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Nudging to get our food choices on a sustainable track

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Food production is one of the major contributors to environmental damage. Adaptations in our food choices are needed to preserve resources for the needs of future generations. More sustainable consumption patterns have been encouraged by economic incentives, laws, education and communication campaigns. Nonetheless, consumers still find difficulties in trying to change their current food habits. This review takes a behavioural approach in encouraging sustainable food choices among consumers. From a nudging perspective, many behavioural changes can be encouraged in a non-obtrusive way by adapting the complex food environment in which consumers are operating. These interventions do not restrict consumers' choices but rather adapt the choice architecture wherein food decisions are made. Drawing on the literature from diverse theoretical perspectives, we provide an overview of the application of nudging for more sustainable food choices and highlight where more research is needed. More specifically, we discuss research that used nudging to engender cognitive impact (i.e. the use of labels or visibility enhancements), affective responses (i.e. sensorial and social influence cues) and behavioural effects (i.e. adjustments in convenience and product size). We conclude that this review only shows the tip of the iceberg of the research on nudging and sustainable consumption that is likely forthcoming in the next few years, following the successes of nudging applications in other domains. Nonetheless, each individual nudging intervention requires careful examination. Personal predispositions towards the environment should be considered when designing interventions, demonstrating the complementarity of nudging with education on sustainable consumption.

Food choices: Nudging: Sustainable consumption

Our current food production has a tremendous effect on the environment. The livestock sector accounts for 14.5 % of human-induced greenhouse gas emissions⁽¹⁾, while the impact of global food consumption in 2010 was estimated at 1.5 metric tons total greenhouse gas emission per capita⁽²⁾.

Moreover, the agricultural intensification needed to meet our food demand is one of the major contributors to biodiversity loss⁽³⁾. At the level of household consumption, food contributes 48–70 % of the impact on water and land resources, with meat, dairy and processed foods as the main drivers⁽⁴⁾. As our global population is

still growing (9.6 billion by 2050)⁽¹⁾, the future impact of food production on the environment will only become more intense⁽⁵⁾.

Food producers are held responsible for climate damage by the public opinion, although consumers are increasingly acknowledging the responsibility of food providers as well^(6,7). Retailers, cafeterias, canteens and restaurants all play an important role in shaping our food choices, as they decide on what food will be available to the consumer^(8,9). Nonetheless, the role of customers should not be underestimated, as small changes in the individual dietary pattern can collectively significantly decrease

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environmental damage⁽¹⁰⁾. After all, changes in consumer food choice habits dictate changes in food supply⁽²⁾.

Sustainable food choices

Sustainable consumption has been defined in the Oslo Roundtable of 1994⁽¹¹⁾ as 'The use of goods and services that respond to basic needs and bring a better quality of life, while minimizing the use of natural resources, toxic materials and emissions of waste and pollutants over the life cycle, so as not to jeopardize the needs of future generations'. As food is an important factor in our consumption pattern, it is not surprising that the 2015 European Nutrition Conference was hosted with a special symposium on 'sustainable consumption'⁽¹²⁾. Nonetheless, an in-depth discussion of what can be labelled as 'sustainable food' is out of the scope of the present paper and will mainly be illustrated by the foods that are targeted in the studies of our review. That is, many researchers focus on how to effectively promote products that contribute less to CO₂-emissions (e.g. plant-based food such as vegetarian products, vegetables and fruit), while also investigating how consumers can be motivated to reduce their consumption of products with high CO₂-emissions (e.g. red meat^(13,14)). Besides, the promotion of products that are locally produced has also been heavily studied because these products avoid environmental damage from transportation⁽¹⁵⁾. Nonetheless, transportation accounts for only 11 % of the greenhouse gas emissions in the food cycle, and production is still the main source, accounting for 83 % in the USA⁽¹⁶⁾.

Nudging

This review focuses on interventions that aim to promote sustainable food choices and discourage less sustainable options. More specifically, we provide an overview of the results obtained by means of nudging. Nudging aims to change people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives⁽¹⁷⁾. Hence, nudging differs from initiatives that aim to make sustainable consumption more economically appealing, for instance subsidies for solar panels. Moreover, nudging initiatives tend to be relatively less costly than educational initiatives⁽¹⁸⁾. Nudging also does not impose any restrictions as do enforced laws, such as the banning of plastic, but embraces the freedom of choice for the customer⁽¹⁹⁾. This principle of libertarian paternalism is one of the two core principles of nudging⁽²⁰⁾.

Indeed, nudging interventions are rather unobtrusive and trigger consumer responses without requiring much cognitive effort⁽¹⁷⁾. This difference in cognitive effort is also exactly what differentiates nudging from classic informational campaigns and education, which aim to convince consumers to change their attitudes with rational arguments⁽²¹⁾; a process that requires more cognitive effort⁽²²⁾. This approach might not be suitable in a food context, where a choice between options is often guided by fast, automatic and/or cognitively effortless responses to environmental stimuli. A thoughtful, slow

and/or analytical processing of all available food options would be too time-consuming in many conditions, such as in making food decisions⁽²³⁾.

Indeed, many so-called dual process theories distinguish between two processing styles⁽²⁴⁾, of which Kahneman's System 1 (fast and effortless processing) and System 2 (slower and analytical processing) are the most prominent⁽²⁵⁾. Even if communication campaigns succeed, such that sustainable information is processed under high cognitive effort and positive attitudes have been created, behavioural changes are still not guaranteed. The attitude-behaviour gap for sustainable behaviour illustrates that consumers often have positive predispositions towards sustainable consumption, but these do not always translate into actual behavioural changes⁽²⁶⁾.

For this reason, nudging starts from the perspective of the consumer. Knowing how consumers make food decisions in a complex food environment provides insight into how food presentation may lead to sustainable food purchase choices by the consumer. This is called an optimisation of the choice architecture, which establishes the second core principle of nudging⁽²⁰⁾. Many elements in a food environment will affect our choices, such as the way products are positioned⁽²⁷⁾, their visibility⁽²⁸⁾ or packaging⁽²⁹⁾. The results of these types of interventions at the point of purchase, such as in retail stores, cafeterias and restaurants, seem promising^(30,31), and consumers also believe that these interventions can help them more easily regulate their in-store consumption decisions⁽³²⁾.

Our review provides a non-exhaustive overview of the application of nudging for more sustainable food choices at the point of purchase. For some categories of nudging, research on sustainable food choices is still in its infancy, so we enriched our discussion with insights from general sustainable consumption, health research, policy making and consumer behaviour. In doing so, we also highlighted the domains where more research is needed. To the best of our knowledge, no framework on sustainable food choices has yet been published. Therefore, we built our review on the framework for the in-field health interventions of Cadario and Chandon⁽³³⁾. They categorised the nudges according to whether the nudge exerted an influence on consumers' cognition (i.e. consumer knowledge), effect (i.e. consumers' feelings) or behaviour (i.e. motor responses).

Cognitively oriented interventions

Descriptive labelling

Consumers' interest for specific product attributes, such as origin, ingredients and production process, has gradually increased over the years⁽³⁴⁾. Consequently, labels focusing on food attributes have become increasingly popular, as demonstrated by the many studies on energy and nutrition labelling (see Cowburn and Stockley⁽³⁵⁾ for a systematic review). A similar trend can be detected for sustainable products, such that many products display sustainable labels on food packaging, menus in restaurants or next to the product in buffets⁽³⁴⁾. The complexity of what can be considered sustainable consumption also implies that

a wide variety of sustainable labels can be used⁽³⁶⁾, ranging from where the product is coming from (i.e. 'local'^(37,38)), to how it is produced (i.e. 'organic', 'fair trade', 'recycled'^(39,40)) or which non-sustainable ingredients are removed from the product (i.e. 'free from'⁽⁴¹⁾).

Sustainable labels might function as eye-catchers when consumers are shopping in an environment where many products are competing for attention and cognitive resources are limited⁽⁴²⁾. Labels can also help consumers determine whether a product is sustainable^(43,44). For example, labels can give information on the seasonality of products^(37,45), and whether the product is certified by a third party according to specific sustainability criteria (cf. Rainforest Alliance certificate⁽⁴⁶⁾) or human respect criteria (cf. Fair Trade certificate⁽⁴⁷⁾). Recent research also shows the positive effects of sustainable labels on product perceptions; eco-labels have positively affected taste judgements and willingness to pay⁽⁴⁸⁾, wine labelled as organic has led to higher taste ratings⁽⁴⁹⁾, and products that are defined as 'local' have become more popular because of higher taste and quality associations⁽³⁷⁾.

However, descriptive labels not only impact consumers' attention, information and associations with sustainable products but also have been shown to evoke emotional and behavioural responses. Products labelled as organic are believed to contribute to environmental protection (i.e. appealing to utilitarian attitudes), and as such, people experience emotional gratification from buying organic (i.e. appealing to hedonic attitudes⁽⁵⁰⁾). Even before buying, feelings of anticipated pride can predict pro-environmental choices later on⁽⁵¹⁾. Nonetheless, a more negative feeling (i.e. guilt) has been demonstrated to make people feel more personally responsible for environmental damage and increase the likelihood that people buy products with sustainable labels⁽⁵²⁾ or support pro-environmental behaviour^(53,54). Eco-labels that focus on omitting non-sustainable ingredients, such as 'free from palm oil', affect behavioural intentions such as the 'willingness to pay a price premium' among people who actively look for information and have a high preference for naturalness⁽⁴¹⁾.

Numerous studies have demonstrated the effects of sustainable labels on consumer response; however, the direction of the effects is ambiguous and largely determined by personality traits such as environmental concern^(39,48,55–58). For example, whether consumers notice sustainable labels has been shown to depend largely on their implicit (i.e. neurophysiological emotional reactions) and explicit (i.e. self-reported feelings) positive predispositions towards sustainable behaviour^(40,59). Moreover, the positive effects of sustainability claims are more profoundly observed when consumers understand and trust the labels^(26,60–62). Organic labels may also backfire, such that consumers who are less concerned with the environment perceive organic labelled products as less tasty^(63,64). Buying organic labelled products might also trigger compensation behaviour (i.e. additional purchases of less sustainable products), so that consumers end up with a higher total environmental impact of their food purchases⁽⁶⁵⁾. Moreover, the wide

variety and multiple application of sustainable logos⁽⁶⁶⁾ can be confusing for consumers⁽⁶⁷⁾, so that they might follow the heuristic that a labelled product is better than one without label, instead of actually deciphering the provided information on the sustainability label of the product^(41,60). To better align labels with consumers' preferences, more research is needed on the level at which labels should be created (e.g. Belgian v. European⁽⁶⁸⁾) and on which measures they should be based (e.g. food miles v. CO₂ emissions⁽⁶⁸⁾). Lastly, few studies have investigated how sustainable labels affect actual food choices; a 2013 study⁽⁶⁹⁾ even found that sustainable logos did not affect the food choices of European consumers at the time.

Evaluative labelling

As consumers face a hard time deciphering different sustainable attributes, it is suggested to ease their understanding by providing evaluative information rather than descriptive information⁽⁷⁰⁾. Evaluative labels of sustainability can use ratings that provide an immediate indication of how sustainable the product is, such that food labels carry low–medium–high descriptions or a one-, two- or three-star rating^(71,72). A field study on healthiness showed that significantly fewer 'high-fat' and 'high-energy' products were sold when labelled as such, while the sales of 'low-fat' and 'low-energy' products went up⁽⁷³⁾. One study on sustainable evaluative labelling⁽⁷⁴⁾ also highlights the importance of healthiness perceptions. They found that a high sustainability label increases product preference only if the food product is perceived as being high in healthiness. Hence, a fit between the level of sustainability and healthiness was needed for the 'high' sustainable label to be successful, perhaps because the average consumer expects sustainable products to be more healthy, as demonstrated in another study⁽⁵⁵⁾. In a similar vein, ample research efforts have recently been put into creating labels that combine the impact of food on healthiness and sustainability^(75,76). These labels provide an overall dietary quality score, although the approach on how to quantify this measure is not yet unified among researchers.

Colour coding can be another way to support consumers in making better decisions⁽⁷⁷⁾. For example, traffic light labelling builds on our socially learned associations that the colour green signals safety, while red signals danger, which leads to the assumption that red can function as a consumption-stopping cue⁽⁷⁸⁾. Applying this idea to evaluative labelling, more sustainable products would be marked with a green label, while less sustainable products would be marked with a red label^(79,80). Research showed that health decisions were improved by applying traffic light labelling in a cafeteria or university canteen^(79–81), although an online experiment found mixed results depending on the country of origin (positive effect in Germany v. no significant difference in Poland)⁽⁸²⁾. In a grocery setting, the sales of black labelled products (i.e. high carbon emission) decreased by 6 %, while the sales of green labelled products (i.e. low carbon emission) increased by 4 %⁽⁷⁷⁾. Interestingly, the intention to

avoid red labels is greater than the preference for green labels^(72,83). This might be explained by consumers' perception that negative information (i.e. red logo) looms larger⁽⁸⁴⁾ than positive information. However, the effectiveness of colour labelling does not generalise across products; the negative effect of a red surface on food selection appears to be more profoundly observed for unhealthy (v. healthy) products⁽⁸⁵⁾. This highlights the importance of a fit between consumers' perceptions on what is 'bad' and the colour (e.g. unhealthy food and red) and that the effects are less clear when there is a mismatch (e.g. healthy food and red). This raises the question of whether colour coding would work for sustainable food choices, for which consumers' associations on what is 'bad' and 'good' might be less strong.

Note that not all studies find positive effects in evaluative labelling on food choices^(82,86), and some authors warn of compensatory consumption⁽⁸⁷⁾. Consumers might compensate for 'low' label purchases with less sustainable choices in side dishes or in their following food choices. Moreover, they may be exclusively focused on the characteristic that is 'low', so they overlook other negative characteristics of the food product (e.g. low-fat and high-sugar food⁽⁸⁸⁾). Future research should determine whether evaluative labelling on sustainable products also triggers such compensatory effects.

Visibility enhancements

Visual attention (i.e. the amount of fixation time) is an important proxy for product selection⁽⁸⁹⁾; therefore, the positioning of sustainable products at the point of purchase should be carefully considered. For example, products that are presented at eye level^(90,91) have been shown to draw more attention and enter more easily the set of products considered by the consumer⁽⁹²⁾. Another attention hotspot in retail stores is the shelf next to the cash register, where consumers have time to process the offerings while queuing to pay⁽⁹³⁾. Even the order of products on a restaurant menu can impact food choices, such that products placed at the top of the menu benefit from a primacy effect and tend to be selected more often^(94,95). A recent study⁽⁹⁶⁾ applied two visibility interventions on sustainable products for 9 months in a university canteen by changing the menu order (i.e. from the middle to the top position) and increasing the visibility of vegetarian products (i.e. more visible location). Combining both interventions increased the sales share of the vegetarian dishes significantly compared to all purchases with six percentage points. Moreover, a significant long-term effect was observed, so that after the intervention period, the share of vegetarian dishes was still four percentage points higher compared to the baseline period.

Increasing the availability of sustainable products in the assortment is also often related to greater visibility, and together, they have a strong effect on purchase intentions⁽²⁸⁾. Although the assortment of more sustainable food choices, such as organic and vegetarian products, has been increasing over the years, its share is still relatively small compared to general products^(97,98). Studies

on healthier food choices show promising results in that increasing the relative share of healthier foods (e.g. from 25 to 75 %) translates into more healthy purchases: the chances of buying a healthy product were multiplied by 2.9 times in an online study and 3.5 times in a canteen⁽⁹⁹⁾. Interestingly, regarding the principles of nudging⁽¹⁷⁾, consumers did not perceive the assortment to be more restrictive by the intervention. Another field experiment combines healthy labelling and increased availability so that students chose more healthy options in the vending machine⁽⁷²⁾. One study found mixed results: increasing the share of healthy options encouraged the sales of healthy dishes in only two out of six cafeterias⁽¹⁰⁰⁾.

Incorporating sustainable products in the existing assortment can be challenging for managers⁽¹⁰¹⁾, as they can choose to mix them with the existing assortment (i.e. comparative positioning) or offer them separately (i.e. unique feature positioning). For example, meat substitutes, which are vegetarian products that are sensory similar to a specific meat product, are currently mostly shelved in a unique feature positioning⁽¹⁰²⁾. However, this separate shelf might be consistently skipped by non-vegetarians, so that meat substitutes do not enter the consideration set of these consumers. Non-users could be helped in recognizing meat substitutes as valuable alternatives by placing them next to the mimicked meat product⁽¹⁰³⁾. Suggestions are made that in this choice architecture, meat substitutes might appear as more familiar and less novel, as their sensory similarity with the mimicked product can be easily observed^(104–106).

This positioning question also pertains to when evaluative labels are used (e.g. one-, two- or three-star sustainability rating) and raises the question of where the 'mildly' sustainable products should be offered. Research suggests⁽¹⁰⁷⁾ that when there is a fit between the price setting and the product (i.e. intermediate price and intermediate star rating), sales increase if these products are positioned in a separate section. However, if there is no match and the two-star product is offered at a low price, mixing them with the low and high ratings (i.e. comparative positioning) has been found to boost the sales of the intermediate product. Positioning is also a critical challenge in online food retail, as the categorisation of the products highly affects purchases⁽¹⁰⁸⁾. Moreover, environmental attitudes should again be considered when optimizing shelf management. That is, if the assortment is aligned with the consumers' goal, so that organic products are presented separately and the consumer has the intention to buy an organic product, organic purchases have been found to be higher compared to when they are comparatively positioned with other products that are not related to consumers' goal⁽¹⁰⁷⁾.

Affectively oriented interventions

Hedonic enhancements

Hedonic interventions trigger our senses so that products become more attractive by appealing to our taste, vision,

olfaction (i.e. smell), audition and haptics (i.e. touch). Research on sensory marketing has gained importance over the past few years⁽¹⁰⁹⁾. Therefore, we will extend the original category in the framework of Cadario and Chandon⁽³³⁾ on hedonic enhancements by discussing research on each sense. We categorise on the main sensory characteristic of the nudge, although some nudges might trigger other senses and processes too, so the categorisation is not mutually exclusive.

Vision. Visual packaging elements play an important role in shaping expectations about products and their sensory properties, and some might even affect taste perceptions⁽⁵⁸⁾. A recent study shows that the sales of vegetarian products can be boosted by giving them a more attractive description, such as 'fresh seasonal risotto primavera', instead of 'risotto primavera'⁽¹¹⁰⁾, although this effect was negatively related to the frequency of eating vegetarian foods. Other studies focus more on 'fun' descriptions; however, 'wacky wundermelon slushies' were not more frequently bought than general melons, even in combination with a taste-testing⁽¹¹¹⁾. In contrast, indulgent descriptions such as 'slow-roasted caramelised zucchini bites' increased both the food choice and portion serving in a university cafeteria⁽¹¹²⁾. More research is thus needed to determine which types of descriptions work to encourage sustainable choices.

Other visual elements are non-descriptive; the use of curvature figures on packaging, such as circles, has been shown to increase the consumers' sensitivity for sweetness and hedonic ratings⁽¹¹³⁾. Warm and saturated (v. less vibrantly coloured) packages are perceived as more attractive for healthy food packages because these colours are closer to the ones of general products and thus might reduce the lower hedonic associations with healthy foods⁽²⁹⁾. This might also be an appealing strategy to promote sustainable products for consumers who are less concerned with the environment, as they perceive organic products as less tasty⁽⁶³⁾. Food in sustainable packaging is also perceived as having better quality compared to non-sustainable packaging because of the fit between sustainable food and a higher perceived naturalness⁽¹¹⁴⁾.

The way in which food is presented can also be an important predictor of food preference. Monochrome (v. coloured) pictures of food on menus have been demonstrated to be preferred and evoke a higher willingness to try the foods, and even the presentation of the food (i.e. balance) moderates this effect, such that pictures with colours and a balanced food presentation are rated as more attractive⁽¹¹⁵⁾. Moreover, some research reports on the consumer belief that healthier products are less tasty⁽¹¹⁶⁾, although some recent findings demonstrate that this belief is not shared by everyone^(117,118). Hence, mimicking junk food characteristics (i.e. association with better taste) on healthy foods can help mitigate these associations. For example, seasonal fruit and vegetables presented in the format of a burger in advertising might be appreciated more because of the inferred taste associations to the junk food⁽¹¹⁹⁾. Implying motion in the way food is presented in advertising enhances freshness perceptions and evaluations of the

food, which is theorised to be a consequence of an evolutionary learned sensitivity to motion⁽¹²⁰⁾. Another cue that enhances product freshness perceptions and appeal is a glossy package⁽¹²¹⁾, which is suggested to be a result of our innate need for water⁽¹²²⁾.

Some visual nudges are more related to the atmosphere of the store (see Spence *et al.*⁽¹²³⁾ for a review). It is suggested that store traffic could be enhanced by putting effort into creative store windows⁽¹²⁴⁾. Moreover, hanging nature posters above vending machines has been found to evoke healthiness feelings and increase the sales of healthy options⁽¹²⁵⁾. As consumers appear to link sustainability with healthiness⁽⁷⁴⁾, future research could examine whether this intervention would also enhance the sales of sustainable food products. In-store, brighter (v. softer) lighting increased the attention time and chances of picking up the product, although it did not increase the sales of the target product⁽¹²⁶⁾. Another field experiment⁽¹²⁷⁾ did not find any influence of light interventions in-store; it is thus questionable whether lightning could stimulate sustainable product sales.

Taste. The sampling of food can be a strong nudge in itself and is a frequently applied intervention in-store⁽¹²³⁾. Food sampling has positive effects on perceptions of food quality, consumer trial and long-term food sales^(128,129). Tastings can be especially useful for increasing the familiarity of novel sustainable products, such as tofu and soya milk, particularly among food neophobic people who have a less positive attitude towards novel foods^(111,130). Food choice can also be led by taste beliefs. A well-known example of taste beliefs is the place-of-origin cue, such as the strong association between pasta and Italy. The narrower the geographic origin (Italy v. Tuscany) is, the higher the quality associations and willingness to pay for a specialty food⁽¹³¹⁾. This is an interesting finding for sustainable foods that are produced locally⁽¹³²⁾. Moreover, this positive cue also influences sampling experiences, such that a positive region-of-origin association has shown a greater effect on taste assessments when this information is provided before (v. after) the sampling^(133,134).

Audition. Music at the point-of-purchase generally has a positive impact on consumer behaviour^(135,136), although its effect also depends heavily on contextual factors⁽¹³⁶⁾. For example, the fit between the environment and the music plays a crucial role, such that French wine has been shown to sell more when French music is played⁽¹³⁷⁾. Ambient music also affects cognitive perceptions; classical music has been associated with a higher expected service^(131,138) and leads to more spending⁽¹³⁹⁾. Not only purchase-related behaviour can be influenced by music, but also the speed of in-store traffic; a slower tempo in music has been found to literally slow down customers⁽¹³⁶⁾ and increase sales⁽¹⁴⁰⁾. One recent study⁽¹⁴¹⁾ examined the relationship between nature sounds and the willingness to purchase sustainable products in a field experiment. The results showed a medium size effect for male customers that initially had a lower purchase intention for organic foods.

Haptics. Lush, a soap store with a focus on sustainability, approaches entering customers by asking

if they want to try their products⁽¹²³⁾. Why has this been proven to be a valuable marketing strategy and are we so keen on touching products? Much of our likeability for touch is related to our personal 'need for touch'⁽¹⁴²⁾, and consumers with a higher need for touch feel more confident about their product judgement after touch (*v.* not⁽¹⁴³⁾). In general, touching a product leads to increased feelings of ownership⁽¹⁴⁴⁾, which makes us value the product more highly (*i.e.* endowment effect). Considering our innate loss aversion towards products we own, higher ownership feelings after touching sustainable products can nudge consumers into buying them⁽¹⁴⁵⁾. However, touch can also evoke feelings of 'disgust', so that it is demonstrated that consumers like products less when they are touched by others (*i.e.* consumer contamination⁽¹⁴⁶⁾). The appeal of sustainable food also decreases if they are 'touching' (*i.e.* physically next to each other on the shelf) moderately disgusting products, such as trash bags and cat litter (*i.e.* product contagion⁽¹⁴⁷⁾).

The importance of touch in our daily life also poses a challenge for marketers considering the novel ways in which we are buying foods. Online grocery shopping does not involve any haptics, so purchases might be different from those in a regular brick-and-mortar store. Sales data show that consumers make more healthy purchases in online compared to offline channels⁽¹⁴⁸⁾. In an additional laboratory study, the authors explain this finding by demonstrating that consumers are more tempted to purchase unhealthy items offline because of higher product vividness, while online, products are only symbolically presented. Even the way in which we buy online affects purchases, such that 'direct touch' via an iPad has been shown to lead to more healthier (*v.* healthier) choices than 'indirect touch' via the mouse of a desktop computer⁽¹⁴⁹⁾. Research is needed to determine whether sustainable sales would also be greater in purchase channels involving less touch, and if sustainable products lose to less sustainable products if both can be touched.

Olfaction. In general, although we have some difficulties with naming scents, people are masters in distinguishing different odours⁽¹⁵⁰⁾. Smell is the only sense that is related directly to our memory, such that the use of odours and olfactory information in marketing has been a frequently researched topic⁽¹⁰⁹⁾. For example, the recall of brand attributes has shown to be higher if the product was scented *v.* not, and this effect was stronger for a product scent compared to an ambient scent (*i.e.* scents in the environment⁽¹⁵¹⁾). The authors believe that this latter finding can be explained because product scent focuses on the scent-related associations of only one product (*v.* multiple products). Nonetheless, in general, research shows a positive effect of ambient scents on store evaluations, such that some stores even sprinkle a signature scent^(152,153). Ambient scents can evoke emotions that lead to enhanced product evaluations as long as there is a fit between the scent and the product⁽¹⁵⁴⁾. However, the effect of scent on actual food choice is less clear. Bread and cucumber odours improved mood among participants, but no

effect was found on their subsequent lunch choice⁽¹⁵⁵⁾. Another study⁽¹⁵⁶⁾ also found contradictory results, such that bread was not the preferred option in the bread aroma condition (*i.e.* congruency between aroma and choice) but in a non-congruent aroma condition. Although research shows some tentative results for using scents to enhance the in-store experience of sustainable stores, further research is needed to determine whether scents can influence actual product choices.

Social influences

In addition to changing the food choice architecture, people can also be nudged by other consumers' behaviour⁽¹⁵⁷⁾. Because social desirability plays an important role in sustainable behaviour⁽¹⁵⁸⁾, we will extend the discussion of Cadario and Chandon⁽³³⁾ on 'healthy eating calls' by incorporating insights into different types of social influences. First, the use of social norms is a frequently applied intervention to nudge consumers towards a desired behaviour; it accompanies rules and standards that are shared by the members of the same community⁽¹⁵⁹⁾. Social norms can be either descriptive or injunctive, such that descriptive norms describe the behaviour of people (*e.g.* the average household energy consumption), while injunctive norms also evaluate this information in terms of consumers' approval (*e.g.* adding a happy or sad smiley to indicate whether people are under or above the average energy consumption⁽¹⁶⁰⁾). Authors warn that descriptive norms can backfire, for example, when people score better than the provided norm (and consequently increase their energy consumption⁽¹⁶⁰⁾) or when the message implies that it is acceptable to perform harmful behaviour because many people are doing so (*e.g.* the majority of the people throw cigarette butts on the street⁽¹⁶¹⁾).

Nonetheless, these counterproductive effects can be eliminated by adding an injunctive norm to descriptive information (*e.g.* sad/happy smiley⁽¹⁶⁰⁾). Anthropomorphic cues, attributing human characteristics (*e.g.* sad faces) to non-human products, have been demonstrated to evoke feelings of sympathy towards the messenger that appear to reinforce normative behaviour, so that it eventually leads to increased sustainable behaviour to favour the messenger, but only when this behaviour does not come at an extra cost⁽¹⁶²⁾. Similarly, anthropomorphism can be applied to advertise wonky foods (*i.e.* misshapen produce). Although generally perceived as less tasty, higher purchase intentions when wonky foods are anthropomorphised show the potential of anthropomorphism as an intervention for battling food waste⁽¹⁶³⁾. Other symbols, such as the use of predetermined compartments on lunch trays for vegetables and fruit, can also evoke a social norm to increase the intake of targeted products.

Another recommendation is to frame the descriptive message in a positive way (*e.g.* the majority of the people throw cigarette butts in the bin⁽¹⁶⁴⁾). A recent study⁽¹⁵⁸⁾ shows the effectiveness of using positive descriptive norms if consumers perceive the message as credible,

even when the promoted behaviour is not sustainable (i.e. avoid overpackaging) and not yet adopted by the majority of the people. Conversely, descriptive (but not injunctive) norms are better for promoting behaviour than preventing it⁽¹⁶⁵⁾. The persuasiveness of the message might also play a role, such that a field experiment shows that stronger (v. weaker) norms are more effective in enhancing eco-labelled purchases⁽¹⁶⁶⁾. However, some studies found no effects of positive descriptive messages^(167,168). Overall, social norms and feedback seem to be promising nudges⁽¹⁶⁹⁾, as also identified by a meta-analysis that classifies these interventions as having one of the greater effect sizes among interventions in promoting sustainable behaviour⁽¹⁷⁰⁾.

Another promising intervention indicated by this meta-analysis⁽¹⁷⁰⁾ is verbal prompting. A recent field study⁽¹⁷¹⁾ applied a diverse set of verbal prompts, such as questioning whether customers would buy non-environmental or environmentally friendly bananas (cf. question-behaviour effect⁽¹⁷²⁾), and approaching customers with the assumption that they seem interested in buying eco-labelled products. All verbal prompts increased sustainable choices compared with the baseline sales. In a self-service restaurant, more healthy side dishes were bought when customers were verbally prompted, while customers indicated feeling no buying pressure⁽¹⁷³⁾. Signalling towards other people appears to be very important; sustainable purchases can be increased by verbal prompting in the presence of other store-employees⁽¹⁷¹⁾. Indeed, pro-environmental behaviour shows some links with status signalling⁽¹⁷⁴⁾, such that a status motive has been demonstrated to lead to more sustainable purchases^(157,174). In fact, some evidence⁽¹⁷⁵⁾ shows that the signal works in that vegetarian and meat alternative (e.g. insect-based burger) eaters are perceived as being more environmentally friendly and even more brave and interesting compared to meat eaters.

When eating in a social environment, people are also affected by the food choice and intake of others and adapt these according to the group, as demonstrated in a meta-analysis⁽¹⁷⁶⁾. Field data from a restaurant show that people tend to seek variety in their individual dishes but not in the menu category⁽¹⁷⁷⁾. This is an interesting finding to nudge sustainable food choices; perhaps if someone orders vegetarian food, the others might follow with dishes within the vegetarian food category. Promoting vegetarian foods by framing them as the 'recommendation of the chef' is also a way to prompt vegetarian food choices among infrequent eaters of vegetarian food⁽¹¹⁰⁾.

Social influences even go beyond written and verbal interactions with people. For example, consumers attach some social beliefs to the positioning of products in-store, such that products in-between two products of the same category are believed to be more popular because of the middle position, which functions as a positive cue leading to higher purchases^(178,179). If consumers do not have strong preferences for products, the scarcity of products on shelves might also function as a popularity cue that affects consumer choices⁽¹⁸⁰⁾. Lastly, in view of the many ways in which social influences affect sustainable

purchases, note that social desirability biases in the survey and experimental research on sustainability should always be taken into account⁽¹⁵⁸⁾.

Behaviourally oriented interventions

Convenience enhancements

To make sustainable food choices more attractive, they should be convenient and easy to access, while the required effort for buying less sustainable products is preferably larger. Studies on choice architecture show that accessibility enhancements, for example, placing fruit and vegetables at the beginning of the buffet increase the self-serving portions of these target products⁽¹⁸¹⁾. Moreover, the increase in fruit and vegetables was not compensated for by other meal components; the increase substituted servings of other meal components. Another study in a cafeteria setting⁽¹⁸²⁾ changed the order of foods so that energy-dense products were less accessible to favour the sales of low-energy foods. However, no effects were observed by placing wholegrain bread in a more convenient place⁽¹⁸³⁾. Placing products on a lower v. higher shelf also did not affect the sales of healthier snacks⁽⁹⁹⁾. Perhaps, the effectiveness of product accessibility as a nudge depends on the type of product to which the nudge is applied. For example, a field experiment was not able to generate greater sales of unfamiliar vegetables by increasing their accessibility⁽¹⁸⁴⁾.

A concept that is closely related to accessibility is proximity. In a trade-off between healthy (i.e. apples) and non-healthy options (i.e. popcorn) that are manipulated in terms of distance (within-reach v. 2 m away), researchers found higher consumption of the food that is positioned closer⁽¹⁸⁵⁾. Putting a bowl of M&Ms at 20, 70 and 140 cm decreased intake with increasing distance⁽¹⁸⁶⁾. At work, it is shown that fewer snacks are purchased if the vending machine is placed further from the office desks⁽¹⁸⁷⁾. Even small required efforts, such as when potato chips are located in a distant snack bar v. at the cash register, have been found to discourage unhealthy choices⁽¹⁸⁸⁾. Notably, no main effects were found on the proximity (20 v. 70 cm) or snack type when simultaneously presenting a bowl of chocolates and fruit⁽¹⁸⁹⁾. Rather, a relative proximity effect was observed, such that higher consumption of fruit was only obtained when the chocolate bowl was placed further (v. closer).

A typically employed and effective nudging strategy is to present the consumer with a 'default option', in which consumers are presented with a pre-determined item as a first or more prominent choice, thus requiring less effortful analytical decision making on the part of the consumer⁽¹⁹⁰⁾. Defaults can also be used in food research; research shows that parents select healthier breakfast options for their children when they are readily available (v. only available on request)⁽¹⁹¹⁾. Another study shows that healthier whole wheat (v. white) bread was more often selected when it was the default option for ordering a sandwich⁽¹⁹²⁾. Further evidence can be found in a

restaurant setting⁽¹⁹³⁾, where healthier choices were ordered more when presented as the default option on the menu. Overall, these studies suggest the potential to increase sustainable food choices by making them the default option. Note that nudging theory does not support choice restriction⁽¹⁹⁴⁾.

Convenience can also be related to the way in which food products are offered. For example, self-servings are found to be lower when customers have to take the food with a pair of tongs *v.* a spoon⁽¹⁸²⁾. Other research shows that servings from squeeze tubes (*v.* regular jars) are more easy to monitor by consumers⁽¹⁹⁵⁾, and that people eat less from resealable (*v.* non-resealable) packages because they have to re-open them⁽¹⁹⁶⁾, which might be interesting findings in the case of less healthy content. Findings are less clear on preparing foods so that they are easier to eat; pre-sliced fruit was perceived as less attractive in terms of sensory and packaging characteristics⁽¹⁹⁷⁾. Supermarkets are also increasingly offering bundles of food (e.g. all ingredients for a dish in one box). A recent study shows that this might be a promising nudge to counter the effect that people choose less healthy options when they are cognitively loaded as a result of the mental process of planning and sourcing individual ingredients⁽¹⁹⁸⁾. Food bundles simplify shopping choices so that customers under cognitive load have been found to more frequently choose food bundles, although only if the food bundles are non-discounted (*v.* discounted). Packages of sustainable food products might thus be an appealing nudge in making sustainability more convenient.

Size enhancements

Portion size interventions might be especially interesting in decreasing the sales volume for products of which its production has a high impact on the environment, such as meat⁽¹⁹⁹⁾. Research has extensively demonstrated that portion sizes and intake are also positively related (i.e. portion size effect^(200,201)) so that smaller portion sizes also decrease consumption. Verbal prompting by asking customers in a restaurant whether they want to downsize their portion successfully increased the number of smaller portions by one-third, while no compensation behaviour (i.e. higher energetic side dishes or drinks) was observed⁽²⁰²⁾. Another way to encourage smaller portions is offering them next to default larger portion sizes, which significantly nudged customers in a cafeteria to switch from a larger to a smaller portion size⁽³⁰⁾. A field experiment⁽²⁰³⁾ found that adding two smaller portions of meat sausage units next to the default portion size unobtrusively encouraged customers to buy smaller units. During a 1-month intervention period, more than half the units sold (52 %) were smaller portions than the default larger portion size, which established a decrease in meat volume of 13 % if all units sold would have been the default size. Portion sizes can also be adapted to promote sales volume and intake, and increasing the portion sizes of vegetables and fruit led to a greater intake among children⁽²⁰⁴⁾. Nonetheless, the effects of changes in portion sizes on food choices

and consumption should be carefully examined. Authors warn of the possible backfire effects that (multiple) smaller portions would eventually lead to higher consumption, and that smaller portions (compared to larger ones) are less likely to activate a self-control conflict that leads to careful monitoring of consumption⁽²⁰⁵⁾.

Portion size judgement is also heavily influenced by our perception. For example, the same portion size has been found to be perceived as being larger when presented horizontal (*v.* vertical) on a plate⁽²⁰⁶⁾. Moreover, consumers perceive food portions placed centrally on a plate (*v.* slightly offset) as larger. In addition to the way food is presented on a plate, plate size also affects perceptions, so that consumers have been demonstrated to eat more from larger plates⁽²⁰¹⁾. Nonetheless, other studies found no effect of plate size on consumption⁽²⁰⁷⁾, and larger plate sizes might also lead to a greater intake of vegetables⁽²⁰⁸⁾. Considering consumers' preference for middle options⁽¹⁷⁸⁾, size labels might trigger people to always go for the in-between-option, regardless of its portion size. Moreover, people report to feel less guilty when consuming a larger portion of hedonic food if it is labelled as 'small'⁽²⁰⁹⁾. Nonetheless, the authors also found that consumers are not 'fooled' by smaller items carrying a 'large' label.

Conclusion

In 2017, the Nobel Prize for Economics was awarded to Thaler for his work on behavioural economics⁽²⁰⁾. Inspired by his theory on nudging, which was co-created with Cass. S. Sunstein, many researchers are currently looking at how we can apply nudging principles for societal outcomes, such as improved healthiness and safety of people, and nature preservation. This review aimed to provide a non-exhaustive overview of nudging and sustainable food choices and highlights the different areas where more research is needed. In summary, our review has demonstrated the potential of nudging to be a valuable technique in encouraging environmentally friendly purchases. Nonetheless, not all studies were able to obtain significantly beneficial results from only changing the choice architecture. Personal predispositions towards sustainable consumption cannot be overlooked in designing nudges, demonstrating the complementarity of nudging research with educational interventions. The vast majority of the studies were conducted in Western and highly developed societies. Less is known about the effectiveness of nudges in other cultures. Interventions should also be carefully designed, taking cognitive processes⁽²¹⁰⁾ and the conditions of the environment into account (see Meder *et al.*⁽²¹¹⁾). Moreover, as many nudging studies have focused on short-term interventions, it is still unclear whether nudging will work in the long term. Nudging and its libertarian paternalism view have also been criticised for its use of defaults⁽²¹²⁾ and other ethical criteria (see Rebonato⁽²¹³⁾ for an overview). We also call for more multidisciplinary research so that behavioural scientists focus their research on the topics that may yield the highest ecological return. It is our hope that

this review can inspire researchers to tackle these challenges and contribute to further research on nudging and sustainability.

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Conflicts of Interest

None.

Authorship

J. V. drafted the manuscript. I. V., M. G., H. S. and A. K. V. revised the manuscript. All the authors have read and approved the final manuscript.

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