When Nudges Fail to Scale

Addressing Internalities in Energy Consumption

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Externalitites and Internalities in the Energy Sector

- Energy supply and demand by households is characterized by a number of frictions caused by externalities and internalities

- **Externalities** in energy production and consumption
  - Climate change via GHG emissions (extreme weather events, ecosystems, flooding, losses in farming …)
  - Impacts of air pollutants (health, material damages, crop degradation, biodiversity loss …)
  - Visual intrusion and noise impacts through renewables
  - Innovation and diffusion of energy technology

Externalitites and Internalities in the Energy Sector

- Internality
  - Consumers maximize "decision" utility $\tilde{v}$ instead of "experienced" utility v $\quad (W = \int_{\tilde{v}>p}(v-p)dF(\tilde{v}))$
    → $\tilde{v}$ determines choice while v determines the choice-related utility payoff
  - Internality (as analogy to externality) $I = v - \tilde{v}$ exists whenever $\tilde{v} \neq v$ (biased consumer)
  - Example: Consumer buys an energy-efficient product iff $\tilde{v} = v - I > p$
    where p is the price of the product.
  - welfare rationale for interventions through taxes/subsidies, legal mandates/C&C, nudges
  - behavioural effects in energy efficiency (consumers are not able to make utility maximizing decisions)
    - Consumers might be myopic...
    - Consumers might lack information ...
    - the benefits of energy-efficient vehicles may not be sufficiently salient .

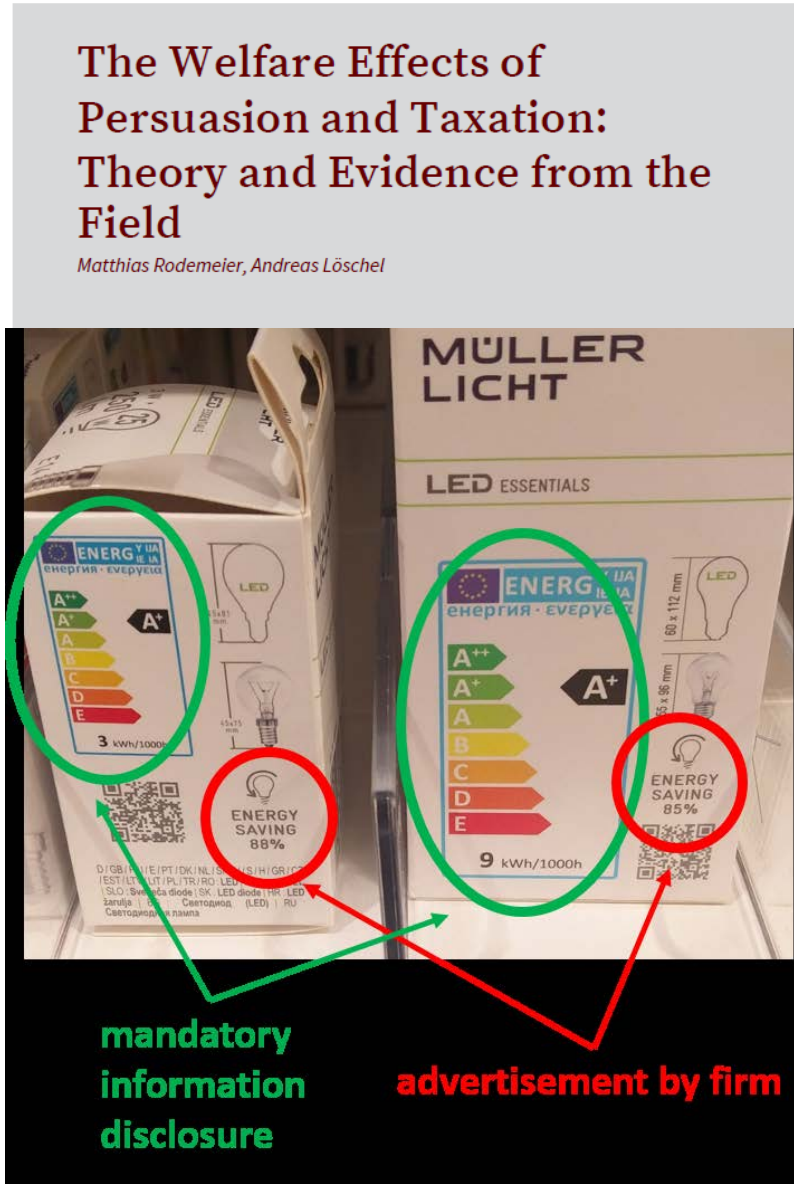
Interventions to internalize externality / correct internality

- **market based instruments** like CO2 taxes, emissions trading, renewable subsidies to internalize externalities or subsidy that reduces the price for energy-efficient products to $p_1 = c - s$ if lower operating costs are neglected due to salience bias (decision utility $\tilde{\mathrm{v}}$ <"experienced" utility v) $[\frac{dW}{ds} = 0 \rightarrow s^* = \mathrm{E}(I|\tilde{v} = c - s^*)]$
- **command and control policies**, legal mandates → rebound effects in energy efficiency
- **non-pecuniary (soft) interventions** based on a number of 'behavioural' effects
  - social norms (Alcott, 2014)
  - information provision and help processing (Alcott & Taubinski, 2015, Rodemeier and Löschel, 2020)
  - goals with 'psychological' effects (Harding & Hsiaw, 2014, **Löschel, Werthschulte, Rodemeier, 2020)**

  → nudges "steer people in particular directions" and also "maintain freedom of choice." – Cass Sunstein (correct bias without affecting decisions of optimizing consumers)

Example: Information provision

- Rodemeier, Löschel (2020): Welfare Effects of Persuasion and Taxation
  - large-scale (N > 600; 000) natural field experiment w appliance retailer
  - EU Energy efficiency label may cause consumers to overvalue energy efficiency and make privately sub-optimal choices (too much eff.)
  - consumers receive more- or less-informative signals regarding the energy savings of energy-efficient household lighting (%, % and Euro)
  - labels may still increase social welfare by lowering climate externalities
  - information may be designed to steer choices towards the social (instead of the private) optimum → trade-off between consumer surplus and externalities



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When Nudges Fail to Scale: Field Experimental Evidence from Goal Setting on Mobile Phones

Andreas Löschel, Matthias Rodemeier, Madeline Werthschulte

Motivation

- Non-pecuniary incentives motivated by insights from psychology (“nudges") have shown to be effective tools to change behavior in a variety of fields.
- Often unanswered question relevant for public policy: How to scale up these promising interventions?
- In cooperation with a large public utility in Germany, we develop an energy savings application for mobile phones that can be used by the majority of the population.
- The app randomizes a “goal setting nudge" prompting users to set themselves energy consumption targets.
- Roll-out of app is promoted by a mass marketing campaign and various financial incentives.

Contributions to the Literature

- Goal Setting Prompts: Prompting people to make plans and set goals has shown to help them reduce smoking (Armitage, Arden, 2008), eat healthier (Achtziger, Gollwitzer, Sheeran, 2008), get vaccinated (Milkman et al., 2011) and vote during elections (Nickerson and Rogers 2010).

  What's the role of these promising interventions for energy conservation? First study that uses randomly assigned goal setting prompts to evaluate its causal effect on energy conservation.

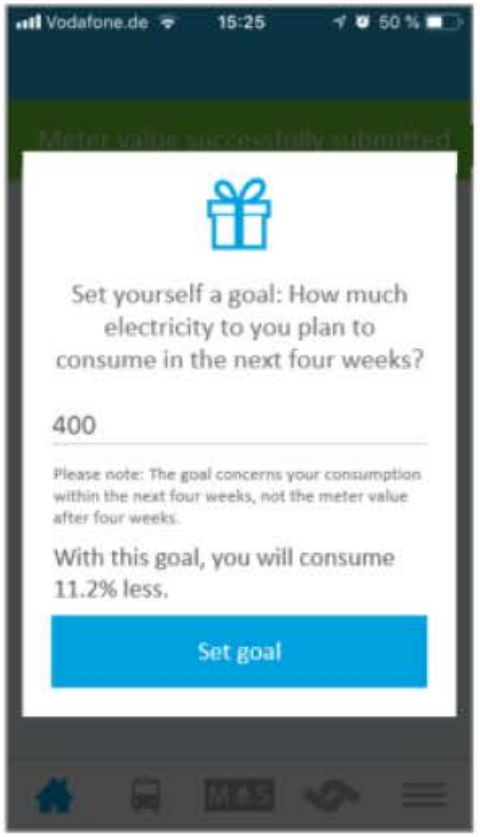
- Scalability of Nudges: Interventions often yield disappointing results once brought to scale (Al-Ubaydli, List, and Suskind 2017,Al-Ubaydli, List, and Suskind 2019, DellaVigna and Linos 2020).

  How does a goal setting nudge perform at scale? Are mobile devices an appropriate scaling device for behaviorally motivated interventions?

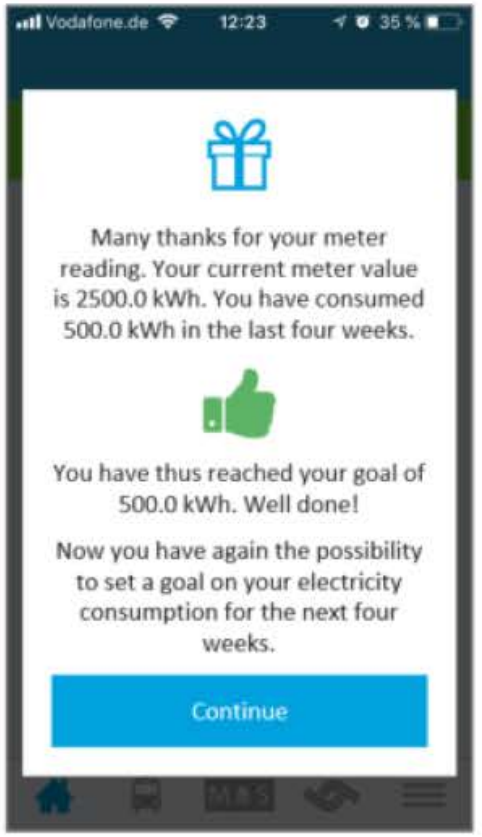
The Energy App

a) Meter scan

b) Appliance information



c) Goal choice



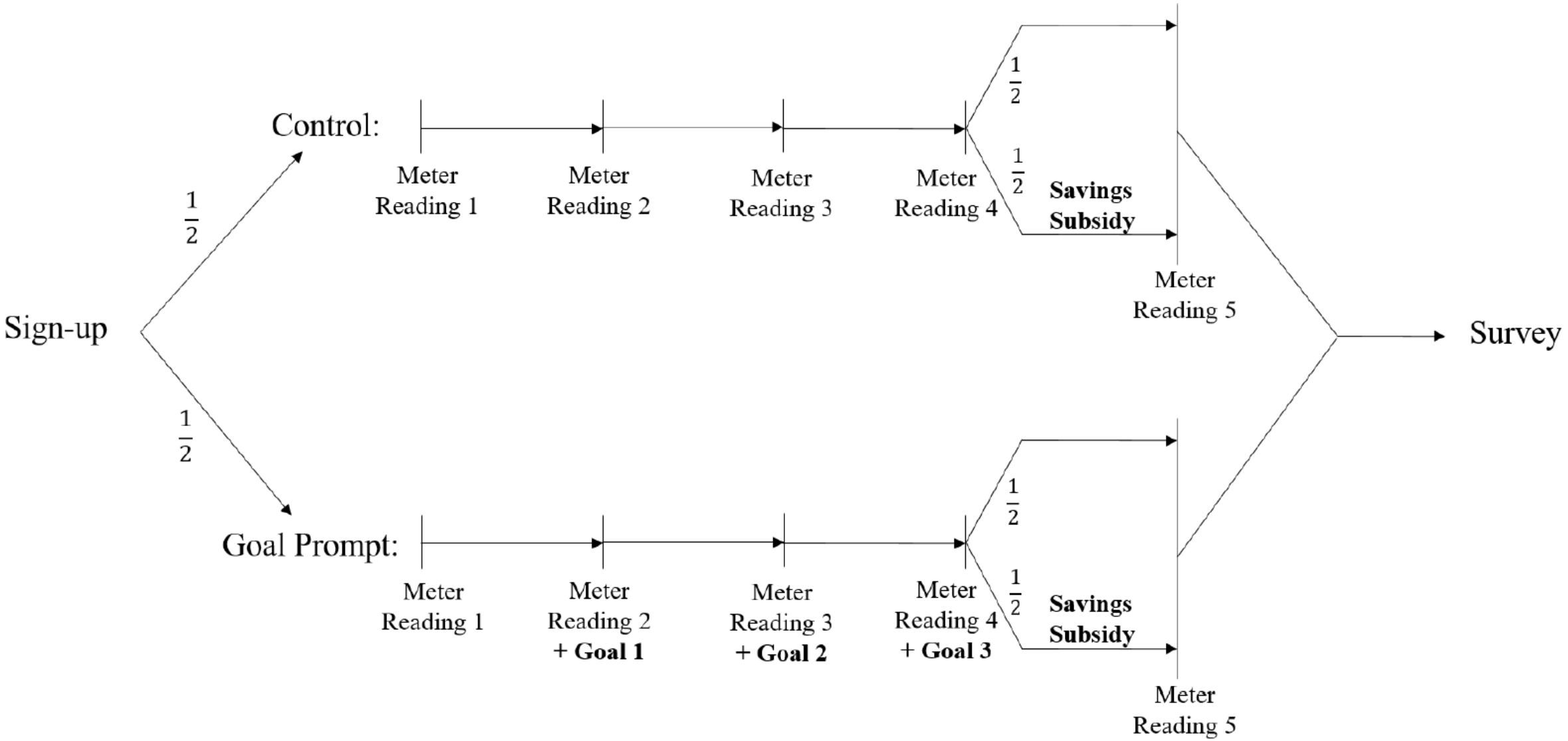
d) Achieved goal

e) Failed goal

Features available to everyone: Scan meter and receive information about energy use of appliances.

Randomized feature: Energy consumption goals for upcoming month.

Experimental Design



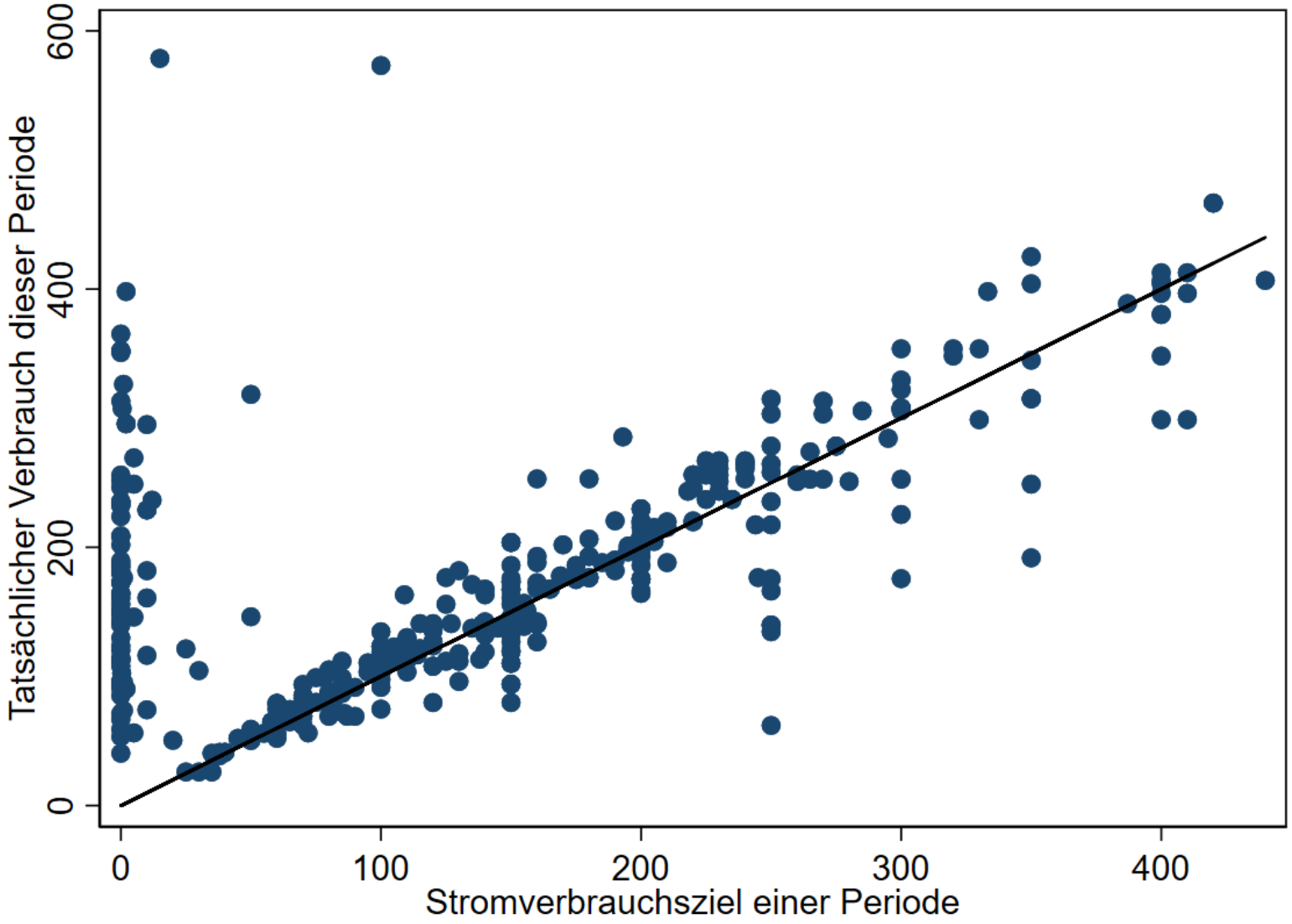
Technology Diffusion

- Industry experts design app and marketing campaign.
- Campaign targets entire municipality:
  - Frequent radio spots.
  - 69,000 personalized mails to utility customers.
  - 14,000 flyers attached to energy bills.
  - 66,000 newspaper prints with advertisement.
  - 4,000 yers distributed door-to-door.
  - Integrate Energy App into the popular local app "muenster:app“ (>120,000 downloads).
- Financial Incentives:
  - 45 € voucher for an online shop for every user who uses the app for 4 months.
  - Additional lotteries with various prizes: Apple iPads, holiday trips, restaurant vouchers, etc. (Total value: 6.000 €)

Effect on Extensive Margin: Probability of Using the App over Time

	(1) Period 1	(2) Period 2	(3) Period 3	(4) Period 4	(5) Period 4
Goal Treatment	-0.006	-0.013	-0.014	-0.042**	-0.050*
	(0.026)	(0.023)	(0.022)	(0.020)	(0.028)
Savings Subsidy				0.029	0.021
				(0.020)	(0.029)
Goal × Subsidy					0.016
					(0.040)
Constant	0.517***	0.293***	0.237***	0.190***	0.194***
	(0.018)	(0.017)	(0.016)	(0.018)	(0.020)
N	1,493	1,493	1,493	1,493	1,493

Effect on Intensive Margin: Electricity Consumption



Effect on Intensive Margin: Electricity Consumption

	(1) Log(kWh)	(2) Log(kWh)	(3) Log(kWh)
First Goal	0.015	0.008	
	(0.026)	(0.024)	
Second Goal	0.047	0.053	
	(0.036)	(0.037)	
Third Goal	-0.034		
	(0.046)		
Savings Subsidy	0.028		
	(0.040)		
Goals (pooled)			0.027
			(0.025)
Period-4 consumption included	Yes	No	No
N	1,813	1,538	1,538

Mechanisms

- To understand mechanism of null effect, we need a theory of why goals do affect behavior: Koch and Nafziger (2011), Hsiaw (2013).
- Rationale of these models: Goals help people with **self-control problems** because they act as a commitment device.
- A goal causes a reference point to which consumers are **loss-averse**.
- Core parameters of theoretical models: present bias ($\beta < 1$) and loss aversion ($\lambda > 1$).
  → Survey elicits these parameters for app users.

Behavioral Parameters Elicited in Survey

	Sample Average (Std. error)	Percentile 10th	25th	50th	75th	90th	N	Representative Average for Comparison (Std. error)	Comparison Study
β	1.030 (0.007)	0.972	1	1	1.013	1.090	353	0.95 (0.02)	Imai, Rutter, and Camerer (2019) (Meta-analysis)
λ	0.826 (0.100)	–0.933	0	0.933	1.25	1.875	352	1.31 (0.11)	Walasek, Mullet, and Stewart (2018) (Meta-analysis)
$p_{max} - p_{min}$	6.658 (1.589)	0	2	4	9	15	193	12.10 (0.519)	Werthschulte and Löschel (2019) (German average)

- Majority of subjects has no self-control problem and no loss aversion ($\beta \approx \lambda \approx 1$)
  → parameter values would predict null effect!
- Parameter values are not representative of general population.
  → Disadvantageous selection into subject pool?

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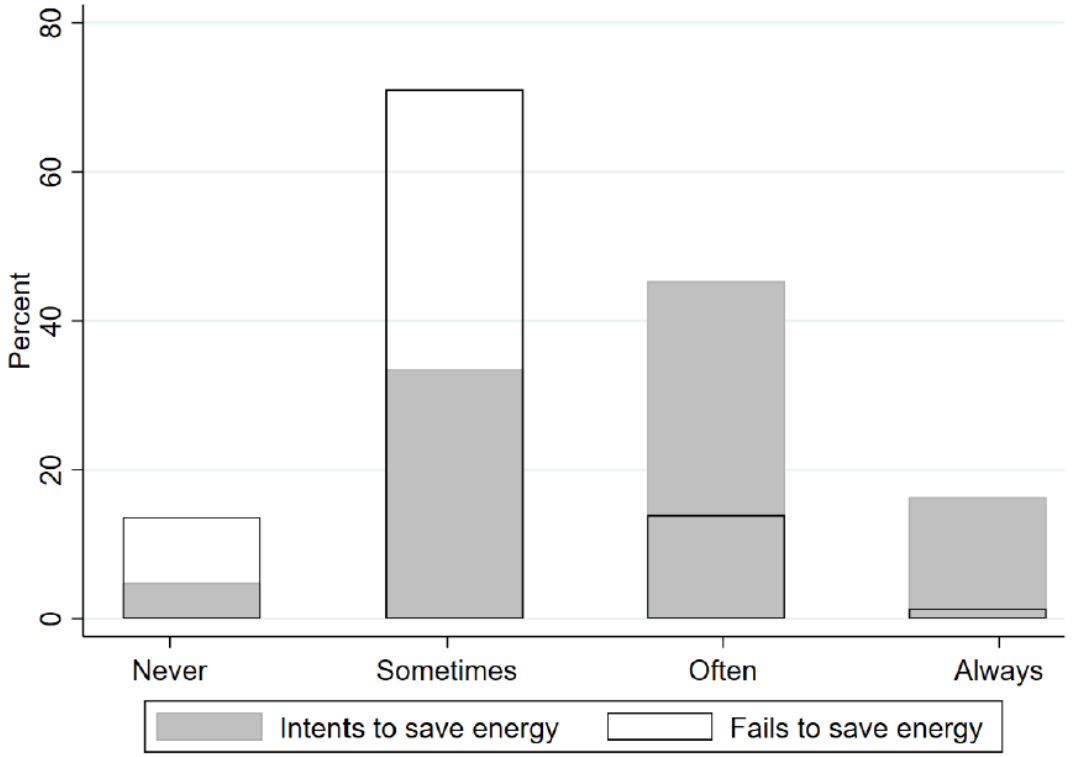
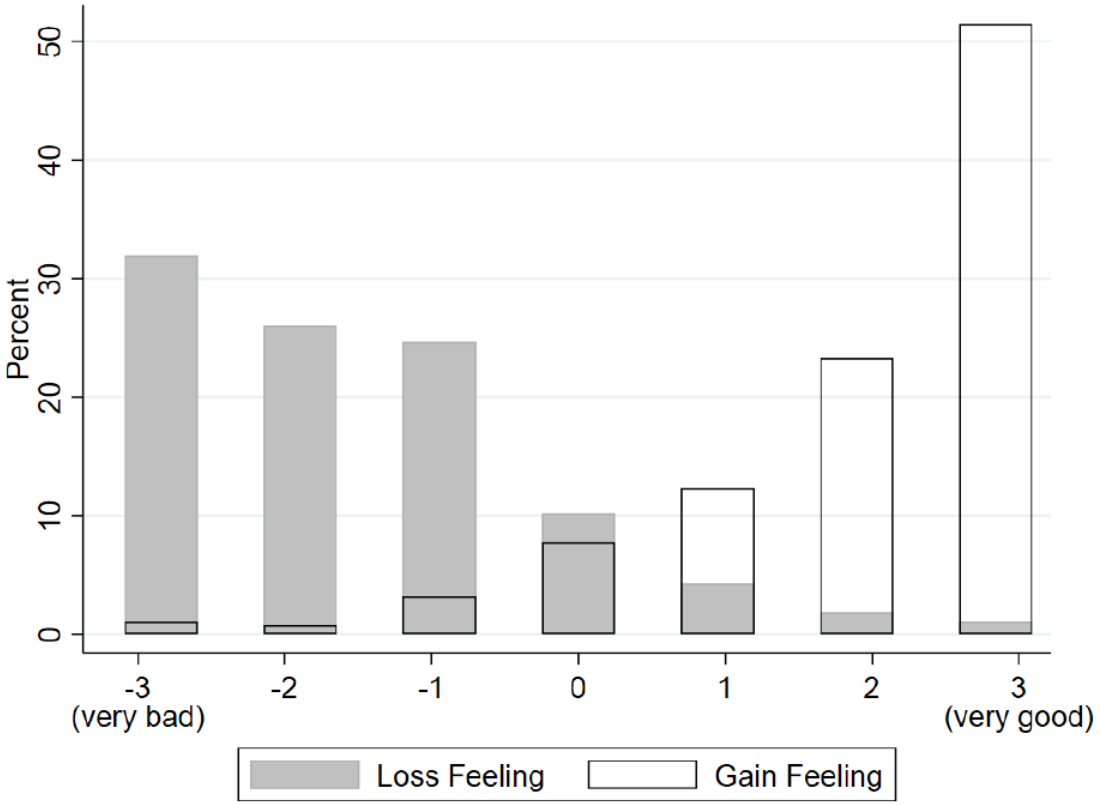
- Additional evidence for selection: App users belief distribution about their electricity price, p, has much smaller condence interval than German average.
  → App has attracted “energy nerds" with pretty rational preference parameters.
- German average: Werthschulte and Löschel (2019), Cost misperceptions and energy consumption: Experimental evidence for present bias and biased price beliefs, Revise and Resubmit: *Journal of Environmental Economics and Management (JEEM)*

Intentions and Self-Control



Gain versus Loss Feeling



Conclusions

- Our study simulates a large-scale behavioral policy intervention to encourage resource conservation.
- Despite substantial marketing efforts and financial incentives surprisingly little demand for the energy app.
- We estimate tight null effects on energy consumption among app users even though they set themselves meaningful goals that are highly predictive of future consumption.
- Observable subject characteristics point to sub-optimal targeting properties of app as a likely mechanism.
- Nudge has relatively large negative effect on consumer surplus and social welfare.
- Results cast doubt on the prospects of mobile phones as cost-effective scaling devices for energy consumption goals → but more evidence on the effects of digitalization on demand response needed.
- Dynamic development in the digitalization of the energy transition opens new possibilities –
  the tyranny of the status quo should not be trusted too much