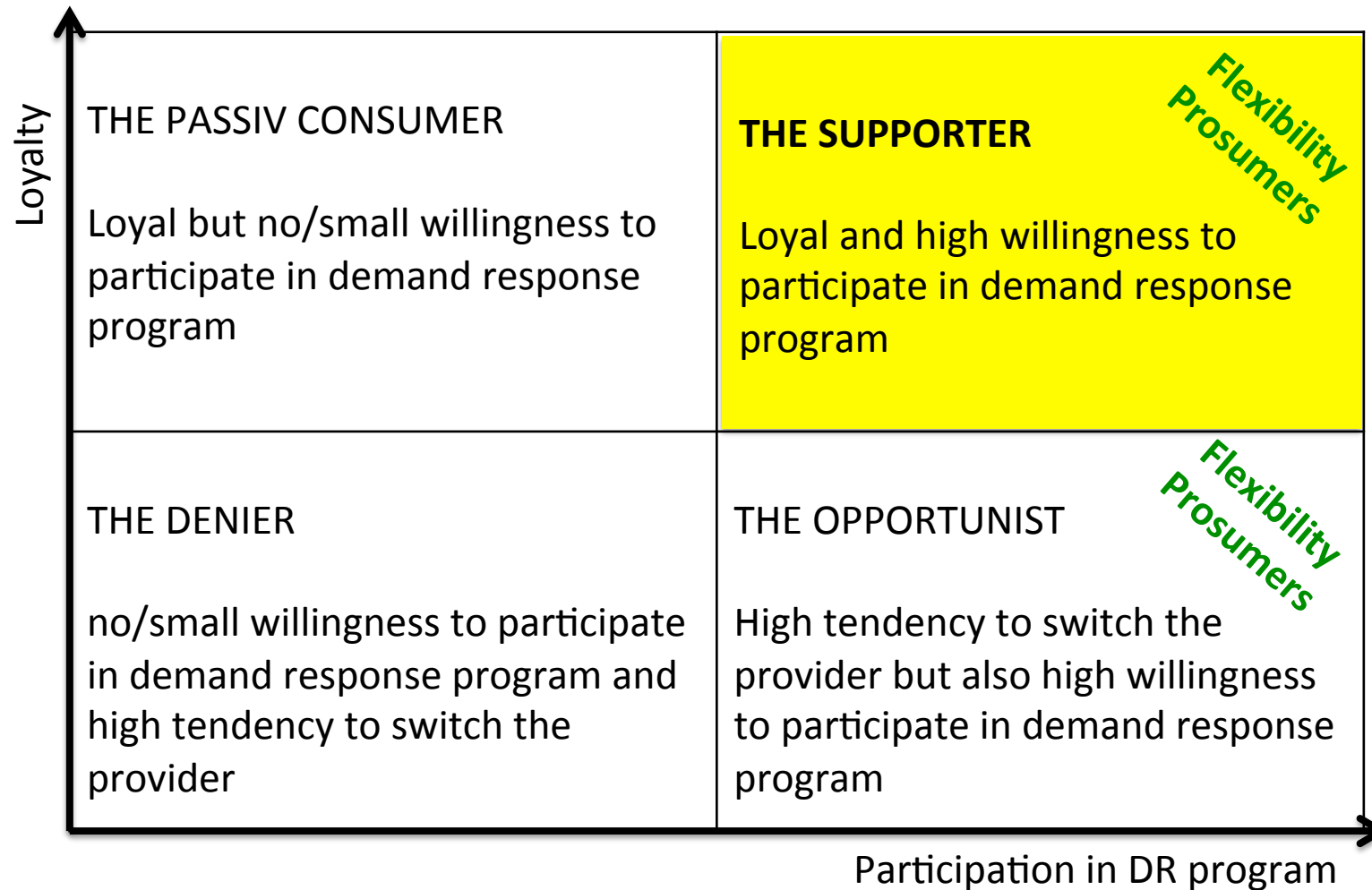


Paying for flexibility

Increasing customer participation in demand response programs through rewards and punishments

Karoline Gamma (co-authors: Moritz Loock and Claudio Cometta)

Goal of this research - Increasing participation without jeopardizing loyalty



Two ways of understanding “Paying for Flexibility”



PAYING FOR FLEXIBILITY

=

Paying customers because they
provide flexibility to the grid

**„ ...demand response is to be
understood as voluntary changes by
end-consumers of their usual electricity
use patterns - in response to market
signals (such as time-variable electricity
prices or incentive payments)“** [http://](http://ec.europa.eu/energy/gas_electricity/doc/com_2013_public_intervention_swd07_en.pdf)

[ec.europa.eu/energy/gas_electricity/doc/
com_2013_public_intervention_swd07_en.pdf](http://ec.europa.eu/energy/gas_electricity/doc/com_2013_public_intervention_swd07_en.pdf)

PAYING FOR FLEXIBILITY

=

Customers pay for being able
(flexible) to consume energy
whenever and wherever they
want



Research Questions

- (1) Are rewards and punishments effective market instruments to increase customer acceptance of demand response programs? Should rewards be preferred over punishments?*
- (2) How does one have to design and frame punishments in order to mitigate potential negative side effects?*

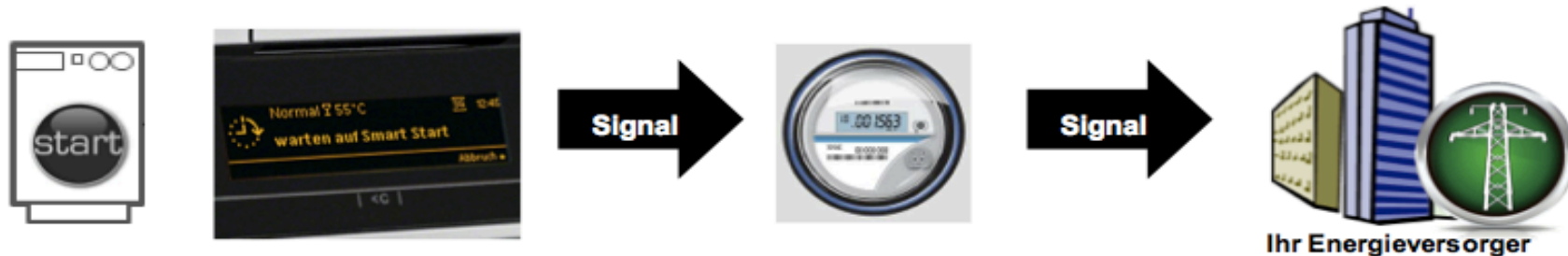


The effect of reward vs. punishments on costs



Automated DR program for shiftable load

1. You start your dishwasher which sends a signal over the smart meter to the energy provider.



2. The energy provider sends a signal over the smart meter to the dishwasher in order to automatically start it – depending on whether there is enough renewable energy available in the grid.

a) more electricity available than needed



b) less electricity available than needed



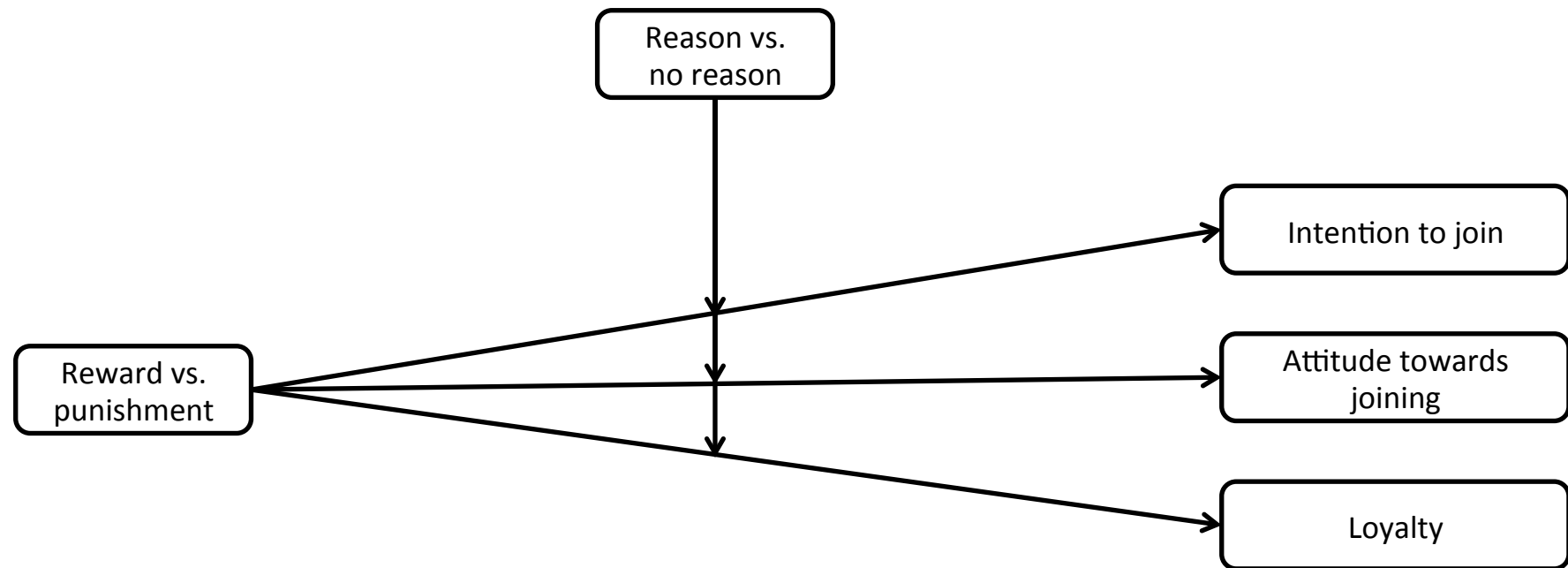
3. Your dishes will be clean after 8 hours latest

8 hours →



You can prevent the automatic steering and start the washing program immediately by pushing a button on a mobile app, on an online portal or by pushing a button on the dishwasher.

Research Model



Collective interest

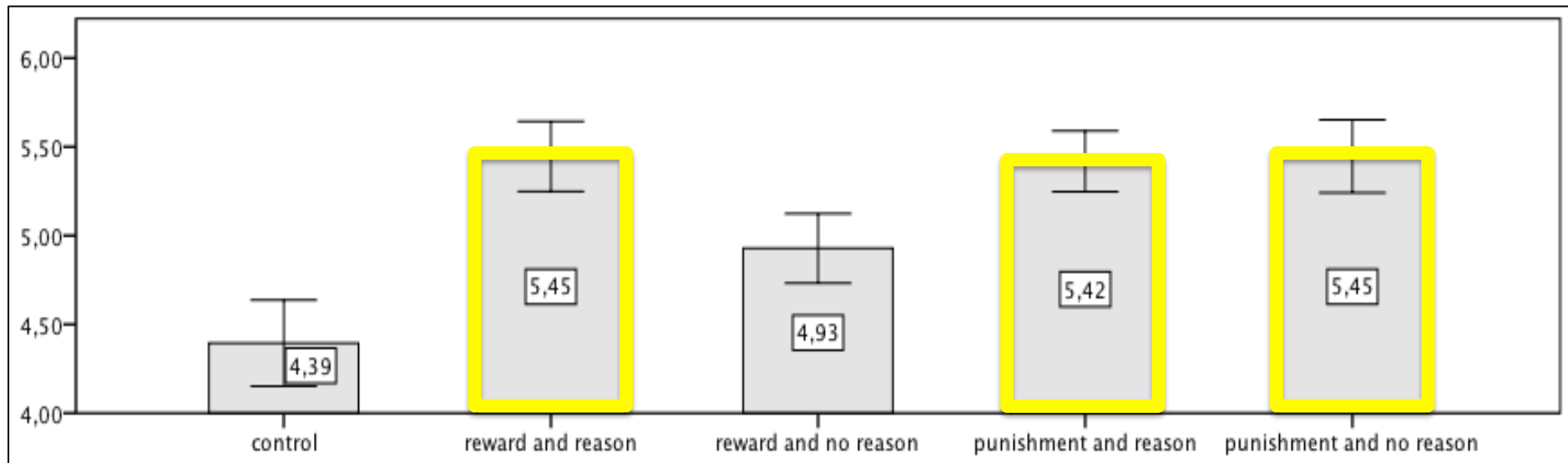
Self-interest

Signaling effect

concerns

Punishments always increase intention to join the DR program but rewards only do so when they are accompanied by a reason

7-point Likert scale



N=254

one-way MANOVA effect, Wilks' Lambda = .842, $F_{(12,654)} = 4.35$, $p < .001$, $\eta_p^2 = .056$

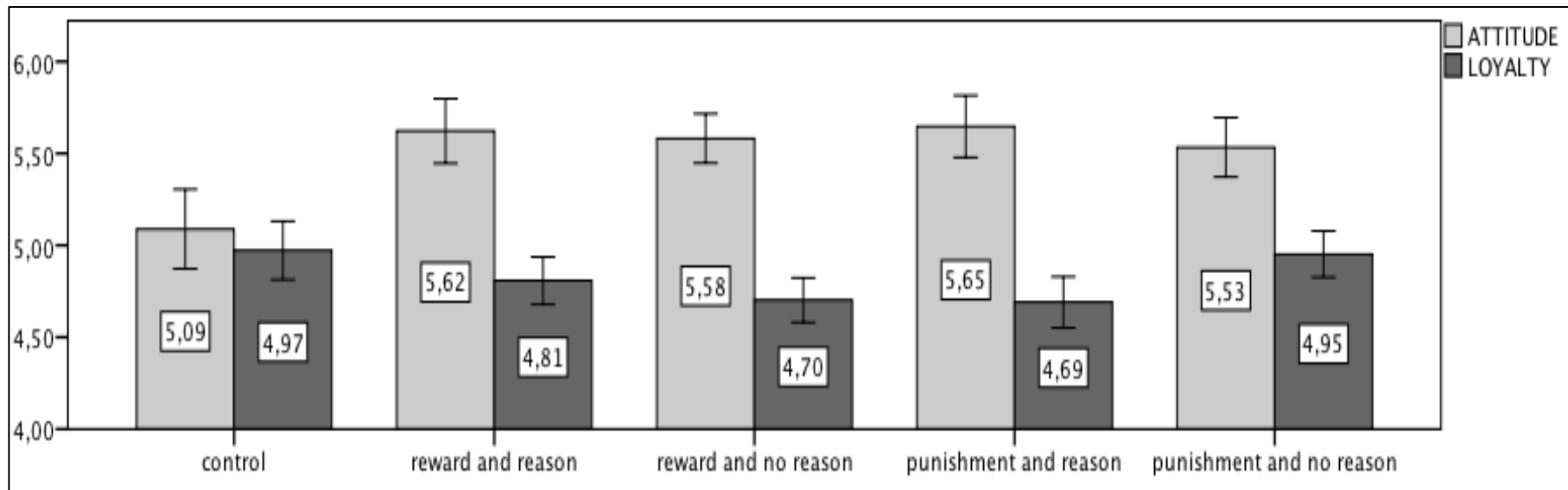
one-way ANOVA significant effect for intention to join, $F_{(4,249)} = 5.14$, $p = .001$, $\eta_p^2 = .076$

post-hoc: Bonferroni significant difference to control group

- reward with reason (M=5.45), $p = .003$
- punishment with reason (M=5.42), $p = .005$
- punishment without reason (M=5.45), $p = .004$

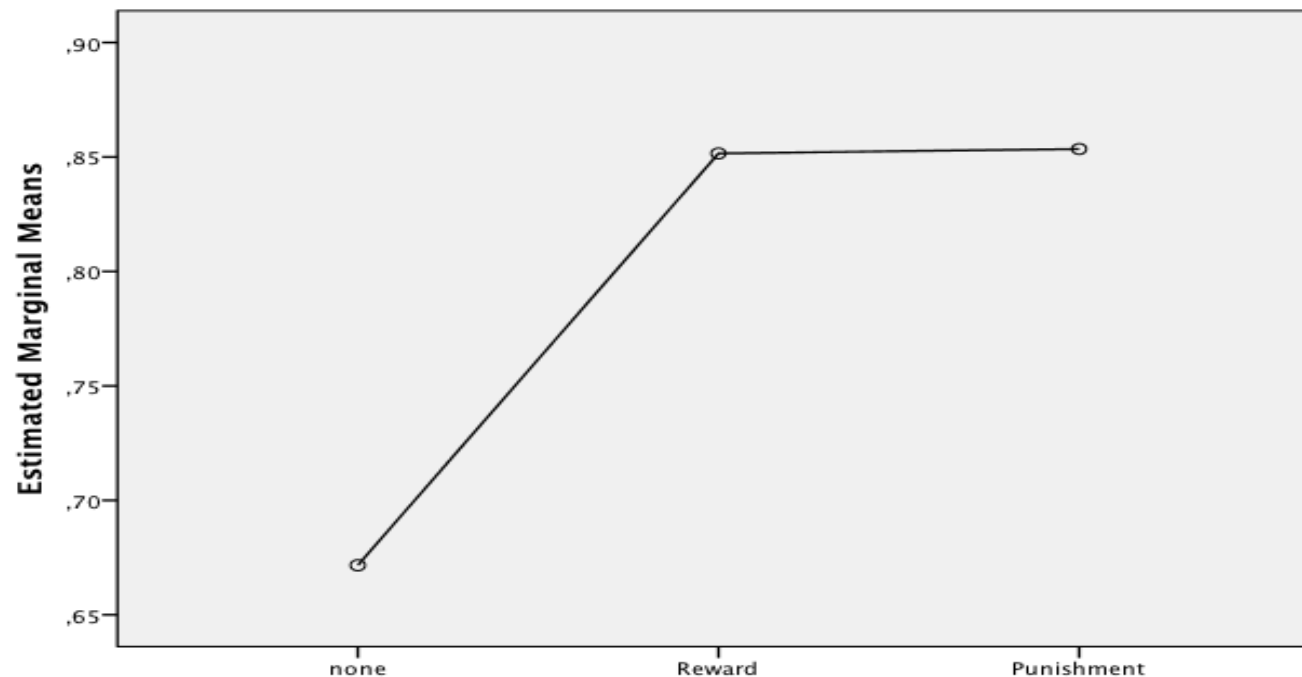
No effect on attitude and loyalty

7-point Likert scale



Punishment and Rewards are effective to reduce discrepancy between self- and collective interest

Estimated Marginal Means of Self-Interest/Collective Interest



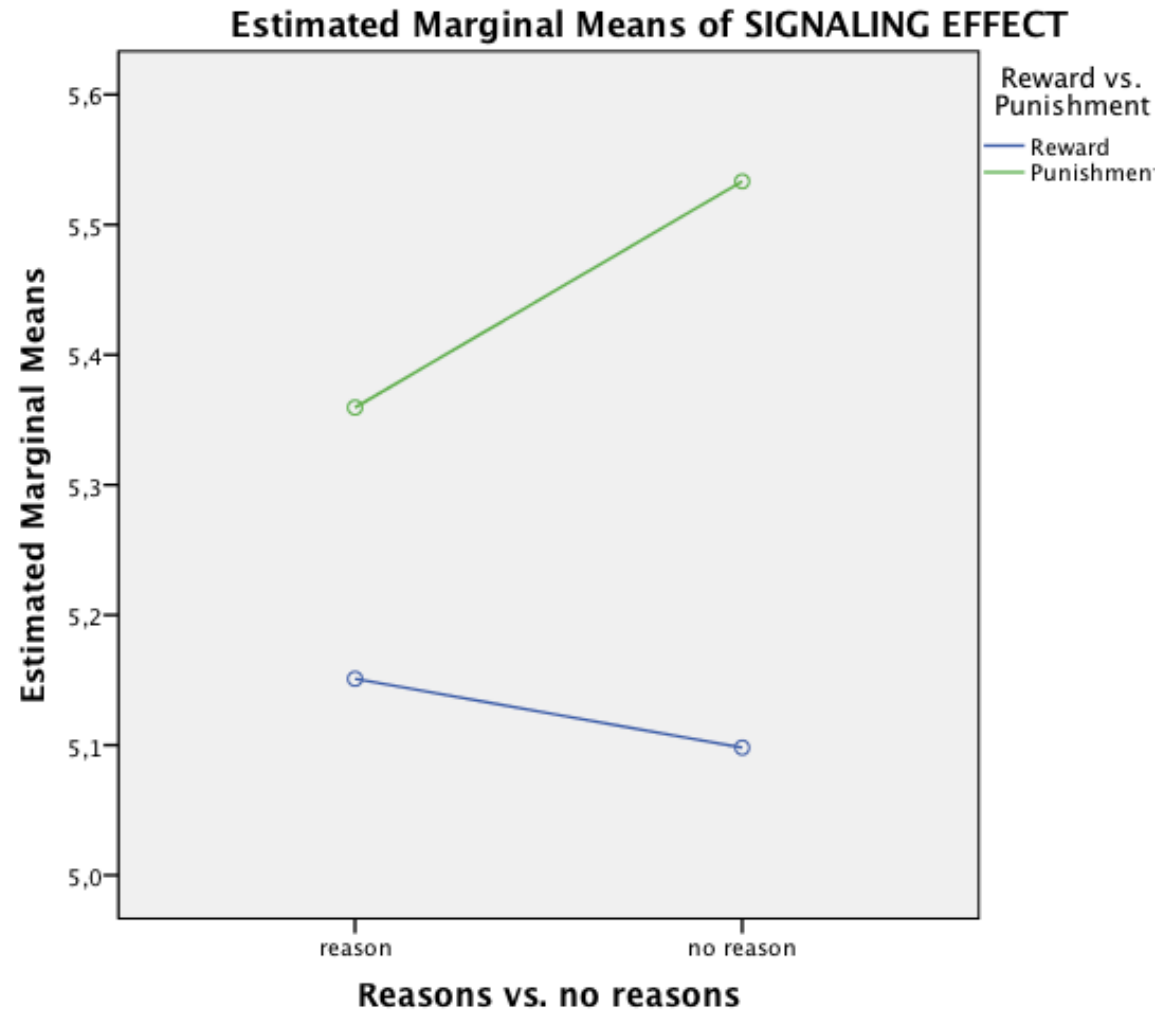
Dependent Variable: Ratio Interest Self Interest divided by collective interest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power ^b
Corrected Model	1,294 ^a	2	,647	7,163	,001	,054	14,326	,931
Intercept	141,487	1	141,487	1566,614	,000	,862	1566,614	1,000
Reward_punishment	1,294	2	,647	7,163	,001	,054	14,326	,931
Error	22,669	251	,090					
Total	193,765	254						
Corrected Total	23,963	253						

a. R Squared = ,054 (Adjusted R Squared = ,046)

Punishments rather than rewards due to signaling effect

7-point Likert scale

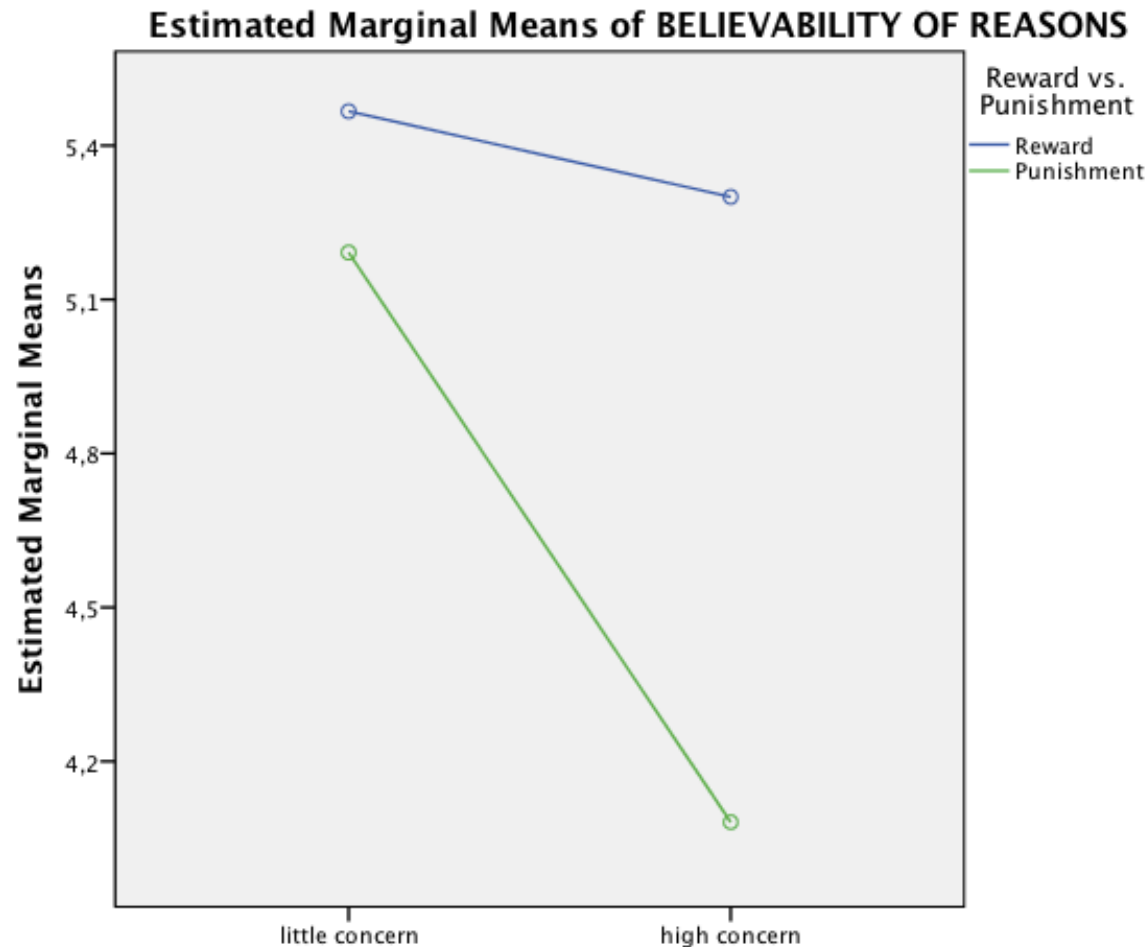


Anova: Significant main effect of rewards vs. punishments $F(1, 201) = 3.898, p = .05, \eta_p^2 = .019$



Believability of reasons for a reward is not influenced by concern. Believing in the reasons for punishments depends however on whether customers have little or high concerns!

7-point Likert scale



Significant main effect of rewards vs. punishments $F(1, 100) = 12.276.898$, $p = .001$, $\eta_p^2 = .109$

Significant main effect of rewards vs. punishments $F(1, 100) = 8.972$, $p = .003$, $\eta_p^2 = .082$

Significant main effect of rewards vs. punishments $F(1, 100) = 4.899$, $p = .029$, $\eta_p^2 = .047$

Optimizing reasons in the punishment conditions

7-point Likert scale

N=159

one-way MANOVA effect

Wilks' Lambda = .881, $F_{(6,308)}=3.37$, $p=.003$, $\eta_p^2=.062$

one-way ANOVA

- on Attitude, $F_{(2,156)}=3.02$, $p=.052$, $\eta_p^2=.037$

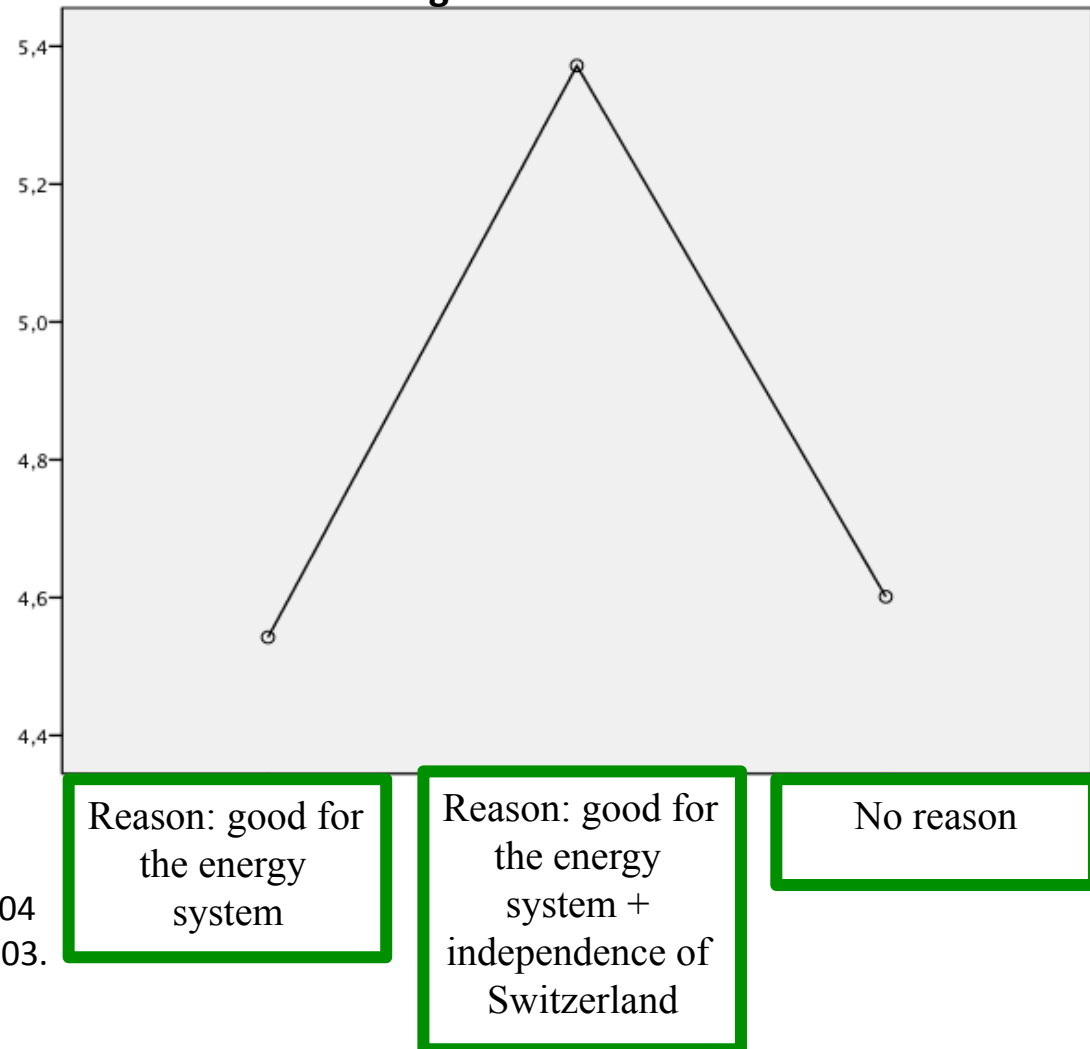
- on loyalty, $F_{(2,156)}=2.64$, $p=.075$, $\eta_p^2=.033$

Post hoc (Fisher's LSD) for Attitude

- new reason (M=5.37) vs. no reason (M=4.60), $p=.04$

- New reason (M 5.37) vs. old reason (M=4.54), $p=.03$.

Estimated Marginal Means of ATTITUDE



Conclusion

- Punishment & rewards are effective in increasing participation in a DR program, however for rewards that holds only true if they are accompanied with a reason.
- Thus, practitioners aiming at rewarding customers for participation in a DR program should make sure that the customers are provided with a clear reason for the reward, otherwise the reward may fail to have the intended effect.
- Further, practitioners and policy makers should reevaluate the use of punishment and should not to be afraid of environmental fines in the consumer context because punishments are effective in increasing participation without jeopardizing customer loyalty or provoking a negative attitude.
- As demand side management based on punishment is also less costly than based on rewards, it further appears that less investment can actually lead to higher value creation with customers

Backup Slides

Stimuli – Study 1

A1. Reward / no reason If you join the FLEX program and let your devices automatically be controlled by the signal of your energy provider, you will be rewarded with a discount of 50 CHF per month on your electricity bill.

A2. Punishment / no reason If you join the FLEX program and let your devices automatically be controlled by the signal of your energy provider, you **will not** be charged with an additional fee of 50 CHF per month on your electricity bill.

A3. Reward / reason If you join the FLEX program and let your devices automatically be controlled by the signal of your energy provider, you will be rewarded with a discount of 50 CHF per month on your electricity bill.

Your utility provides this reward for customers joining the FLEX program due to the following reasons:

While bringing about the Energiewende, your utility also wants to guarantee that energy prizes do not rise, so that energy is affordable for all, even poor, households. Customers' participation in the FLEX program can achieve this. Customers participating will be rewarded because they help to guarantee stable and low energy prizes.

Further, due to customers' participation in the FLEX program, there will be fewer costs related to grid enforcement and provision of storage capacity. Both of which are necessary for a better integration of renewable energies. Additionally, the energy provided in the region can be used efficiently and thus your utility will not be forced to buy additional energy for high prizes in the energy market. Your utility wants to make sure that the resulting savings are fairly distributed among their customers. Thus, receiving a share of the savings through the discount on their bill will reward customers who participate in the FLEX program. Customers who do not participate will not receive this reward because they do not contribute to achieve this savings.

Stimuli – Study 1

A4. Punishment / reason If you join the FLEX program and let your devices automatically be controlled by the signal of your energy provider, you will not be charged with an additional fee of 50 CHF per month on your electricity bill.

Your utility imposes this fee to customers who do not join the FLEX program due to the following reasons:

While bringing about the Energiewende, your utility also wants to guarantee that energy prizes do not rise, so that energy is affordable for all, even poor, households. Customers' participation in the FLEX program can achieve this. Customers not participating will be charged an extra fine because otherwise stable and low energy prizes cannot be guaranteed.

Further, due to customers' refusal of participation in the FLEX program there will be higher costs related to grid enforcement and provision of storage capacity. Both of which are necessary for a better integration of renewable energies. Additionally, it might not be possible to use the energy provided in the region in an efficient manner and thus your utility will be forced to buy additional energy for high prizes in the energy market. Your utility wants to make sure that the resulting higher costs will be distributed fairly among their customers. Thus, customers who do not participate in the FLEX program will be charged the extra fee on their bill. Customers who do participate will not be charged because they do not contribute to these higher costs.

DV – Intention to join

How likely are you to join the FLEX-Program?

	1	2	3	4	5	6	7	
highly unlikely	☐	☐	☐	☐	☐	☐	☐	highly likely

How inclined are you to join the FLEX-Program?

	1	2	3	4	5	6	7	
not very inclined	☐	☐	☐	☐	☐	☐	☐	very inclined

How willing are you to join the FLEX-Program?

	1	2	3	4	5	6	7	
very unwilling	☐	☐	☐	☐	☐	☐	☐	very willing

DV - loyalty

To what extent do you agree with the following statements when thinking about the launch of the FLEX-Program by your electricity supplier in a liberalized energy market?

I will be a customer of my energy provider in the future.

	1	2	3	4	5	6	7	
<u>not</u> at all	☐	☐	☐	☐	☐	☐	☐	<u>very</u> much

The chances of me staying with my energy provider are very high.

	1	2	3	4	5	6	7	
<u>not</u> at all	☐	☐	☐	☐	☐	☐	☐	<u>very</u> much

The probability that I will try other energy services and products from my energy provider is very high.

	1	2	3	4	5	6	7	
<u>not</u> at all	☐	☐	☐	☐	☐	☐	☐	<u>very</u> much

If someone asks me, I will speak positively of my energy provider.

	1	2	3	4	5	6	7	
<u>not</u> at all	☐	☐	☐	☐	☐	☐	☐	<u>very</u> much

I would recommend my energy provider to a friend.

	1	2	3	4	5	6	7	
<u>not</u> at all	☐	☐	☐	☐	☐	☐	☐	<u>very</u> much