Food Policy 110 (2022) 102298

Contents lists available at ScienceDirect

Food Policy

journal homepage: www.elsevier.com/locate/foodpol

Review: Do green defaults reduce meat consumption?

Johanna Meier [a,*], Mark A. Andor [b], Friederike C. Doebbe [c], Neal R. Haddaway [d,e], Lucia A. Reisch [f,g]

[a] Ruhr University Bochum – Universitätsstraße 150, 44801 Bochum, Germany
[b] RWI - Leibniz Institute for Economic Research – Hohenzollernstraße 1-3, 45128 Essen, Germany
[c] Stockholm School of Economics, DMO, Misum – Sveavägen 65, 113 83 Stockholm, Sweden
[d] Leibniz Centre for Agricultural Landscape Research (ZALF) – Eberswalder Straße 84, 15374 Müncheberg, Germany
[e] Africa Centre for Evidence, University of Johannesburg – Johannesburg, South Africa
[f] Copenhagen Business School, MSC – Dalgas Have 15, 2000 Frederiksberg, Denmark
[g] Cambridge Judge Business School, University of Cambridge – Trumpington Street, Cambridge CB2 1AG, United Kingdom

ARTICLE INFO

Keywords:
Defaults
Meat consumption
Food policy
Behavioural intervention
Climate change
Evidence synthesis

ABSTRACT

Meat consumption and production cause a significant share of greenhouse gas (GHG) emissions in the food sector. Behavioural food policy suggests using defaults – i.e., pre-setting a specific choice option – as an effective demand-side instrument to reduce meat consumption. This systematic review compiles, critically appraises, and synthesises existing empirical evidence on defaults that aim to reduce meat consumption. Beyond that, the underlying mechanisms and potential effect moderators in this context are explored. Our synthesis includes twelve individual studies comprising sixteen different default interventions. Although the extent of evidence is limited, we assess the quality to be relatively good. We find that defaults are effective in nudging consumers to eat less meat; despite heterogeneity in the design and implementation of interventions, virtually all studies find the default to reduce meat consumption. Moreover, our explorative analysis provides insights into how the default works in this context. First, we suppose the default primarily operates through the underlying mechanisms of endorsement and effort. Second, we identify four contextual moderators – namely the default's invasiveness, the recognisability and presentation of the alternative, and the objective of the study setting – that appear to influence the impact. We conclude that defaults are a promising tool for climate-sensitive food policy. Future research could verify and quantify the causal impact of mechanisms and moderators, and assess defaults' long-term and large-scale effectiveness.

1. Introduction

To meet Paris Agreement targets, substantial reductions in greenhouse gas (GHG) emissions are necessary across sectors, including global food systems (Clark et al., 2020; Lawrence and Friel, 2020; Science Advice for Policy by European Academies, 2020). Current diets and the production practices that support them put extensive pressure on the environment, contributing markedly to anthropogenic GHG emissions and environmental degradation generally (Garnett, 2011; Intergovernmental Panel on Climate Change, 2019). While supply-side changes are important, demand-side dietary changes are expected to be critical (Poore and Nemecek, 2018; Springmann et al., 2018). Prior research suggests that reductions in animal protein consumption are essential, as even those animal products with the lowest environmental impacts exceed the average environmental impacts of plant-based alternatives; therefore, reducing meat consumption – ruminant meat specifically – holds considerable benefits for the environment in general and climate in specific (Clark and Tilman, 2017; Poore and Nemecek, 2018). In addition to environmental and climate concerns, health and animal welfare concerns further justify the political goal of regulating meat consumption (Bonnet et al., 2020). To promote the necessary shift towards less meat-intensive diets, effective, scalable, and robust food policies are needed.

Here, we systematically review existing evidence on default interventions that aim to reduce meat consumption, including fish. Default interventions are one of the most commonly discussed behavioural policies, whereby a particular choice option is pre-set to simplify and steer decisions (Shafir, 2013; Sunstein, 2014). As such, the default is the

* Corresponding author.
E-mail address: johanna.meier@rub.de (J. Meier).

https://doi.org/10.1016/j.foodpol.2022.102298
Received 13 August 2021; Received in revised form 30 May 2022; Accepted 3 June 2022
Available online 11 June 2022

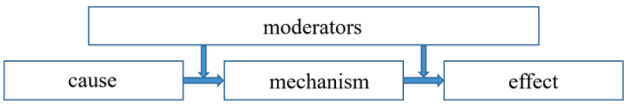

Fig. 1. Basic structure of experimental studies on behavioural interventions. Adapted from van Kleef and van Trijp (2018).

option in a choice set that individuals will automatically receive unless they actively opt-out and choose another option. They are found to be impactful in various decision-making contexts (Hummel and Maedche, 2019; Jachimowicz et al., 2019), for instance, in increasing the signup for organ donation (Johnson and Goldstein, 2003), and participation in retirement savings programs (Madrian and Shea, 2001). Several individual studies show that defaults also have the potential to reduce meat consumption.

The present review aims to systematically compare these studies to understand the robustness of the effect and to explore the underlying mechanisms and moderators that affect effect sizes in this decision-making context. We find that defaults can nudge consumers to reduce meat consumption and seem to primarily operate through the underlying mechanisms of endorsement and effort, i.e., the default being perceived as the recommended or socially expected option or constituting the easiest choice to make. Moreover, we identify four contextual moderators that appear to systematically alter the impact, namely the default's invasiveness, the recognisability and presentation of the alternative, and the objective of the study setting, which affects the intention with which individuals engage in the setting.

The paper proceeds as follows: In the subsequent Section 2, we embed our paper in the context of prior research and provide a theoretical framework. Section 3 outlines our methodology. In Section 4, we synthesise the study results and explore underlying mechanisms and moderators. Section 5 discusses our findings by providing key learnings, limitations of the study, and recommendations for future research and policy. Section 6 concludes.

2. Defaults and meat consumption

Eligible and potentially effective policy instruments to reduce meat consumption include regulatory tools such as regulations and requirements, price policies, public procurement, information provision like dietary guidelines, and education (Bonnet et al., 2020). Behavioural interventions aim to subtly prompt the choice of a particular option within a set of alternatives through choice architecture, i.e., a careful design of the decision-making setting to promote the desired behaviour (Sunstein, 2020; Thaler and Sunstein, 2021). Choice architecture can be used as a policy tool by itself; moreover, applying behavioural knowledge can make traditional instruments more effective and thus complement these policies (Carlsson et al., 2021). Holding the ability to attain potentially large impacts while being choice-preserving, inexpensive, fast and easy to implement (Sunstein, 2014; Thaler and Sunstein, 2021) as well as widely socially accepted (Sunstein et al., 2019), the use of so-called nudges has been discussed in the context of environmental policies (Carlsson et al., 2021) and increasingly within food policies (Bonnet et al., 2020; Reisch, 2021).

Defaults are among the most discussed behavioural policies and have proven their effectiveness in various decision-making settings (Hummel and Maedche, 2019; Jachimowicz et al., 2019). So-called *green defaults* have been found to encourage more sustainable consumption, e.g., promoting the uptake of green energy (Ebeling and Lotz, 2015; Kaiser et al., 2020; Liebe et al., 2021; Pichert and Katsikopoulos, 2008) and energy-saving behaviour (Brown et al., 2013; Heydarian et al., 2016; Hirst et al., 2013), increasing installation rates of smart-grid technology (Broman Toft et al., 2014; Ölander and Thøgersen, 2014) and the selection of energy-efficient light bulbs (Dinner et al., 2011), as well as reducing paper consumption when printing (Egebark and Ekström, 2016).

In the context of food choices, defaults differ from many other (green) default applications in two important dimensions: First, they do not address a one-time decision with potential long-term consequences or commitments such as decisions for the uptake of green energy or smart-grid installation. Instead, individuals make many food choices every day and can decide differently each time again. Thereby, individuals tend to choose fast and intuitively rather than based on careful considerations (Wansink and Sobal, 2007). Second, as will be shown in our analysis, in many default interventions applied in the context of food choice, individuals do not automatically receive a specific meal or product in the absence of choice; while the default is the promoted option, they still need to actively decide for or at least confirm it.

In regards to meat consumption, several literature reviews on behavioural interventions have been published recently (Bianchi et al., 2018a; Bianchi et al., 2018b; Byerly et al., 2018; Harguess et al., 2020; Taufik et al., 2019; Vandenbroele et al., 2020; Wynes et al., 2018). These reviews provide an overview of which interventions are mostly employed and suitable to nudge consumers to eat less meat. Most identify the implementation of defaults as one possible intervention, yet none of them specifically analyses their effectiveness and the mechanisms or moderators influencing their impact in this context. Two other reviews exclusively examine defaults but are not designed to analyse their ability to influence food choices (Jachimowicz et al., 2019; Lemken, 2021). Instead, these reviews investigate the effectiveness of defaults across various domains such as environment, consumer choice, and health, along with their underlying psychological mechanisms (Jachimowicz et al., 2019), or their taxonomic design characteristics and ethical implications (Lemken, 2021).

2.1. Default mechanisms and moderators

Following van Kleef and van Trijp (2018), experimental studies testing behavioural interventions can be structured into four main components: cause, effect, process, and moderation. *Cause* refers to the specific change in choice architecture, i.e., the implemented intervention. *Effect* relates to the key measure of interest, i.e., the choices made in the changed decision-environment. *Process* refers to the underlying mechanisms that drive human decision-making, such as biases and heuristics, and mediate the relationship between cause and effect. This relationship is further affected by *moderation*; so-called moderators are influencing factors at the individual or contextual level that determine for whom and how the intervention works. They can influence the relationship between cause and effect by triggering a particular mechanism or can work independently of it. Fig. 1 illustrates the basic structure of this framework.

In regards to the process, prior research suggests that the effect of defaults can be mainly attributed to three underlying mechanisms: effort, endorsement, and endowment (Dinner et al., 2011; Jachimowicz et al., 2019): *Effort* relates to individuals sticking with the default and relying on the status quo due to this being easier for them and not requiring the effort to evaluate other options. Reasons for this can be consumers' inertia and/or cognitive or attentional limitations. *Endorsement* refers to individuals assuming that the choice architect implemented the default in their best interest and is therefore perceived as a recommendation. Similarly, the default is sometimes interpreted as the choice that is socially expected. Both effort and endorsement are particularly relevant when the decision is perceived as complicated or when morality plays a role. *Endowment* suggests that the pre-set option establishes an instant 'entitlement', leading to individuals using the default as a reference point for further considerations. This relates to the human bias of loss aversion, i.e., individuals being more acutely affected by losses than comparable gains. Here, the consumer judges opting out of the default as a loss compared to the pre-set option.

Despite their importance for understanding for whom the default works and how, little is known about specific individual and contextual

Table 1
Bibliographic databases and search information.

Database	Platform	Library subscription	Search string used	Search restrictions
ABI/Inform Collection	ProQuest	London School of Economics	full Boolean	2019–01-01 – 2020–31-12; everything except full-text
Academic Search Premier	EBSCO	Ruhr University Bochum	full Boolean	2019–01-01 – 2020–31-12; none
Business Source Premier	EBSCO	Ruhr University Bochum	full Boolean	2019–01-01 – 2020–31-12; none
International Bibliography of the Social Sciences (IBSS)	ProQuest	London School of Economics	full Boolean	2019–01-01 – 2020–31-12; everything except full-text
Medline and associated databases	NCBI	Ruhr University Bochum	full Boolean	2019–2020; none
PAIS Index	ProQuest	Ruhr University Bochum	full Boolean*	2019–01-01 – 2020–31-12; everything except full-text
PsycInfo	APA	Ruhr University Bochum	full Boolean	2019–2020; none
Scopus	Elsevier	Ruhr University Bochum	full Boolean	2019–2020; only title-abstract-keywords
Sociological Abstracts	ProQuest	Ruhr University Bochum	full Boolean	2019–01-01 – 2020–31-12; everything except full-text
Web of Science Core Collections**	Clarivate	Ruhr University Bochum	full Boolean	2019–2020; none

The date of search for all databases was 4th January 2021.
*: indicates the "$" in the search string was changed to "?" due to database requirements.
**: Web of Science ™ Core Collection including Science Citation Index Expanded (1945-present), Social Sciences Citation Index (1956-present), Arts & Humanities Citation Index (1975-present), Conference Proceedings Citation Index-Science (1990-present), Conference Proceedings Citation Index- Social Science & Humanities (1990-present), BIOSIS Previews ® (1926-present), MEDLINE ® (1950-present).

moderators that might influence the default effect. As these moderators are highly specific to the study population and decision-making situation, their generalisability into other default intervention settings might also be limited. Yet, knowledge of which moderators may systematically alter the default effect in a specific context is crucial to support the design of successful interventions. While data on the individual level is needed to investigate individual moderators, e.g., underlying attitudes and preferences, contextual moderators might also be explored by retrospectively comparing studies that took place in a similar decision-making setting.

Building on the important contributions from previous research, the present systematic review is, to the best of our knowledge, the first to investigate the use and potential of defaults to effectively reduce meat consumption and to explore the mechanisms and moderators that might influence this impact.

3. Methods

This systematic review was conducted following the guidelines for evidence synthesis made available by the Collaboration for Environmental Evidence (Collaboration for Environmental Evidence, 2018). An a priori systematic review protocol outlining our planned methods following the Reporting Standards for Systematic Evidence Syntheses (Haddaway et al., 2018) was published on the Open Science Framework (see Meier et al., 2020). Minor deviations from this protocol are described in Notes A.1 in Appendix A.

3.1. Literature search

This review is partly based on a previously published systematic map of behavioural interventions for reducing GHG emissions in food consumption (Reisch et al., 2021). Defaults were one of twelve behavioural intervention types identified in the map. We updated the database by Reisch et al. (2021) to identify relevant articles published up to and including December 2020. We followed the search strategy of the systematic map and outline minor deviations in Notes A.2 in Appendix A. Literature searches were performed in bibliographic databases, a search engine for scholarly literature, an academic journal considered to be highly relevant, and a theses repository. Moreover, we conducted supplementary searches on specialist websites and in the bibliographies of recent reviews on the topic of interest. We intentionally included grey literature, that is, documents published by non-commercial publishers like organisational and governmental publications and academic theses, to address potential publication bias, i.e., the preferential publication of studies with positive or significant results in academic journals leading to a distorted depiction of existing evidence. Table 1 provides an overview of the search terms used for the core search in academic databases. Full details on the search strings and terms used in other resources are provided in Tables A.1 through A.4 in Appendix A.

3.2. Literature screening

Search results were screened for eligibility to be included in our data set at three successive levels, namely at title, abstract, and full-text level, following a set of predetermined inclusion criteria. The criteria were developed along with the so-called PICO criteria (Collaboration for Environmental Evidence, 2018), an acronym for *population*, *intervention*, *comparator*, and *outcome,* and extended by the two additional elements *framing* and *study type* as described in the systematic map (Reisch et al., 2021). Eligible studies had to fulfil each of the PICO-FS inclusion criteria (see Table A.5 in Appendix A). A list of all articles excluded at full-text level with exclusion reasons is provided in Supplementary data 1 in Appendix B. Literature search and screening were conducted by one of the authors involved in the same tasks for the systematic map (see Reisch et al. (2021) for details on the extensive consistency checking for the map).

3.3. Data extraction

Studies included after screening were combined with studies from the published systematic map to produce an updated database. We provide the complete updated database containing relevant descriptive information (meta-data) and study findings (quantitative or qualitative data) from all full-texts for the research community in Supplementary data 2 in Appendix B. Where necessary, supplementary materials, linked publications, or contact with authors were used to impute study data. Data extraction was conducted by one author and cross-checked by another author. The updated database was then filtered to identify the studies that investigated the effect of a default intervention.

3.4. Critical appraisal

Critical appraisal was conducted to assess each default study's risk of bias. The tool used was developed based on the Cochrane risk-of-bias assessment tools (Sterne et al., 2019; Sterne et al., 2016) and adapted to fit the research question of this review. Seven assessment categories contained several questions designed to identify possible risks of bias in the study. The assessment categories were as follows: the selection of study subjects, deviations from intended interventions, missing data,

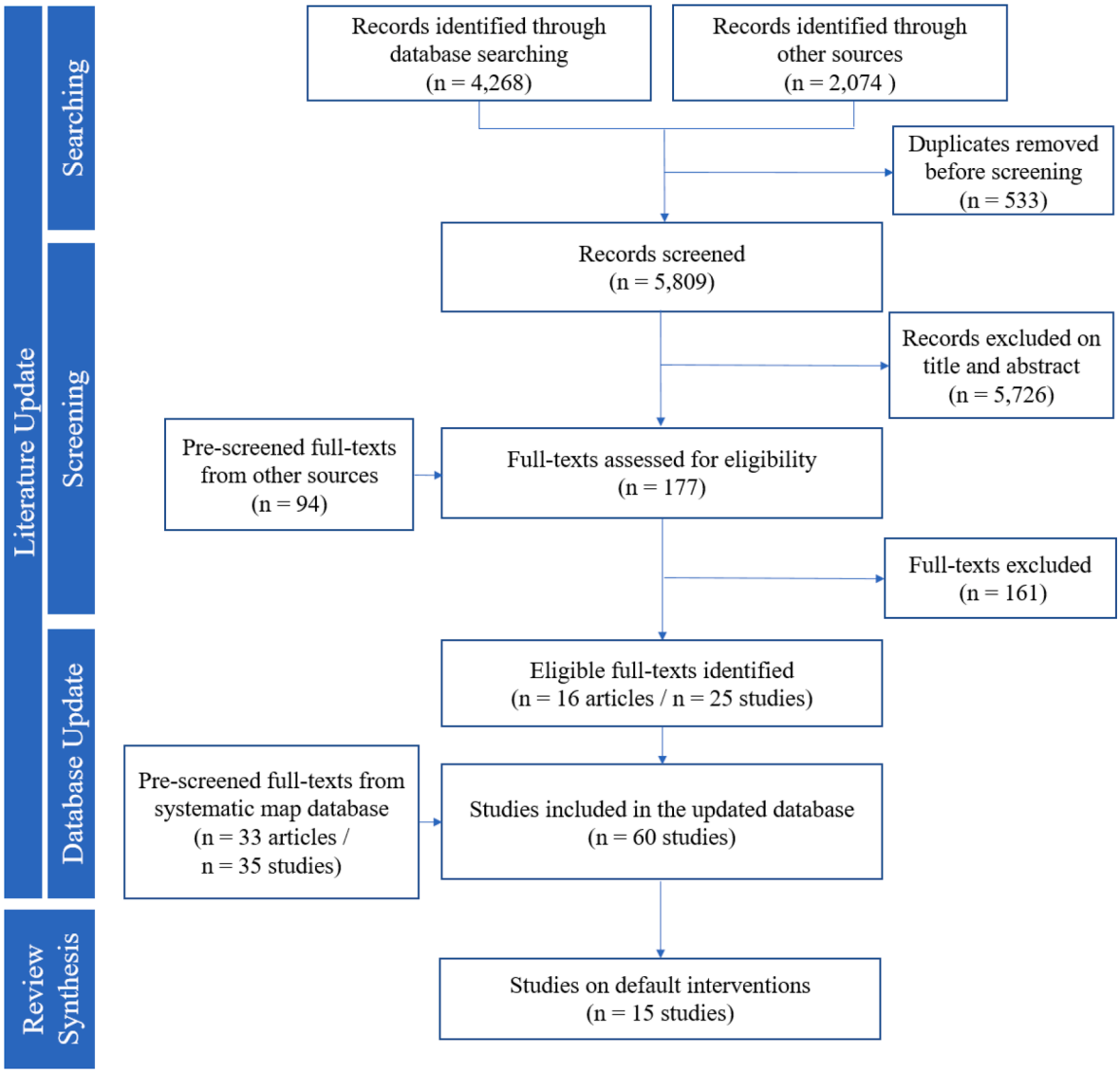

Fig. 2. Flow diagram showing the number of articles/studies at each stage of the review.

confounding factors, methods and measurements, selection of reported results, and other. The category 'other' was introduced to address individual study aspects not covered by the previous assessment. For each category, the risk of bias was assessed as low, moderate (i.e., raising some concerns), or high. Each study's overall risk of bias was then evaluated across categories as low, moderate, serious, or critical. Each study was critically appraised by at least two authors independently. Assessments were compared and deviations discussed until an agreed-upon judgment was reached. The appraisal tool and evaluations of all studies are provided in Supplementary data 3 in Appendix B.

3.5. Research synthesis

We first analysed the study characteristics of the evidence base, which comprised all articles identified that investigated default interventions. We then used the critical appraisal results to exclude studies deemed to have critical risk of bias from our final synthesis. For the synthesis, we first investigated the effectiveness of interventions. Afterwards, we took an exploratory approach to investigate relevant mechanisms and moderators.

4. Results

Through the literature update process, we identified ten articles comprising 15 independent studies investigating default interventions aimed at reducing meat consumption (Campbell-Arvai et al., 2014; Gravert and Kurz, 2019; Hansen et al., 2019; Leenaert, 2012; Leidig, 2012; Lorenz-Walther et al., 2019; Reinders et al., 2017, 2020; Vandenbroele et al., 2018; Stewart et al., 2016). Fig. 2 illustrates the number of records included and excluded throughout the stages of the process.

4.1. Description of the evidence base

An overview of the characteristics of all studies identified through the literature update process (before exclusion based on critical appraisal) is presented in Table 2. Article publication dates reveal growing academic interest in the effects of default interventions in the context of meat consumption in recent years. Targeted populations in all studies were individual consumers in real-life out-of-home food choice environments, e.g., when eating out in restaurants, canteens, or cafeterias, or when purchasing food in the supermarket. A similar share of studies investigated interventions that implemented either a default meat-free meal or menu or reduced the default portion size of the meat

Table 2
Overview of study characteristics.

Study characteristics	Number of studies	Study characteristics	Number of studies
Publication dates		Populations	
2012	2	individual consumers	15
2014	1	Intervention designs	
2016	1	default meat-free meal/ product	8
2017	1	reduced meat portion size	7
2018	1	Comparators	
2019	5	treatment–control group design	6
2020	4	pre-post intervention design	8
Study locations (country)		cross-over design	1
Belgium	2	Outcomes	
Denmark	3	number of meat(-free) meals/products chosen	7
Germany	1	amount of meat consumed	5
Netherlands	5	other	3
Sweden	1	Locations	
United Kingdom	1	canteen/cafeteria/ restaurant	9
United States of America	2	supermarket	1
		other	5
Study characteristics	**Min./max. values**	**Risk of bias assessment**	**Number of studies**
Sample sizes		low	2
smallest	66	moderate	9
largest	3,195	serious	2
Study durations		critical	2
shortest	1 day		
longest	6 months		

component within a meal or product. Studies used treatment–control group designs and before-after intervention comparisons as the method of evaluation. All studies were conducted in the Global North, with the majority of studies presenting evidence from European countries. Meat consumption was measured by the number of respective options chosen or by weighing of leftovers. Almost all studies measured actual consumption, i.e., targeted individuals received (and paid for) their chosen options. Sample sizes and study durations varied considerably among studies.

As a result of the individual critical appraisal of each study, we excluded three of the fifteen studies from full synthesis. As previously outlined in the review protocol, studies deemed to be at critical risk of bias were excluded from the final synthesis of the review. This was the case for two studies (Leenaert, 2012; Leidig, 2012), which lacked critical information, namely missing data and/or unclear intervention and outcome measures, such that the intervention effect and study validity were difficult to determine. In addition, a third study had to be excluded (Lorenz-Walther et al., 2019). Although the study was rated at serious risk of bias – and would therefore be included according to our protocol – it had to be excluded because the reported outcome did not specify whether food leftovers were meat or vegetables.

Fig. 3 presents an overview of the final synthesis sample. As illustrated, the numbers of articles, studies, and interventions differ since two articles contain more than one study: Hansen et al. (2019) and Reinders et al. (2020) investigate three and four studies, respectively. Moreover, Campbell-Arvai et al. (2014) and Reinders et al. (2020) investigate more than one intervention within one study. For better traceability throughout our following explanations, we assign an individual number to each intervention (Intervention Identification - IID) (see Fig. 3).

Of the remaining twelve studies eligible for full synthesis, two were deemed to be at low risk of bias (Gravert and Kurz, 2019 [IID5];

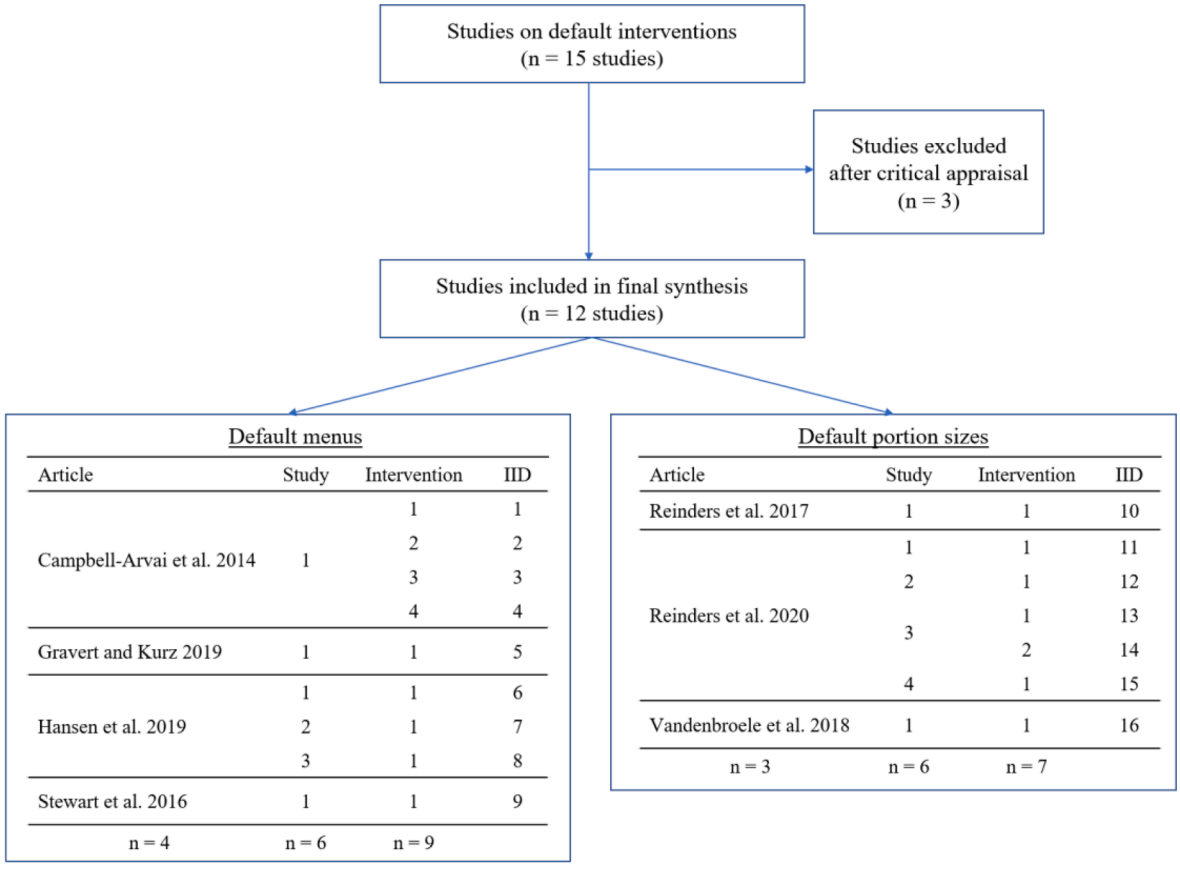

Fig. 3. Overview of final analysis sample.

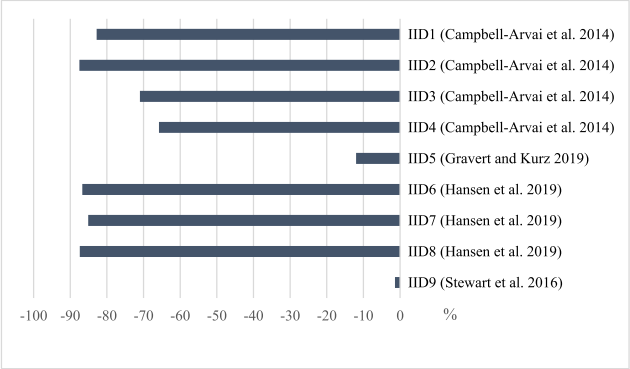

Fig. 4. Percentage change reductions in meat consumption induced by default menus.

Vandenbroele et al., 2018 [IID16]), nine were categorised to be at moderate risk (Campbell-Arvai et al., 2014 [IID1-4]; Hansen et al., 2019 [IID6-8]; Reinders et al., 2020 [11–15]; Reinders et al., 2017 [IID10]), and one at serious risk of bias (Stewart et al., 2016 [IID9]). Differences that distinguished studies rated to be at low risk of bias from those at moderate or serious risk of bias were mainly risks of potential self-selection and response bias, as participation in the experiment or survey was voluntary (Campbell-Arvai et al., 2014 [IID1-4]; Reinders et al., 2020 [IID11-15]; Reinders et al., 2017 [IID10]). Note that our critical appraisal indicates the study's validity relative to our study aims, yet studies might be rated differently if based on different evaluation criteria.

4.2. Effectiveness of interventions

In the following, we briefly outline the design and effectiveness of tested interventions. As depicted in Fig. 3, we group studies according to the default design, i.e., either the implementation of a default meat-free menu or a reduction in default meat portion size.

4.2.1. Default menus

Four articles comprising six studies tested the effect of default menus in nine different interventions. All of these studies used the number or share of meat(-free) options chosen as the measure of outcome.

Campbell-Arvai et al. (2014) [IID1-4] tested the effect of four different default interventions in a university canteen by presenting either appealing or unappealing vegetarian options in a meat-free default menu along with or without the provision of information. The menu presented five different meat-free meals and a hint to a second menu containing other meals. For all interventions, results showed that participants who were asked to choose a meal from the vegetarian default menu decided to order a meat option substantially less often than those who chose from the non-vegetarian default menu. In the appealing vegetarian default menu condition [IID1-2], 10.3% and 7.5% of participants selected a meal containing meat in the "default-only" and "default + information" conditions, respectively, compared to 60% in the control condition. For unappealing vegetarian meals [IID3-4], 26.8% and 31.6% of participants chose a meal containing meat in the "default-only" and "default + information" conditions, respectively, compared to 92.5% in the control condition.

In the study by Gravert and Kurz (2019) [IID5], a restaurant menu was rearranged with the vegetarian meal presented first, followed by a fish option and a note that another meat option was available upon request. While the share of mammal meat meals chosen decreased from 45.7% to 21.4%, the share of fish meals chosen increased from 50.9% to 63.6% in the meat and vegetarian menu condition, respectively. Overall, results showed that the default decreased the share of meat meals (including fish) chosen from 96.6% in the meat menu condition to 85% in the vegetarian menu condition.

Hansen et al. (2019) [IID6-8] report the findings of three studies from three conferences. The intervention in all studies was a vegetarian lunch default in the conferences' electronic registration form. In the experimental condition, conference participants were presented a vegetarian lunch buffet as default with the option to indicate their preference to get a non-vegetarian buffet instead. The vegetarian default decreased non-vegetarian buffet selection from 98%, 94%, and 87.5%, respectively, in the non-vegetarian default condition, to 13%, 14%, and 11%, respectively, in the vegetarian default condition.

In the study by Stewart et al. (2016) [IID9], the existing default meal setting in the booking system of a college was changed from the standard option containing meat to vegetarian. Orders of meat meals dropped from 85.7% to 83.9% on average. The results were not statistically significant, yet the reason for this could be the study's low sample size of 66 booked meals, which was one of the major reasons the study's risk of bias was assessed to be serious, along with sparsely reported results.

Overall, while effect sizes vary, all studies implementing default menus found the default to decrease consumers' meat consumption. Fig. 4 illustrates the percentage change in meat consumption induced by the respective intervention.

4.2.2. Default portion sizes

Three articles comprising six studies with seven different default interventions examined the effect of a reduced default meat portion size, either as a meal component or in a single product.

Reinders et al. (2017) [IID10] reduced the portion sizes of meat by 12.5% while simultaneously doubling the amount of vegetables contained in the main dishes of a restaurant. Results showed that mean meat consumption decreased by approximately 13%, while mean vegetable consumption increased by 87%.

The article by Reinders et al. (2020) [IID11-15] contained four studies, one of which investigated two interventions [IID13-14]. In the first study [IID11], meat portions were decreased in selected meals offered in a restaurant by 12% on average, while portion sizes of vegetables were increased by 31%. The intervention lowered median meat consumption by 13% and raised median vegetable consumption by 14%. In the second study [IID12], sandwiches offered in company canteens were adapted to contain 34% less meat and 237% more vegetables on average. The measure of outcome in this study was the self-reported amount of sandwich eaten. As the sandwiches were reported as eaten completely, the intervention led to shifts in consumption corresponding to exactly the portion size modifications. The third study [IID13-14] adjusted meals to contain 14% less meat and 100% more vegetables in a self-service restaurant setting. While customers were not made aware of the changes in portion sizes during the first intervention [IID13], they were during the second intervention [IID14]. That is, they were asked directly to choose between the two versions, i.e., a meal with adapted or regular portion sizes. The first intervention [IID13] led to a reduction in median meat consumption by 12% and an increase in median vegetable consumption by 99%. When customers were given the choice between two options [IID14], 35% opted for the adapted version, resulting in 5% less meat and 35% more vegetables consumed. In the fourth study [IID15], the buffet in a restaurant was modified by a replacement of some dishes containing meat with completely meat-free dishes and by halving the meat portion size in another dish, leading to an average reduction of meat of 87.5%. As a result, the median meat consumption was 4% lower and the median vegetable consumption 113% higher.

In a supermarket setting, Vandenbroele et al. (2018) [IID16] added two smaller portion size versions of meat sausages to the supermarket assortment with a reduction in meat portion size of 17% and 33% compared to the regular product version. Results showed that the additional portion sizes made up 52% of product sales during the treatment period and led to 13% less meat sold compared to the control.

Overall, all studies reducing default meat portion sizes found the default to decrease meat consumption, yet sometimes deviating

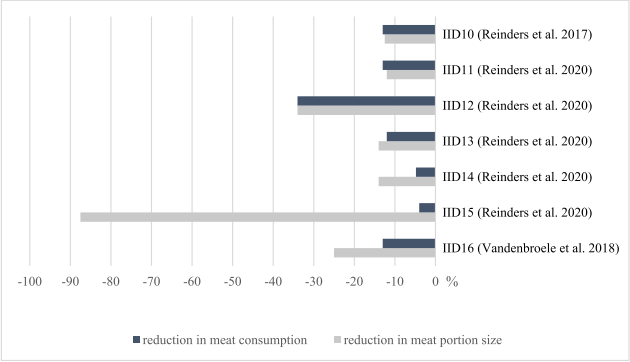

Fig. 5. Percentage change reductions in meat consumption induced by reduced default portion sizes.

substantially from respective portion size reductions. Fig. 5 illustrates the percentage change in actual meat consumption compared to the respective portion size reduction.

4.3. Exploration of mechanisms and moderators

As illustrated in Figs. 4 and 5, individual study findings show a divergence in effect sizes across studies, also within study groups. Beyond differences in study validity assessed by the critical appraisal, this might be attributed to several other factors. In the following, we explore potential underlying mechanisms and effect moderators.

None of the studies was designed to pin down the underlying mechanism through which the default affected behaviour, i.e., effort, endorsement, or endowment (Dinner et al., 2011; Jachimowicz et al., 2019). While it is not possible to unambiguously identify these mechanisms ex-post, we here investigate their relevance in the studies analysed (as also done by e.g., Altmann et al., 2019; Jachimowicz et al., 2019). The contextual moderators are deduced by comparing the different designs and implementations of default interventions across studies. We further complement our explanations with individual-level information provided in the studies.

4.3.1. Underlying mechanisms

One mechanism likely at play in the context of food choice and meat consumption is *endorsement*, which refers to individuals' perception of the default as the recommended or socially expected choice (as described in Section 2.1). Social desirability plays an important role in the context of sustainable food consumption (Cerri et al., 2019). Moreover, the decision (not) to eat meat can be a status choice or moral consideration for some people (de Backer and Hudders, 2015; Feinberg et al., 2019; Hartmann et al., 2018).

From a contextual perspective, endorsement can be determined by the recognisability of options relative to one another, as this determines individuals' awareness of having a choice. For example, regarding the studies on default portion sizes, we see that reductions in meat consumption substantially vary across interventions (see Fig. 5). While this effect is partly predetermined by the given reduction in meat portion size, Fig. 5 also illustrates that study findings can be further divided into two subgroups: (1) studies in which the reduction in meat consumption was roughly equal to the reduction in portion size (Reinders et al., 2020 [IID11-13]; Reinders et al., 2017 [IID10]), and (2) studies in which meat consumption was reduced by substantially less than the portion size change (Reinders et al., 2020 [IID14-15]; Vandenbroele et al., 2018 [IID16]). In the case of the former, the default was designed such that it was highly integrated in the decision-environment. Customers had to decide on a meal or product rather than a portion size; if they selected a targeted meal, they received the modified version, and the reduced meat portion size was most likely recognised only after receiving the meal – if at all. Consequently, the perceived recommendation or social expectation of the default portion size was likely rather high in these studies. By contrast, in the case of the second subgroup, customers had to choose between the different portion sizes of the same meal or product. They were either asked directly whether they would like to receive the regular or modified portion size version of the meal [IID14], they served themselves at a buffet [IID15], or they were presented with all portion size versions of the targeted product next to one another [IID16]. In these studies, the perceived recommendation or social expectation of the default portion size was comparably low since the recognisability of options was not biased towards the desired default but rather neutral between options.

Another important contextual factor related to the mechanism of endorsement can be the way in which the different alternatives in the choice set are presented relative to one another. For instance, comparing effect sizes across default menu studies (see Fig. 4), the largest default effects were found in those studies that presented the control alternative containing meat as rather subordinated compared to the default. For instance, Campbell-Arvai et al. (2014) [IID1-4] tested four different interventions and found reductions in meat consumption between 66% and 85%. The implemented menu presented a default meat-free menu with five meal options and a simple sentence at the bottom of the menu indicating the availability of other options presented on a wall three metres distant. In contrast to the presentation of the meat-free options, there was no further description of the meat options available, e.g., what ingredients or recipes the customers could expect. In fact, the note at the bottom of the menu did not even indicate that the "additional menu items" contained meat. Consequently, the meat-free default was likely perceived as the recommended choice. The same study also revealed that the attractiveness of the default meat-free meals influenced the intervention effect; appealing meat-free menu options [IID1-2] led more individuals to stick to the default than the unappealing ones [IID3-4]. The three studies by Hansen et al. (2019) [IID6-8] found percentage changes in meat consumption between 85% and 87%. The wording used in the conference registration forms "At the conference a vegetarian buffet will be served. Please state if you would like to have a non-vegetarian dish prepared for you" likely led individuals to perceive the meat-free default as the socially expected choice. The study by Gravert and Kurz (2019) [IID5] further supports the importance of the relative presentation of alternatives. The authors found a substantially smaller intervention effect than almost all other studies on default menus. In contrast to the other studies, they presented the fish option on the menu right below the meat-free meal and a statement at the bottom of the menu that an option containing mammal meat was available on request. While the fish option was described with an equal amount of descriptive information as the meat-free option, the mammal meat option was not described further. Consequently, customers likely perceived the fish option as more or less equivalent to the meat-free default, while this was not the case for the mammal meat option. Indeed, results showed that, while overall meat consumption including fish dropped by 12%, the share of mammal meat dishes sold decreased substantially by 53.2%, whereas the sales of fish dishes increased by 25%.

On an individual level, whether individuals consider the default as the recommended choice might be, amongst other factors, determined by their experience in the respective study setting. For example, those customers, who visit a specific restaurant or canteen more frequently, are familiar with the regular menu prior to the intervention. They are thus less likely to perceive the default as a recommendation compared to first-time visitors. Across the studies analysed, Reinders et al. (2017) [IID10] controlled for customer experience in their analysis. While they found that customers, who indicated visiting the restaurant more frequently, tended to consume significantly less vegetables in both control and intervention periods, no significant correlation was found regarding the amount of meat consumed by these customers. Gravert and Kurz (2019) [IID5] found the effect of the default meat-free menu treatment decreasing over time and ascribed this – at least to some

degree – to regular customers reverting to their usual meal choices throughout the intervention period.

In sum, this suggests that the recognisability and presentation of the control alternative relative to the default moderate the default effect in this context. A less recognisable and appealing alternative leads to more individuals sticking with the default. While likely, based on the available evidence, no clear statement can be made as to whether customer experience constitutes an individual moderator.

The mechanism of *effort* seems to be relevant but playing a secondary role in the studies considered. Effort relates to individuals sticking with the default because it constitutes the easiest choice. One reason for this is inertia, i.e., the unwillingness or procrastination to make a decision. From a contextual perspective, the probability of this being a factor differs across the studies analysed as some of them employ default rules while others implement default options. Default rules ensure that individuals who do not make an active choice automatically receive the established default, while default options require individuals' active decision or at least confirmation for the default to apply (Altmann et al., 2019). Across all studies analysed, the majority implemented default options such that most interventions still required the effort of individuals to choose or confirm. Moreover, in these studies individuals entered the respective setting with the intention to eat, either immediately (e.g., restaurants, canteens etc. [IID1-5], [IID10-15]) or in the near future (e.g., meal booking system [IID9] or supermarket [IID16]). As such, it does not seem plausible why individuals would refrain or hesitate to make a choice. Moreover, prior research also suggests that individuals face many food choices every day and tend to base these decisions less on time-consuming information processing and lengthy cognitive deliberation, but follow their habits, rely on simple heuristics and make food decisions rather automatically, fast, and partly unconsciously (Wansink and Sobal, 2007). Yet, beyond the cognitive effort, in some studies, other forms of effort are likely to have supported the default effect. For example, Campbell-Arvai et al. (2014) [IID1-4] implemented a more invasive default that required individuals to physically move to even see the other options offered and find some of the largest default effects (see Fig. 4).

Another factor that can determine the mechanism of effort is attentional limitation. The three studies by Hansen et al. (2019) [IID6-8] constitute an interesting example. The effort to opt-out was comparably low in these studies as it only required a digital entry in the registration form. Still, these studies find the largest reductions in meat consumption (see Fig. 4). We see two potential reasons for this: One reason could be evoked endorsement (as described above), and another reason could be attentional limitations in combination with the implementation of a default rule. As outlined above, all other study settings implemented default options and were entered by individuals with the intention to make a food choice. In these settings, individuals can be expected to have placed more attention to their decision. By contrast, in the studies by Hansen et al. (2019) [IID6-8], individuals' attention was probably more focused on the conference registration itself than on what they would eventually eat at the conference, and those who did not indicate a prefererence for a non-vegetarian lunch were automatically assigned a vegetarian meal.

Beyond the study setting, attention is also likely to be moderated on an individual level. For example, in the study by Vandenbroele et al. (2018) [IID16], individuals' attention could have been on the intention to specifically purchase the targeted product. In contrast, the decision for or against the targeted product could have been only one of many decisions within a larger grocery shopping in the supermarket. Moreover, in settings like restaurants or canteens, it cannot be ruled out that individuals' attention is limited, for example, due to the restaurant visit being part of a business meeting.

In sum, these elaborations suggest that the invasiveness of the default and the objective of the study setting are likely to moderate the default effect. A more invasive default and a lower attention of individuals on food choice are likely to support the default effect. Moreover, individual capabilities are likely to influence whether the effort to opt-out is perceived as high or low.

We suppose the mechanism of *endowment* not to be of high relevance in this context. This mechanism refers to individuals perceiving the default as an implicit entitlement to which they compare the other options available. As in the studies considered, the majority implemented default options rather than default rules. Thus, requiring an active choice or confirmation of the default, individuals' perception of being endowed with the default was presumably relatively low. Moreover, as many people associate eating meat with tradition, pleasure, and satisfaction (Biermann and Rau, 2020; Michel et al., 2021; Piazza et al., 2015), even if the meat-free default were perceived as an endowment, this would not necessarily be perceived positively.

Lastly, it is important to note that the impact of the underlying mechanisms to be induced is also affected by the strength of individuals' attitudes and preferences. Those who strongly prefer a meal or product containing meat (in general or in the specific situation, e.g., due to cravings) are less likely to stick with the meat-free default despite perceived recommendation or increased effort. For example, prior research suggests that, on average, men have a stronger preference to consume meat than women (Daniel et al., 2011; Hayley et al., 2015; Pfeiler and Egloff, 2018; Prattala et al., 2007; Rozin et al., 2012). Three out of four of the analysed studies that collected data on gender found that the tendency to deviate from the meat-free default was significantly higher for men than for women (Campbell-Arvai et al., 2014; Hansen et al., 2019 [IID7-8]). This indicates that within the set of studies synthesised, men seemed to have stronger preferences for meat consumption that were harder to alter by a default.

In sum, we see that for default interventions in the context of meat consumption, the mechanisms of endorsement and effort seem to be of relevance. Thereby, intervention designs triggering the endorsement mechanism lead to the most considerable reductions in meat consumption; those studies that presumably induced higher perceived recommendation or social expectation found the largest default effects, irrespective of whether the effort needed to opt-out was rather high (e.g., Campbell-Arvai et al., 2014 [IID1-4]) or low (e.g., Hansen et al., 2019 [IID6-8]). This finding is in line with prior research showing that defaults operating through endorsement (or endowment) are more effective than defaults operating through effort (Jachimowicz et al. 2019). Moreover, we suggest the evocation of certain mechanisms to be induced by characteristics of the intervention design, i.e., the contextual moderators.

4.3.2. Contextual moderators

Based on the elaborations above, we deduce the following contextual moderators: the invasiveness of the default, the recognisability and presentation of the alternative, and the objective of the setting. As these moderators – just like the mechanisms – are entangled and have a different weight in each intervention, it is difficult to quantify their individual impact on the default effect in each study in this ex-post analysis. Yet, these moderators are likely to influence the induced mechanism and the default effect that is enhanced or impaired by their combination within an intervention.

Invasiveness of the default refers to how easy or difficult it is to choose the meat alternative instead of the default containing less or no meat. It relates to the mechanism of effort and presumably, the more invasive the default, that is, the higher the cognitive or physical effort required to opt-out, the more likely individuals stick with it.

Recognisability of the alternative relates to how easy or difficult it is to notice the availability of the meat alternative (in regular portion size) and thus, being aware of having a choice. It relates to the mechanism of endorsement, and a lower recognisability of the alternative is likely to reduce its probability of being selected and thus, supports the default effect.

Presentation of the alternative refers to the way in which the meat alternative (in regular portion size) is presented relative to the default. It

Table 3
Overview of included studies.

Reference IID	Study design and location	Default design Intervention design	Sample size and study duration	Outcome measure	Main findings (%)	Critical appraisal rating
default meat free menus						
Campbell-Arvai et al. 2014 IID1-4	controlled trial university canteen in East Lansing, Michigan USA	appealing/unappealing default/non-default presentation of meat-free menu items + disclosure/non-disclosure of information about environmental benefits of reduced meat consumption IID1 appeal + default + non-disclosure IID2 appeal + default + disclosure [other conditions: disclosure only / control] IID3 unappeal + default + non-disclosure IID4 unappeal + default + disclosure [other conditions: disclosure only / control]	n = 319 individuals 2 weeks	share of meat-free menu items chosen (%)	IID1 89.7% of participants chose the meat-free menu item IID2 92.5% of participants chose the meat-free menu item [versus 47.5% / 40% in other conditions] IID3 73.2% of participants chose the meat-free menu item IID4 68.4% of participants chose the meat-free menu item [versus 20% / 7.5% in other conditions]	moderate risk of bias
Gravert and Kurz, 2019 IID5	randomised controlled trial restaurant in Gothenburg, Sweden	default/non-default presentation of the daily vegetarian meal	n = 3,195 meals sold 8 weeks	share of vegetarian meals sold (%)	15% of customers chose the vegetarian meal in the vegetarian default condition [versus 3.5% in the meat default condition]	low risk of bias
Hansen et al., 2019 IID6	randomised controlled trial conference registration form, Copenhagen, Denmark	vegetarian/non-vegetarian buffet default in conference's electronic registration form	n = 108 individuals 1 day	share of vegetarian buffets chosen (%)	87% of participants chose the vegetarian option in the vegetarian buffet default condition [versus 2% in the non-vegetarian buffet default condition]	moderate risk of bias
Hansen et al., 2019 IID7	randomised controlled trial conference registration form, Copenhagen, Denmark	vegetarian/non-vegetarian buffet default in conference's electronic registration form	n = 112 individuals 1 day	share of vegetarian buffets chosen (%)	86% of participants chose the vegetarian option in the vegetarian buffet default condition [versus 6% in the non-vegetarian buffet default condition]	moderate risk of bias
Hansen et al., 2019 IID8	randomised controlled trial conference registration form, Copenhagen, Denmark	vegetarian/non-vegetarian buffet default in conference's electronic registration form	n = 110 individuals 1 day	share of vegetarian buffets chosen (%)	89% of participants chose the vegetarian option in the vegetarian buffet default condition [versus 12.5% in the non-vegetarian buffet default condition]	moderate risk of bias
Stewart et al. 2016 IID9	before-after analysis college meal-booking system, Cambridge, United Kingdom	vegetarian/non-vegetarian meal default	n = 66 meals booked 4 weeks	number of vegetarian meals booked	18% (first treatment period) and 11% (second treatment period) of students chose the vegetarian option in the vegetarian default treatment [versus 14% and 17% in meat default]*	serious risk of bias

* Percentage shares were calculated by the authors of this review based on the numbers given in the study

Reference IID	Study design and location	Default design Intervention design	Sample size and study duration	Outcome measure	Main findings (%)	Critical appraisal rating
reduced default meat portion sizes						
Reinders et al. 2017 IID10	cross-over design three restaurants in The Netherlands	12.5% average (avg.) reduction in meat portion size (p-s.)	n = 1,006 individuals 12 weeks	mean of meat consumption[by weighing of leftovers (gram)]	13% reduction in meat consumption [87% increase in vegetable consumption]	moderate risk of bias

(*continued on next page*)

Table 3 (*continued*)

Reference IID	Study design and location	Default design Intervention design	Sample size and study duration	Outcome measure	Main findings (%)	Critical appraisal rating
Reinders et al. 2020 IID11	before-after analysis restaurant in Utrecht, The Netherlands	12% avg. reduction in meat p-s.	n = 182 individuals 16 weeks	median meat/fish consumption[by weighing of leftovers (gram)]	13% reduction in meat/fish consumption [14% increase in vegetable consumption]	moderate risk of bias
Reinders et al. 2020 IID12	before-after analysis six company canteens in The Hague, The Netherlands	34% avg. reduction in meat p-s.	n = 395 individuals 16 weeks	amount of sandwich eaten [self-reported(%)]	34% reduction in meat/fish consumption [237% increase in vegetable consumption]	moderate risk of bias
Reinders et al. 2020 IID13-14	before-after analysis self-service restaurant in Utrecht, The Netherlands	14% avg. reduction in meat p-s. IID13 non-active choice IID14 active choice	IID13 n = 347 individuals 8 days IID14 n = 308 individuals 4 days	median meat/fish consumption[by weighing of leftovers (gram)]	IID13 12% less meat/fish consumed [99% increase in vegetable consumption] IID14 35% of guests actively chose the dish containing less meat/fish and more vegetables	moderate risk of bias
Reinders et al. 2020 IID15	before-after analysis buffet restaurant in The Netherlands	87.5% avg. reduction in meat p-s.	n = 542 individuals 6 days	median meat/fish consumption[by weighing of leftovers (gram)]	4% less meat/fish consumed [113% increase in vegetable consumption]	moderate risk of bias
Vandenbroele et al. 2018 IID16	randomised controlled trial supermarkets in Belgium	17% and 33% reduction in meat p-s. (provision of two additional versions)	n = 1,538 8 weeks	percentage share of different portion sizes sold	13% reduction of meat consumption	low risk of bias

Table 4
Overview of contextual moderators.

Contextual moderator	Description	Impact on default effect		
		[+]	*Examples*	[-]
Invasiveness of the default	the level of ease or difficulty needed not to choose the default	the separate menu presenting the meat alternatives offered was posted on a wall around 3 m distant (Campbell-Arvai et al., 2014 [IID1-4])		the vegetarian lunch default could be changed to non-vegetarian via digital entry in conference registration forms (Hansen et al., 2019 [IID6-8])
Recognisability of the alternative	the extent to which individuals are able to notice the alternative to the default	individuals were not made aware of changed portion sizes (Reinders et al., 2020 [IID13])		individuals were asked whether they would like to get the regular or reduced meat portion size version (Reinders et al., 2020 [IID14])
Presentation of the alternative	how the control alternative is presented (e.g., salience, descriptive information etc.)	a sentence at the bottom of the menu indicated that the mammal meat option was available on request (Gravert and Kurz, 2019 [IID5])		the fish option was presented right below and described with an equal amount of information as the vegetarian option (Gravert and Kurz, 2019 [IID5])
Objective of the setting	the intention with which individuals engage in the setting	registration for an upcoming conference (Hansen et al., 2019 [IID6-8])		restaurant visit (Reinders et al., 2017 [IID10])

also relates to the mechanism of endorsement as it influences individuals' perception of which meals are promoted by the food provider. Presumably, a lower salience and (subjective) appeal of the alternative relative to the default increase the effectiveness of the default.

Objective of the setting relates to the intention with which individuals engage in the respective decision-environment. It relates to the mechanism of effort. A lower intention to make and thus, lower attention on, the food choice is likely to support the default effect.

Table 3 provides an overview of the (non-exhaustive set of) contextual moderators identified and exemplarily illustrates their varying degrees across the studies analysed. A detailed overview of these moderators assessed for all studies is provided in Supplementary data 4 in Appendix Bín Appun. As described above, note that the combination of several influencing factors within each study can explain the variations in effect sizes across studies. Yet, as these are entangled and have a different weight in each intervention, no clear statement can be made at this point about the ways and extent to which each of these factors impacted the effects.

5. Discussion

5.1. Key learnings

Overall, we find that defaults can effectively reduce meat consumption. We realise that the number of studies reviewed is rather small and that the heterogeneity in the application of interventions is large. However, in contrast to many other systematic reviews, we do not find ambiguous results; virtually all studies find significant default effects. Moreover, while the extent of evidence is limited, we assess the quality to be relatively good: Our critical appraisal deemed almost all studies at low or moderate risk of bias.

Beyond effectiveness, our analysis suggests defaults addressing meat consumption to be mediated by the underlying psychological mechanisms of endorsement and effort. Moreover, our comparison across different intervention designs suggests the invasiveness of the default, the recognisability and presentation of the alternative relative to the default, as well as the objective of the setting to operate as contextual moderators. Beyond that, individual moderators such as customer experience, individuals' attitudes and preferences, and gender seem to play a role in this context, but could not be further investigated due to a lack of information and data.

5.2. Limitations and directions for future research

Future research might address the limitations of this review. First, due to language restrictions in our search, our review may have omitted study findings published in languages other than English or German (although the databases searched do translate titles, abstracts, and keywords into English). Second, the climate frame as an inclusion criterion might have led to the exclusion of studies with a different research motivation, e.g., animal welfare or health (Bonnet et al., 2020), that still analysed the intervention effect of interest. Another limitation is that our evidence base may suffer from publication bias. Prior research compares the effect estimates of research on behavioural interventions published in academic journals with those obtained by the research of two nudge units and finds intervention effects in published research to be overstated (yet still having a significant impact) (DellaVigna and Linos, 2022). Although we made an effort to minimise this risk to our findings by intentionally including grey literature (including nudge units), as for every literature review, studies might have been conducted but not detected despite extensive search.

Beyond the limitations of our review, we call for future research to close the prevailing gaps in the literature. Specifically, most studies analyse actual rather than hypothetical meat consumption in field experiments. Field experiments that focus on actual consumption have the advantage that people act in real-world settings: Usually, participants do not know they are part of an experiment, which makes them behave "naturally", i.e., less likely to act in a way they consider socially desirable. Moreover, they also have to face the consequences of their decisions, like paying for their food choice, rather than hypothetically stating a preference. However, a shortcoming of such a study design is the difficulty to collect additional data on participants' characteristics to better understand for whom and how the intervention might work. Studies conducted in the field that rely on questionnaires during or after the intervention to collect more information may suffer from participants' self-selection into the experiment. This in turn, might result in a study sample that is not representative of the target population. Moreover, a questionnaire might raise the awareness of being observed and result in participants changing their natural behaviour. Thus, research in a laboratory setting could complement existing or prepare future field studies to gather more knowledge on the effects of underlying psychological mechanisms and moderators at work in specific contexts. As part of such lab experiments, researchers can collect additional information on participants, such as attitudes and preferences, and have more ability to control the experimental design. Such settings would also allow to verify and quantify the impact of the contextual moderators suggested in this review. Moreover, research designs of field experiments themselves could benefit from even more careful ex-ante and ex-post evaluations, such as interview or survey studies, to improve the design of defaults in the context of meat consumption and to better understand how they work. With regards to these different approaches to examine the same research question, van Kleef and van Trijp (2018) distinguish between three types of studies: proof of principle, proof of concept, and proof of implementation. *Proof of principle* studies typically take place in laboratory settings in which experimental conditions are well controlled, which allows to investigate effectiveness and its causes relatively precisely. *Proof of concept* studies are usually controlled field experiments in which experimental conditions are under less control, but allow to

observe more natural behaviours and thus to explore situational effects and their causes. *Proof of implementation* studies take place in the field and allow for even less controlled experimental conditions but to test the generalisability of findings. The three study types provide different levels of internal and external validity and researchers have to compromise on what is of more interest. Yet, the approaches are complementary. Hence, we suggest researchers to plan their study designs alongside those criteria to enable a comprehensive understanding of the research topic.

In addition, our explorations do not rule out the possibility that other undisclosed factors modified the magnitude of effects. For instance, the overall effect might have been compromised by compensatory behaviours, e.g., in the form of (un)consciously adapted food consumption prior to, within the same, or after the meal targeted by the default intervention. One reason for this behaviour might be dissatisfaction with the meal, i.e., customers anticipating that they will not be satisfied by their meal, therefore ordering more food items than they normally would if they got a meal containing meat. Another explanation might be moral licensing, i.e., customers who chose the meat-free option feeling entitled or even obliged (e.g., due to health considerations) to eat a meal containing (more) meat later. Of the studies analysed, two examined whether customers showed some kind of compensatory behaviour in the same location and did not find evidence for it (Gravert and Kurz, 2019 [IID5]; Vandenbroele et al., 2018 [IID16]). Yet, there is no evidence on whether some of the effect might have been compensated for by increased meat consumption at home or in other locations. From a climate-change perspective (and other environmental perspectives), it is important to reduce levels of meat consumption, particularly in areas of the world where it is overconsumed. Thus, future research in this direction would be valuable.

Another relevant factor for evaluation is the persistence of effects, i.e., whether the intervention effect changes when the default is removed. As defaults do not necessarily evoke cognitive involvement, this might lead to individuals not reflecting on and/or identifying as much with their choice. This lowers the probability of them making the same decision when the intervention is not in place. Moreover, the intervention effect might decrease because of long-term implementation, as individuals might get used to the default as the status quo. None of the studies analysed observed the default effects for longer than six months, which is a rather short period in comparison to other contexts, such as energy conservation (Allcott and Rogers, 2014). Yet, one of the studies analysed supports both considerations. Gravert and Kurz (2019) [IID5] found the treatment effect decreasing over the three-weeks intervention period and meal choices reverting to pre-treatment levels immediately after returning to the original menu. However, other studies show that default treatment effects can be sustained (Venema et al., 2018) or even increase over time (Malhotra et al., 2016) in other contexts. These diverging results imply that the persistence of default effects may also depend on specific moderator effects. Further, it is unclear how defaults to reduce meat consumption might perform at scale. For behavioural interventions in general, there is growing evidence that in the long-term and at scale, the effects decrease considerably (Al-Ubaydli et al., 2017; Al-Ubaydli et al., 2019). Thus, more longitudinal and large-scale research is needed to better understand these effects, an aspect that prior reviews on nudging with other food policy objectives have pointed out as well (Laiou et al., 2021).

Similar to other more explored areas such as energy conservation (Allcott and Kessler, 2019; Andor and Fels, 2018), a critical shortcoming of all studies reviewed in this article is the lack of proper social welfare analysis. The studies observe meat consumption and some relate it to saved GHG emissions, yet little is known about the cost of the interventions. While the monetary cost of defaults is usually small, another argument in this context could be psychological cost – for instance, in the form of a reduction in the pleasure of and satisfaction with food consumption or an increased psychological pressure for more sustainable and/or healthier diets. By collecting data on customer satisfaction, five studies offered some indication in this direction (Reinders et al., 2020 [IID11-15]; Reinders et al., 2017 [IID10]). They found that customers remained (very) satisfied with their restaurant visit and their meal despite changed meat and vegetable portion sizes. These results indicate that the psychological cost might not be very high, but further research in this direction would be desirable.

5.3. Policy implications

In general, systematic maps and reviews can support policymakers in gaining a better understanding of what might work, which risks exist, and which factors to consider when designing evidence-based policies. Systematic evidence syntheses can help policymakers to understand existing research and insights as well as identify core research groups that might be available for commissioned research.

Besides the knowledge gaps mentioned above, the following aspects should be taken into account by policymakers and food scholars: First, the impact of defaults (and behavioural interventions in general) might be different when applied in combination with other policy measures. As they are not intended to replace but rather to complement traditional instruments, reinforcing and competing effects within a given policy mix must be considered (see e.g., Carlsson et al., 2021; Goulder and Parry, 2008). Second, defaults to reduce meat consumption might work differently across different geographical contexts. Consumption of meat is especially high among affluent societies in the “Global North”, but is substantially increasing in developing regions of the “Global South” due to a growing world population and rising incomes (OECD-FAO, 2020). Policymakers need to be aware of cultural differences possibly altering the impact. Third, none of the studies analysed involved participants in the design of the intervention, e.g., through ex-ante evaluations in form of interviews, focus groups or similar. However, co-designing interventions is an important element in relation to public perception and acceptance of policy measures (Sunstein et al., 2019). Allowing for and encouraging scrutiny of and/or participation in the policy development seems particularly reasonable in the context of meat consumption, as many people consider eating less meat as a loss of quality of life. Hence, it is important to take these concerns seriously when designing policies and reduce the perception of limited freedom of (food) choice and avoid invoking associations of abstinence and reduced well-being. Lastly, concerns might be raised about how such interventions can be employed in an ethical and responsible manner (Schubert, 2017). As defaults do not intentionally address individuals’ cognition or attention but rather their habitual behaviour, they differ from other intervention strategies like informational campaigns and education, as well as from behavioural interventions like labelling or giving feedback. This does not exclude the (food) decision being “cross-checked” by individuals to ensure the choice is not entirely against one’s personal preferences. Nevertheless, policymakers and choice architects should design any default intervention in a transparent and recognisable manner, preserving full freedom of choice by making the opt-out easy and without any exit cost (Sunstein, 2014).

Much of this research will involve case-specific testing, learning, adapting, and sharing the results (see e.g., van Bavel, 2020). Depending on how the policy design process is organized (e.g., in a ministry), it might be conducted by specialized nudge units in-house or externally, or by behavioural specialists within the public administration. If the project is large and complex, the research might be best conducted by commissioned science. This review, the map (Reisch et al., 2021), and the presented larger literature show potential research partners.

6. Conclusion

The main conclusion is simple: Green defaults are an effective policy measure to reduce meat consumption. While levels vary, the effect itself does not. Beyond the effect itself, this review reveals the important role of underlying mechanisms and moderators. In particular, we suppose

the default in this context primarily operates through the mechanisms of endorsement and effort. Moreover, the default's invasiveness, the recognisability and presentation of its alternative, and the objective of the study setting appear to moderate the impact in this context..

Our findings are valuable for policy, practice, and research. Choice architects gain a better understanding on how effective they can expect the default to be in this context. At the same time, we identify several moderators that can systematically alter the intervention effect, thus offering valuable insights into what to consider when designing and implementing the default.

The importance of transforming food systems and planetary diets has gained increased attention over the last years (as reflected e.g., by the United Nations Food Systems Summit in 2021). This includes healthier and more sustainable diets and the role of national governments in fostering these (Reisch, 2021; UK Department for Environment et al., 2021). On this backdrop, further empirical evidence on both "what works" to change food behaviour and "how it works" is more important and timelier than ever.

CRediT authorship contribution statement

Johanna Meier: Writing – original draft, Conceptualization, Investigation, Formal analysis, Visualization. **Mark A. Andor:** Writing – review & editing, Conceptualization. **Friederike C. Doebbe:** Writing – review & editing, Investigation, Validation. **Neal R. Haddaway:** Writing – review & editing, Methodology. **Lucia A. Reisch:** Writing – original draft, Writing – review & editing, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

We thank our research assistant Victoria Wilms for invaluable support. Lucia Reisch gratefully acknowledges the financial support by the Novo Nordisk Foundation within the BeaCon project (grant number NNF21SA0069203).

Appendix A

Notes A.1: Deviations from the protocol

An a priori systematic review protocol following the RepOrting Standards for Systematic Evidence Syntheses (ROSES) was published on the Open Science Framework: https://osf.io/trz95/. In the course of conducting the review, we realised a few aspects differently than we stated in our a priori protocol. The deviations are listed below:

- We conducted the literature update later than initially planned, namely in January 2021. Consequently, our literature search included articles up to and including December 2020 instead of December 2019.
- We added the World Resources Institute to the list of organisational websites in which we conducted grey literature search.
- We added another assessment category to the critical appraisal tool; that is, we added the category 'other' to be able to evaluate individual study aspects not captured by the other categories.
- We changed the wording for overall appraisal ratings from *high, acceptable, low,* and *unacceptable quality* to *low, moderate, serious,* and *critical risk of bias* in order to use consistent wording throughout our text.

Table A1
Search strings used in the review literature update.

Full Boolean search string
((nudg OR bias* OR "choice-architecture") OR (behavio$r* AND (stimul* OR polic* OR interven*)))* *AND ((food* OR meat* OR beef OR bovine OR veal OR cattle OR lamb OR ovine OR pork OR poultry OR chicken OR turkey OR egg* OR fish OR fisher* OR seafood OR dairy OR milk OR "animal protein" OR "non-plant" OR "plant-based" OR vegetabl* OR vegetar* OR vegan* OR flexitarian*)* *AND (consum* OR intak* OR intention* OR purchas* OR choos* OR select* OR prefer* OR demand* OR buy* OR avoid* OR choice* OR use OR using OR eat OR eating OR drink* OR diet*OR "reduc*"))* *AND ("climate change" OR "global warming" OR "greenhouse gas*" OR carbon OR methane OR "low-carbon" OR emission* OR CO2 OR CH4 OR sustainab*)*
Short search string
((nudg OR bias* OR "choice-architecture") OR (behavior$r* AND (stimul* OR polic* OR interven*)) AND (food* OR meat* OR fish OR dairy OR milk) AND (climate OR emission* OR "greenhouse gas*" OR carbon OR methane))*
Google Scholar search string
((nudge OR bias OR "choice-architecture") OR (behaviour OR behavior AND (stimuli OR policy OR policies OR intervention)) AND (food OR meat OR fish OR dairy OR milk) AND (climate OR emission OR "greenhouse gas" OR carbon OR methane))

Search strings are based on the ones used in the systematic map by Reisch et al. (2021), adapted to reflect the focus on food consumption, i.e., animal protein consumption. Therefore, terms related to food waste were removed from all three versions of the search string.
The original search strings and a detailed report on their stepwise development are provided by Reisch et al. (2021).

- Due to study heterogeneity and differences in reported outcome measures, we did not visualise findings using plots of mean effect size and variance and did not conduct *meta*-analysis.

Notes A.2: Deviations from the systematic map

To ensure consistent and comprehensive literature search, all steps of the literature update were carried out following the approach of the systematic map by Reisch et al. (2021). Deviations from this strategy are listed below:

- We adapted the search string of the map by excluding the terms exclusively related to food waste in order to reflect the systematic review's focus on food, i.e., meat consumption. The adapted search string was not targeted at defaults specifically to ensure a consistent literature search as close as possible to the original search string used in the systematic map. Morover, we are now able to provide an extensive updated database to use for the research community.

Table A2
Additional searches and search information.

Resource	Type of resource	Search string used	Search restrictions
Behavioural Public Policy	Journal	full Boolean	2019–01-01 – 2020–31-12; none
Google Scholar	Search engine	1) short 2) Google Scholar	2019–2020; all viewable results (up to 1,000) for each of the two search strings used
ProQuest Dissertations and Theses	Thesis repository	full Boolean	2019–2020; everything except full-text

Two searches with slightly different search strings were used in the search engine Google Scholar. The two versions were applied due to uncertainty about the exact algorithm used in the search engine, i.e., how wildcards and asterisk are treated.).

Table A3
List of specialist websites used for the supplementary search.

Institution / Organisation	Website link
Behavioural Economics in Action at Rotman University of Toronto, CA	https://www.rotman.utoronto.ca/FacultyAndResearch/ResearchCentres/BEAR
Behavioural Economics Team of the Australian Government, AUS	https://www.behaviouraleconomics.pmc.gov.au/
Behavioural Insights Team, UK	https://www.bi.team/
Behavioural Science and Policy Association	https://www.behavioralpolicy.org/
Deloitte Insights	www2.deloitte.com/insights/us/en.html
Department for Environment, Food & Rural Affairs, UK	https://www.gov.uk/government/organisations/department-for-environment-food-rural-affairs
Environment Agency, UK	https://www.gov.uk/government/organisations/environment-agency
Environmental Protection Agency, USA	https://www.epa.gov/
European Commission Joint Research Centre, EU	https://www.ec.europa.eu/jrc/en
European Environment Agency, EU	https://www.eea.europa.eu/
Federal Environment Agency, GER	https://www.umweltbundesamt.de/
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, GER	https://www.bmu.de/
Federal Ministry of Food and Agriculture, GER	https://www.bmel.de/
Harvard Kennedy School Centre for Public Leadership, Behavioral Insights Group, US	https://www.cpl.hks.harvard.edu/behavioral-insights-group
ideas42	https://www.ideas42.org/
International Institute for Environment and Development	https://www.iied.org/
NSW Government Behavioral Insights Unit, AUS	https://www.bi.dpc.nsw.gov.au/
Organisation for Economic Co-operation and Development	https://www.oecd.org/
PBL Netherlands Environmental Assessment Agency, NL	https://www.pbl.nl/en/
Rare	https://www.rare.org
The European Nudge Network	https://www.tenudge.eu/
The Food and Agriculture Organization of the United Nations	https://www.fao.org/home/en/
The London School of Economics and Political Sciences (LSE), Centre for Analysis of Risk and Regulation, UK	https://www.lse.ac.uk/accounting/CARR
The World Bank	https://www.worldbank.org/
Thünen-Institute, GER	https://www.thuenen.de/
United Nations Development Programme	https://www.undp.org/
United Nations Environment Programme	https://www.unenvironment.org/
United Nations Framework Convention on Climate Change	https://www.unfccc.int/
United States Department of Agriculture, USA	https://www.usda.gov/
World Resources Institute*	https://www.wri.org/

*The World Resources Institute has been newly added to the list for the literature update.
The detailed documentation of the supplementary search conducted on the specialist websites is available from the corresponding author upon request.

- The original literature search and screening for the systematic map were conducted by three authors independently. The literature update for the review was conducted by one of these authors. Being conducted by one experienced author, no consistency checks were necessary for this process (see Reisch et al. (2021) for details on the extensive consistency checking for the systematic map).
- For the map, a shortened version of the search string was applied where databases did not allow for the insertion of the full Boolean version. For the literature update, we did not apply the adapted shortened version of the search string in any of the databases as the only database in which the short version was applied in the map (Science Direct) did no longer allow for this version (allowing for no

Table A4
List of reviews used for bibliographic checking.

Review reference	Type of review
Abrahamse, W. (2020). How to Effectively Encourage Sustainable Food Choices: A Mini-Review of Available Evidence. Frontiers in psychology, 11.	Rapid review
Ferrari, L., Cavaliere, A., De Marchi, E., & Banterle, A. (2019). Can nudging improve the environmental impact of food supply chain? A systematic review. Trends in Food Science & Technology, 91, 184–192.	Systematic review
Nisa, C. F., Bélanger, J. J., Schumpe, B. M., & Faller, D. G. (2019). Meta-analysis of randomised controlled trials testing behavioural interventions to promote household action on climate change. Nature communications, 10(1), 1–13.	Meta-analysis
Taufik, D., Verain, M. C., Bouwman, E. P., & Reinders, M. J. (2019). Determinants of real-life behavioural interventions to stimulate more plant-based and less animal-based diets: A systematic review. Trends in Food Science & Technology, 93, 281–303.	Systematic review
Vandenbroele, J., Vermeir, I., Geuens, M., Slabbinck, H., & Van Kerckhove, A. (2020). Nudging to get our food choices on a sustainable track. Proceedings of the Nutrition Society, 79(1), 133–146.	Literature review
Vermeir, I., Weijters, B., De Houwer, J., Geuens, M., Slabbinck, H., Spruyt, A., … & Verbeke, W. (2020). Environmentally sustainable food consumption: A review and research agenda from a goal-directed perspective. Frontiers in Psychology, 11, 1603.	Literature review

Table A5
Eligibility criteria.

Screening Criteria	Inclusion criteria	Exclusion criteria
Population	Studies that include individual consumers, private households and large households (such as public or corporate cafeterias) that consume animal protein or substitutes as the target population	Studies that do not fulfil population inclusion criteria, but instead include e.g., on self-production, cooperatives or forms of alternative agriculture
Interventions	Studies that examine behavioural insight-based policies such as nudges or choice architecture with the aim to change consumer behaviour directly (e.g., defaults) or indirectly (by improving *another* policy, e.g., a label, designed on the base of behavioural insights, but only if the effect of the behaviourally informed intervention was reported)	Studies that do not fulfil intervention inclusion criteria, but instead examine e.g., command-and-control regulation, market-based policies such as trading schemes, taxes and subsidies, or purely informational and educational interventions that do not make use of behavioural insights instead
Comparator	Studies that compare levels of animal protein consumption or substitutes with a) those that did not receive an intervention (i.e., the control group in an experimental setting), b) those that received a different intervention, or c) with the level of animal protein consumption before the intervention was implemented	Studies that do not fulfil comparator inclusion criteria, but instead e.g., do not report changes in the populations' behaviour
Outcomes	Studies that report changes in actual consumption of animal protein or substitutes	Studies that do not fulfil outcome inclusion criteria, but instead report e.g., consumption of food other than animal protein or substitutes or pre-behaviour variables such as values, intentions, attitudes, or willingness to pay
Framing	Studies that use some sort of climate framing that embeds or motivates the study as contributing to the discourses on climate change, global warming, greenhouse gas emissions (e.g., carbon dioxide, methane or GHG equivalent), sustainable or green consumption or similar	Studies that do not fulfil framing inclusion criteria, but instead use framings like e.g., tackling climate change adaptation, water use, or pollution or improving public health or social issues (unless combined with climate change)
Relevant study type	All types of empirical studies that provide primary data, both quantitative (e.g., experimental studies, panel studies, regressions) or qualitative (e.g., self-reports in an interview study); further (and separately) all types of academic literature reviews (qualitative, quantitative, systematic, non-systematic, critical/umbrella reviews etc.), serving for completeness checks for our search of relevant publications	Studies that do not fulfil relevant study type inclusion criteria, but instead e.g., are commentaries or conceptual pieces; reviews that do not fulfil relevant study type inclusion criteria, but instead e.g., are not academic literature like summaries or policy reports

Eligibility criteria are fully based on the ones used in the systematic map by Reisch et al. (2021) but adapted to reflect the focus on food, i.e., animal protein, consumption: as for the search strings, terms and criteria related to food waste were removed. In addition to these criteria, full-texts had to be retrievable and written in English or German in order to be included.

more than 8 Boolean connectors and no wildcards in January 2021). Consequently, we conducted the literature search in ten instead of eleven databases.

- For the literature update, we did not search in the academic journal *Decision – A Journal for Research about Judgement and Decision Making* as we did for the map, since this journal was included in one of the databases in the meantime.

Appendix B. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.foodpol.2022.102298.

References

Allcott, H., Kessler, J.B., 2019. The welfare effects of nudges: A case study of energy use social comparisons. Am Econ J: Appl Econ 11 (1), 236–276. https://doi.org/10.1257/app.20170328.

Allcott, H., Rogers, T., 2014. The short-run and long-run effects of behavioral interventions: Experimental evidence from energy conservation. Am Econ Rev 104 (10), 3003–3037. https://doi.org/10.1257/aer.104.10.3003.

Altmann, S., Falk, A., Heidhues, P., Jayaraman, R., Teirlinck, M., 2019. Defaults and donations: Evidence from a field experiment. Rev Econ Stat 101 (5), 808–826. https://doi.org/10.1162/rest_a_00774.

Al-Ubaydli, O., List, J.A., Suskind, D., 2019. The science of using science: Toward an understanding of the threats to scalability. NBER Working Paper No. 25848. doi: 10.3386/w25848.

Al-Ubaydli, O., List, J.A., Suskind, D.L., 2017. What can we learn from experiments? Understanding the threats to the scalability of experimental results. Am Econ Rev 107 (5), 282–286. https://doi.org/10.1257/aer.p20171115.

Andor, M.A., Fels, K.M., 2018. Behavioral economics and energy conservation – A systematic review of non-price interventions and their causal effects. Ecol Econ 148, 178–210. https://doi.org/10.1016/j.ecolecon.2018.01.018.

de Backer, C.J.S., Hudders, L., 2015. Meat morals: relationship between meat consumption consumer attitudes towards human and animal welfare and moral behavior. Meat Sci 99, 68–74. https://doi.org/10.1016/j.meatsci.2014.08.011.

Bianchi, F., Dorsel, C., Garnett, E., Aveyard, P., Jebb, S.A., 2018a. Interventions targeting conscious determinants of human behaviour to reduce the demand for meat: a systematic review with qualitative comparative analysis. Int J Behav Nutr Phys Act 15, 102. https://doi.org/10.1186/s12966-018-0729-6.

Bianchi, F., Garnett, E., Dorsel, C., Aveyard, P., Jebb, S.A., 2018b. Restructuring physical micro-environments to reduce the demand for meat: a systematic review and qualitative comparative analysis. The Lancet Planetary Health 2 (9). https://doi.org/10.1016/S2542-5196(18)30188-8 e384-e397.

Biermann, G., Rau, H., 2020. The meaning of meat: (Un)sustainable eating practices at home and out of home. Appetite 153, 104730. https://doi.org/10.1016/j.appet.2020.104730.

Bonnet, C., Bouamra-Mechemache, Z., Réquillart, V., Treich, N., 2020. Viewpoint: Regulating meat consumption to improve health, the environment and animal welfare. Food Policy 97, 101847. https://doi.org/10.1016/j.foodpol.2020.101847.

Broman Toft, M., Schuitema, G., Thøgersen, J., 2014. The importance of framing for consumer acceptance of the Smart Grid: A comparative study of Denmark, Norway and Switzerland. Energy Res Social Sci 3, 113–123. https://doi.org/10.1016/j.erss.2014.07.010.

Brown, Z., Johnstone, N., Haščič, I., Vong, L., Barascud, F., 2013. Testing the effect of defaults on the thermostat settings of OECD employees. Energy Econ 39, 128–134. https://doi.org/10.1016/j.eneco.2013.04.011.

Byerly, H., Balmford, A., Ferraro, P.J., Hammond Wagner, C., Palchak, E., Polasky, S., Ricketts, T.H., Schwartz, A.J., Fisher, B., 2018. Nudging pro-environmental behavior: evidence and opportunities. Front Ecol Environ. 16 (3), 159–168. https://doi.org/10.1002/fee.1777.

Campbell-Arvai, V., Arvai, J., Kalof, L., 2014. Motivating sustainable food choices: The role of nudges, value orientation, and information provision. Environ Behav 46 (4), 453–475. https://doi.org/10.1177/0013916512469099.

Carlsson, F., Gravert, C., Johansson-Stenman, O., Kurz, V., 2021. The use of green nudges as an environmental policy instrument. Rev Environ Econ Policy 15 (2), 216–237. https://doi.org/10.1086/715524.

Cerri, J., Thøgersen, J., Testa, F., 2019. Social desirability and sustainable food research: A systematic literature review. Food Qual Prefer 71, 136–140. https://doi.org/10.1016/j.foodqual.2018.06.013.

Clark, M., Tilman, D., 2017. Comparative analysis of environmental impacts of agricultural production systems, agricultural input efficiency, and food choice. Environ Res Lett 12 (6), 064016. https://doi.org/10.1088/1748-9326/aa6cd5.

Clark, M.A., Domingo, N.G.G., Colgan, K., Thakrar, S.K., Tilman, D., Lynch, J., Azevedo, I.L., Hill, J.D., 2020. Global food system emissions could preclude achieving the 1.5° and 2°C climate change targets. Science 370 (6517), 705–708.

Collaboration for Environmental Evidence, 2018. Guidelines and standards for evidence synthesis in environmental management. Collaboration for Environmental Evidence. http://www.environmentalevidence.org/information-for-authors (Accessed 1 May 2021).

Daniel, C.R., Cross, A.J., Koebnick, C., Sinha, R., 2011. Trends in meat consumption in the USA. Public Health Nutr 14 (4), 575–583. https://doi.org/10.1017/S1368980010002077.
DellaVigna, S., Linos, E., 2022. RCTs to scale: Comprehensive evidence from two nudge units. Econometrica 90 (1), 81–116.
Dinner, I., Johnson, E.J., Goldstein, D.G., Liu, K., 2011. Partitioning default effects: Why people choose not to choose. J Exp Psychol Appl 17 (4), 332–341. https://doi.org/10.1037/a0024354.
Ebeling, F., Lotz, S., 2015. Domestic uptake of green energy promoted by opt-out tariffs. Nature Clim Change 5 (9), 868–871. https://doi.org/10.1038/nclimate2681.
Egebark, J., Ekström, M., 2016. Can indifference make the world greener? J Environ Econ Manag 76, 1–13. https://doi.org/10.1016/j.jeem.2015.11.004.
Feinberg, M., Kovacheff, C., Teper, R., Inbar, Y., 2019. Understanding the process of moralization: How eating meat becomes a moral issue. J Pers Soc Psychol 117 (1), 50–72. https://doi.org/10.1037/pspa0000149.
Garnett, T., 2011. Where are the best opportunities for reducing greenhouse gas emissions in the food system (including the food chain)? Food Policy 36, S23–S32. https://doi.org/10.1016/j.foodpol.2010.10.010.
Goulder, L.H., Parry, I.W.H., 2008. Instrument choice in environmental policy. Rev Environ Econ Policy 2 (2), 152–174. https://doi.org/10.1093/reep/ren005.
Gravert, C., Kurz, V., 2019. Nudging à la carte: A field experiment on climate-friendly food choice. Behav Public Policy 1–18. https://doi.org/10.1017/bpp.2019.11.
Haddaway, N.R., Macura, B., Whaley, P., Pullin, A.S., 2018. ROSES RepOrting standards for Systematic Evidence Syntheses: pro forma, flow-diagram and descriptive summary of the plan and conduct of environmental systematic reviews and systematic maps. Environ Evid 7 (1). https://doi.org/10.1186/s13750-018-0121-7.
Hansen, P.G., Schilling, M., Malthesen, M.S., 2019. Nudging healthy and sustainable food choices: three randomized controlled field experiments using a vegetarian lunch-default as a normative signal. J Public Health (Oxf.) 1–6. https://doi.org/10.1093/pubmed/fdz154.
Harguess, J.M., Crespo, N.C., Hong, M.Y., 2020. Strategies to reduce meat consumption: A systematic literature review of experimental studies. Appetite 144, 104478. https://doi.org/10.1016/j.appet.2019.104478.
Hartmann, C., Ruby, M.B., Schmidt, P., Siegrist, M., 2018. Brave, health-conscious, and environmentally friendly: Positive impressions of insect food product consumers. Food Qual Prefer 68, 64–71. https://doi.org/10.1016/j.foodqual.2018.02.001.
Hayley, A., Zinkiewicz, L., Hardiman, K., 2015. Values, attitudes, and frequency of meat consumption. Predicting meat-reduced diet in Australians. Appetite 84, 98–106. https://doi.org/10.1016/j.appet.2014.10.002.
Heydarian, A., Pantazis, E., Carneiro, J.P., Gerber, D., Becerik-Gerber, B., 2016. Lights, building, action: Impact of default lighting settings on occupant behaviour. J Environ Psychol 48, 212–223. https://doi.org/10.1016/j.jenvp.2016.11.001.
Hirst, J.M., Reed, D.D., Kaplan, B.A., Miller, J.R., 2013. Making it easier to be green: A single case demonstration of the effects of computer defaults to conserve energy in a university computer lab. Sustainability J Record 6 (6), 340–344. https://doi.org/10.1089/sus.2013.9827.
Hummel, D., Maedche, A., 2019. How effective is nudging? A quantitative review on the effect sizes and limits of empirical nudging studies. J Behav Exp Econ 80, 47–58. https://doi.org/10.1016/j.socec.2019.03.005.
Intergovernmental Panel on Climate Change, 2019. Climate change and land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. https://www.ipcc.ch/srccl/download/ (Accessed 21 May 2021).
Jachimowicz, J.M., Duncan, S., Weber, E.U., Johnson, E.J., 2019. When and why defaults influence decisions: A meta-analysis of default effects. Behav Public Policy 3 (2), 159–186. https://doi.org/10.1017/bpp.2018.43.
Johnson, E.J., Goldstein, D., 2003. Medicine. Do defaults save lives? Science 302 (5649), 1338–1339. https://doi.org/10.1126/science.1091721.
Kaiser, M., Bernauer, M., Sunstein, C.R., Reisch, L.A., 2020. The power of green defaults: The impact of regional variation of opt-out tariffs on green energy demand in Germany. Ecol Econ 174, 106685. https://doi.org/10.1016/j.ecolecon.2020.106685.
Laiou, E., Rapti, I., Schwarzer, R., Fleig, L., Cianferotti, L., Ngo, J., Rizos, E.C., Wetle, T. F., Kahlmeier, S., Vigilanza, A., Tsilidis, K.K., Trichopoulou, A., Serra-Majem, L., Brandi, M.L., Ntzani, E.E., 2021. Review: Nudge interventions to promote healthy diets and physical activity. Food Policy 102, 102103. https://doi.org/10.1016/j.foodpol.2021.102103.
Lawrence, M., Friel, S., 2020. Healthy and sustainable food systems, first ed. Routledge, Abingdon, Oxon and New York, NY.
Leenaert, T., 2012. Meat moderation as a challenge for government and civil society: The Thursday Veggie Day campaign in Ghent, BelgiumVilijoen, A., Wiskerke, J.S.C. (Eds.), In: Sustainable food planning: Evolving theory and practice. Wageningen Academic Publishers, Wageningen, pp. 189–196. https://doi.org/10.3920/978-90-8686-187-3_16.
Leidig, R., 2012. Sodexo meatless monday survey results. The Johns Hopkins Center for a Livable Future. https://clf.jhsph.edu/sites/default/files/2019-05/Sodexo-meatless-monday-survey-results.pdf (Accessed 1 May 2021).
Lemken, D., 2021. Options to design more ethical and still successful default nudges: A review and recommendations. Behav Public Policy 1-33. https://doi.org/10.1017/bpp.2021.33.
Liebe, U., Gewinner, J., Diekmann, A., 2021. Large and persistent effects of green energy defaults in the household and business sectors. Nature Hum Behav 5 (5), 576–585. https://doi.org/10.1038/s41562-021-01070-3.
Lorenz-Walther, B.A., Langen, N., Göbel, C., Engelmann, T., Bienge, K., Speck, M., Teitscheid, P., 2019. What makes people leave LESS food? Testing effects of smaller portions and information in a behavioral model. Appetite 139, 127–144. https://doi.org/10.1016/j.appet.2019.03.026.
Madrian, B.C., Shea, D.F., 2001. The power of suggestion: Inertia in 401(k) participation and savings behavior. Q J Econ 116 (4), 1149–1187. https://doi.org/10.1162/003355301753265543.
Malhotra, S., Cheriff, A.D., Gossey, J.T., Cole, C.L., Kaushal, R., Ancker, J.S., 2016. Effects of an e-Prescribing interface redesign on rates of generic drug prescribing: exploiting default options. J Am Med Inform Assoc: JAMIA 23 (5), 891–898. https://doi.org/10.1093/jamia/ocv192.
Meier, J., Andor, M.A., Doebbe, F.C., Haddaway, N.R., Reisch, L.A, 2020. Green defaults to reduce meat consumption? A systematic review protocol. https://osf.io/trz95/ (Accessed 20 February 2022).
Michel, F., Hartmann, C., Siegrist, M., 2021. Consumers' associations, perceptions and acceptance of meat and plant-based meat alternatives. Food Qual Prefer 87, 104063. https://doi.org/10.1016/j.foodqual.2020.104063.
OECD-FAO, 2020. OECD-FAO Agricultural Outlook 2020-2029. OECD Publishing, Paris / FAO, Rome.
Ölander, F., Thøgersen, J., 2014. Informing versus nudging in environmental policy. J Consum Policy 37 (3), 341–356. https://doi.org/10.1007/s10603-014-9256-2.
Pfeiler, T.M., Egloff, B., 2018. Examining the "Veggie" personality: Results from a representative German sample. Appetite 120, 246–255. https://doi.org/10.1016/j.appet.2017.09.005.
Piazza, J., Ruby, M.B., Loughnan, S., Luong, M., Kulik, J., Watkins, H.M., Seigerman, M., 2015. Rationalizing meat consumption. The 4Ns. Appetite 91, 114–128. https://doi.org/10.1016/j.appet.2015.04.011.
Pichert, D., Katsikopoulos, K.V., 2008. Green defaults: Information presentation and pro-environmental behaviour. J Environ Psychol 28 (1), 63–73. https://doi.org/10.1016/j.jenvp.2007.09.004.
Poore, J., Nemecek, T., 2018. Reducing food's environmental impacts through producers and consumers. Science 360 (6392), 987–992.
Prattala, R., Paalanen, L., Grinberga, D., Helasoja, V., Kasmel, A., Petkeviciene, J., 2007. Gender differences in the consumption of meat, fruit and vegetables are similar in Finland and the Baltic countries. Eur J Public Health 17 (5), 520–525. https://doi.org/10.1093/eurpub/ckl265.
Reinders, M.J., Huitink, M., Dijkstra, S.C., Maaskant, A.J., Heijnen, J., 2017. Menu-engineering in restaurants - adapting portion sizes on plates to enhance vegetable consumption: a real-life experiment. Int J Behav Nutr Phys Act 14, 41. https://doi.org/10.1186/s12966-017-0496-9.
Reinders, M.J., van Lieshout, L., Pot, G.K., Neufingerl, N., van den Broek, E., Battjes-Fries, M., Heijnen, J., 2020. Portioning meat and vegetables in four different out of home settings: A win-win for guests, chefs and the planet. Appetite 147, 104539. https://doi.org/10.1016/j.appet.2019.104539.
Reisch, L.A., 2021. Shaping healthy and sustainable food systems with behavioural food policy. Eur Rev Agric Econ 48 (4), 665–693. https://doi.org/10.1093/erae/jbab024.
Reisch, L.A., Sunstein, C.R., Andor, M.A., Doebbe, F.C., Meier, J., Haddaway, N.R., 2021. Mitigating climate change via food consumption and food waste: A systematic map of behavioral interventions. J Clean Prod 279, 123717. https://doi.org/10.1016/j.jclepro.2020.123717.
Rozin, P., Hormes, J.M., Faith, M.S., Wansink, B., 2012. Is meat male? A quantitative multimethod framework to establish metaphoric relationships. J Consum Res 39 (3), 629–643. https://doi.org/10.1086/664970.
Schubert, C., 2017. Green nudges: Do they work? Are they ethical? Ecol Econ 132, 329–342. https://doi.org/10.1016/j.ecolecon.2016.11.009.
Science Advice for Policy by European Academies, 2020. A sustainable food system for the European Union - Evidence review report No. 7, first ed. SAPEA, Berlin, Germany.
Shafir, E., 2013. The behavioral foundations of public policy. Princeton University Press, Princeton, New Jersey, US.
Springmann, M., Clark, M., Mason-D'Croz, D., Wiebe, K., Bodirsky, B.L., Lassaletta, L., de Vries, W., Vermeulen, S.J., Herrero, M., Carlson, K.M., Jonell, M., Troell, M., DeClerck, F., Gordon, L.J., Zurayk, R., Scarborough, P., Rayner, M., Loken, B., Fanzo, J., Godfray, H.C.J., Tilman, D., Rockström, J., Willett, W., 2018. Options for keeping the food system within environmental limits. Nature 562 (7728), 519–525. https://doi.org/10.1038/s41586-018-0594-0.
Sterne, J.A., Hernán, M.A., Reeves, B.C., Savović, J., Berkman, N.D., Viswanathan, M., Henry, D., Altman, D.G., Ansari, M.T., Boutron, I., Carpenter, J.R., Chan, A.-W., Churchill, R., Deeks, J.J., Hróbjartsson, A., Kirkham, J., Jüni, P., Loke, Y.K., Pigott, T.D., Ramsay, C.R., Regidor, D., Rothstein, H.R., Sandhu, L., Santaguida, P.L., Schünemann, H.J., Shea, B., Shrier, I., Tugwell, P., Turner, L., Valentine, J.C., Waddington, H., Waters, E., Wells, G.A., Whiting, P.F., Higgins, J.P., 2016. ROBINS-I: a tool for assessing risk of bias in non-randomised studies of interventions. BMJ (Clinical research ed.) 355, i4919. https://doi.org/10.1136/bmj.i4919.
Sterne, J.A.C., Savović, J., Page, M.J., Elbers, R.G., Blencowe, N.S., Boutron, I., Cates, C. J., Cheng, H.-Y., Corbett, M.S., Eldridge, S.M., Emberson, J.R., Hernán, M.A., Hopewell, S., Hróbjartsson, A., Junqueira, D.R., Jüni, P., Kirkham, J.J., Lasserson, T., Li, T., McAleenan, A., Reeves, B.C., Shepperd, S., Shrier, I., Stewart, L.A., Tilling, K., White, I.R., Whiting, P.F., Higgins, J.P.T., 2019. RoB 2: a revised tool for assessing risk of bias in randomised trials. BMJ (Clinical research ed.) 366, l4898. https://doi.org/10.1136/bmj.l4898.
Stewart, G., Patel, R., Sucharitakul, G., 2016. Can simple nudges reduce meat consumption? The Cambridge Green Challenge. https://www.environment.admin.cam.ac.uk/getting-involved/living-laboratory-sustainability/projects/can-simple-nudges-reduce-meat-consumption. (Accessed 01 May 2021).
Sunstein, C.R., 2014. Nudging: A very short guide. J Consum Policy 37 (4), 583–588. https://doi.org/10.1007/s10603-014-9273-1.

Sunstein, C.R., 2020. Behavioral science and public policy. Cambridge University Press, Cambridge, United Kingdom.
Sunstein, C.R., Reisch, L.A., Kaiser, M., 2019. Trusting nudges? Lessons from an international survey. J Eur Public Policy 26 (10), 1417–1443. https://doi.org/10.1080/13501763.2018.1531912.
Taufik, D., Verain, M.C., Bouwman, E.P., Reinders, M.J., 2019. Determinants of real-life behavioural interventions to stimulate more plant-based and less animal-based diets: A systematic review. Trends Food Sci Technol 93, 281–303. https://doi.org/10.1016/j.tifs.2019.09.019.
Thaler, R.H., Sunstein, C.R., 2021. Nudge: The final edition. Penguin LCC US pages cm.
UK Department for Environment, Food and Rural Affairs, 2021. National Food Strategy for England. https://www.gov.uk/government/publications/national-food-strategy-for-england (Accessed 20 February 2022).
van Bavel, R., 2020. Behavioural insights for EU policymakingŠucha, V., Sienkiewicz, M. (Eds.), In: Science for Policy Handbook. European Commission, Joint Research Centre, Brussels, Belgium, pp. 197–205.
van Kleef, E., van Trijp, H.C.M., 2018. Methodological challenges of research in nudging. In: Ares, G., Varela, P. (Eds.), Methods in consumer research, Volume 1. Woodhead Publishing, Duxford, United Kingdom / Cambridge, United States / Kidlington / United Kingdom, pp. 329–349.
Vandenbroele, J., Slabbinck, H., van Kerckhove, A., Vermeir, I., 2018. Curbing portion size effects by adding smaller portions at the point of purchase. Food Qual Prefer 64, 82–87. https://doi.org/10.1016/j.foodqual.2017.10.015.
Vandenbroele, J., Vermeir, I., Geuens, M., Slabbinck, H., Van Kerckhove, A., 2020. Nudging to get our food choices on a sustainable track. Proc Nutr Soc 79 (1), 133–146. https://doi.org/10.1017/S0029665119000971.
Venema, T.A.G., Kroese, F.M., De Ridder, D.T.D., 2018. I'm still standing: A longitudinal study on the effect of a default nudge. Psychol Health 33 (5), 669–681. https://doi.org/10.1080/08870446.2017.1385786.
Wansink, B., Sobal, J., 2007. Mindless eating. Environ Behav 39 (1), 106–123. https://doi.org/10.1177/0013916506295573.
Wynes, S., Nicholas, K.A., Zhao, J., Donner, S.D., 2018. Measuring what works: quantifying greenhouse gas emission reductions of behavioural interventions to reduce driving, meat consumption, and household energy use. Environ Res Lett 13 (11), 113002. https://doi.org/10.1088/1748-9326/aae5d7.