Synergies of interventions to promote pro-environmental behaviours

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A meta-analysis of experimental studies

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1 Conceptual Framework

Table 1: Interventions analyzed in the meta-analysis

Domains	Intervention		Explanation	Mechanism	Source
Standard economic domain	Monetary Incentives	Subsidy	They are directed to support an economic agent through a)Market price support, b)cost-reducing payments, and c)payments for explicit environmental purpose. We focus on the latter, i.e., conditional subsidies, which are only issued in return for a certain behaviour.	By providing additional payments for a certain behaviour, subsidies increase the marginal benefits of inclining in this behaviour and thereby increase the occurrence of this behaviour.	Myers (1998), OECD (2003)
		Tax	Single-rate levies differentiated by commodity (at times by type of enterprise). Turnover taxes are used as a mechanism to regulate prices and to support the allocation of resources. In the case of taxation of environmental behaviour, taxes are used to reduce the consumption of goods with relatively large negative externalities.	By issuing a levy on a certain behaviour, e.g., consumption of a good, taxes increase the marginal costs of inclining in this behaviour and thereby reduce the occurrence of this behaviour.	Myrick Freeman III (1984), Martinez-Vazquez and McNab (1999)
Behavioral economic domain	Nudges	Norm	Provision of either descriptive norm, injunctive norm or both. Descriptive norm provides information about the behaviour of others. The injuctive norm provides information about what ought to be done in this situation.	1) desire for success relative to other people 2) people care about their status and relative consumption ("conspicuous conservation") 3) inform people of the societal norm and induce compliance with this norm	Carlsson et al. 2021
		Feedback	Individuals receive information about their past performance	Can influence behavior since it provides information about some given performance that people have undertaken. Increases attention to own performance and might thereby enhance it.	Zhou and Yang (2016)

		Observe	Behavior is observable to at least one other person	1)Induces social pressure 2) people care about their status (“conspicuous conservation”) to gain social recognition	Carlsson et al. 2021
		Communic.	Exchange of information within groups is allowed	1)Coordination 2) social pressure to act in common interest	Brandts et al. (2018)
		Prime	Actively prompting subjects to think about specific concepts or recollect past experiences	Priming refers to the activation of mental concepts through subtle situational cues which have a possible influence on behavior	Cohn and Maréchal 2016
		Goal	prompt individuals to set a goal or make a commitment to undertake a proenvironmental behavior in the future.	most individuals gain utility from following through with their plans and promises	Carlsson et al. 2021
		Information	Provision of information regarding a certain aspect of the decision	Brings attention to certain aspects of a decision and thereby alleviates inattention bias	Carlsson et al. 2021
		Reminder	A notification that reminds individuals on acting upon a certain behavior	1) enhance attention to a decision and thereby reduce forgetfulness. 2) can impose a moral cost if no action is taken	Carlsson et al. 2021
		Default	Pre-selecting the pro-environmental option	A default exploits the tendency of people to remain with an alternative which is already pre-selected, even when the cost of making their own active choice is very small.	Carlsson et al. 2021
		Motivational Intervention	Empathic appeal to incline in a pro-environmental behavior	Increases the motivation to engage in a certain behavior for the sake of the behavior itself or the positive effect it has on others	Carlsson et al. 2021, Czap et al. 2015
	Boosts	Boost	interventions that target competences of individuals	Enlist human cognition, the environment, or both. Aims at permanently change the cognitive and behavioural repertoire by adding a new competence or enhancing an existing one, creating a “capital stock” that can be engaged at will and across situations.	Grüne-Yanoff and Hertwig 2016

2 Meta-analysis criteria

Table 2: Criteria of studies to be included in the meta analysis according to the PICOS framework

PICOS Element	Inclusion Criterion	Exclusion Criterion
Population	Human sample	No human target population (n = 0)
Interventions	Minimum of two interventions from different clusters of interventions. Three clusters established (material incentives, consequential sanctions, behavioural economic interventions)	Fractional factorial design: no control / unusable singe intervention(n = 6)
Comparator	Control (i.e. absence of intervention), comparison treatment 1 (i.e. at least two single intervention), comparison treatment 2 (i.e. joint appliance of the two single interventions)	Fractional factorial design: no policy mix treatment (n = 17)
Outcomes	Synergetic effect of two different interventions on environmental outcome. The two intervention treatments must be commonly applied in an additional treatment.	Non-environmental outcome (4)
Experimental approach	Experiment, RCT	No experimental method (n = 9)
Language	English, German, French, Spanish	Other language (0)
Publication Type/Status	Published and unpublished empirical articles, conference papers, dissertations, and master theses	Other publication type (0)
Full Text	Available online or 6 weeks after request to authors	Study not available (n = 3)
Sufficient Reporting	Statistical information available or six weeks after request to authors	Insufficient data reporting (n = 9)

3 Literature search

Table 3: Search Terms for libraries, Web of Science

PICOS Elements		Search Terms
Population		
Interventions	1	TS=((("price*based*" OR "incent*" OR "mone*induce*" OR "reward*") AND ("price*based*" OR "sanction*" OR "penal*" OR "tax" OR "taxes" OR "charg*" OR "surcharg*" OR "punish*")) OR (("price*based*" OR "incent*" OR "mone*induce*" OR "reward*") AND ("nudg*"OR "choice architect*" OR "label*" OR "priming*" OR "prime*" OR "prompt*" OR "remind*" OR "feedback" OR "feed-back" OR "default*" OR "commit*" OR "boost*" OR "norm*" OR "intrins*incent*" OR "tailored*information*" OR "information*intervene*" OR "tailored*recommendation*" OR "recommendation*interv*" OR "prais*" OR "non-monetary*")) OR (("price*based*" OR "sanction*" OR "penal*" OR "tax" OR "taxes" OR "charg*" OR "surcharg*" OR "punish*") AND ("nudg*"OR "choice architect*" OR "label*" OR "priming*" OR "prime*" OR "prompt*" OR "remind*" OR "feedback" OR "feed-back" OR "default*" OR "commit*" OR "boost*" OR "norm*" OR "intrins*incent*" OR "tailored*information*" OR "information*intervene*" OR "tailored*recommendation*" OR "recommendation*interv*" OR "prais*" OR "non-monetary*")))
Study design	2	AND TS=("experiment*" OR "RCT" OR "controlled*trial")
Comparator		
Outcome	3	AND TS=("joint*" OR "interaction*" OR "mutual*" OR "combin*" OR "synerg*" OR "mix*" OR "common*" OR "together*" OR "unit*" OR "both" OR "adhere*" OR "bundle*" OR "addi*")
	4	AND TS=("pro-environment*" OR "proenvironment*" OR "sustainab*" OR "unsustainab*" OR "nonsustainab*" OR "non-sustainab*" OR "eco*" OR "environment*" OR "climate" OR "energy" OR "electric*" OR "renewable*" OR "water" OR "recycl*" OR "car" OR "cars" OR "bus" OR "car-shar*" OR "carshar*" OR "car-pool*" OR "carpool*" OR "public transport*" OR "bicycle*" OR "cycle" OR "cycling" OR "temperature" OR "conserv*" OR "preserve" OR "preserving" OR "pre-serve" OR "pre-serving" OR "donat*" OR "volunteer*" OR "litter*" OR "organic food" OR "vegan" OR "vegetarian" OR "meat" OR ("green*" NEAR/2 ("product*" OR "consum*" OR "purchas*" OR "buy*" OR "power" OR "behavio*" OR "attitud*" OR "intention*")) OR "insulat*" OR "solar" OR "wind power" OR "buying used" OR "second hand" OR "second-hand" OR "buying pre-owned" OR "reus*" OR "re-us*" OR "emission*" OR "carbon*" OR "single-use" OR "disposable*" OR "compost*" OR "travel*" OR "airplane*" OR "plane*" OR "turn-off" OR "turnoff" OR "switch-off" OR "pollut*" OR "CO2")

Note: The search terms to target environmental studies (Outcome, 4) were adopted from Geiger et al. 2021.

Table 4: Search Terms for libraries, Scopus

PICOS Elements		Search Terms
Population		
Interventions	1	TITLE-ABS-KEY (((“price*based*” OR “incent*” OR “mone*induce*” OR ”reward*”) AND (“price*instrum*” OR ”sanction*” OR ”penal*” OR ”tax” OR ”taxes” OR ”charg*” OR ”surcharg*” OR ”punish*”)) OR ((“price*based*” OR “incent*” OR “mone*induce*” OR ”reward*”) AND (”nudg*”OR ”choice architect*” OR ”label*” OR ”priming*” OR “prime*” OR ”prompt*” OR ”remind*” OR ”feedback” OR ”feed-back” OR ”default*” OR ”commit*” OR “boost*” OR “norm*” OR “intrins*incent*” OR “tailored*information*” OR “information*intervene*” OR “tailored*recommendation*” OR “recommendation*interv*” OR “prais*” OR “non-monetary*”)) OR ((“price*instrum*” OR ”sanction*” OR ”penal*” OR ”tax” OR ”taxes” OR ”charg*” OR ”surcharg*” OR ”punish*”) AND (”nudg*”OR ”choice architect*” OR ”label*” OR ”priming*” OR “prime*” OR ”prompt*” OR ”remind*” OR ”feedback” OR ”feed-back” OR ”default*” OR ”commit*” OR “boost*” OR “norm*” OR “intrins*incent*” OR “tailored*information*” OR “information*intervene*” OR “tailored*recommendation*” OR “recommendation*interv*” OR “prais*” OR “non-monetary*”)))
Study design	2	AND TITLE-ABS-KEY (“experiment*” OR ”RCT” OR “controlled*trial”)
Comparator		
Outcome	3	AND TITLE-ABS-KEY (“joint*” OR “interaction*” OR “mutual*” OR “combin*” OR “synerg*” OR “mix*” OR “common*” OR “together*” OR “unit*” OR “both” OR “adhere*” OR “bundle*” OR “addi*”)
	4	AND TITLE-ABS-KEY (”pro-environment*” OR ”proenvironment*” OR ”sustainab*” OR ”unsustainab*” OR ”nonsustainab*” OR ”non-sustainab*” OR ”eco*” OR ”environment*” OR ”climate” OR ”energy” OR ”electric*” OR ”renewable*” OR ”water” OR ”recycl*” OR ”car” OR ”cars” OR ”bus” OR ”car-shar*” OR ”carshar*” OR ”car-pool*” OR ”carpool*” OR ”public transport*” OR ”bicycle*” OR ”cycle” OR ”cycling” OR ”temperature” OR ”conserv*” OR ”preserve” OR ”preserving” OR ”pre-serve” OR ”pre-serving” OR ”donat*” OR ”volunteer*” OR ”litter*” OR ”organic food” OR ”vegan” OR ”vegetarian” OR ”meat” OR (”green*” NEAR/2 (”product*” OR ”consum*” OR ”purchas*” OR ”buy*” OR ”power” OR ”behavio*” OR ”attitud*” OR ”intention*”)) OR ”insulat*” OR ”solar” OR ”wind power” OR ”buying used” OR ”second hand” OR ”secondhand” OR ”buying pre-owned” OR ”reus*” OR ”reus*” OR ”emission*” OR ”carbon*” OR ”single-use” OR ”disposable*” OR ”compost*” OR ”travel*” OR ”airplane*” OR ”plane*” OR ”turn-off” OR ”turnoff” OR ”switch-off” OR “pollut*” OR “CO2”)

Note: The search terms to target environmental studies (Outcome, 4) were adopted from Geiger et al. 2021.

Table 5: Additional Searches

Platform	Description
Google Scholar	Full-text search limited to the first 300 results ((incentive AND nudge) OR (punishment and nudge) OR (punishment AND incentive) OR (incentive AND boost) OR (nudge AND boost)) AND (pro-environmental OR sustainable OR green OR climate OR energy) AND experiment
Reference lists	Relevant literature reviews and meta-analysis (Geiger et al. 2021; Buckley 2020)
Scientific community	Through spreading the word on the conceptualization of the meta-analysis and presentations on conferences and seminars, we received additional relevant literature from other scientists.

4 Studies included in the meta-analysis

Panzone, L. A., Ulph, A., Hilton, D., Gortemaker, I., and Tajudeen, I. A. (2021a). Sustainable by design: Choice architecture and the carbon footprint of grocery shopping. *Journal of Public Policy & Marketing*, 40(4):463–486

Schall, D. L., Wolf, M., and Mohnen, A. (2016). Do effects of theoretical training and rewards for energy-efficient behavior persist over time and interact? A natural field experiment on eco-driving in a company fleet. *Energy Policy*, 97:291–300

McConky, K., Chen, R. B., and Gavi, G. R. (2018). A comparison of motivational and informational contexts for improving eco-driving performance. *Transportation Research Part F: Traffic Psychology and Behaviour*, 52:62–74

Panzone, L. A., Ulph, A., Zizzo, D. J., Hilton, D., and Clear, A. (2021b). The impact of environmental recall and carbon taxation on the carbon footprint of supermarket shopping. *Journal of Environmental Economics and Management*, 109:102137

Soregaroli, C., Ricci, E. C., Stranieri, S., Nayga Jr, R. M., Capri, E., and Castellari, E. (2021). Carbon footprint information, prices, and restaurant wine choices by customers: A natural field experiment. *Ecological Economics*, 186:107061

Osman, M., Schwartz, P., and Wodak, S. (2021). Sustainable consumption: what works best, carbon taxes, subsidies and/or nudges? *Basic and Applied Social Psychology*, 43(3):169–194

Fanghella, V., Ploner, M., and Tavoni, M. (2021). Energy saving in a simulated environment: An online experiment of the interplay between nudges and financial incentives. *Journal of Behavioral and Experimental Economics*, 93:101709

Pellerano, J. A., Price, M. K., Puller, S. L., and Sánchez, G. E. (2017). Do extrinsic incentives

undermine social norms? evidence from a field experiment in energy conservation. *Environmental and Resource Economics*, 67(3):413–428

Mizobuchi, K. and Takeuchi, K. (2013). The influences of financial and non-financial factors on energy-saving behaviour: A field experiment in japan. *Energy Policy*, 63:775–787

Sudarshan, A. (2017). Nudges in the marketplace: The response of household electricity consumption to information and monetary incentives. *Journal of Economic Behavior & Organization*, 134:320–335

Czap, N. V., Czap, H. J., Khachaturyan, M., Burbach, M. E., et al. (2018). Comparing female and male response to financial incentives and empathy nudging in an environmental context. *Review of Behavioral Economics*, 5(1):61–84

Máca, V., Ščasnỳ, M., Zvěřinová, I., Jakob, M., and Hrnčíř, J. (2020). Incentivizing commuter cycling by financial and non-financial rewards. *International Journal of Environmental Research and Public Health*, 17(17):6033

Kerr, J., Bum, T., Lapinski, M., Liu, R., Lu, Z., and Zhao, J. (2019). The effects of social norms on motivation crowding: experimental evidence from the tibetan plateau. *International Journal of the Commons*, 13(1):430–454

Fanghella, V., d'Adda, G., and Tavoni, M. (2019). On the use of nudges to affect spillovers in environmental behaviors. *Frontiers in Psychology*, 10:61

Delmas, M. A. and Lessem, N. (2014). Saving power to conserve your reputation? the effectiveness of private versus public information. *Journal of Environmental Economics and Management*, 67(3):353–370

Fuster, A. and Meier, S. (2010). Another hidden cost of incentives: The detrimental effect on norm enforcement. *Management Science*, 56(1):57–70

Ferraro, P. J. and Miranda, J. J. (2013). Heterogeneous treatment effects and mechanisms in information-based environmental policies: Evidence from a large-scale field experiment. *Resource and Energy Economics*, 35(3):356–379

Hackel, J., Yamamoto, H., Okada, I., Goto, A., and Taudes, A. (2021). Asymmetric effects of social and economic incentives on cooperation in real effort based public goods games. *PLoS ONE*, 16(4):e0249217

Rosenfield, A., Attanucci, J. P., and Zhao, J. (2020). A randomized controlled trial in travel demand management. *Transportation*, 47(4):1907–1932

Figueroa, A., de Moliere, L., Pegels, A., Never, B., and Kutzner, F. (2019). Show me (more

than) the money! Assessing the social and psychological dimensions to energy efficient lighting in Kenya. *Energy Research & Social Science*, 47:224–232

Møller, N. F., Andersen, L. M., Hansen, L. G., and Jensen, C. L. (2019). Can pecuniary and environmental incentives via sms messaging make households adjust their electricity demand to a fluctuating production? *Energy Economics*, 80:1050–1058

Burtch, G., Hong, Y., Bapna, R., and Griskevicius, V. (2018). Stimulating online reviews by combining financial incentives and social norms. *Management Science*, 64(5):2065–2082

Schram, A. and Charness, G. (2015). Inducing social norms in laboratory allocation choices. *Management Science*, 61(7):1531–1546

Hoenink, J. C., Mackenbach, J. D., Waterlander, W., Lakerveld, J., van der Laan, N., and Beulens, J. W. (2020). The effects of nudging and pricing on healthy food purchasing behavior in a virtual supermarket setting: a randomized experiment. *International Journal of Behavioral Nutrition and Physical Activity*, 17(1):1–12

Peth, D., Mußhoff, O., Funke, K., and Hirschauer, N. (2018). Nudging farmers to comply with water protection rules–experimental evidence from germany. *Ecological Economics*, 152:310–321

Gächter, S. and Fehr, E. (1999). Collective action as a social exchange. *Journal of Economic Behavior & Organization*, 39(4):341–369

Chen, X.-P., Pillutla, M. M., and Yao, X. (2009). Unintended consequences of cooperation inducing and maintaining mechanisms in public goods dilemmas: Sanctions and moral appeals. *Group Processes & Intergroup Relations*, 12(2):241–255

Weng, Q. and Carlsson, F. (2015). Cooperation in teams: The role of identity, punishment, and endowment distribution. *Journal of Public Economics*, 126:25–38

Frederiks, E. R., Romanach, L. M., Berry, A., and Toscas, P. (2020). Making energy surveys more impactful: Testing material and non-monetary response strategies. *Energy Research & Social Science*, 63:101409

Wadehra, S. and Mishra, A. (2018). Encouraging urban households to segregate the waste they generate: Insights from a field experiment in Delhi, India. *Resources, Conservation and Recycling*, 134:239–247

Oda, R. and Ichihashi, R. (2016). Effects of eye images and norm cues on charitable donation: A field experiment in an izakaya. *Evolutionary Psychology*, 14(4):1474704916668874

Kawamura, Y. and Kusumi, T. (2017). The norm-dependent effect of watching eyes on donation.

Evolution and Human Behavior, 38(5):659–666

Hilton, D., Charalambides, L., Demarque, C., Waroquier, L., and Raux, C. (2014). A tax can nudge: The impact of an environmentally motivated bonus/malus fiscal system on transport preferences. *Journal of Economic Psychology*, 42:17–27

Riggs, W. (2017). Painting the fence: Social norms as economic incentives to non-automotive travel behavior. *Travel Behaviour and Society*, 7:26–33

Banerjee, S. (2022). *Choice Architecture 2.0 with Nudge Plus*. PhD Thesis, London School of Economics and Political Science, London

Bicchieri, C., Dimant, E., and Xiao, E. (2021). Deviant or wrong? the effects of norm information on the efficacy of punishment. *Journal of Economic Behavior & Organization*, 188:209–235

Vesely, S. and Klöckner, C. A. (2018). How anonymity and norms influence costly support for environmental causes. *Journal of Environmental Psychology*, 58:27–30

Vesely, S., Klöckner, C. A., Carrus, G., Chokrai, P., Fritsche, I., Masson, T., Panno, A., Tiberio, L., and Udall, A. M. (2022). Donations to renewable energy projects: The role of social norms and donor anonymity. *Ecological Economics*, 193:107277

Howley, P. and Ocean, N. (2022). Can nudging only get you so far? Testing for nudge combination effects. *European Review of Agricultural Economics*, 49(5):1086–1112

Rodemeier, M. and Löschel, A. (2020). The welfare effects of persuasion and taxation: Theory and evidence from the field

Betz, A.-K., Seger, B. T., and Nieding, G. (2022). How can carbon labels and climate-friendly default options on restaurant menus contribute to the reduction of greenhouse gas emissions associated with dining? *PLoS Climate*, 1(5):e0000028

Vellinga, R., Eykelenboom, M., Olthof, M., Steenhuis, I., de Jonge, R., and Temme, E. (2022). Less meat in the shopping basket. the effect on meat purchases of higher prices, an information nudge and the combination: a randomised controlled trial. *BMC Public Health*, 22(1):1137

Faccioli, M., Law, C., Caine, C. A., Berger, N., Yan, X., Weninger, F., Guell, C., Day, B., Smith, R. D., and Bateman, I. J. (2022). Combined carbon and health taxes outperform single-purpose information or fiscal measures in designing sustainable food policies. *Nature Food*, 3(5):331–340

Löschel, A., Rodemeier, M., and Werthschulte, M. (forthcoming). Can self-set goals encourage resource conservation? Field experimental evidence from a smartphone app. *European Economic Review*

5 Extracted information

Table 6: Coding of the extracted information from the articles

Extracted Information	Coding
Author	
Year	
Title	
Journal	
Country	
Publication status	0 = unpublished, 1 = published
Peer-reviewed	0 =not published in peer-reviewed journal, 1 = published in peer-reviewed journal
Mean age	
Gender distribution (female in %)	
Population counterparts of sample	0 = general population, 1 = university student, 2 = other, 3 = unspecified
Total sample size N	
Sample size n per treatment	
Effectiveness in single-intervention (on PEB)	0 = ineffective in single intervention, 1 = only one effective in single intervention, 2 = both effective in single interventions
Effectiveness in combined application (on PEB)	0 = ineffective in combined intervention, 1 = effective in combined interventions compared to one comparator, 2 = effective in combined interventions compared to both comparator
Spillover effect in single intervention	0 = no spillover effect in single intervention, 1 = only one spillover effect in single intervention, 2 = both single interventions lead to spillover effects
Spillover effect in combined application	0 = no spillover effect in combined intervention, 1 = spillover effect in combined interventions
Type1	0 = nudge, 1 = monetary incentive, 3 = other
Type2	0 = nudge, 1 = monetary incentive, 3 = other
Intervention domains	0 = across domain interventions, 1 = within traditional economic intervention domain, 2 = within behavioural economic intervention domain
Type of experiment	0 = laboratory experiment, 1 = online experiment, 2 = field experiment, 3 = combination, 4 = N/A
Comparator condition	0 = control, 1 = comparison1, 2 = comparison2, 3 = synergy comparison
Measurement of outcome	0 = hypothetical statement, 1 = self-reported behavior, 2 = revealed behavior, 3 = N/A
Direction of synergy effect	0 = backfiring, 1 = negative, 2 = no synergy effect, 3 = positive
Direction of synergic spillover effect	0 = amplifying, 1 = mixed, 2 = mitigating,
Visibility of outcome	0 = not visible, 1 = visible for other participants, 2 = publicly visible
Prevalence of behavior	0 = uncommon, 1 = rather common, 2 = common
Environmental Behavior	1 = Energy conservation, 2=Green consumption, 3=Pollution control, 4= Abstract task, 5=Donation to NGO, 6=Others
Study design	0 = no experiment, 1 = experiment, 2 = N/A
Full factorial design	0=no, 1=yes
General quality/fit of study	0=high : 9=very low
Reason for quality	
Quality indicator 1: Low sample size (n¡30)	0=no, 1=yes
Quality indicator 2: No clear baseline treatment	0=no, 1=yes

Quality indicator 3: No clean intervention treatments	0=no, 1=yes
Quality indicator 4: other interfering treatments	0=no, 1=yes
Quality indicator 5: no clean laboratory/ field conditions	0=no, 1=yes
Quality indicator 6: hypothetical answer	0=no, 1=yes
Quality indicator 7: Behavior only remotely related to environment	0=no, 1=yes
Quality indicator 8: No statistical sound analysis	0=no, 1=yes
Quality indicator 9: within treatment	0=no, 1=yes
Description Design	
Treatment separation	Within-subject treat rand. = 0, between subj. Treat rand. = 1, Between and within =2
Dependent variable	
Treatments	

Effect sizes:

Cohen's d, Synergy T1 vs T12
Cohen's d, Synergy T1 vs T12_CIL
Cohen's d, Synergy T1 vs T12_CIH
Cohen's d, Synergy T2 vs T12
Cohen's d, Synergy T2 vs T12_CIL
Cohen's d, Synergy T2 vs T12CIH
Cohen's d, Synergy C vs. T12
Cohen's d, Synergy C vs. T12_CIL
Cohen's d, Synergy C vs. T12_CHI
Cohen's d, T1
Cohen's d, T1_CIL
Cohen's d, T1_CIH
Cohen's d, T2
Cohen's d, T2_CIL
Cohen's d, T2_CIH
Spillover comparison
Spillover:
Cohen's d, Synergy T1 vs T12
Spillover:
ohen's d, Synergy T1 vs T12_CIL
Spillover:
Cohen's d, Synergy T1 vs T12_CIH
Spillover:
Cohen's d, Synergy T2 vs T12
Spillover:
Cohen's d, Synergy T2 vs T13_CIL
Spillover:
Cohen's d, Synergy T2 vs T14CIH
Spillover:
Cohen's d, Synergy C vs. T12
Spillover:
Cohen's d, Synergy C vs. T12_CIL
Spillover:
Cohen's d, Synergy C vs. T12_CHI

Spillover:
Cohen's d, T1
Spillover:
Cohen's d, T1_CIL
Spillover:
Cohen's d, T1_CIH
Spillover:
Cohen's d, T2
Spillover:
Cohen's d, T2_CIL
Spillover:
Cohen's d, T2_CIH

Values extracted from articles:
SD or SE
Mean Control
Mean Control_SD
Mean/Effect T1
Mean/Effect T1_SD
Mean/Effect T2
Mean/Effect T2_SD
Mean/Effect T1+T2
Mean/Effect T1+T2_SD

Figure 1 provides a structured overview of the categories of information that was retrieved from the articles. The first dimensions deal with the nature of the interventions applied in the study. Since the studies contain at least two interventions, we distinguish between the intervention "Type 1" and "Type 2". Here, we allow for each intervention from the traditional or behavioral economic toolbox, excluding command and control policies. In the dimension "Domain", we distinguish whether the two interventions originate from the same family of interventions (either traditional or behavioral) or whether they come from different intervention families. This facilitates obtaining a notion of how similar the interventions are to each other and whether an appliance of two very different interventions is more effective than applying two rather similar ones. Concerning the setting, we distinguish the type of the experimental study, differentiating between a laboratory experiment, an online experiment, a field experiment, or a combination of those. In terms of synergy effects, we assess the measurement of pro-environmental behavior and how it has been elicited (hypothetical behavior, self-reported behavior, and incentivized behavior). Additionally, we retrieve the direction of the synergy effect and its magnitude. On the particular behavior which is investigated in the experiment, we collect the type of the pro-environmental behavior (e.g., recycling, car driving, energy conservation, etc.), its observability in the experiment, and the prevalence of the behavior within society. Regarding the method, basic sample characteristics were collected. These involve whether the sample contains the general population, university students, or another particular subgroup. In addition, information about the country of conduction of the study was retrieved.

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Figure 1: Morphological box of Included Articles

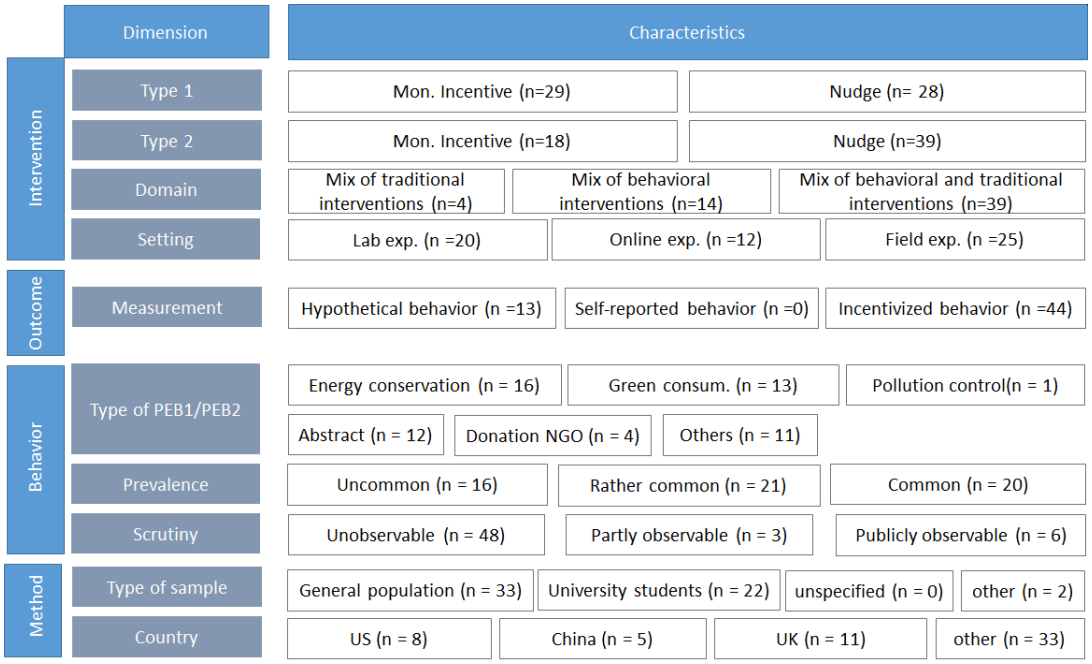


Table 7: Data included in the meta-analysis

Article		Intervention		Effect		Variables			
Author	**Publication status**	**Intervention 1**	**Intervention 2**	**Synergy effect**	**N**	**Prevalence of behavior**	**Scrutiny**	**Experiment**	**Sample**
Full factorial design									
Panzone et al. 2021	published	Nudge	Nudge	-0.61	185	very common	not-visible	Online	Student
Panzone et al. 2021(2)	published	Nudge	Mon.Inc.	-0.56	178	very common	not-visible	Online	Student
McConky et al. 2017	published	Mon.Inc.	Nudge	-0.81	24	rather common	visible	Lab	Student
Panzone et al. 2017	published	Nudge	Mon.Inc.	0.55	199	rather common	not-visible	Online	Student
Soregaroli et al. 2021	published	Nudge	Mon.Inc.	0.21	199	rather common	visible	Field	Non-student
Osman et al. 2021	published	Mon.Inc.	Nudge	-0.11	200	rather common	not-visible	Online	Non-student
Osman et al. 2021(2)	published	Mon.Inc.	Mon.Inc.	-0.15	393	rather common	not-visible	Online	Non-student
Fanghella et al. 2021	published	Mon.Inc.	Nudge	-0.09	566	rather common	not-visible	Online	Non-student
Czap et al. 2015	published	Mon.Inc.	Nudge	0.02	400	uncommen	not-visible	Lab	Student
Maca et al. 2020	published	Nudge	Mon.Inc.	0.08	320	very common	not-visible	Field	Non-student
Kerr et al. 2019	published	Mon.Inc.	Nudge	0.08	128	uncommen	visible for other partic.	Field	Non-student
Fanghella et al. 2019	published	Nudge	Nudge	0.09	397	uncommen	not-visible	Online	Non-student
Fuster et al. 2010	published	Mon.Inc.	Mon.Inc.	-0.07	348	uncommen	not-visible	Lab	Student
Hackel et al. 2021	published	Mon.Inc.	Nudge	-0.57	242	uncommen	not-visible	Online	Non-student
Rosenfield et al. 2020	published	Nudge	Mon.Inc.	0.03	1967	very common	visible	Field	Non-student
Figueroa et al. 2019	published	Nudge	Mon.Inc.	0.46	271	very common	visible for other partic.	Field	Non-student
Møller et al. 2019	published	Mon.Inc.	Nudge	-0.54	973	very common	not-visible	Field	Non-student
Møller et al. 2019(2)	published	Mon.Inc.	Nudge	-0.52	973	very common	not-visible	Field	Non-student
Møller et al. 2019(3)	published	Mon.Inc.	Nudge	-0.53	973	very common	not-visible	Field	Non-student
Møller et al. 2019(4)	published	Mon.Inc.	Nudge	-0.54	973	very common	not-visible	Field	Non-student
Møller et al. 2019(5)	published	Mon.Inc.	Nudge	-0.51	973	very common	not-visible	Field	Non-student
Møller et al. 2019(6)	published	Mon.Inc.	Nudge	-0.25	973	very common	not-visible	Field	Non-student
Burtch et al. 2015	published	Mon.Inc.	Nudge	-0.13	1600	rather common	visible	Field	Non-student
Schram et al. 2015	published	Nudge	Nudge	0.31	85	uncommen	visible	Lab	Student
Hoenink et al. 2020	published	Nudge	Mon.Inc.	-0.02	532	very common	not-visible	Lab	Non-student

Gächter et al. 1999	published	Nudge	Nudge	0.32	65	uncommen	not-visible	Lab	Student
Chen et al. 2009	published	Mon.Inc.	Mon.Inc.	-0.54	104	uncommen	not-visible	Lab	Student
Weng et al. 2015	published	Nudge	Mon.Inc.	0.64	240	uncommen	not-visible	Lab	Student
Weng et al. 2015(2)	published	Nudge	Mon.Inc.	-0.12	192	uncommen	not-visible	Lab	Student
Weng et al. 2015(3)	published	Nudge	Mon.Inc.	-0.45	240	uncommen	not-visible	Lab	Student
Frederiks et al. 2020	published	Mon.Inc.	Nudge	-0.14	3089	rather common	not-visible	Field	Non-student
Frederiks et al. 2020(2)	published	Mon.Inc.	Nudge	0.04	3096	rather common	not-visible	Field	Non-student
Frederiks et al. 2020(3)	published	Mon.Inc.	Nudge	0.00	3048	rather common	not-visible	Field	Non-student
Frederiks et al. 2020(4)	published	Mon.Inc.	Nudge	-0.18	3155	rather common	not-visible	Field	Non-student
Frederiks et al. 2020(5)	published	Mon.Inc.	Nudge	0.10	3121	rather common	not-visible	Field	Non-student
Frederiks et al. 2020(6)	published	Mon.Inc.	Nudge	-0.02	3078	rather common	not-visible	Field	Non-student
Frederiks et al. 2020(7)	published	Nudge	Nudge	-0.10	3122	rather common	not-visible	Field	Non-student
Frederiks et al. 2020(8)	published	Nudge	Nudge	-0.10	3086	rather common	not-visible	Field	Non-student
Frederiks et al. 2020(9)	published	Nudge	Nudge	-0.06	3028	rather common	not-visible	Field	Non-student
Kawamura et al. 2017	published	Nudge	Nudge	0.01	139	rather common	not-visible	Lab	Student
Hilton et al. 2014	published	Mon.Inc.	Nudge	0.19	434	very common	not-visible	Lab	Student
Hilton et al. 2014(2)	published	Mon.Inc.	Nudge	0.36	429	very common	not-visible	Lab	Student
Banerjee 2021	unpublished	Nudge	Nudge	-0.23	1201	rather common	not-visible	Online	Non-student
Banerjee 2021(2)	unpublished	Nudge	Nudge	-0.23	1199	rather common	not-visible	Online	Non-student
Bicchieri et al. 2021	published	Mon.Inc.	Nudge	0.43	579	uncommen	not-visible	Lab	Student
Bicchieri et al. 2021(2)	published	Mon.Inc.	Nudge	0.09	795	uncommen	not-visible	Lab	Student
Bicchieri et al. 2021(3)	published	Mon.Inc.	Nudge	0.03	579	uncommen	not-visible	Lab	Student
Bicchieri et al. 2021(4)	published	Mon.Inc.	Nudge	-0.22	795	uncommen	not-visible	Lab	Student
Vesely et al. 2022	published	Nudge	Nudge	0.09	300	rather common	visible	Lab	Student
Vesely et al. 2018	published	Nudge	Nudge	0.14	134	rather common	visible	Lab	Student
Howley et al. 2021	published	Nudge	Nudge	-0.03	1805	uncommen	not-visible	Field	Non-student
Rodemeier et al. 2022	unpublished	Nudge	Mon.Inc.	-0.04	172000	very common	not-visible	Field	Non-student
Rodemeier et al. 2022(2)	unpublished	Nudge	Mon.Inc.	-0.05	172000	very common	not-visible	Field	Non-student
Betz et al. 2022	published	Nudge	Nudge	-0.10	2385	very common	not-visible	Lab	Student
Vellinga et al. 2022	published	Nudge	Mon.Inc.	0.24	533	very common	not-visible	Online	Non-student
Faccioli et al. 2022	published	Mon.Inc.	Mon.Inc.	-0.21	5912	very common	not-visible	Online	Non-student
Löschel et al. 2020	published	Nudge	Mon.Inc.	0.04	275	very common	not-visible	Field	Non-student
Fractional factorial design									
Schall et al. 2016	published	Mon.Inc.	Nudge	-0.27	179	rather common	visible	Field	Non-student
Schall et al. 2016(2)	published	Nudge	Nudge	-0.02	176	rather common	visible	Field	Non-student
Osman et al. 2021(3)	published	Mon.Inc.	Mon.Inc.	0.40	397	rather common	not-visible	Online	Non-student
Osman et al. 2021(4)	published	Mon.Inc.	Mon.Inc.	0.21	306	rather common	not-visible	Online	Non-student
Pellerano et al. 2017	published	Nudge	Mon.Inc.	0.02	18775	very common	not-visible	Field	Non-student
Mizobuchi et al. 2013	published	Mon.Inc.	Nudge	0.51	208	very common	not-visible	Field	Non-student
Sudarshan et al. 2017	published	Nudge	Mon.Inc.	-0.06	484	very common	not-visible	Field	Non-student
Fanghella et al. 2019(2)	published	Nudge	Nudge	0.03	486	uncommen	not-visible	Online	Non-student
Delmas et al. 2014	published	Nudge	Nudge	0.36	3564	very common	visible	Field	Student
Ferraro et al. 2013	published	Nudge	Nudge	0.04	95200	very common	not-visible	Field	Non-student
Peth et al. 2018	published	Nudge	Nudge	0.05	163	rather common	not-visible	Lab	Non-student
Wadehra et al. 2018	published	Nudge	Nudge	1.59	570	very common	visible	Field	Non-student
Wadehra et al. 2018(2)	published	Nudge	Mon.Inc.	2.03	570	very common	visible	Field	Non-student
Riggs et al. 2017	published	Mon.Inc.	Nudge	0.00	338	very common	visible	Online	Student
Jessoe et al. 2014	published	Mon.Inc.	Nudge	0.21	437	very common	not-visible	Field	Non-student
Jessoe et al. 2014(2)	published	Mon.Inc.	Nudge	0.17	437	very common	not-visible	Field	Non-student

6 Statistical method

Table 8: Priors used in estimates

Table	Hypothesis Test	Model	Parameter	Prior
Table 3	Hypothesis 1	Synergy effect	Intercept	Student-t(3,0.3,2.5)
Table 3	Hypothesis 1	Synergy effect	Std. Dev. - article level	Student-t(3,0.2,2.5)
Table 3	Hypothesis 1	Synergy effect	Std. Dev. - pro-env. level	Student-t(3,0.2,2.5)
Table 3	Hypothesis 1	Synergy effect	Treatment	Normal(-0.05, 0.05)

Table 3	Hypothesis 2		Synergy effect	Intercept	Student-t(3,0.3,2.5)
Table 3	Hypothesis 2		Synergy effect	Std. Dev. - article level	Student-t(3,0.2,2.5)
Table 3	Hypothesis 2		Synergy effect	Std. Dev. - pro-env. level	Student-t(3,0.2,2.5)
Table 3	Hypothesis 2		Synergy effect	Treatment	Normal(-0.05, 0.05)
Table 3	Hypothesis 2		Synergy effect	cross-domain indicator	Normal(0, 1)
Table 3	Hypothesis 2		Synergy effect	cross-domain ind.*Treat.	Normal(0.025, 0.05)
Table 3	Hypothesis 3	Prevalence	Synergy effect	Intercept	Student-t(3,0.3,2.5)
Table 3	Hypothesis 3	Prevalence	Synergy effect	Std. Dev. - article level	Student-t(3,0.2,2.5)
Table 3	Hypothesis 3	Prevalence	Synergy effect	Std. Dev. - pro-env. level	Student-t(3,0.2,2.5)
Table 3	Hypothesis 3	Prevalence	Synergy effect	Prevalence	Normal(-0.1,0.05)
Table 3	Hypothesis 3	Prevalence	Synergy effect	Treatment	Normal(-0.05,0.05)
Table 3	Hypothesis 3	Prevalence	Synergy effect	Prevalence* Treatment	Normal(0,0.025)
Table 3	Hypothesis 3	Scrutiny	Synergy effect	Intercept	Student-t(3,0.3,2.5)
Table 3	Hypothesis 3	Scrutiny	Synergy effect	Std. Dev. - article level	Student-t(3,0.2,2.5)
Table 3	Hypothesis 3	Scrutiny	Synergy effect	Std. Dev. - pro-env. level	Student-t(3,0.2,2.5)
Table 3	Hypothesis 3	Scrutiny	Synergy effect	Prevalence	Normal(-0.1,0.05)
Table 3	Hypothesis 3	Scrutiny	Synergy effect	Treatment	Normal(-0.05,0.05)
Table 3	Hypothesis 3	Scrutiny	Synergy effect	Prevalence* Treatment	Normal(0,0.025)
Table 3	Hypothesis 4		Synergy effect	Intercept	Student-t(3,0.2,2.5)
Table 3	Hypothesis 4		Synergy effect	Std. Dev. - article level	Student-t(3,0.2,2.5)
Table 3	Hypothesis 4		Synergy effect	Std. Dev. - pro-env. level	Student-t(3,0.2,2.5)
Table 3	Hypothesis 4		Synergy effect	treatment	Normal(0, 0.05)
Table 4 - row 1	Hypothesis 4		Synergy effect	Intercept	Student-t(3,0.3,2.5)
Table 4 - row 1	Hypothesis 4		Synergy effect	Std. Dev.	Student-t(3,0,2.5)
Table 4 - row 1	Hypothesis 4		Synergy effect	treatment	Normal(-0.05 , 0.05)
Table 4 - row 2	Hypothesis 4		Synergy effect	Intercept	Student-t(3,0.3,2.5)
Table 4 - row 2	Hypothesis 4		Synergy effect	Std. Dev.	Student-t(3,0,2.5)
Table 4 - row 2	Hypothesis 4		Synergy effect	treatment	Normal(-0.05 , 0.05)
Table 4 - row 4	Hypothesis 4		Synergy effect	Intercept	Student-t(3,0.3,2.5)
Table 4 - row 4	Hypothesis 4		Synergy effect	Std. Dev.	Student-t(3,0,2.5)
Table 4 - row 4	Hypothesis 4		Synergy effect	treatment	Normal(-0.05 , 0.05)
Table 4 - row 5	Hypothesis 4		Synergy effect	Intercept	Student-t(3,0.3,2.5)
Table 4 - row 5	Hypothesis 4		Synergy effect	Std. Dev.	Student-t(3,0,2.5)
Table 4 - row 5	Hypothesis 4		Synergy effect	treatment	Normal(-0.05 , 0.05)
Table 4 - row 6	Hypothesis 4		Synergy effect	Intercept	Student-t(3,0.3,2.5)
Table 4 - row 6	Hypothesis 4		Synergy effect	Std. Dev.	Student-t(3,0,2.5)
Table 4 - row 6	Hypothesis 4		Synergy effect	treatment	Normal(-0.05 , 0.05)

Table 5	Hypothesis 2	Nudge paired with Mon.Inc.	Effect of intervention	Intercept	Student-t(3,0.1,2.5)
Table 5	Hypothesis 2	Nudge paired with Mon.Inc.	Effect of intervention	Std. Dev. - article level	Student-t(3,0.2,2.5)
Table 5	Hypothesis 2	Nudge paired with Mon.Inc.	Effect of intervention	Std. Dev. - pro-env. level	Student-t(3,0.2,2.5)
Table 5	Hypothesis 2	Nudge paired with Mon.Inc.	Effect of intervention	Treatment	Normal(0,0.05)
Table 5	Hypothesis 2	Mon.Inc. paired with Nudge	Effect of intervention	Intercept	Student-t(3,0.1,2.5)
Table 5	Hypothesis 2	Mon.Inc. paired with Nudge	Effect of intervention	Std. Dev. - article level	Student-t(3,0.2,2.5)
Table 5	Hypothesis 2	Mon.Inc. paired with Nudge	Effect of intervention	Std. Dev. - pro-env. level	Student-t(3,0.2,2.5)
Table 5	Hypothesis 2	Mon.Inc. paired with Nudge	Effect of intervention	Treatment	Normal(0,0.05)
Table 5	Hypothesis 2	Nudge paired with Nudge	Effect of intervention	Intercept	Student-t(3,0.1,2.5)
Table 5	Hypothesis 2	Nudge paired with Nudge	Effect of intervention	Std. Dev. - article level	Student-t(3,0.2,2.5)
Table 5	Hypothesis 2	Nudge paired with Nudge	Effect of intervention	Std. Dev. - pro-env. level	Student-t(3,0.2,2.5)
Table 5	Hypothesis 2	Nudge paired with Nudge	Effect of intervention	Treatment	Normal(-0.05,0.05)
Table 5	Hypothesis 2	Mon.Inc. paired with Mon.Inc.	Effect of intervention	Intercept	Student-t(3,0.1,2.5)
Table 5	Hypothesis 2	Mon.Inc. paired with Mon.Inc.	Effect of intervention	Std. Dev. - article level	Student-t(3,0.2,2.5)
Table 5	Hypothesis 2	Mon.Inc. paired with Mon.Inc.	Effect of intervention	Std. Dev. - pro-env. level	Student-t(3,0.2,2.5)
Table 5	Hypothesis 2	Mon.Inc. paired with Mon.Inc.	Effect of intervention	Treatment	Normal(-0.05,0.05)
Table 6 - column 1	Hypothesis 2	Nudges by type of nudge	Effect of intervention	Intercept	Student-t(3,0.1,2.5)
Table 6 - column 1	Hypothesis 2	Nudges by type of nudges	Effect of intervention	Std. Dev. - article level	Student-t(3,0.2,2.5)
Table 6 - column 1	Hypothesis 2	Nudges by type of nudges	Effect of intervention	Std. Dev. - pro-env. level	Student-t(3,0.2,2.5)
Table 6 - column 1	Hypothesis 2	Nudges by type of nudges	Effect of intervention	Treatment	Normal(-0.05,0.05)
Table 6 - column 1	Hypothesis 2	Nudges by type of nudges	Effect of intervention	non-monetary	Normal(0,0.5)
Table 6 - column 1	Hypothesis 2	Nudges by type of nudges	Effect of intervention	cognitive	Normal(0,0.05)
Table 6 - column 1	Hypothesis 2	Nudges by type of nudges	Effect of intervention	Treatment*non-monetary	Normal(0,0.025)
Table 6 - column 1	Hypothesis 2	Nudges by type of nudges	Effect of intervention	Treatment*cognitive	Normal(0,0.025)
Table 6 - column 2	Hypothesis 2	Mon.Inc. by type of nudge	Effect of intervention	Intercept	Student-t(3,0.1,2.5)
Table 6 - column 2	Hypothesis 2	Mon.Inc. by type of nudge	Effect of intervention	Std. Dev. - article level	Student-t(3,0.2,2.5)
Table 6 - column 2	Hypothesis 2	Mon.Inc. by type of nudge	Effect of intervention	Std. Dev. - pro-env. level	Student-t(3,0.2,2.5)
Table 6 - column 2	Hypothesis 2	Mon.Inc. by type of nudge	Effect of intervention	Treatment	Normal(-0.05,0.05)
Table 6 - column 2	Hypothesis 2	Mon.Inc. by type of nudge	Effect of intervention	non-monetary	Normal(0,0.05)
Table 6 - column 2	Hypothesis 2	Mon.Inc. by type of nudge	Effect of intervention	cognitive	Normal(Normal(0,0.05))
Table 6 - column 2	Hypothesis 2	Mon.Inc. by type of nudge	Effect of intervention	Treatment*non-monetary	Normal(0,0.025)
Table 6 - column 2	Hypothesis 2	Mon.Inc. by type of nudge	Effect of intervention	Treatment*cognitive	Normal(0,0.025)

Note: The priors for the treatment indicator, i.e., the indicator whether an effect size belongs to the sum of single interventions or policy mixes, was obtained by adopting the distribution of the difference in both the effect sizes of the sum of single interventions and the effect size of the policy mixes. A similar procedure has been followed to identify the priors of "prevalence" and "Scrutiny". The analytical model 'Effect of intervention' is identical to the model 'Synergy effect'. However, in the model 'Synergy effect', the intercept measures the effect size of the sum of single interventions, while the treatment indicator measures the synergy effect. In the model 'Effect of intervention', the intercept measures the effect size of the single intervention, while the treatment indicator measures the deviation in effectiveness of that intervention within policy mixes.

7 Estimation results

Table 9: Synergy effect estimation, Hypothesis 1

	effect size — se(sd)	
Predictors	Estimates	CI (95%)
Intercept	0.40	-0.02 – 0.76
Synergy_effect	-0.03	-0.08 – 0.02
Lab_exp	0.08	-1.12 – 1.30
Field_exp	-0.04	-1.29 – 1.23
Online_exp	-0.02	-1.07 – 1.03
Observability	-0.03	-0.19 – 0.12
Prevalence	-0.00	-0.26 – 0.25
qual1	0.01	-0.16 – 0.17
qual2	-0.02	-1.41 – 1.39
qual3	0.01	-1.38 – 1.39
qual5	0.09	-0.17 – 0.35
qual6	-0.02	-0.20 – 0.16
qual7	-0.18	-0.40 – 0.05
qual8	-0.14	-0.37 – 0.08
qual9	-0.03	-0.18 – 0.12
Random Effects		
σ^2	1.00	
τ_{00}study	0.15	
τ_{00}typePEB	0.15	
τ_{11}study.Synergy_effect	0.01	
τ_{11}typePEB.Synergy_effect	0.00	
ρ_{01}		
ρ_{01}		
ICC	0.24	
N_{study}	34	
$N_{typePEB}$	6	
Observations	114	
Marginal R2 / Conditional R2	0.417 / 0.787	

Note: Estimates based on a random effects hierarchical Bayes model. Priors used can be retrieved from Table 8

Table 10: Synergies of within- and cross-domain policy mixes, Hypothesis 2

	effect size — se(sd)	
Predictors	Estimates	CI (95%)
Intercept	0.38	-0.04 – 0.75
Synergy effect	-0.05	-0.10 – 0.01
cw treat	0.04	-0.36 – 0.48
Lab exp	0.05	-1.12 – 1.24
Field exp	-0.03	-1.25 – 1.17
Online exp	-0.03	-1.04 – 0.98
Observability	-0.04	-0.20 – 0.11
Prevalence	0.02	-0.26 – 0.29
qual 1	0.03	-0.15 – 0.20
qual 2	-0.03	-1.38 – 1.46
qual 3	0.03	-1.46 – 1.41
qual 5	0.14	-0.13 – 0.40
qual 6	-0.01	-0.21 – 0.16
qual 7	-0.19	-0.43 – 0.05
qual 8	-0.17	-0.40 – 0.06
qual 9	-0.02	-0.15 – 0.13
Synergy_effect:cw_treat	0.04	-0.03 – 0.11
Random Effects		
σ^2	1.00	
τ_{00}study	0.13	
τ_{00}typePEB	0.17	
τ_{11}study.Synergy_effect	0.00	
τ_{11}study.cw_treat	0.07	
τ_{11}study.Synergy_effect:cw_treat	0.01	
τ_{11}typePEB.Synergy_effect	0.00	
τ_{11}typePEB.cw_treat	0.16	
τ_{11}typePEB.Synergy_effect:cw_treat	0.01	
ρ_{01}		
ρ_{01}		
ICC	0.30	
N_{study}	34	
$N_{typePEB}$	6	
Observations	114	
Marginal R2 / Conditional R2	0.414 / 0.792	

Note: Estimates based on a random effects hierarchical Bayes model. Priors used can be retrieved from Table 8

Table 11: Effectiveness of nudges paired with mon. inc., Hypothesis 2

	effect size — se(sd)	
Predictors	Estimates	CI (95%)
Intercept	0.18	-0.19 – 0.52
Synergy effect	-0.02	-0.08 – 0.03
Lab exp	0.06	-1.14 – 1.25
Field exp	-0.09	-1.37 – 1.17
Online exp	0.02	-0.91 – 0.95
Observability	0.08	-0.09 – 0.25
Prevalence	0.02	-0.30 – 0.28
qual 1	-0.06	-0.33 – 0.20
qual 2	0.05	-1.33 – 1.43
qual 3	0.08	-1.31 – 1.46
qual 5	0.17	-0.14 – 0.50
qual 6	-0.06	-0.22 – 0.08
qual 7	-0.18	-0.43 – 0.05
qual 8	-0.04	-0.22 – 0.14
qual 9	0.02	-0.11 – 0.17
Random Effects		
σ^2	1.00	
τ_{00}study	0.06	
τ_{00}typePEB	0.13	
τ_{11}study.Synergy_effect	0.00	
τ_{11}typePEB.Synergy_effect	0.00	
ρ_{01}		
ρ_{01}		
ICC	0.16	
N_{study}	22	
$N_{typePEB}$	5	
Observations	78	
Marginal R2 / Conditional R2	0.485 / 0.657	

Note: Estimates based on a random effects hierarchical Bayes model. Priors used can be retrieved from Table 8

Table 12: Effectiveness of mon. inc. paired with nudges, Hypothesis 2

	effect size — se(sd)	
Predictors	Estimates	CI (95%)
Intercept	0.28	-0.38 – 0.77
Synergy effect	-0.02	-0.07 – 0.03
Lab exp	0.05	-1.16 – 1.25
Field exp	-0.03	-1.33 – 1.24
Online exp	-0.03	-0.99 – 0.91
Observability	-0.05	-0.28 – 0.21
Prevalence	-0.16	-0.56 – 0.20
qual 1	0.08	-0.29 – 0.47
qual 2	0.01	-1.39 – 1.40
qual 3	0.03	-1.35 – 1.42
qual 5	-0.06	-0.56 – 0.41
qual 6	-0.05	-0.29 – 0.17
qual 7	-0.22	-0.56 – 0.13
qual 8	-0.05	-0.32 – 0.21
qual 9	0.06	-0.13 – 0.25
Random Effects		
σ^2	1.00	
τ_{00}study	0.14	
τ_{00}typePEB	0.35	
τ_{11}study.Synergy_effect	0.00	
τ_{11}typePEB.Synergy_effect	0.00	
ρ_{01}		
ρ_{01}		
ICC	0.33	
N_{study}	22	
$N_{typePEB}$	5	
Observations	78	
Marginal R2 / Conditional R2	0.464 / 0.620	

Note: Estimates based on a random effects hierarchical Bayes model. Priors used can be retrieved from Table 8

Table 13: Effectiveness of nudges paired with nudges, Hypothesis 2

	effect size — se(sd)	
Predictors	Estimates	CI (95%)
Intercept	0.24	-0.77 – 1.21
Synergy effect	-0.04	-0.12 – 0.05
Lab exp	0.01	-1.35 – 1.35
Field exp	-0.02	-1.55 – 1.52
Online exp	0.01	-1.23 – 1.23
Observability	0.09	-0.25 – 0.43
Prevalence	0.07	-0.48 – 0.55
qual 1	0.10	-0.74 – 0.88
qual 5	0.29	-0.28 – 0.74
qual 6	0.06	-0.27 – 0.41
qual 7	-0.01	-1.55 – 1.51
qual 8	-0.23	-0.70 – 0.41
Random Effects		
σ^2	1.00	
τ_{00}study	0.11	
τ_{00}typePEB	1.16	
τ_{11}study.Synergy_effect	0.01	
τ_{11}typePEB.Synergy_effect	0.09	
ρ_{01}		
ρ_{01}		
ICC	0.58	
N_{study}	11	
$N_{typePEB}$	4	
Observations	56	
Marginal R2 / Conditional R2	0.492 / 0.700	

Note: Estimates based on a random effects hierarchical Bayes model. Priors used can be retrieved from Table 8

Table 14: Effectiveness of mon. inc. paired with mon. inc., Hypothesis 2

	effect size — se(sd)	
Predictors	Estimates	CI (95%)
Intercept	0.21	-2.19 – 2.57
Synergy effect	-0.06	-0.15 – 0.04
Lab exp	-0.02	-1.73 – 1.77
Online exp	-0.01	-1.77 – 1.77
Prevalence	-0.02	-1.78 – 1.79
qual 1	0.06	-0.95 – 0.92
qual 6	0.01	-1.78 – 1.74
Random Effects		
σ^2	1.00	
τ_{00}study	1.02	
τ_{00}typePEB	5.34	
τ_{11}study.Synergy_effect	0.11	
τ_{11}typePEB.Synergy_effect	0.37	
ρ_{01}		
ρ_{01}		
ICC	0.87	
N_{study}	4	
$N_{typePEB}$	2	
Observations	16	
Marginal R2 / Conditional R2	0.470 / 0.451	

Note: Estimates based on a random effects hierarchical Bayes model. Priors used can be retrieved from Table 8

Table 15: Synergies and prevalence behavior, Hypothesis 3

	effect size — se(sd)	
Predictors	Estimates	CI (95%)
Intercept	0.45	-0.03 – 0.91
Prevalence	-0.00	-0.74 – 0.75
Synergy effect	-0.03	-0.07 – 0.02
Lab exp	0.06	-1.11 – 1.25
Field exp	-0.04	-1.24 – 1.22
Online exp	-0.04	-1.02 – 0.99
Observability	-0.12	-0.55 – 0.34
qual 1	0.01	-0.15 – 0.17
qual 2	0.03	-1.40 – 1.45
qual 3	0.02	-1.41 – 1.46
qual 5	0.10	-0.17 – 0.36
qual 6	-0.03	-0.22 – 0.16
qual 7	-0.18	-0.42 – 0.05
qual 8	-0.17	-0.39 – 0.07
qual 9	-0.03	-0.18 – 0.13
Prevalence:Synergy_effect	0.00	-0.07 – 0.08
Random Effects		
σ^2	1.00	
τ_{00}study	0.15	
τ_{00}typePEB	0.18	
τ_{11}study.Synergy_effect	0.00	
τ_{11}study.Prevalence	0.11	
τ_{11}study.Synergy_effect:Prevalence	0.01	
τ_{11}typePEB.Synergy_effect	0.00	
τ_{11}typePEB.Prevalence	0.68	
τ_{11}typePEB.Synergy_effect:Prevalence	0.04	
ρ_{01}		
ρ_{01}		
ICC	0.41	
N_{study}	34	
$N_{typePEB}$	6	
Observations	114	
Marginal R2 / Conditional R2	0.431 / 0.798	

Note: Estimates based on a random effects hierarchical Bayes model. Priors used can be retrieved from Table 8

Table 16: Synergies and scrutiny of the behavior, Hypothesis 3

	effect size — se(sd)	
Predictors	Estimates	CI (95%)
Intercept	0.42	0.00 – 0.91
Scrutiny	-0.08	-0.67 – 0.52
Synergy effect	-0.04	-0.08 – 0.02
Lab exp	0.07	-1.10 – 1.27
Field exp	-0.05	-1.25 – 1.19
Online exp	-0.02	-1.01 – 1.01
Prevalence	0.01	-0.65 – 0.57
qual 1	0.01	-0.16 – 0.17
qual 2	0.04	-1.34 – 1.42
qual 3	-0.02	-1.39 – 1.37
qual 5	0.12	-0.17 – 0.37
qual 6	-0.04	-0.25 – 0.15
qual 7	-0.18	-0.42 – 0.07
qual 8	-0.16	-0.39 – 0.07
qual 9	-0.03	-0.18 – 0.13
Scrutiny:Synergy_effect	0.03	-0.06 – 0.10
Random Effects		
σ^2	1.00	
τ_{00}study	0.16	
τ_{00}typePEB	0.22	
τ_{11}study.Synergy_effect	0.01	
τ_{11}study.Scrutiny	0.15	
τ_{11}study.Synergy_effect:Scrutiny	0.01	
τ_{11}typePEB.Synergy_effect	0.00	
τ_{11}typePEB.Scrutiny	0.23	
τ_{11}typePEB.Synergy_effect:Scrutiny	0.02	
ρ_{01}		
ρ_{01}		
ICC	0.30	
N_{study}	34	
$N_{typePEB}$	6	
Observations	114	
Marginal R2 / Conditional R2	0.428 / 0.795	

Note: Estimates based on a random effects hierarchical Bayes model. Priors used can be retrieved from Table 8

Table 17: Synergies regarding behavioral spillovers, Hypothesis 4

	effect size — se(sd)	
Predictors	Estimates	CI (95%)
Intercept	0.49	-2.99 – 4.03
Synergy effect	-0.05	-0.15 – 0.04
Lab exp	-0.01	-1.76 – 1.67
Field exp	0.02	-1.66 – 1.79
Online exp	-0.01	-1.94 – 1.97
Observability	0.03	-1.60 – 1.68
Prevalence	0.03	-1.60 – 1.59
qual 1	0.05	-0.60 – 0.58
qual 2	-0.02	-1.99 – 2.01
qual 3	0.00	-1.99 – 1.99
qual 5	-0.02	-1.99 – 1.92
qual 6	0.02	-1.44 – 1.48
qual 7	-0.00	-1.98 – 1.98
qual 8	-0.00	-1.95 – 1.92
qual 9	0.02	-2.04 – 2.02
Random Effects		
σ^2	1.00	
τ_{00}study	0.68	
τ_{00}typePEB	2.74	
τ_{11}study.Synergy_effect	0.48	
τ_{11}typePEB.Synergy_effect	0.86	
ρ_{01}		
ρ_{01}		
ICC	0.81	
N_{study}	6	
$N_{typePEB}$	4	
Observations	10	
Marginal R2 / Conditional R2	0.363 / 0.898	

Note: Estimates based on a random effects hierarchical Bayes model. Priors used can be retrieved from Table 8

Table 18: Effectiveness of nudges differentiated by channel of nudges, exploratory results

	effect size — se(sd)	
Predictors	Estimates	CI (95%)
Intercept	0.18	-0.19 – 0.52
Synergy effect	-0.02	-0.08 – 0.03
non mon	0.00	-0.07 – 0.08
cognitive	-0.01	-0.08 – 0.07
Lab exp	0.01	-1.56 – 1.58
Field exp	-0.14	-1.88 – 1.58
Online exp	-0.02	-1.24 – 1.22
Observability	0.08	-0.08 – 0.25
Prevalence	0.02	-0.30 – 0.30
qual 1	-0.06	-0.32 – 0.22
qual 2	0.06	-1.31 – 1.49
qual 3	0.06	-1.37 – 1.44
qual 5	0.17	-0.15 – 0.49
qual 6	-0.07	-0.23 – 0.09
qual 7	-0.19	-0.43 – 0.06
qual 8	-0.04	-0.22 – 0.15
qual 9	0.03	-0.12 – 0.17
Synergy_effect:non_mon	-0.00	-0.04 – 0.04
Synergy_effect:cognitive	0.01	-0.03 – 0.05
Random Effects		
σ^2	1.00	
τ_{00}study	0.06	
τ_{00}typePEB	0.13	
τ_{11}study.Synergy_effect	0.00	
τ_{11}typePEB.Synergy_effect	0.00	
ρ_{01}		
ρ_{01}		
ICC	0.17	
N_{study}	22	
$N_{typePEB}$	5	
Observations	78	
Marginal R2 / Conditional R2	0.488 / 0.657	

Note: Estimates based on a random effects hierarchical Bayes model. Priors used can be retrieved from Table 8

Table 19: Effectiveness of monetary incentives differentiated by channel of nudges being paired with, exploratory results

	effect size — se(sd)	
Predictors	Estimates	CI (95%)
Intercept	0.27	-0.47 – 0.78
Synergy effect	-0.03	-0.08 – 0.03
non mon	0.01	-0.07 – 0.08
cognitive	-0.00	-0.08 – 0.07
Lab exp	0.01	-1.59 – 1.58
Field exp	-0.09	-1.83 – 1.64
Online exp	-0.07	-1.31 – 1.17
Observability	-0.04	-0.29 – 0.22
Prevalence	-0.16	-0.59 – 0.20
qual 1	0.08	-0.30 – 0.46
qual 2	0.03	-1.33 – 1.41
qual 3	0.02	-1.38 – 1.36
qual 5	-0.05	-0.55 – 0.42
qual 6	-0.05	-0.29 – 0.18
qual 7	-0.23	-0.57 – 0.12
qual 8	-0.05	-0.32 – 0.22
qual 9	0.06	-0.13 – 0.24
Synergy_effect:non_mon	0.00	-0.03 – 0.04
Synergy_effect:cognitive	0.01	-0.03 – 0.05
Random Effects		
σ^2	1.00	
τ_{00}study	0.14	
τ_{00}typePEB	0.38	
τ_{11}study.Synergy_effect	0.00	
τ_{11}typePEB.Synergy_effect	0.00	
ρ_{01}		
ρ_{01}		
ICC	0.34	
N_{study}	22	
$N_{typePEB}$	5	
Observations	78	
Marginal R2 / Conditional R2	0.466 / 0.622	

Note: Estimates based on a random effects hierarchical Bayes model. Priors used can be retrieved from Table 8

Table 20: Effectiveness differentiated by type of nudges, exploratory results

	effect size — se(sd)	
	effect size — se(sd)	
Predictors	Estimates	CI (95%)
Intercept	0.19	-0.56 – 0.95
Synergy effect	-0.04	-0.11 – 0.03
norm	0.00	-0.09 – 0.10
info	0.00	-0.09 – 0.10
empathy	0.00	-0.10 – 0.10
reminder	0.00	-0.09 – 0.10
Lab exp	0.10	-0.32 – 0.52
Online exp	0.03	-0.11 – 0.20
Prevalence	0.04	-0.46 – 0.58
qual 1	0.01	-0.54 – 0.59
qual 2	0.03	-1.40 – 1.42
qual 3	0.05	-1.35 – 1.48
qual 5	0.16	-0.71 – 0.97
qual 6	-0.05	-0.33 – 0.22
qual 7	-0.18	-0.62 – 0.32
qual 8	-0.09	-0.40 – 0.23
qual 9	0.00	-0.29 – 0.29
Synergy_effect:norm	0.00	-0.04 – 0.05
Synergy_effect:info	0.00	-0.04 – 0.05
Synergy_effect:empathy	-0.00	-0.05 – 0.04
Synergy_effect:reminder	0.00	-0.05 – 0.05
Random Effects		
σ^2	1.00	
τ_{00}study	0.04	
τ_{00}typePEB	0.48	
τ_{11}study.Synergy_effect	0.00	
τ_{11}study.norm	0.34	
τ_{11}study.info	0.19	
τ_{11}study.empathy	1.07	
τ_{11}study.reminder	6.63	
τ_{11}study.Synergy_effect:norm	0.03	
τ_{11}study.Synergy_effect:info	0.01	
τ_{11}study.Synergy_effect:empathy	0.05	
τ_{11}study.Synergy_effect:reminder	5.11	
τ_{11}typePEB.Synergy_effect	0.02	
τ_{11}typePEB.norm	0.48	
τ_{11}typePEB.info	1.02	
τ_{11}typePEB.empathy	1.19	
τ_{11}typePEB.reminder	6.42	
τ_{11}typePEB.Synergy_effect:norm	0.07	
τ_{11}typePEB.Synergy_effect:info	0.23	
τ_{11}typePEB.Synergy_effect:empathy	0.05	
τ_{11}typePEB.Synergy_effect:reminder	5.54	
ρ_{01}		
ρ_{01}		
ICC	0.75	
N_{study}	22	
$N_{typePEB}$	5	
Observations	78	
Marginal R2 / Conditional R2	0.503 / 0.680	

Note: Estimates based on a random effects hierarchical Bayes model. Priors used can be retrieved from Table 8

Table 21: Effectiveness differentiated by type of mon. inc., exploratory results

	effect size — se(sd)	
Predictors	Estimates	CI (95%)
Intercept	0.24	-0.36 – 0.77
Synergy effect	-0.02	-0.06 – 0.04
tax	0.00	-0.09 – 0.10
Lab exp	0.04	-0.37 – 0.47
Online exp	-0.01	-0.20 – 0.19
Prevalence	-0.15	-0.60 – 0.28
qual 1	0.07	-0.27 – 0.41
qual 2	0.04	-1.37 – 1.41
qual 3	0.02	-1.36 – 1.41
qual 5	-0.04	-0.52 – 0.45
qual 6	-0.02	-0.31 – 0.25
qual 7	-0.19	-0.60 – 0.19
qual 8	-0.04	-0.29 – 0.19
qual 9	0.06	-0.18 – 0.35
Synergy_effect:tax	0.01	-0.08 – 0.10
Random Effects		
σ^2	1.00	
τ_{00}study	0.11	
τ_{00}typePEB	0.32	
τ_{11}study.Synergy_effect	0.00	
τ_{11}study.tax	0.25	
τ_{11}study.Synergy_effect:tax	0.01	
τ_{11}typePEB.Synergy_effect	0.00	
τ_{11}typePEB.tax	0.75	
τ_{11}typePEB.Synergy_effect:tax	0.08	
ρ_{01}		
ρ_{01}		
ICC	0.44	
N_{study}	22	
$N_{typePEB}$	5	
Observations	78	
Marginal R2 / Conditional R2	0.434 / 0.634	

Note: Estimates based on a random effects hierarchical Bayes model. Priors used can be retrieved from Table 8

8 Additional Analysis

Table 22: Variation in effectiveness of nudges and monetary incentives by type of intervention within cross domain policy mixes

Norm intervention	Effect size	0.0087
(vs. remaining nudges)	BF	1.31
	N	10
Information interv.	Effect size	0.003
(vs. remaining nudges)	BF	1.21
	N	7
Motivational interv.	Effect size	-0.004
(vs. remaining nudges)	BF	0.77
	N	13
Reminder	Effect size	0.025
(vs. remaining nudges)	BF	1.01
	N	2
Tax	Effect size	0.01
(vs. subsidy)	BF	1.38
	N	24

Note: Estimates based on a random effects hierarchical Bayes model. Priors used can be retrieved from Table 8. The effect size of remaining nudges amount to -0.037 (BF=5.37).

8.1 Synergy effects of peer reviewed studies only

Table 23: Main results, restricted sample

			Effect size and Bayes factor for:		
			Policy mix	**Sum of individual effect**	**Synergy Effect**
1	Synergy effects are negative.		0.382 (BF=35.70)	0.409 (BF=40.67)	-0.026 (BF=5.79)
2	Cross-domain combinations of interventions are more effective than within-domain combinations.	Within-domain	0.323 (BF=14.43)	0.369 (BF=25.67)	-0.046 (BF=18.90)
		Across-domain	0.4354 (BF=21.22)	44.72 (BF=22.96)	-0.012 (BF=0.59)
		Difference	0.113 (BF=2.69)	0.078 (BF=1.92)	0.034 (BF=5.17)
3	The synergy effects are not dependent on contextual factors.	Non-Prevalent	0.4532 (BF=32.33)	0.478 (BF=40.67)	-0.025 (BF=0.16)
		Prevalent	0.404 (BF=7.64)	0.42 (BF=8.28)	-0.017 (BF=0.53)
		Difference	-0.057 (BF=0.79)	0.074 (BF=0.73)	0.005 (BF=1.28)
		No Scrutiny	0.408 (BF=22.26)	0.439 (BF=28.85)	-0.031 (BF=7.05)
		Scrutiny	0.382 (BF=6.68)	0.39 (BF=6.94)	-0.009 (BF=2.04)
		Difference	-0.026 (BF=1.19)	-0.048 (BF=1.39)	0.022 (BF=2.35)
4	The synergies regarding behavioral spillovers are negative.	Spillover	0.439 (BF=1.48)	0.493 (BF=1.57)	-0.054 (BF=6.29)

Note: Main results based on the restricted sample of peer reviewed papers only (32 out of 34). Effects are reported in Cohen's d. The Bayes Factor (BF) quantifies evidence strength for the alternative relative to the null hypothesis. We interpret a $BF > 100$ as extreme, 30-100 as very strong, 10-30 as strong, 3-10 as moderate, and 1-3 as weak evidence for the alternative hypothesis. A $BF < 1$ suggests evidence for the null hypothesis.

8.2 Synergy effects by quality of study

Table 24: Distribution of studies over the sum of the quality indicators

Sum of quality indicators	Observations
0	16
1	23
2	6
3	11
5	1

Note: There are nine quality indicators comprising low sample size (n<30), no clear baseline treatment, no clean intervention treatments, other interfering treatments, no clean laboratory/ field conditions, hypothetical answer, Behavior only remotely related to environment, No statistical sound analysis, within-subject treatment variation. The sum of the indicators ranges from 0 to 9 with 0 indicating full compliance with all quality indicators and 9 indicating compliance with none of the quality indicators.

Table 25: Synergy effects by quality of study

	Estimate	**Est.Error**	**CI.Lower**	**CI.Upper**	**Evid.Ratio**	**Observations**
Synergy effect						
Entire data set	-0.0299	0.0241	-0.0.078	0.018	8.59	57
Best quality	-0.0169	0.0416	-.0872	0.05	1.8612	39

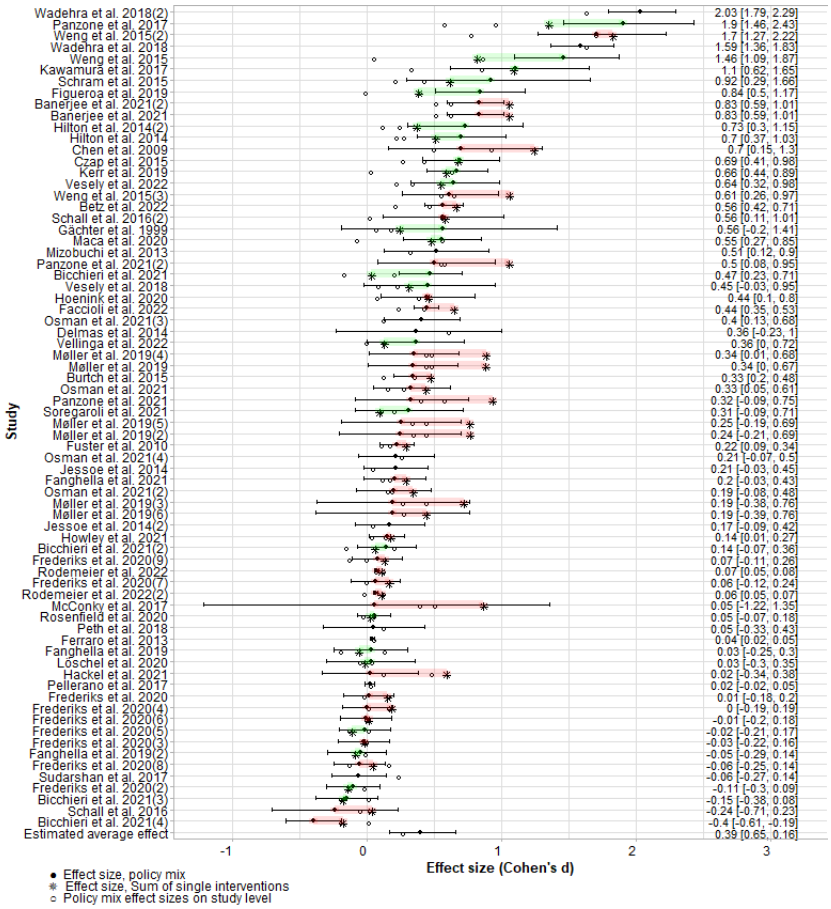
Note: There are nine quality indicators comprising low sample size (n<30), no clear baseline treatment, no clean intervention treatments, other interfering treatments, no clean laboratory/ field conditions hypothetical answer, Behavior only remotely related to environment, No statistical sound analysis, within-subject treatment variation. The sum of the indicators ranges from 0 to 9 with 0 indicating full compliance with all quality indicators and 9 indicating compliance with none of the quality indicators.

9 Sensitivity analysis

9.1 Extended sample analysis

The extended sample analysis includes also the effect sizes from the fractional factorial designs (n=16), where one single intervention effect is missing in the data set. To assess how robust the findings on the average synergy effects are with respect to additional findings on the effectiveness of policy mixes, we compare the extended sample results with the results from the data set containing full factorial designs only. Figure 2 shows the results for the extended data set. We observe that adding 10 additional articles (16 effect sizes) results in an increase of the effect size to 0.39. However, this deviation from the original effect size of policy mixes of 0.37 remains small in size. Therefore, we conclude that our results are robust to the additional evidence collected from the fractional factorial design studies.

Figure 2: Forest Plot of Synergy effects of different interventions, full sample



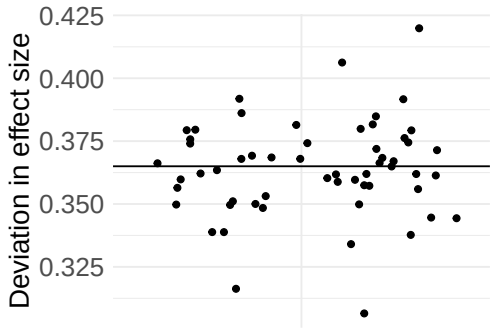
9.2 Robustness checks

We test the robustness of the result based on their dependencies on the model. For this, we use the R-package "bridgesampling", which compares the log marginal likelihood values of the models to assess whether they statistically differ. The set-up of the standard model is, as described in the main text, based on a hierarchical Bayesian model with a prior for the intercept following a student-t distribution, $y_i \sim t(0.3, 2.5)$. To assess the influence of the Intercept's prior, we repeat the estimation of the Bayes model using alternative priors. Applying a normal distribution, $y_i \sim N(0, 2)$ results in a minor deviation of 0.003 in effect size which can be interpreted as no evidence for an impact of changing the prior on the estimation results (BF=0.015). Alternatively, we apply a Cauchy distribution, $y_i \sim Cauchy(0, 2)$ to estimate the average effect size of combined interventions. This results in a deviation of -0.005 in effect size. A comparison of the models'

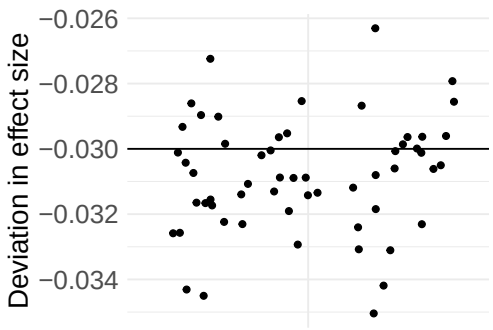
log-likelihood values leads to weak evidence for a difference in the models (BF=2.41). We conduct a similar comparison of models to analyze the effect of the intercept within the model. Therefore, we estimated an additional model which does not contain an intercept. In this case, the average effect size decreases substantially by an effect size of 1.5. The analysis using the bridge sampler, finds extreme evidence for a significant difference in the models(BF=1532826). Since single observations in the data might have a particularly strong effect on the results, we conduct a "leave-one-out" analysis to investigate to which degree the average effect sizes are dependent on results from a single study. Figure 3 shows the distribution of the estimates given a single observation has been removed from the sample. While the left graph shows the variation given estimates on the effectiveness of combined interventions, the graph on the right shows the variations in the effect sizes of synergy effects. We observe a moderate variability in deviations ranging from effect sizes of 0.31 to 0.42 for effect sizes of combined interventions. The standard deviation of the 57 different effect sizes is 0.019. In the case of the variability of synergy effects, we observe variations in effect sizes within a range of -0.035 to -0.026, containing a standard deviation of 0.0018. Based on these results, we conclude that the influence of certain single observations within the data-set is of minor concern for the direct effect of combinations of different interventions.

Figure 3: Deviations in effect size of the policy mix (a) and the direct synergy effect (b) based on the leave-one-out analysis

(a) Leave-one-out analysis for estimation of policy mix effect size



(b) Leave-one-out analysis for estimation of synergy effect's effect size

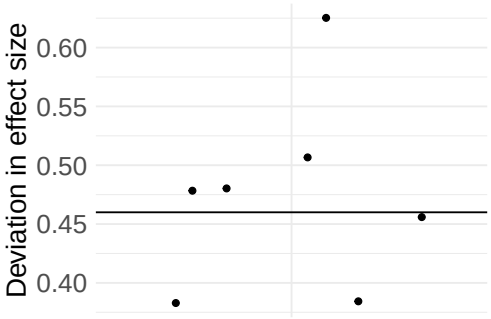


We conduct a similar analysis to assess the influence of single interventions on the estimates of the average effect size of spillover effects. Figure 5 displays these variations, showing the deviations from the average effect size of spillovers of combined interventions on the left and deviations given the synergy effects of spillovers of combined interventions on the right. We

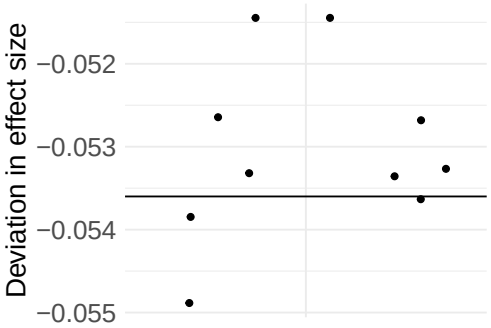
observe a strong variability in effect sizes for the estimates of the spillover effects of policy mixes, ranging in a scope of 0.24 in effect size for the spillover effect of combined interventions (SD=0.20). Less variation is observed for the synergy effect of the different spillover effects, varying by 0.0035 in effect size (SD=0.001). This reveals a strong dependency of the average estimated effect size from single interventions in the case of the estimation of the policy mix's average effect size. Reasons for this are given by the low sample size for these estimates and the large variation in effect sizes between studies. Therefore, we need to interpret the average effect sizes for spillovers of combined intervention with caution.

Figure 4: Deviations in average effect size of spillover effects of policy mix (a) and synergy effect (b) based on the leave-one-out analysis

(a) Leave-one-out analysis for estimation of spillover effects of policy mix's effect size



(b) Leave-one-out analysis for estimation of spillover effects of synergy effect's effect size

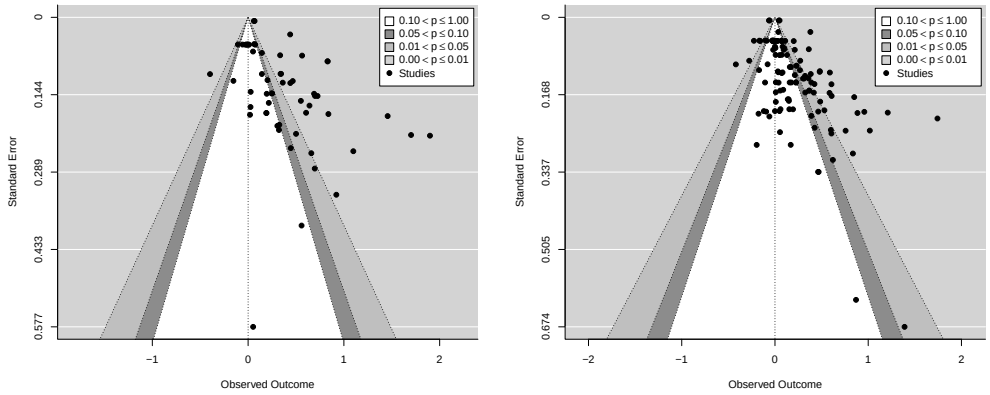


9.3 Publication bias analysis

We analyze the presence of the publication bias of our average synergy effect using a contour-enhanced funnel plot (Peters et al. 2008). The left graph shows the funnel plot for the effect sizes of the combinations of different interventions in comparison to the control treatment (n=57). We observe a rather asymmetric result as a large part of the observations range on the upper right part of the plot, suggesting the presence of a publication bias. The graph on the right shows the funnel plot for the effect size of combinations of different interventions in comparison to the effect size of the interventions in single application (n=57). Although the distribution of effect sizes still tends towards the upper right part of the plot, the publication bias seems to be less strong for the comparison with the interventions in single application effect analysis. This suggests that having a joint intervention effect that outperforms the single intervention effects is

less subject to a publication bias. These findings indicate that the estimated overall effect sizes from the meta-analysis at hand might suffer from an upward bias caused by a higher publication rate among studies that find a policy mix that is comparably effective.

Figure 5: Contour-enhanced funnel plot



The left graph shows the funnel plot for the effect sizes of the combinations of different interventions in comparison to the control treatment (n=57). The graph on the right shows the funnel plot for the effect size of combinations of different interventions in comparison to the effect size of the interventions in single application (n=57).

References

Banerjee, S. (2022). *Choice Architecture 2.0 with Nudge Plus*. PhD Thesis, London School of Economics and Political Science, London.

Betz, A.-K., Seger, B. T., and Nieding, G. (2022). How can carbon labels and climate-friendly default options on restaurant menus contribute to the reduction of greenhouse gas emissions associated with dining? *PLoS Climate*, 1(5):e0000028.

Bicchieri, C., Dimant, E., and Xiao, E. (2021). Deviant or wrong? the effects of norm information on the efficacy of punishment. *Journal of Economic Behavior & Organization*, 188:209–235.

Burtch, G., Hong, Y., Bapna, R., and Griskevicius, V. (2018). Stimulating online reviews by combining financial incentives and social norms. *Management Science*, 64(5):2065–2082.

Chen, X.-P., Pillutla, M. M., and Yao, X. (2009). Unintended consequences of cooperation inducing and maintaining mechanisms in public goods dilemmas: Sanctions and moral appeals. *Group Processes & Intergroup Relations*, 12(2):241–255.

Czap, N. V., Czap, H. J., Khachaturyan, M., Burbach, M. E., et al. (2018). Comparing female and male response to financial incentives and empathy nudging in an environmental context. *Review of Behavioral Economics*, 5(1):61–84.

Delmas, M. A. and Lessem, N. (2014). Saving power to conserve your reputation? the effectiveness of private versus public information. *Journal of Environmental Economics and Management*, 67(3):353–370.

Faccioli, M., Law, C., Caine, C. A., Berger, N., Yan, X., Weninger, F., Guell, C., Day, B., Smith, R. D., and Bateman, I. J. (2022). Combined carbon and health taxes outperform single-purpose information or fiscal measures in designing sustainable food policies. *Nature Food*, 3(5):331–340.

Fanghella, V., d'Adda, G., and Tavoni, M. (2019). On the use of nudges to affect spillovers in environmental behaviors. *Frontiers in Psychology*, 10:61.

Fanghella, V., Ploner, M., and Tavoni, M. (2021). Energy saving in a simulated environment: An online experiment of the interplay between nudges and financial incentives. *Journal of Behavioral and Experimental Economics*, 93:101709.

Ferraro, P. J. and Miranda, J. J. (2013). Heterogeneous treatment effects and mechanisms in information-based environmental policies: Evidence from a large-scale field experiment. *Resource and Energy Economics*, 35(3):356–379.

Figueroa, A., de Moliere, L., Pegels, A., Never, B., and Kutzner, F. (2019). Show me (more than) the money! Assessing the social and psychological dimensions to energy efficient lighting in Kenya. *Energy Research & Social Science*, 47:224–232.

Frederiks, E. R., Romanach, L. M., Berry, A., and Toscas, P. (2020). Making energy surveys more impactful: Testing material and non-monetary response strategies. *Energy Research & Social Science*, 63:101409.

Fuster, A. and Meier, S. (2010). Another hidden cost of incentives: The detrimental effect on norm enforcement. *Management Science*, 56(1):57–70.

Gächter, S. and Fehr, E. (1999). Collective action as a social exchange. *Journal of Economic Behavior & Organization*, 39(4):341–369.

Hackel, J., Yamamoto, H., Okada, I., Goto, A., and Taudes, A. (2021). Asymmetric effects of social and economic incentives on cooperation in real effort based public goods games. *PLoS ONE*, 16(4):e0249217.

Hilton, D., Charalambides, L., Demarque, C., Waroquier, L., and Raux, C. (2014). A tax can nudge: The impact of an environmentally motivated bonus/malus fiscal system on transport preferences. *Journal of Economic Psychology*, 42:17–27.

Hoenink, J. C., Mackenbach, J. D., Waterlander, W., Lakerveld, J., van der Laan, N., and Beulens, J. W. (2020). The effects of nudging and pricing on healthy food purchasing behavior in a virtual supermarket setting: a randomized experiment. *International Journal of Behavioral Nutrition and Physical Activity*, 17(1):1–12.

Howley, P. and Ocean, N. (2022). Can nudging only get you so far? Testing for nudge combination effects. *European Review of Agricultural Economics*, 49(5):1086–1112.

Kawamura, Y. and Kusumi, T. (2017). The norm-dependent effect of watching eyes on donation. *Evolution and Human Behavior*, 38(5):659–666.

Kerr, J., Bum, T., Lapinski, M., Liu, R., Lu, Z., and Zhao, J. (2019). The effects of social norms on motivation crowding: experimental evidence from the tibetan plateau. *International Journal of the Commons*, 13(1):430–454.

Löschel, A., Rodemeier, M., and Werthschulte, M. (forthcoming). Can self-set goals encourage resource conservation? Field experimental evidence from a smartphone app. *European Economic Review*.

Máca, V., Ščasnỳ, M., Zvěřinová, I., Jakob, M., and Hrnčíř, J. (2020). Incentivizing commuter cycling by financial and non-financial rewards. *International Journal of Environmental Research and Public Health*, 17(17):6033.

McConky, K., Chen, R. B., and Gavi, G. R. (2018). A comparison of motivational and informational contexts for improving eco-driving performance. *Transportation Research Part F: Traffic Psychology and Behaviour*, 52:62–74.

Mizobuchi, K. and Takeuchi, K. (2013). The influences of financial and non-financial factors on energy-saving behaviour: A field experiment in japan. *Energy Policy*, 63:775–787.

Møller, N. F., Andersen, L. M., Hansen, L. G., and Jensen, C. L. (2019). Can pecuniary and environmental incentives via sms messaging make households adjust their electricity demand to a fluctuating production? *Energy Economics*, 80:1050–1058.

Oda, R. and Ichihashi, R. (2016). Effects of eye images and norm cues on charitable donation: A field experiment in an izakaya. *Evolutionary Psychology*, 14(4):1474704916668874.

Osman, M., Schwartz, P., and Wodak, S. (2021). Sustainable consumption: what works best, carbon taxes, subsidies and/or nudges? *Basic and Applied Social Psychology*, 43(3):169–194.

Panzone, L. A., Ulph, A., Hilton, D., Gortemaker, I., and Tajudeen, I. A. (2021a). Sustainable by design: Choice architecture and the carbon footprint of grocery shopping. *Journal of Public Policy & Marketing*, 40(4):463–486.

Panzone, L. A., Ulph, A., Zizzo, D. J., Hilton, D., and Clear, A. (2021b). The impact of environmental recall and carbon taxation on the carbon footprint of supermarket shopping. *Journal of Environmental Economics and Management*, 109:102137.

Pellerano, J. A., Price, M. K., Puller, S. L., and Sánchez, G. E. (2017). Do extrinsic incentives undermine social norms? evidence from a field experiment in energy conservation. *Environmental and Resource Economics*, 67(3):413–428.

Peters, J. L., Sutton, A. J., Jones, D. R., Abrams, K. R., and Rushton, L. (2008). Contour-enhanced meta-analysis funnel plots help distinguish publication bias from other causes of asymmetry. *Journal of clinical epidemiology*, 61(10):991–996.

Peth, D., Mußhoff, O., Funke, K., and Hirschauer, N. (2018). Nudging farmers to comply with water protection rules–experimental evidence from germany. *Ecological Economics*, 152:310–321.

Riggs, W. (2017). Painting the fence: Social norms as economic incentives to non-automotive travel behavior. *Travel Behaviour and Society*, 7:26–33.

Rodemeier, M. and Löschel, A. (2020). The welfare effects of persuasion and taxation: Theory and evidence from the field.

Rosenfield, A., Attanucci, J. P., and Zhao, J. (2020). A randomized controlled trial in travel demand management. *Transportation*, 47(4):1907–1932.

Schall, D. L., Wolf, M., and Mohnen, A. (2016). Do effects of theoretical training and rewards for energy-efficient behavior persist over time and interact? A natural field experiment on eco-driving in a company fleet. *Energy Policy*, 97:291–300.

Schram, A. and Charness, G. (2015). Inducing social norms in laboratory allocation choices. *Management Science*, 61(7):1531–1546.

Soregaroli, C., Ricci, E. C., Stranieri, S., Nayga Jr, R. M., Capri, E., and Castellari, E. (2021). Carbon footprint information, prices, and restaurant wine choices by customers: A natural field experiment. *Ecological Economics*, 186:107061.

Sudarshan, A. (2017). Nudges in the marketplace: The response of household electricity consumption to information and monetary incentives. *Journal of Economic Behavior & Organization*, 134:320–335.

Vellinga, R., Eykelenboom, M., Olthof, M., Steenhuis, I., de Jonge, R., and Temme, E. (2022). Less meat in the shopping basket. the effect on meat purchases of higher prices, an information nudge and the combination: a randomised controlled trial. *BMC Public Health*, 22(1):1137.

Vesely, S. and Klöckner, C. A. (2018). How anonymity and norms influence costly support for environmental causes. *Journal of Environmental Psychology*, 58:27–30.

Vesely, S., Klöckner, C. A., Carrus, G., Chokrai, P., Fritsche, I., Masson, T., Panno, A., Tiberio, L., and Udall, A. M. (2022). Donations to renewable energy projects: The role of social norms and donor anonymity. *Ecological Economics*, 193:107277.

Wadehra, S. and Mishra, A. (2018). Encouraging urban households to segregate the waste they generate: Insights from a field experiment in Delhi, India. *Resources, Conservation and Recycling*, 134:239–247.

Weng, Q. and Carlsson, F. (2015). Cooperation in teams: The role of identity, punishment, and endowment distribution. *Journal of Public Economics*, 126:25–38.