

Can Self-Set Goals Encourage Resource Conservation? Field Experimental Evidence from a Smartphone App

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Motivation

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- One of the most important fields for policy interventions: resource conservation
- We apply an established nudge to resource conservation: self-set goals
 - reduce smoking ([Armitage and Arden \(2008\)](#))
 - eat healthier ([Achtziger et al. \(2008\)](#))
 - get vaccinated ([Milkman et al. \(2011\)](#))
 - vote during elections ([Nickerson and Rogers \(2010\)](#))

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 - What are the mechanisms underlying demand response?
 - What is the willingness to pay for the goal setting feature?

Basic Set-Up

- Cooperated with a large public utility and an IT company in Germany

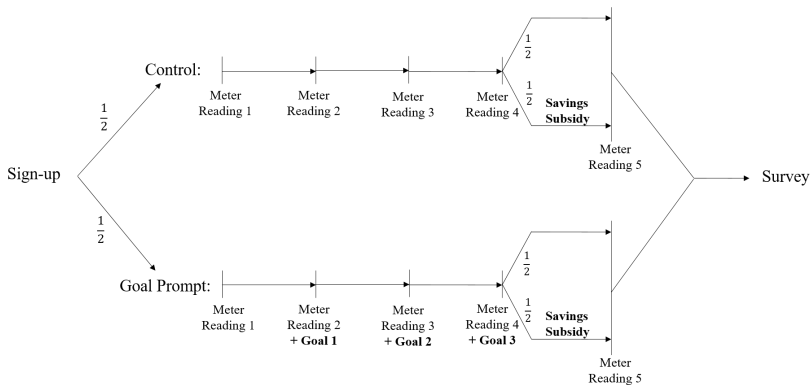
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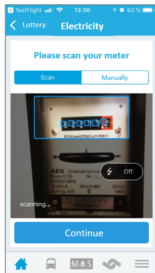
- Cooperated with a large public utility and an IT company in Germany
- Developed an energy savings app for smartphones: easily accessible & suited for large-scale rollout
- Main feature of app: Meter reader
 - Automatically reads and submits reader to utility
 - Major advantage for utilities: Meter readings are still done manually in Germany
 - Allows us to observe consumption over four months in 2018

Experimental Design

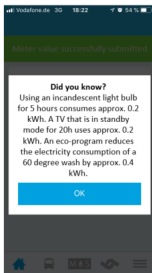


<i>Period 1 (week 1-4)</i>	<i>Period 2 (week 5-8)</i>	<i>Period 3 (week 9-12)</i>	<i>Period 4 (week 13-16)</i>
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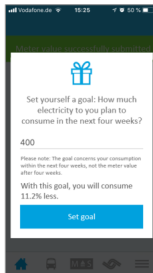
The Energy App



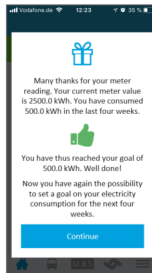
a) Meter scan



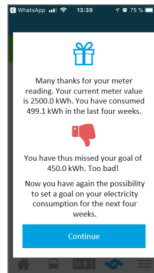
b) Appliance information



c) Goal choice



d) Achieved goal



e) Failed goal

Technology Diffusion

- Cooperated with marketing agency which designed marketing campaign

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 - 4,000 flyers distributed door-to-door

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- Campaign targets entire municipality:
 - 69,000 personalized mails to utility customers
 - 14,000 flyers attached to energy bills Flyer
 - 66,000 newspaper prints with advertisement
 - 4,000 flyers distributed door-to-door
 - Integrate Energy App into a popular local app “muenster:app” (>120,000 downloads)

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 - 45 euro voucher for an online shop for every user who uses the app for 4 months
 - Additional lottery with various prizes: Apple iPads, holiday trips, vouchers for local shops, restaurants, etc. (Total value: 6,000€)

Extensive Margin Choice: Technology Adoption

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

Intensive Margin Choice: Electricity Consumption

	(1) Log(kWh)	(2) Log(kWh)	(3) Log(kWh)
First Goal	0.015 (0.026)	0.008 (0.024)	
Second Goal	0.047 (0.036)	0.053 (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

Intensive Margin Choice: Heterogeneity

- No heterogeneous treatment effects by below/above median consumption [Table](#)
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- No “inverse U-shaped” goal effectiveness

Mechanisms

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 - Core parameters of theoretical models: present bias ($\beta < 1$) and loss aversion ($\lambda > 1$)
- Elicit parameters in survey including incentivized experiments

Behavioral Parameters

	Sample Average (Std. error)	Percentile					N	Representative Average (Std. error)	Study
		10	25	50	75	90			
β	1.03 (0.01)	0.97	1	1	1.01	1.09	353	0.95 (0.02)	[1]
λ	0.83 (0.10)	-0.93	0	0.93	1.25	1.88	352	1.31 (0.11)	[2]
$p_{max} - p_{min}$	6.66 (1.59)	0	2	4	9	15	193	12.10 (0.52)	[3]

[1] Imai et al. (2019), [2] Walasek et al. (2018), [3] Werthschulte & Löschel (2021)

- Average user has no self-control problem and no loss aversion
($\beta \approx \lambda \approx 1$) Graph Graph
→ Parameter values would predict null effect!
- Parameter values diverge from representative sample average

→ Disadvantageous selection into subject pool

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- Higher confidence in energy price knowledge than German average
- Energy consumption below national average

→ App has attracted “energy nerds” with rational preference parameters

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→ Average user is willing to pay –7.41 EUR to **avoid** goal-setting feature

Theory

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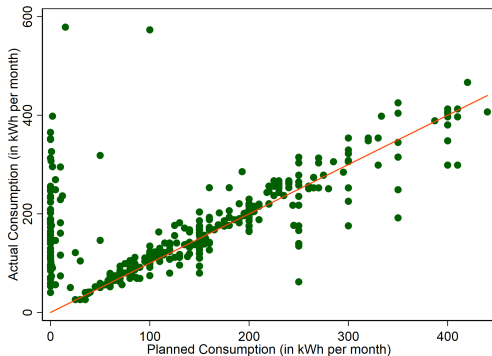
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 - Surprisingly little demand for the energy app
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- Likely mechanism: Sub-optimal targeting
- Users are willing to pay to avoid nudge
- Results cast doubt on the prospects of mobile phones as scaling devices for behaviorally-motivated energy policies

Thanks for your attention!

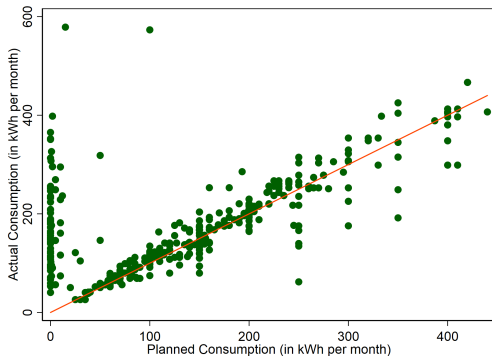
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Intensive Margin Choice: Goal Setting Behavior



Two main groups:

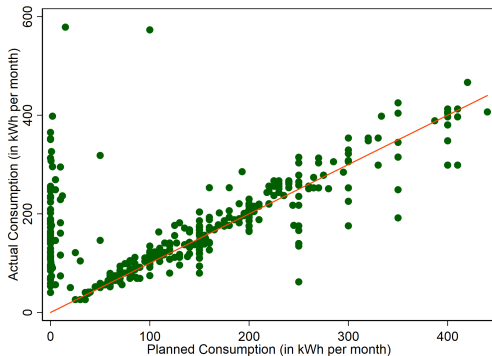
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Intensive Margin Choice: Goal Setting Behavior



Two main groups:

1. Majority (86%): meaningful consumption goals that are highly predictive of actual consumption
2. Meaningless goals of zero. Do not want to engage with nudge?

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- Yet: [Harding and Hsiaw \(2014\)](#) find self-set goals effective in reducing energy consumption
- Identification relies on quasi-random timing of program adoption
- When running same event study regression on our data: Significant treatment effects that are close to [Harding and Hsiaw \(2014\)](#) Table

Marketing campaign

Energie sparen und gewinnen!

Testen Sie die **neue Zählerstandserfassung** in der **münster:app** und nutzen Sie Ihre Gewinnchancen!

3 Reisegutscheine
im Wert von je 1.000 €
8 Apple iPads
10 Münster-Gutscheine
im Wert von je 100 €

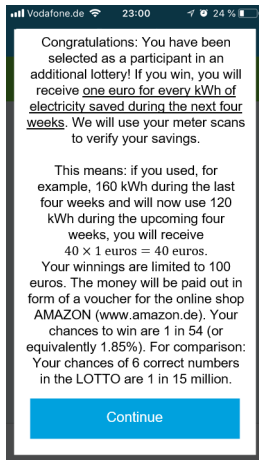


Einfach. Näher. Drauf.



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Screenshot Savings Subsidy



Sample

	Control	Treatment	Difference
Double tariff (1 = yes)	0.036 (0.187)	0.029 (0.167)	-0.008 (0.009)
Meter decimals	1.046 (0.342)	1.049 (0.398)	0.002 (0.018)
Meter pre-decimals	5.806 (0.605)	5.833 (0.615)	0.027 (0.030)
Submitted scans ≥ 2 (1 = yes)	0.527 (0.500)	0.509 (0.500)	-0.017 (0.025)
N	824	803	1,627
Baseline consumption (in kwh)	188.466 (109.235)	193.996 (123.006)	5.530 (8.384)
N	434	410	844

Intensive Margin Choice: Heterogeneity

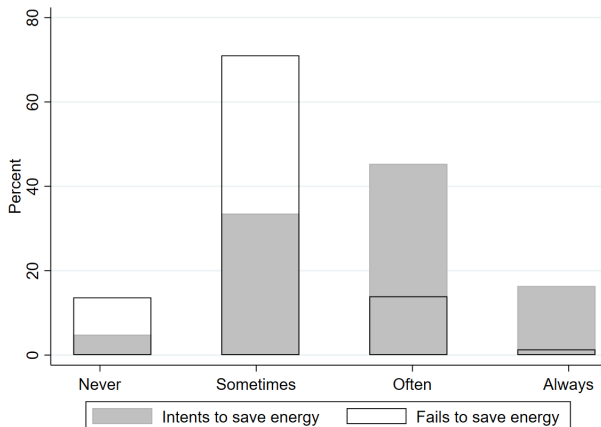
	(1) Log(kWh)	(2) Log(kWh)
First Goal	0.047 (0.054)	
Second Goal	0.076 (0.078)	
Above Median	0.916*** (0.032)	0.916*** (0.032)
First Goal x Above Median	-0.024 (0.058)	
Second Goal x Above Median	-0.028 (0.079)	
Goals (pooled)		0.060 (0.058)
Goals (pooled) x Above Median		-0.025 (0.059)
Constant	4.627*** (0.027)	4.627*** (0.027)
N	1,538	1,538

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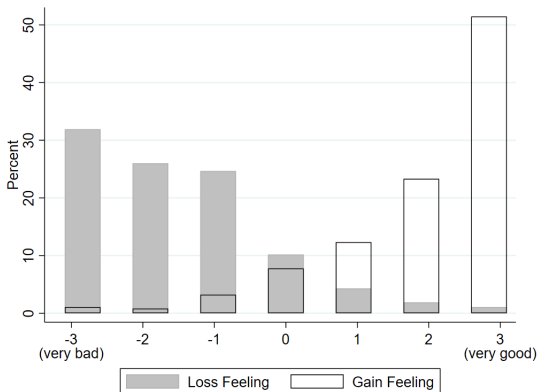
	(1) Log(kWh)	(2) Log(kWh)	(3) Log(kWh)
First Goal	-0.009 (0.044)	0.008 (0.026)	-0.006 (0.040)
Second Goal	0.130*** (0.047)	0.035 (0.041)	0.059 (0.052)
Treatment Subgroup	Lenient Goal	Saving Goal	Zero Goal
N	1,317	1,467	1,288

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Intentions and Self-Control

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Gain vs. Loss Feeling

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Sample Characteristics

	Sample Average (Std. dev.)	Min	Max	N	Country Average (Std. dev.)	Two-sided t-test
Female (1 = Yes)	0.23 (0.42)	0	1	360	0.51 (0.50)	$p < 0.00$
Age	45.76 (14.76)	20	82	369	43.83 (23.29)	$p = 0.01$
High School Degree (1 = Yes)	0.76 (0.43)	0	1	350	0.33 (0.47)	$p < 0.00$
Working (1 = Yes)	0.78 (0.42)	0	1	338	0.76 (0.43)	$p = 0.40$
Personal net income (in Euros)	2514.74 (1113.20)	249.50	4500	283	1770.38 (1671.66)	$p < 0.00$
Dwelling size (in square meters)	107.31 (44.18)	16	260	371	98.29 (45.94)	$p < 0.00$
Household size (count)	2.54 (2.54)	1	6	379	1.98 (1.10)	$p < 0.00$

Simple Model of Technology Adoption

- Consumers decide on two margins.
- 1) Extensive margin: choose to use technology $j \in \{App, Outside\}$.
- 2) Intensive margin: choose goal g_j (if available) and effort e_j to affect energy consumption x .
- Effort induces a draw from $H(x|e)$.
- Goal setting treatment $G \in \{0, 1\}$ causes utility $B(\phi, x, g_j)$.

The **optimal intensive margin choices** are given by

$$(e_j^*, g_j^*) = \arg \max_{e_j, g_j} \{\mathbb{E}[U(x, c_j) + B(\phi, x, g_j)G_j | e_j]\}. \quad (1)$$

The **optimal extensive margin choice** is to choose $j = App$ if and only if

$$\epsilon \geq u. \quad (2)$$

Proposition

If the effect of the goal setting prompt on energy consumption is negligible, then willingness-to-pay for the nudge is given by

$$\phi \approx \underbrace{\frac{\Delta_G D}{\Delta_s D}}_{\text{ratio of treatment effects on extensive margin}} \underbrace{\mathbb{E}[(r - x) | e_a^*, r_a \geq x] \pi_a \Delta s_a}_{\text{first-order cost savings on intensive margin due to subsidy}} \quad (3)$$

The effect of the nudge on consumer surplus is then:

$$CS(G = 1) - CS(G = 0) \approx \frac{\Delta_G D}{\Delta_s D} \mathbb{E}[(r - x) | e_a, r \geq x] \pi \Delta s \left(D + \frac{\Delta_G D}{2} \right) \quad (4)$$

Welfare Effects

Willingness-to-pay for Nudge (in EUR)	Effect on Consumer Welfare (in EUR per consumer)
−7.41	−4.32

- For social welfare we would even need to subtract nudge provision costs

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What would an event study have concluded?

	(1) Log(kWh)	(2) Log(kWh)
Event	-0.095** (0.039)	-0.071** (0.030)
Savings Subsidy	-0.050 (0.062)	
Period-4 consumption included	Yes	No
N	872	751

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