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Social comparison and energy conservation in a collective action context: A field experiment

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ABSTRACT

This field experiment quantifies the impact of social norm information on the demand for indoor temperature. Based on high-frequency data from indoor temperature monitors, we provide participating households with a comparison of average temperature in their apartment relative to that measured in a control group. For more than 90 percent of participants, financial benefits of energy savings are only indirect, as building-level heating costs are shared across apartments in proportion to their volume. Despite the associated collective action problem, we estimate that the intervention induces a −0.28 °C reduction in average indoor temperature. This suggests that direct monetary incentives is not a pre-requisite for social comparison feedback to induce energy savings.

1. Introduction

Social comparison feedback, which informs people about their behavior relative to the typical behavior of others, has been established as a cost-effective tool to promote energy conservation (e.g. Allcott, 2011; Costa and Kahn, 2013; Allcott and Rogers, 2014). Our field experiment quantifies the effect of a social comparison feedback intervention on demand for indoor temperature in apartment buildings.[1] Arguably, lowering indoor temperature during the heating season is associated with significant disutility, and the extent to which social comparison feedback can also incentivize behavior in a high-effort setting is an open question (see Myers and Souza, 2019).

Our study differs from related interventions on two important aspects. First, instead of relying on repeated information provision, we send out a single letter informing subjects about how indoor average temperature measured over one month during the heating season compares to that measured in a group of control apartments. In the apartments we consider, managing indoor temperature involves adjusting valves installed on each individual radiator, which requires more effort than adjusting a single thermostat (as in Myers and Souza, 2019), but less effort than managing a plug load (as in Allcott and Rogers, 2014).

Second, while all subjects are tenants and pay for their use of heating energy, a large majority of subjects rent their apartment in buildings that have no individual meters for heating energy use. For these tenants, building-level energy cost are shared across apartments in proportion to the volume of each property. One implication is that financial benefits of individual energy savings are only indirect, being conditioned on the behavior of other tenants in the same building. The implied collective action problem contrasts with previous studies in which energy savings imply either direct financial benefits (Allcott and Rogers, 2014) or no financial benefits at all (Myers and Souza, 2019). In line with this, our intervention does not provide information

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[1] According to IPCC (2014), in 2010 buildings accounted for 32% of total global energy use and 19% of energy-related GHG emissions. Further, the IEA (2011) reports that around a quarter of buildings' potential energy savings in 2050 come from space heating by the residential sector.

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Table 1
Overview of experimental conditions and treatment assignment.

Condition	Information	Apartments
Control	None	232
Social comparison	Social comparison only	147
Corporate social responsibility	Social comparison + an appeal to cooperate for corporate responsibility goals	154
Financial appeal	Social comparison + an appeal to cooperate for financial savings	143
Environmental appeal	Social comparison + an appeal to cooperate for a better environment	145

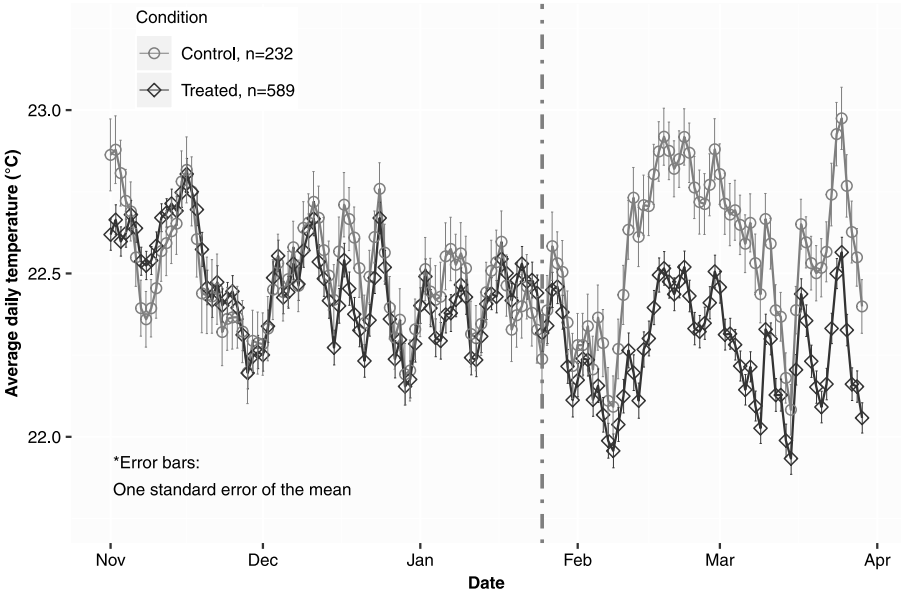


Fig. 1. Average daily temperature levels, conditions pooled °C.

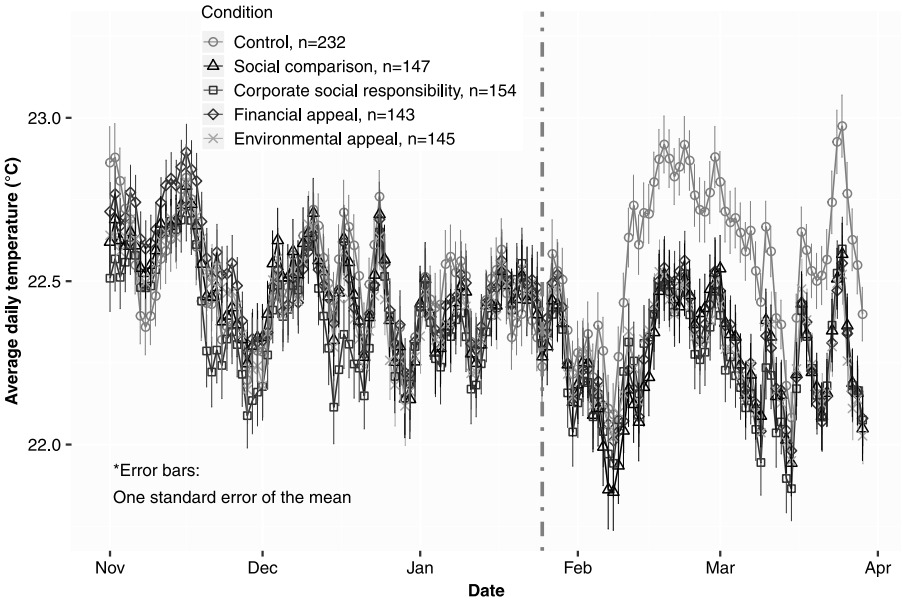


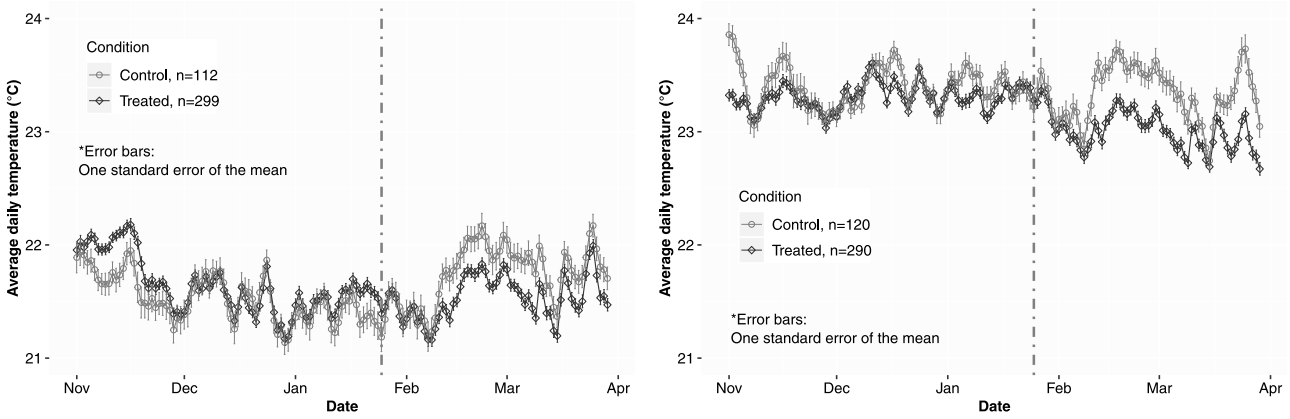
Fig. 2. Average daily temperature levels, all conditions °C.

on individual monetary savings, but rather considers the use of normative appeals referring to specific benefits of reduced energy demand.

We find that our intervention induces a −0.28 °C reduction in average indoor temperature (−1.2%) relative to control, and is virtually unaffected by the presence of normative appeals. This corresponds to a reduction of energy use by at least 2 percent (see Palmer et al., 2012), which is not trivial given the relatively low cost of the informational intervention. Our results also indicate that the presence of indirect monetary incentives is sufficient for social comparison feedback interventions to induce energy conservation behavior.

2. Experimental design

Our sample includes 45 apartment buildings, all located in a single Swiss canton and managed by a common real estate agency. All 855 apartments in these buildings are equipped with



(a) Apartments with below-average pre-treatment temperature

(b) Apartments with above-average pre-treatment temperature

Fig. 3. Average daily temperature levels by pre-treatment temperature, °C.

Table 2
Regression estimates for mean daily indoor temperature (°C).

	Model 1: Fixed-effect regression	Model 2: Fixed-effect quantile regressions				
		q = 0.1	q = 0.25	q = 0.5	q = 0.75	q = 0.9
	(1)	(2)	(3)	(4)	(5)	(6)
Social comparison x post	−0.30***	−0.33***	−0.29***	−0.27***	−0.27***	−0.29***
	(0.07)	(0.07)	(0.05)	(0.05)	(0.06)	(0.09)
Corporate social responsibility x post	−0.25***	−0.27***	−0.24***	−0.23***	−0.25***	−0.23***
	(0.06)	(0.06)	(0.05)	(0.05)	(0.06)	(0.09)
Financial appeal x post	−0.31***	−0.36***	−0.33***	−0.30***	−0.28***	−0.27***
	(0.06)	(0.06)	(0.05)	(0.05)	(0.06)	(0.08)
Environmental appeal x post	−0.27***	−0.28***	−0.26***	−0.26***	−0.24***	−0.25***
	(0.07)	(0.06)	(0.05)	(0.05)	(0.06)	(0.09)
Apartment fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Day fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Apartments	821	821	821	821	821	821
Observations	120,441	120,441	120,441	120,441	120,441	120,441
(Pseudo)R^2	0.01	0.12	0.13	0.13	0.13	0.13

Notes: Column (1) reports linear fixed-effect regressions with robust standard-errors clustered at the apartment-level in parentheses. Columns (2) to (6) report fixed-effect quantile panel regressions (bootstrapped standard-errors). All regressions include apartment and day fixed effects. ∗, ∗∗ and ∗∗∗ denote statistical significance at 5% and 1% and 0.1% levels respectively.

indoor temperature monitors, small devices without a display which record temperature every 15 min. Our intervention includes four experimental treatments and a control. First, we allocate 15 buildings to the control group and 30 in the treatment group.[2] Importantly, apartment-level heating energy meters are only present in two control buildings (34 apartments) and three treated buildings (62 apartments). Second, apartments in treated buildings are allocated to one of four experimental conditions (opt-out design).

For all four treatments, the general layout of the informational intervention closely follows Allcott and Rogers (2014).[3] In particular, each household is informed about average indoor temperature in their apartment measured during December 2018 in comparison to the corresponding average for "more than 200 comparable households" (i.e. the control group). This design also includes a set of normative signals, such as recommended temperature levels and smileys (injunctive norms, see Schultz et al., 2007), as well as households' percentile information: "the indoor temperature in your apartment is higher than X% of comparable apartments" (see Ferraro et al., 2011). One implication of this design is that all the participants, including those performing better than the average, have a benchmark to improve. In addition, we include a collective action statement emphasizing common benefits afforded by individual efforts.

The four treatments vary with respect to the presence of an appeal to reduce indoor temperature, which can potentially enhance the effectiveness of social comparison feedback (Bicchieri and Dimant, 2019). The benchmark "Social Comparison" treatment includes no specific appeal to tenants. In the remaining three treatments, we include an appeal for an efficient use of energy. This is framed as a request for cooperation with the real estate agency to achieve corporate social responsibility objectives (treatment "Corporate Social Responsibility"), financial savings for the households (treatment "Financial Appeal"), or environmental benefits (treatment "Environmental Appeal"). See Table 1 for a summary of treatment assignment.

3. Results

Information letters were sent on January 25, 2019. Out of the 855 apartments, 10 tenants could not be reached by mail and 24 opted-out from the study. The final sample includes 821 apartments.

Fig. 1 depicts daily average temperature levels (pooling all conditions together), with the intervention date indicated by the black vertical line. Average daily temperature before the intervention is 22.49 °C in control apartments, and 22.48 °C in treated

[2] The main sample characteristics are provided in the Supplementary material.

[3] The letter template is reproduced in the Supplementary material.

apartments, suggesting no discernible difference. After the intervention, average temperature slightly increases to 22.57 °C in the control group, while it drops to 22.27 °C in the treatment group.

Fig. 2 suggests little difference in how individual treatments affect average indoor temperature. Finally, Fig. 3 documents possible heterogeneous effects for tenants with pre-treatment temperature below-average and above-average, respectively. In line with studies that include injunctive norms (see Schultz et al., 2007; Allcott, 2011), we observe no undesired reaction to social norm information among low energy consumers.

To quantify these differences, we run a set of difference-in-differences regressions on mean daily indoor temperature, with results reported in Table 2. In column (1), we report a fixed-effect regression with average treatment effect estimated separately for each condition relative to control. Columns (2)–(6) report fixed effect quantile regression results to document heterogeneous effects highlighted above. In all regressions, we include apartment and day fixed effects, and report standard-errors clustered at the apartment level in parenthesis.

Treatment effect estimates vary between −0.25 and −0.31 °C (−1.1% and −1.3% respectively), with pairwise chi-square tests confirming no statistically significant difference between individual treatments. Furthermore, the regression estimates suggest that treatment effects are homogeneous across temperature quantiles. The Supplementary material provides corresponding random effect regressions and estimates for a sample restricted to apartments without individual meters for heating energy. The results are consistent throughout. The Supplementary material also provides separate estimates for each of the nine weeks following the intervention (pooled treatments). Results suggest that significant temperature effects emerge after approximately two weeks and remains broadly stable thereafter, as illustrated in Fig. 1.

4. Conclusions

In this paper, we have studied the impact of an informational intervention centered around social comparison feedback on indoor temperature, and reported an estimated average treatment effect of −0.28 °C (−1.2%). We therefore find that tenants in our sample are willing to sacrifice part of their comfort to reduce energy use, even in the absence of direct financial benefits. Evidence also suggests that the impact of the intervention is stable with time. Whether the intervention induces energy savings in the subsequent heating season is left for future research.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.econlet.2020.108947.

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