption was 3% greater for both the social norms group (SD = .20; *N* = 122) and the individual group (SD = .23; *N* = 124). However, as shown in Table 2, neither of the effects associated with the feedback conditions were statistically significant ($p > .1$ for both *social norms condition* and *individual condition*). Hypothesis *H1* was therefore not supported. The data also shows that household structure had no effect on the impact of feedback ($p > .1$ for *single person household* and *children in household*).

Table 2: Regression analysis of experimental condition on changes in consumption

Impact of the inclusion in the feedback of social norms data (H2)
Table 3 confirms that household structure had no effect on the impact of feedback ($p > .1$ for *single person household* and *children in household*) and shows that there was no significant difference between the impact on consumption of the individual feedback condition and the social norms condition ($p > .1$ for *social norms condition*). In fact, average change in consumption for the former (21.73%) was slightly higher than for the latter (20.93%). Hypothesis *H2* was therefore not supported.

Table 3: Regression analysis of type of feedback onto change in consumption

Impact of social norms data on engagement with the feedback (H3)
Table 4 shows that the number of email downloads was related to the type of feedback ($p < .05$). Those in the social norms condition downloaded emailed graphs 19.8 times, while those in the individual condition only downloaded them 13.4 times (*OR* = 1.48). Web viewings, however, were not related to feedback type (p = .89; analysis not shown). Hypothesis *H3* is therefore proven for emailed feedback but not for web-based feedback. The number of adults in a household had no impact on the downloading of emailed graphs ($p = .96$) or web graphs ($p = .67$), but households with children downloaded less graphs from both sources (emailed graphs: $p < .1$, *Beta* = -.14; web downloads: $p < .1$, *Beta* = -.13).

Table 4: Linear regression of type of feedback onto number of emailed graphs downloaded

Given that only 18 feedback emails were sent during the study, the 19.8 downloads by the average social norms participant is exceptionally high[1]. Typically only 18.35% of UK recipients open marketing emails sent by SMEs and only 31.17% open those sent by government (McNeill, 2012).

Discussion
The objective of this research was to evaluate the impact of feedback on domestic electricity consumption and to determine whether social norms information contributes significantly to the persuasive power of social marketing messages in this domain. In an 18-week experiment ($N = 316$), a control condition received no feedback, a second sample of participants received feedback about their own consumption and a third received information about their own consumption and how it compared to an average for their locality. Statistical analysis assessed whether the feedback caused any changes in consumption (hypothesis *H1*), whether the social norms feedback caused any additional change in consumption compared to feedback on individual consumption alone (hypothesis *H2*) and whether the social norms feedback caused additional engagement with the feedback (hypothesis *H3*). Only the third of these hypotheses was proven.

[1] Note: a single emailed graph could be downloaded more if the email was opened repeatedly by the same person or forwarded to another household member.

Energy consumption saw a decline of 3%, relative to the control, in both intervention conditions. However, the significance test for *H1* was weakened by a smaller than anticipated effect and by the size of the standard deviation of the dependent variable. To avoid the rejection of true hypotheses, a statistical test requires statistical power – a function of sample size, effect size and the standard deviation of the dependent variable – to be at least .80 (Field, 2005). The sample size for the research had been calculated on the assumption that average reductions in consumption would fall into the 5%-15% range identified by Fischer (2008) and Darby (2006). With an effect size of just 3% and a larger than expected standard error (.21), the power of the test for *H1* was just .22 for the social norms condition and .27 for the individual condition (see Buchner *et al.,* 2001).

A number of factors might explain the relatively small reduction in consumption produced by the feedback. One is the difference between consumption patterns in the UK and the US. Daily household usage in this study and in the UK as a whole averaged at about 13 kWh during the study period, compared to the average in Allcott's (2011) US sample of 31 kWh. Furthermore, domestic consumption in the UK is less amenable to behaviour change. In the US, electricity is commonly used as the main source of heating and for air-conditioning, and these are responsible for 25% of US domestic energy consumption (McKenzie-Mohr *et al.*, 2012). In the UK, few domestic properties have air-conditioning and it is unusual to have electric central heating (which is why homes using electricity for their heating were excluded from the study). Space-heating and air-conditioning practices are more easily changed than other high-consuming domestic practices such as cooking and lighting, and relatively small behaviour changes in the former have a larger impact on consumption than similar changes in the latter (see Wilhite, 1997). Hence, the gearing of behaviour-change to electricity-consumption will be lower in the UK and consumption is likely to be less tractable than in the US – especially in the short term. None of the electricity studies reviewed in this study used qualitative research to determine which behaviour changes generated the recorded consumption reductions, but heating and air-conditioning practices are likely to account for the substantial consumption change found in the US studies. In this study, the qualitative interviews and the post-study questionnaire both indicate that changes in standby behaviour and the use of lights were the most common. Standby consumes relatively very little electricity and participant data from the pre-study survey indicated that 53% of light bulbs were already low-energy, so it seems likely that even if the feedback prompted significant behavioural changes, these would not have resulted in substantial consumption reductions.

While the statistical test failed to provide proof of *H1*, the methodological triangulation built into the study provides evidence to suggest that the feedback did cause some reductions in consumption. In the post-study questionnaire, 55% of participants who had received feedback claimed that they had changed the way they "use electricity", compared to just 19% of the control group (N = 320; $d.f.$ = 4; $p < 0.005$; χ^2 = 44.55). This was supported by the qualitative interviews, in which participants attributed a range of behaviour changes to the feedback.

Given that consumption levels in the UK are lower and less open to change than in the US, the similarity in size of the effect in this study to those found by Allcott (2011) and Ayres *et al.* (2009) is surprising. High levels of engagement

indicate that this was due to the frequency and format of the feedback. The interviews reveal how the granularity of the data enabled participants to identify and target those activities that consumed the most electricity. This was not possible for the participants in the three US studies, who were only given aggregated monthly figures.

A further issue is householders' perceptions of the relevance of the social norms feedback. The studies by Alcott (2011) and Ayres *et al.* (2009) analysed data from the Opower programme, in which large-scale participation enabled the social norms approach to be based on comparisons between broadly comparable households. In contrast, like Nolan *et al.* (2008), the social norms comparisons used in the present smaller-scale study did not distinguish by house type or occupancy. However, although this may have influenced the results of the study, the following interview extract illustrates that this did not necessarily reduce the effectiveness of the feedback:

Householder	I thought the average was a bit low. [...] I mean I know that the majority of the streets round here, you know, haven't got that many families. They're either grown up and gone or they're widows [...] But I have… it has made me, I suppose, take note a little bit more for the fact that I switch off all the lights now and you know, I make a point of doing that. [...]
Interviewer	If the graphs had just shown the green bars – just your own energy use – would that have been as good? Would that have made a difference to you? If they'd not had the red lines and the orange lines...?
Householder	No I think what made me…the three things – the three lines that was my usage, the average usage and the best usage in the area – it makes you… it had to be like that to make you think that you were using perhaps a bit too much or, "hang on a minute", you need to tell yourself, "oh I know why I'm using it at that time, because the boys need their dinner". So yeah, you do need the three lines, yeah you do.

(Male professional; married with two children; social norms condition)

More important than the lack of firm evidence in favour of hypothesis *H1* is the much clearer failure to find any evidence for *H2*. Although not statistically significant, the indicative change in consumption caused by the addition of social norms data was the opposite effect to that predicted.

One explanation for this might be that the social norms information was of little interest to participants and perhaps even weakened their inclination to reduce consumption. Such an interpretation is supported by Fischer (2008), who argues that the social norms approach is culturally specific and, citing IEA (2005), claims that UK residents are less interested in social norms data than others. However, the qualitative data from the interviews and focus groups belies this conclusion, for it suggests that participants were, in fact, very interested in the social norms feedback because it allowed them to make relational value judgements about their consumption. As explained by one interviewee, people like to know whether their consumption is "bad" or "good". Fischer's contention is also challenged by the confirmation of *H3*, which shows that people were more likely to download (and presumably also, read) emails that contained social norms feedback.

A final question concerns why the social norms approach seems to be ineffective in the electricity domain despite evidence of its efficacy in other areas.

One possible explanation is that individual-level feedback might have been equally effective in these other areas had it been included as a control. An exhaustive review revealed only two studies that included both a social norms condition and a condition in which only individual-level data was provided: a study by Bewick *et al.* (2008) that allowed students to compare self-reported alcohol consumption with social norms and a study of recycling behaviours by Schultz *et al.* (1999). However, neither of these two studies reported on the statistical significance of any differences between the two forms of feedback.

A further possible explanation is to be found in what Schultz *et al.* (2007) term the *boomerang effect*. Although the social norms feedback may have encouraged some participants to consume less, it may also have prompted some of those below the norm to consume more. Schultz *et al.*'s (2007) experiment indicated that this effect could be avoided by giving positive injunctive messages (e.g. smiling face symbols or congratulatory statements) to those who were 'better' than the norm. However, Ayres *et al.* (2010) found that the use of such messages failed to eliminate the boomerang effect amongst the 35,000 participants in their study who received the social norms feedback. Unfortunately, it was not possible to test for this effect in the present research.

A second possible reason for the failure of the social norms approach lies in the distinction made by Van Raaij and Verhallen (1983) between energy use and energy-related behaviour. As argued above, people do not 'use energy'; rather, they engage in behaviours that happen to use electricity. Hence, in both the current study and the three US studies of domestic electricity, the object of measurement and comparison, electricity use, was an indirect outcome of behaviour rather than behaviour itself. In previous research into the social norms approach it was the behaviours themselves that were measured and compared. Goldstein *et al.*, (2008) provided feedback on the re-use of hotel towels rather than on the energy consequences of their use/re-use; Perkins *et al.* (2009) focussed on bullying rather than on the outcomes of bullying, and studies on alcohol-use enabled students to compare their alcohol consumption with that of others, not with the outcomes of that consumption. If this analysis is correct, the social norms approach would be more successful in the domain of energy use if it were applied to individual energy-consuming practices – for example, by giving householders feedback on how often other people use a tumble-drier or how much electricity others use to boil water for hot drinks.

Conclusions

In this study, the addition of social norms information to electricity feedback was found to increase engagement with the feedback (*H3*) but was not found to reduce consumption (*H2*). The research suggests that earlier studies by Nolan *et al.* (2008), Ayres *et al.* (2009) and Allcott (2011) exaggerated the efficacy of the approach because they failed to control for the influence of individual feedback and thus confounded the effects of social norms feedback and individual feedback. This suggests that social norms data should be a secondary, rather than essential, part of any strategy for achieving reductions. This is of great relevance to the UK Government's Smart Meter programme, its endorsement of Opower's social norm approach (Cabinet Office, 2011) and the adoption of that approach by the UK

electricity provider, First Utility (Solon, 2011). The finding also has implications for social marketing in other fields, for it suggests that where it is possible to give people feedback on their own behaviour, the social norms approach might only yield small additional behavioural benefit.

The study suggests that the style of feedback used was engaging to participants and that they found it interesting to associate peaks and troughs in consumption with the activities that caused them. This detailed level of engagement was not possible in earlier studies and is not provided by most other feedback systems such as those that utilised by the real-time display monitors (RTDs) that are an obligatory component of the Smart Meter programme currently being rolled out amongst the UK's energy providers (DECC 2012). As engagement is often one of the greatest challenges facing the efforts of social marketing to change behaviour, this is in itself an important finding. Hargreaves *et al*., (2010) found that the novelty of the consumption feedback provided by existing RTDs is short-lived. This study suggests three ways in which the impact of RTDs could be improved. Firstly, graphs showing both social norms and individual information can help to sustain consumer interest in feedback and thereby increase and extend engagement. Secondly, frequency of access to the graphs indicates that it would be useful to supplement real-time displays with email and web-based displays of historical data. Thirdly, the presentation of consumption data in hourly blocks helps householders recognise which domestic appliances and activities are responsible for the greatest fluctuations in consumption, thereby enabling them to identify areas where behaviour change would be most worthwhile.

Although smaller than the reductions reported by many earlier studies, a 3% drop in domestic electricity consumption would represent a significant contribution to the UK's goal for reducing carbon dioxide emissions. If the approach used here were also applied to gas and gas heating, which is included in the UK roll-out of RTDs and which may be more susceptible to behaviour change than electricity consumption, the benefits could be higher. This research therefore provides support for the use of feedback to help meet carbon reduction targets.

Limitations and suggestions for further research

Fertile areas for future innovation and research include feedback that clearly identifies the consumption of specific appliances and activities, and the provision of social norms information on particular activities rather than on overall consumption.

Furthermore, alongside the issue of sample size and statistical power, a number of other lessons from this research can be applied to the design of future studies. Although participants were recruited from two socio-demographically different areas, the sample remained unrepresentative of the UK population as a whole. The median gross annual household income (£45,230; SD = £28,899; *N* = 239) suggests that average income was higher than in the UK as a whole, where the average income for those in full-time employment is £26,100 (ONS, 2011). If, as Brandon and Lewis (1999) argue, poorer households respond to consumption feedback with the highest proportional reductions, it will be important for future studies to sample from a broader socio-economic spectrum. In addition, in the questionnaire, 43% of participants agreed that concern for the environment motivated their participation in the research, suggesting that householders who

were more environmentally conscious were overrepresented. Although environmental attitudes are not necessary good predictors of behaviour (Young *et al.,* 2010; Schlegelmilch *et al.,* 1996; Bamberg and Möser, 2007), it is possible that this bias in the sample influenced the size of the reductions identified in this study.

There is also the question of the duration of the consumption monitoring. In the Opower trials, the two-year data collection period allowed more time for the longer-term impacts of the interventions, and Allcott (2011, p7) suggests that reductions in consumption were most evident twelve months after the first social norms feedback was provided. In this study, consumption data was collected for eighteen weeks (including a two-week baseline period) and there is evidence from the interviews that some changes prompted by the intervention (e.g. the purchase of energy efficient appliances) only occurred after the end of this monitoring period.

Finally, it is possible that the effect size was reduced by the *Hawthorne effect* – the impact of trial participation on the behaviour of the control group. By reminding householders that they were participating in research, the presence of the monitors may have exacerbated this effect. Even where the monitors were stored away from view, the process of recruitment and monitor installation is likely to have made participants more aware of their consumption even before the interventions began. By reducing the absolute size of changes in consumption between the baseline period and the end of the monitoring period, this may have reduced the size of the effect in the test of *H1.* This phenomenon could be reduced by minimising awareness of participation amongst the control group or by increasing the impact of the interventions. Advances in technology should make both of these steps possible in future.

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Table 1: Demographic characteristics of the experiment sample (%)

Gender		Social class		Age				Household structure		
F	M	ABC1	C2DE	16-34	35-54	55-65	65+	Adults & kids	Single adult	Adults no kids
59	41	68	32	18	46	22	14	46	8	46

Table 2: Regression analysis of experimental condition on changes in consumption

Independent variables (comparison groups shown in brackets)	**N**	**Std. Error**	**Beta**	**p**	**95% C.I. for B**	
					Lower	**Upper**
Social norms condition (Individual/control condition)	107 217	.03	-.05	.44	-.08	.03
Individual condition (Social norms/control condition)	107 217	.03	-.08	.22	-.09	.02
Single person household (No)	28 296	.04	.08	.20	-.03	.14
Children in household (No)	146 178	.02	-.09	.14	-.08	.01
Constant		.02		.00	.79	.88

Table 3: Regression analysis of type of feedback onto change in consumption

Independent variables (comparison groups shown in brackets)	**N**	**Std. Error**	**Beta**	**p**	**95% C.I. for B**	
					Lower	**Upper**
Social norms condition (Individual condition)	107 107	.03	.04	.59	-.04	.07
Single person household (No)	18 196	.05	.10	.16	-.03	.18
Children in household (No)	103 111	.03	-.11	.14	-.10	.02
Constant		.03		.00	.75	.85

Table 4: Linear regression of type of feedback onto number of emailed graphs downloaded

Independent variables (comparison groups are shown in brackets)	**N**	**Std. Error**	**Beta**	**p**	**95% C.I. for B**	
					Lower	Upper
Social norms condition (Individual condition)	107 107	.15	**.16**	**.02**	.05	.64
Single person household (No)	18 196	.28	.00	.96	.54	.56
Children in household (No)	103 111	.15	**-.14**	**.06**	-.60	.01
Constant		.13		.00	2.17	2.69

Appendix 1 Messages displayed on graphs for members of the social norms group

Condition	Social norm message	Injunctive-norm message
Consumption above average for those in the social norms condition	"Your energy consumption was above average"	None
Consumption 0-30% lower than average	"Your energy consumption was just below average"	"☺ Well done, keep it up!"
Consumption 31-59% lower than average	"Your energy consumption was well below average"	"☺☺ Well done, keep it up!"
Consumption lower than average by 60%+	"Your energy consumption was among the best 20%"	"☺☺☺ Well done, keep it up!"