Evidence-based Decision Making

Interventions: A taxonomy

Rui Mata, FS 2024

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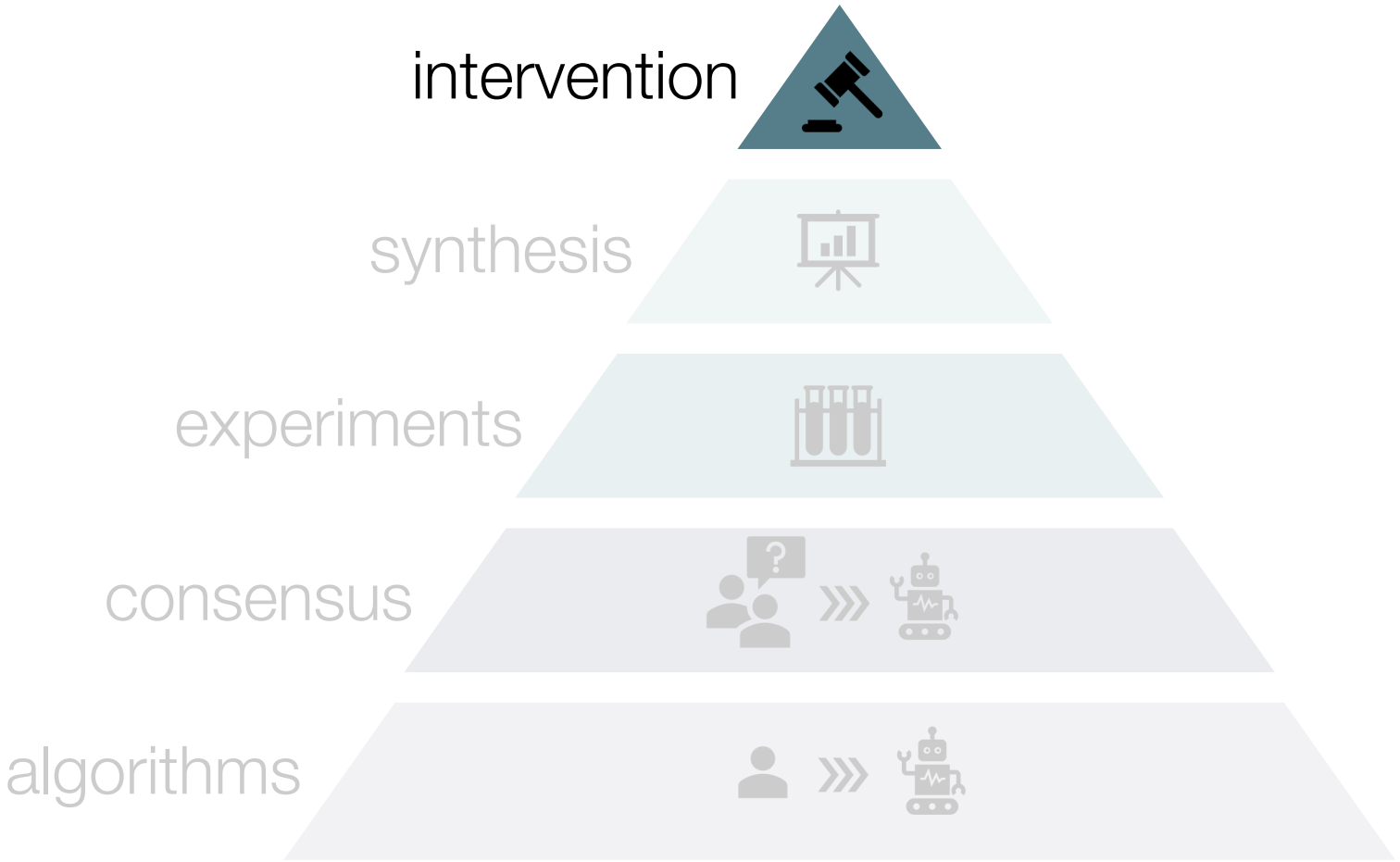
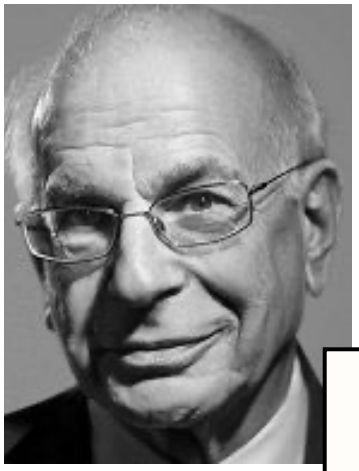

intervention
synthesis
experiments
consensus
algorithms

Goals for today

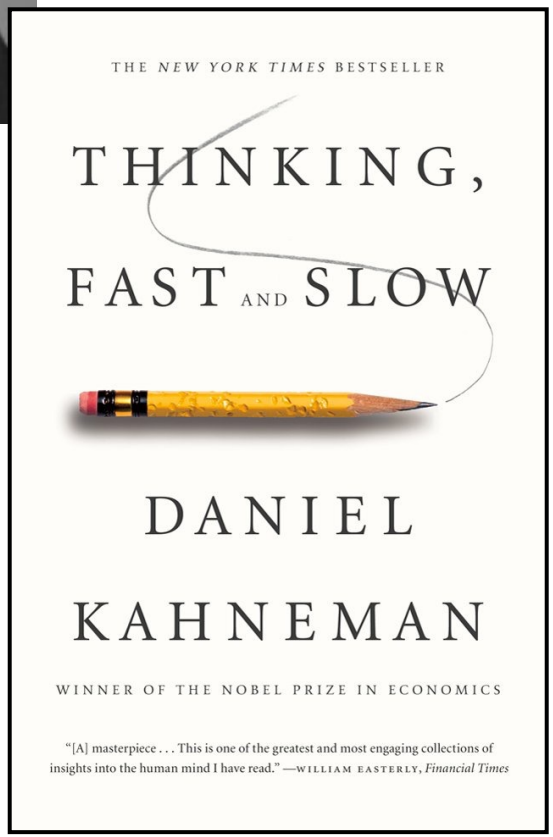
- Become familiar with the concept of nudging and its history
- Discuss conceptual and empirical strengths/weaknesses of nudging
- Become familiar with a comprehensive taxonomy of behavioural interventions - the behavioural change wheel
- Discuss the links between a taxonomy and ontology of behavior change

Behavioral sciences to the rescue!



Daniel Kahneman

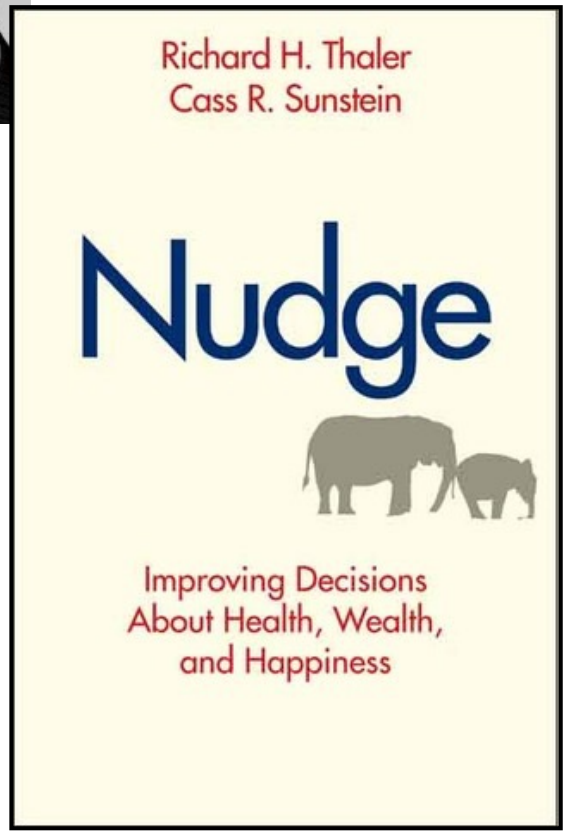
2002 Nobel Memorial Prize in Economic Sciences



2011

Richard Thaler

2017 Nobel Memorial Prize in Economic Sciences

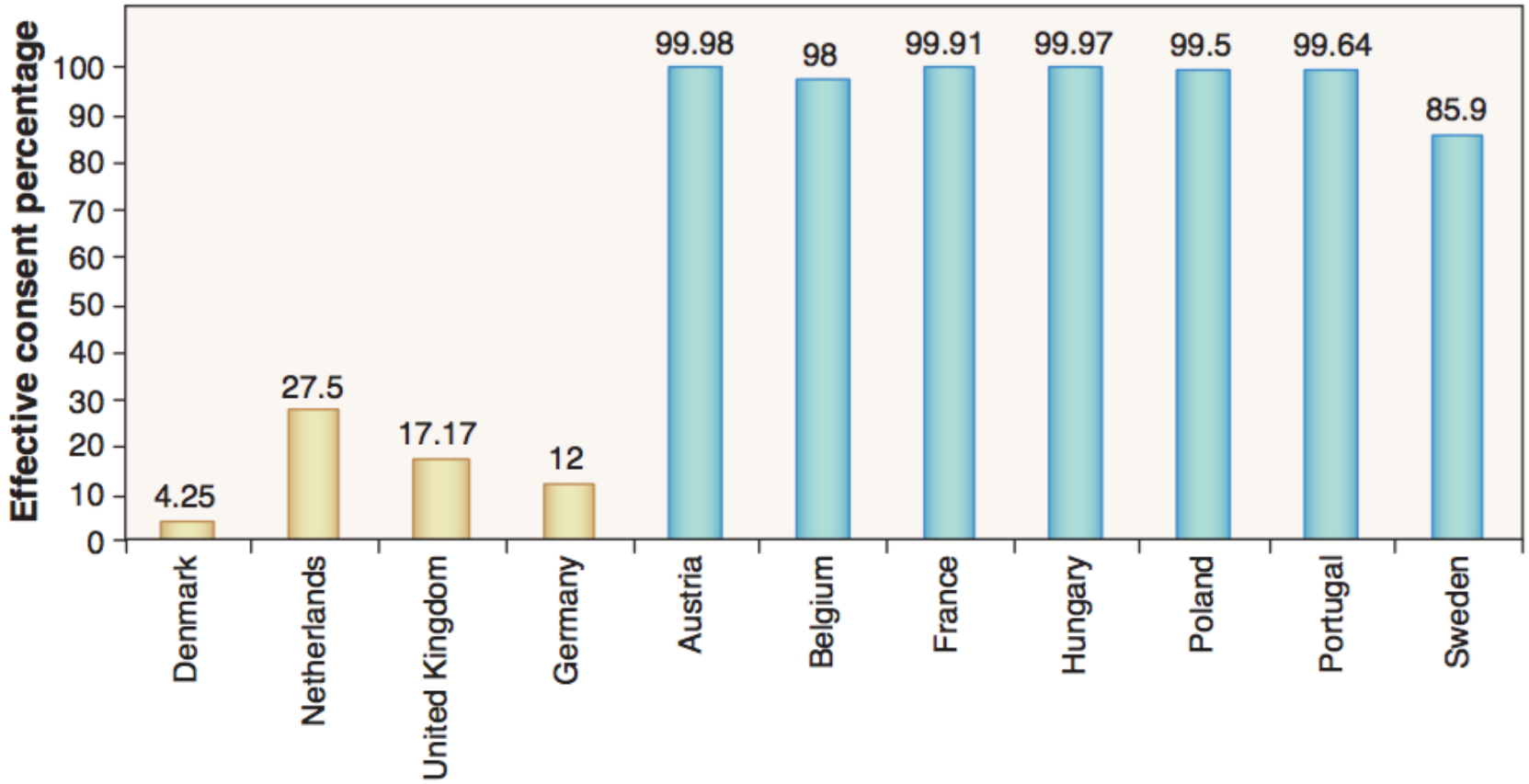


2008

Nudges

Thaler, R., & Sunstein, C. (2008). Nudge: Improving decision about health, wealth, and happiness.

Nudges



Effective consent rates, by country. Explicit consent (opt-in, gold) and presumed consent (opt-out, blue).

Johnson, E. J., & Goldstein, D. (2003). Do defaults save lives? ***Science, 302***(5649), 1338–1339.

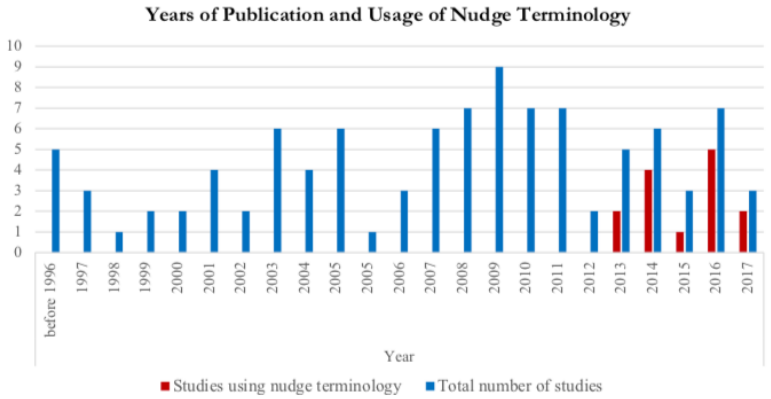
Nudges

1. help decision makers achieve a desired goal
2. exploit known cognitive/motivational shortcomings
3. affect features over which people claim not to care about (e.g., position in a list, defaults, framing)
4. are in principle reversible, allowing the chooser to decide freely

Grüne-Yanoff, T., & Hertwig, R. (2015). Nudge versus Boost: How coherent are policy and theory? *Minds and Machines*, 1–35.

Old wine in new bottles?

Nudge category	Number	Example
A. Decision information		
A1 Translate information	9 (7%)	Emphasizing consequences for patients of proper hand hygiene (Grant & Hofmann, 2011)
A2 Make information visible	23 (19%)	Suggesting alternatives when clinicians propose antibiotics (Meeker et al., 2016)
A3 Provide social reference point	7 (6%)	Showing general practitioners that they prescribe more antibiotics than their peers (Hallsworth et al., 2016)
B. Decision structure		
B1 Change choice defaults	9 (7%)	Changing the default for tests from optional to preselected (Olson et al., 2015)
B2 Change option-related efforts	8(6%)	Putting medical tools in line of sight (hand hygiene dispensers) (Nevo et al., 2010)
B3 Change range or composition of options	10 (8%)	Grouping tests on order forms or displaying them individually (Kahan et al., 2009)
B4 Change option consequences	4 (3%)	Asking for accountable justifications (Meeker et al., 2016)
C. Decision assistance		
C1 Provide reminders	28 (23%)	Putting reminders on operating room schedules (Patterson, 1998)
C2 Facilitate commitment	5 (4%)	Hanging poster-sized commitment letters including photographs and signatures (Meeker et al., 2014)
Other (Multifaceted)	21 (17%)	Providing cues through posters and stickers in a schematic breast shape with space for recording three mammography referrals on charts (Grady, Lemkau, Lee & Caddell, 1997)
Total (n)	**124**	(This is higher than the number of studies as some studies addressed multiple nudges.)



Nagtegaal, R., Tummers, L., Noordegraaf, M., & Bekkers, V. (2019). Nudging healthcare professionals towards evidence-based medicine: A systematic scoping review. Journal of Behavioral Public Administration, 2(2), 1–20. http://doi.org/10.30636/jbpa.22.71

Efficacy: How effective is nudging?

Table 1
Overview of existing literature reviews and quantitative analyses on nudging.

Reference	Context	Main variable	#Papers	Method	Exemplary results
Abrahamse et al. (2005)	Energy	Household energy conservation	38	SLR	Information results in higher knowledge levels, but not necessarily in behavioral change or save energy
Skov et al. (2013)	Health	Eating behavior in self-service settings	12	SLR	Labeling, plate and cutlery size, assortment and other manipulations associated with healthier food choices
Arno and Thomas (2016)	Health	Adult dietary behavior	37	SLR & QA	Nudges resulted in average 15.3 % increase in healthier dietary or nutritional choices
Adam and Jensen (2016)	Health	Obesity related interventions at supermarkets	42	SLR	Most studies reported that store interventions were effective in promoting purchase of healthy food
Bucher et al. (2016)	Health	Positional influences	15	SLR	Manipulating food product order & proximity can influence food choice
Wilson et al. (2016)	Health	Healthy food and beverage choices	13	SLR	Mixed effectiveness of nudging healthier food and beverage choices
Mirsch et al. (2017)	Digital	Digital Nudging	65	SLR	Psychological mechanisms that underlie digital nudging
Lycett et al. (2017)	Health and education	Children's dietary behaviors in the home	40	SLR	Studies showed improvement in dietary behaviors and were more effective in older children
Cadario and Chandon (2018)	Health	Healthy eating nudges	78	QA	Experiments yields a moderate but significant overall effect size (d = 0.28)
Benartzi et al. (2017)	Cross-context	Nudging and tradit. policy tools	18	QA	Nudges often compare favorably with traditional interventions
This study	Cross-context	Overall effect sizes of nudging	100	SLR & QA	See below

Note: SLR = systematic literature review; QA = quantitative analysis

Hummel, D., & Maedche, A. (2019). How effective is nudging? A quantitative review on the effect sizes and limits of empirical nudging studies. Journal of Behavioral and Experimental Economics, 80, 47–58. http://doi.org/10.1016/j.socec.2019.03.005

Efficacy: How effective is nudging?

Dimension	Characteristic								
Setting (100)	Conventional (68)					Digital (32)			
Choice architecture tool (304)	Structuring the choice task (117)					Describe choice options (187)			
Category (290)	Default (60)	Simpli-fication (12)	Social ref. (49)	Change effort (41)	Disclosure (18)	Warnings/ graphics (55)	Precommit-ment (6)	Reminders (34)	Implement. Intent. (8)
Application context (96)	Health (38)	Environment (19)	Finances (12)	Energy (10)	Policy Making (10)				
Clusters of outcomes (317)	Energy consumption (18)	Healthy products chosen or purchase (60)	Sales of environmentally friendly products (43)	Amount donated (20)	Other (176)				
Data collection (291)	Online experiment (46)	Lab experiment (47)	Field experiment (150)	Experiment (other) (6)	Survey (experiment) (42)				
Significance (308)	Insignificant effect (118)			Significant effect (190)					
Magnitude (273)	Low (<10%) (78)		Medium (10%-30%) (81)		High (>30%) (112)				

Fig. 2. Morphological box of empirical nudging studies including counting.

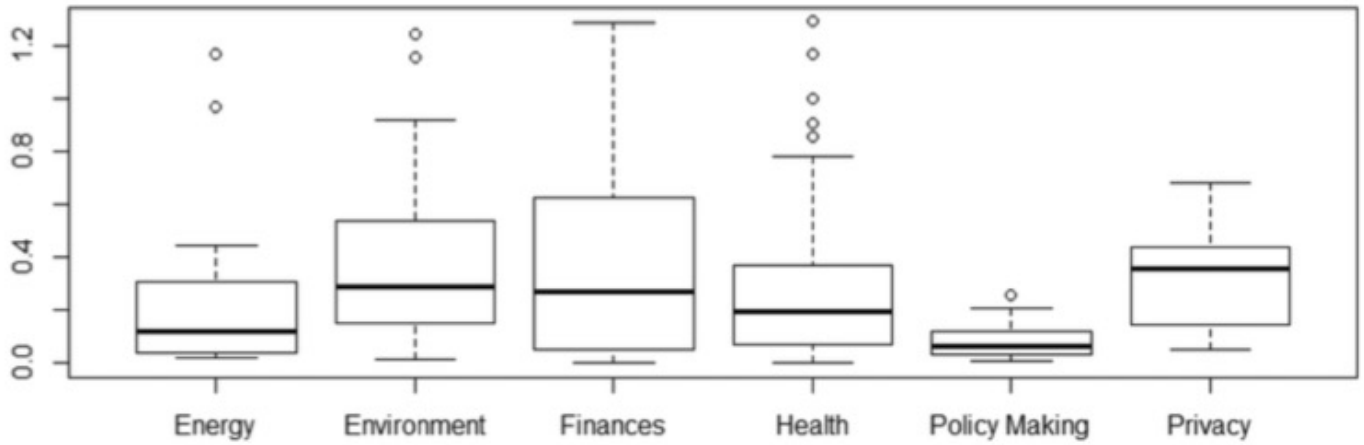


Fig. 4. Boxplot of relative effect sizes per context.

Hummel, D., & Maedche, A. (2019). How effective is nudging? A quantitative review on the effect sizes and limits of empirical nudging studies. Journal of Behavioral and Experimental Economics, 80, 47–58. http://doi.org/10.1016/j.socec.2019.03.005

Efficacy: How effective is nudging?

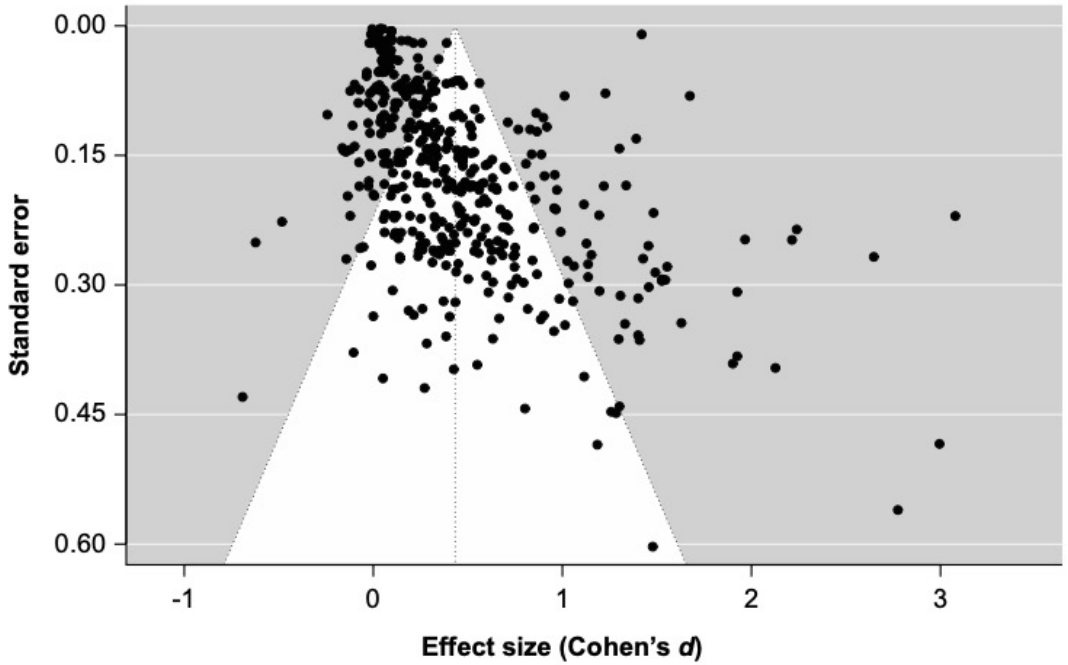


Fig. 3. Funnel plot displaying each observation as a function of its effect size and SE. In the absence of publication bias, observations should scatter symmetrically around the pooled effect size indicated by the gray vertical line and within the boundaries of the 95% confidence intervals shaded in white. The asymmetric distribution shown here indicates a one-tailed publication bias in the literature that favors the reporting of successful implementations of choice architecture interventions in studies with small sample sizes.

Mertens, S., Herberz, M., Hahnel, U. J. J., & Brosch, T. (2022). The effectiveness of nudging: A meta-analysis of choice architecture interventions across behavioral domains. Proceedings of the National Academy of Sciences, 119(1), e2107346118. https://doi.org/10.1073/pnas.2107346118

Efficacy: How effective is nudging?

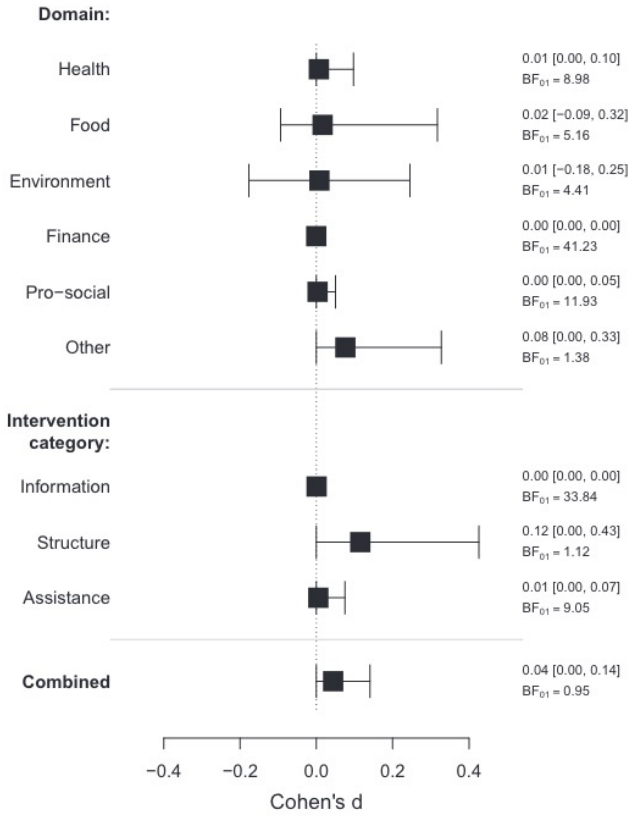
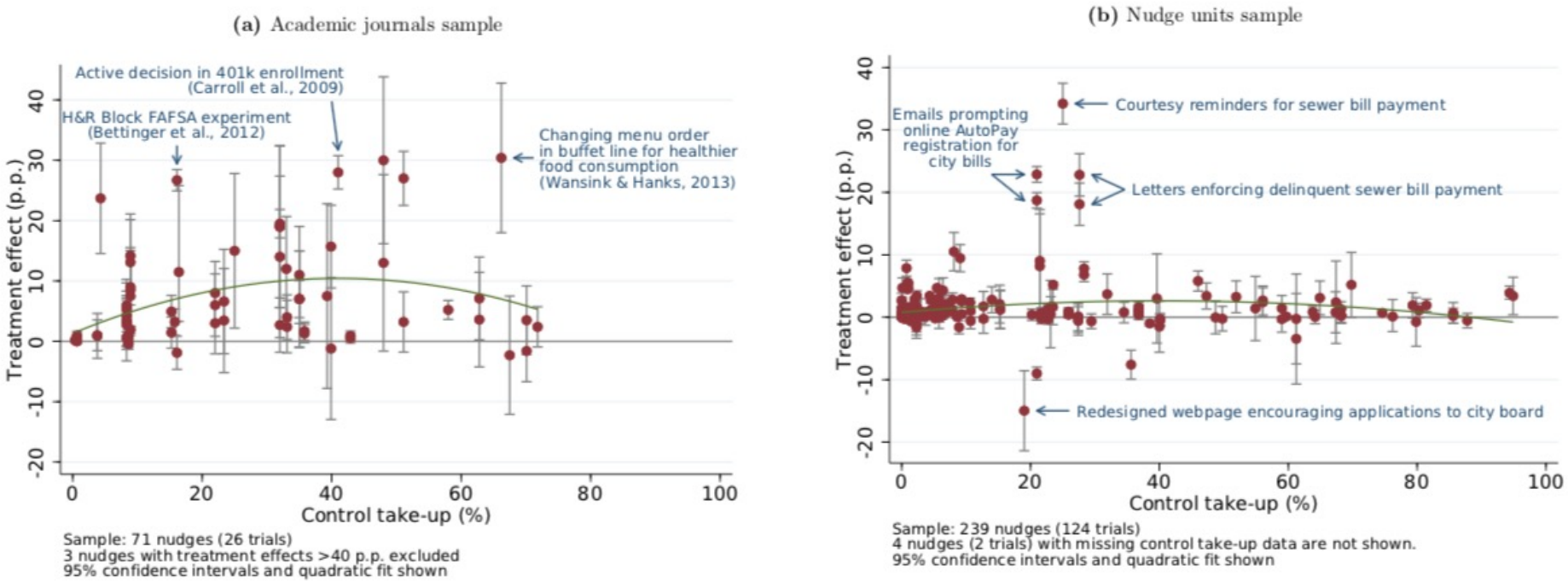


Fig. 1. RoBMA$_{PSMA}$ model-averaged posterior mean effect size estimates with 95% credible intervals and Bayes factors for the absence of the effect for the combined sample or split by either the domain or intervention category (ignoring the clustering of SEs). BF_{01} quantifies evidence for the null hypothesis. BF_{01} larger than one corresponds to evidence in favor of the null hypothesis, and BF_{01} lower than one corresponds to evidence in favor of the alternative hypothesis (evidence for the alternative hypothesis can be obtained by reciprocating the Bayes factor; $BF_{10} = 1/BF_{01}$). As a rule of thumb, Bayes factors between 3 and 10 indicate moderate evidence, and Bayes factors larger than 10 indicate strong evidence.

Maier, M., Bartoš, F., Stanley, T. D., Shanks, D. R., Harris, A. J. L., & Wagenmakers, E.-J. (2022). No evidence for nudging after adjusting for publication bias. *Proceedings of the National Academy of Sciences*, *119*(31), e2200300119. https://doi.org/10.1073/pnas.2200300119

Efficacy vs. Effectiveness? No, publication bias…



We assemble a unique data set of 126 RCTs covering 23 million individuals, including all trials run by two of the largest Nudge Units in the United States. We compare these trials to a sample of nudge trials in academic journals from two recent meta-analyses. In the Academic Journals papers, the average impact of a nudge is very large—an 8.7 percentage point take-up effect, which is a 33.4% increase over the average control. In the Nudge Units sample, the average impact is still sizable and highly statistically significant, but smaller at 1.4 percentage points, an 8.0% increase. We document three dimensions which can account for the difference between these two estimates: (i) statistical power of the trials; (ii) characteristics of the interventions, such as topic area and behavioral channel; and (iii) selective publication. A meta-analysis model incorporating these dimensions indicates that selective publication in the Academic Journals sample, exacerbated by low statistical power, explains about 70 percent of the difference in effect sizes between the two samples. Different nudge characteristics account for most of the residual difference.

DellaVigna, S., & Linos, E. (2022). RCTs to Scale: Comprehensive Evidence From Two Nudge Units. *Econometrica*, *90*(1), 81–116. https://doi.org/10.3982/ECTA18709

Cost-benefit analysis

Article	Intervention type	Treatment	Impact	Cost	Relative effectiveness
Carroll, Choi, Laibson, Madrian, & Metrick (2009)	Nudge	New employees at a company were required to indicate their preferred contribution rate in a workplace retirement-savings plan within their first month of employment.	$200 increase in savings-plan contributions per employee[a]	$2 per employee for distributing the form and for following up with employees who did not respond	$100 increase in savings-plan contributions per $1 spent[a]
Chetty, Friedman, Leth-Petersen, Nielsen, & Olsen (2014)	Traditional (financial incentive)	The Danish government changed the tax deduction for contributions to one type of pension account for the roughly 20% of earners who were in the top tax bracket.	$540 (27) change in contributions to the affected pension account per person affected	$195 change in government revenue per person affected	$2.77 (0.14) change in contributions to the affected pension account per $1 spent
Duflo & Saez (2003)	Traditional (education)	Monetary inducements were offered to employees of a large university for attending a benefits fair where they would receive information about the retirement savings plan.	$58.95 increase in savings-plan contributions per employee[a]	$4.04 per employee for monetary inducements	$14.58 increase in savings-plan contributions per $1 spent[a]
Duflo, Gale, Liebman, Orszag, & Saez (2006)	Traditional (financial incentive)	Clients preparing a tax return at offices in low- and middle-income neighborhoods in St. Louis, Missouri, were offered 20%, 50%, or no matching contributions for the first $1,000 of additional contributions to a retirement savings account.	20% match: $93.6 (9.0) in incremental contributions per person; 50% match: $244.5 (12.8) in incremental contributions per person	20% match: $16.70 in matching dollars per person; 50% match: $82.40 in matching dollars per person	20% match: $5.59 (0.54) increase in contributions per $1 spent; 50% match: $2.97 (0.16) increase in contributions per $1 spent
Duflo, Gale, Liebman, Orszag, & Saez (2007)	Traditional (financial incentive)	The U.S. federal government increased the tax credit on the first $2,000 of retirement savings from 20% to 50% when adjusted gross income dropped below a specified threshold.	$11.6 (1.00) increase in retirement-account contributions per person	$9.35 increase in tax credits per person	$1.24 (0.11) increase in retirement-account contributions per $1 spent

Benartzi, S., Beshears, J., Milkman, K. L., Sunstein, C. R., Thaler, R. H., Shankar, M., et al. (2017). Should Governments Invest More in Nudging? Psychological Science, 28(8), 1041–1055. http://doi.org/10.1177/0956797617702501

Beyond nudges: A taxonomy of interventions

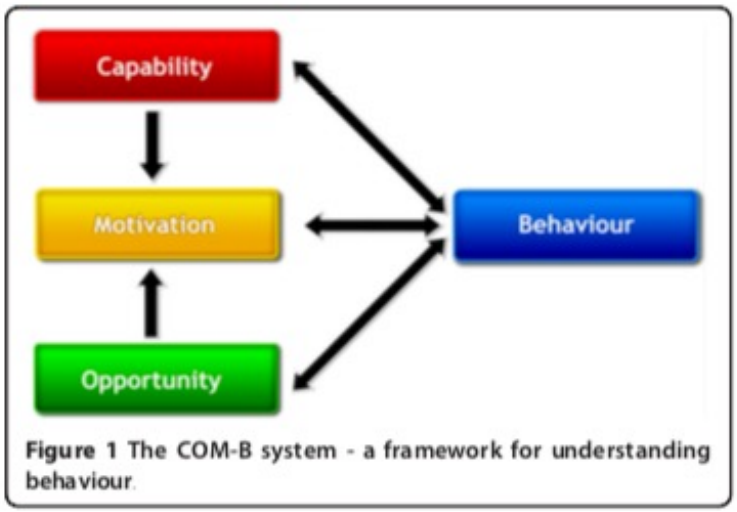
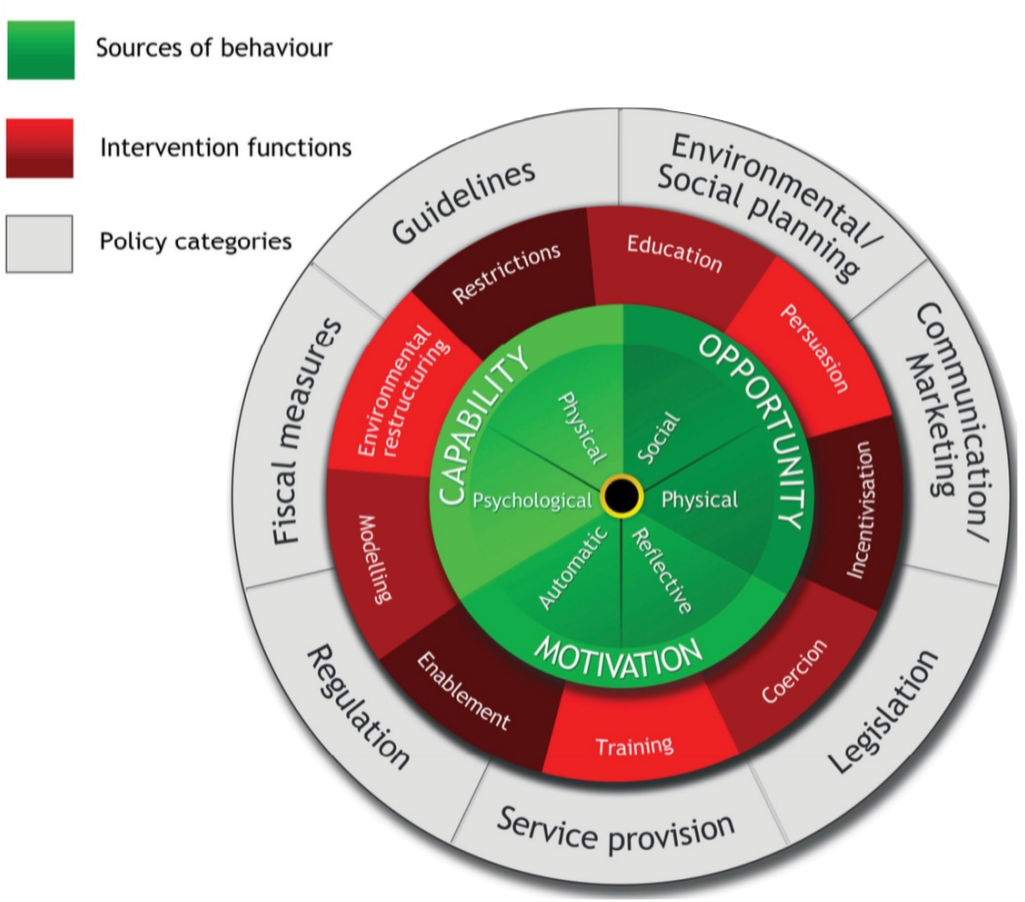


Figure 1 The COM-B system - a framework for understanding behaviour.



Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. ***Implementation Science, 6***(1), 42.

Beyond nudges: A taxonomy of interventions

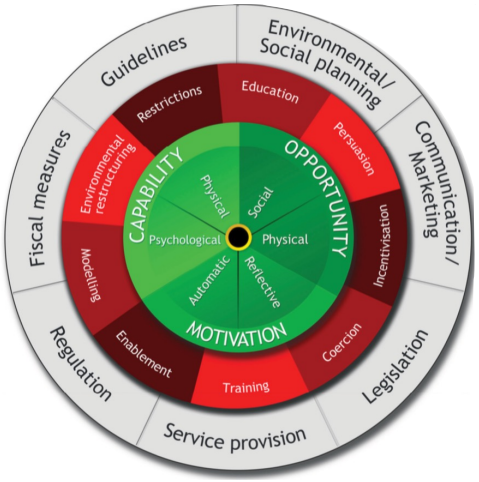


Table 1 Definitions of interventions and policies

Interventions	Definition	Examples
Education	Increasing knowledge or understanding	Providing information to promote healthy eating
Persuasion	Using communication to induce positive or negative feelings or stimulate action	Using imagery to motivate increases in physical activity
Incentivisation	Creating expectation of reward	Using prize draws to induce attempts to stop smoking
Coercion	Creating expectation of punishment or cost	Raising the financial cost to reduce excessive alcohol consumption
Training	Imparting skills	Advanced driver training to increase safe driving
Restriction	Using rules to reduce the opportunity to engage in the target behaviour (or to increase the target behaviour by reducing the opportunity to engage in competing behaviours)	Prohibiting sales of solvents to people under 18 to reduce us for intoxication
Environmental restructuring	Changing the physical or social context	Providing on-screen prompts for GPs to ask about smoking behaviour
Modelling	Providing an example for people to aspire to or imitate	Using TV drama scenes involving safe-sex practices to increas condom use
Enablement	Increasing means/reducing barriers to increase capability or opportunity[1]	Behavioural support for smoking cessation, medication for cognitive deficits, surgery to reduce obesity, prostheses to promote physical activity

Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. ***Implementation Science, 6***(1), 42.

Beyond nudges: A taxonomy of interventions

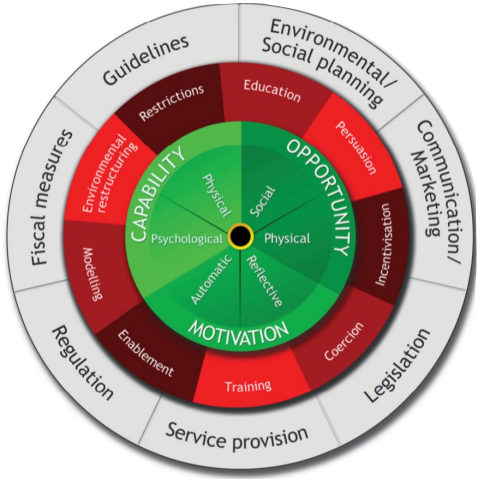


Table 2 Links between the components of the 'COM-B' model of behaviour and the intervention functions

Model of behaviour: sources	Education	Persuasion	Incentivisation	Coercion	Training	Restriction	Environmental restructuring	Modelling	Enablement
C-Ph					√				√
C-Ps	√				√				√
M-Re	√	√	√	√					
M-Au		√	√	√			√	√	√
O-Ph						√	√		√
O-So						√	√		√

1. Physical capability can be achieved through physical skill development which is the focus of training or potentially through enabling interventions such as medication, surgery or prostheses.
2. Psychological capability can be achieved through imparting knowledge or understanding, training emotional, cognitive and/or behavioural skills or through enabling interventions such as medication.
3. Reflective motivation can be achieved through increasing knowledge and understanding, eliciting positive (or negative) feelings about behavioural target.
4. Automatic motivation can be achieved through associative learning that elicit positive (or negative) feelings and impulses and counter-impulses relating to the behavioural target, imitative learning, habit formation or direct influences on automatic motivational processes (*e.g.*, via medication).
5. Physical and social opportunity can be achieved through environmental change.

Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science, 6*(1), 42.

From taxonomy to ontology

Taxonomy: A classification system for organizing interventions into ordered categories, based, for example, on underlying principles or mechanisms, facilitating the understanding and comparison of interventions.

Ontologies: An advanced framework that extends taxonomies by detailing unique identifiers, definitions, and their complex relations. For example, whereas a taxonomy could express a parent–child relationship, such as 'intention is_a mechanism of action', an ontology allows for more complex and multiple relationships, such as 'intention is_part_of mechanism of action' and 'is_measured_by self-report.

Name	Quality assessment				
	Clear definitions	Clear structure	Logically consistent	Evaluated	Maintained
COGAT[24]	To some extent	To some extent	Yes	No	Yes
CogPO[32]	To some extent	Yes	Yes	No	No
EmotionsOnto[33]	No	To some extent	Yes	Yes	No
MFOEM[34]	Yes	Yes	Yes	No	Yes
EPO[35]	No	Yes	Yes	No	Yes
ExO[31]	Yes	Yes	Yes	No	Yes
HBCO[38]	No	To some extent	No	No	No
DOID[29]	Yes	Yes	Yes	No	Yes
MFOMD[27]	Yes	Yes	Yes	No	Yes
MF[25]	Yes	Yes	Yes	No	Yes
NBO[26]	Yes	Yes	Yes	No	Yes
ND[28]	Yes	Yes	Yes	No	Yes
OMRSE[36]	Yes	Yes	Yes	No	Yes
SMASH[37]	No	Yes	No	Yes	No
SYMP[30]	Yes	Yes	Yes	No	Yes

"This review has identified several ontologies […]. However, none meets the criteria for an ontology of human behaviour or of behaviour change interventions, meaning there is scope for developing such an ontology"

Norris, E., Finnerty, A. N., Hastings, J., Stokes, G., & Michie, S. (2019). A scoping review of ontologies related to human behaviour change. Nature Human Behaviour, 3(2), 164–172. https://doi.org/10.1038/s41562-018-0511-4

Summary

- **Nudging:** “Nudges” is an heterogenous (ill-defined?) category of interventions that arose from the collaboration between psychology and economics (i.e., techniques that help decision makers achieve a desired goal by using features over which people claim not to care about; in line with libertarian paternalism by leading to reversible decisions);
- **Limitations of nudges**: Current evidence suggests an overall inflated estimate of the efficacy of “nudges” from the academic literature; real-world deployment in field studies shows small but significant efficacy at low cost when deployed at scale.
- **Behavioral change wheel**: The behavioural change wheel presents a taxonomy of behavioural interventions developed based on a delphi method, which can encompass “nudges” and provide a larger tool-kit of interventions.
- **From taxonomies to an accepted ontology**: various taxonomies and ontologies of behavior change exist; more work is needed to achieve a consensus definition of behavior change techniques, associated mechanisms, and outcome measures that can unite the different proposals and help cumulative progress.

Course evaluation

Link to be added