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Review

Beyond the confines of choice architecture: A critical analysis[☆]Björn Meder^a, Nadine Fleischhut^b, Magda Osman^{c,*}^a Max Planck Institute for Human Development, Max Planck Research Group iSearch, Lentzeallee 94, 14195 Berlin, Germany^b Max Planck Institute for Human Development, Center for Adaptive Rationality, Lentzeallee 94, 14195 Berlin, Germany^c Queen Mary University London, Biology and Experimental Psychology Centre, London, Mile End Rd, E14NS, UK

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ABSTRACT

Behavioral science units across the world advise policy makers on the use of ‘nudge’ techniques with the goal to improve health, wealth, and happiness. Nudges use psychology to steer people toward or away from making particular choices by designing choice architectures that frame or highlight options in particular ways. What has been missing from debates on nudging is a systematic consideration of the environments in which they are embedded. We argue that a detailed examination of the wider environment in which the policy issue is situated is essential for designing, implementing, and evaluating policy-making tools, nudge-like or otherwise. Successful policy making requires a good fit between intervention and the environment, otherwise we risk miscasting policy issues and designing futile interventions. Using real-world cases, we characterize the role of the environment in different policy problems and present a basic taxonomy for policy makers to identify critical factors in the environment beyond the confines of the choice architecture.

1. Introduction

The standard menu of tools at the policy makers’ disposal includes regulatory measures (e.g., banning of tobacco advertising), economic incentives (e.g., taxes on tobacco), and educational resources (e.g., information campaigns or smoking cessation trainings). More recently, policy makers are turning to the behavioral sciences for advice on how to develop effective and efficient interventions. One prominent approach is *nudging*, which sets out ways in which policy makers can devise choice environments (so called *choice architectures*) in order to “nudge” behavior in line with positive life choices (Thaler & Sunstein, 2008). Examples include the use of default systems for automatic enrolment in retirement saving plans and the re-arrangement of healthy items in food establishments to improve dietary choices. The nudge program proposes that effective behavioral change is possible without the need for substantial changes to incentive structures or mandating (Sunstein, 2016; Thaler & Sunstein, 2003). The promise is cheap behavioral change without much leverage.

Can nudges live up to this promise? How can we characterize the circumstances under which nudges are appropriate and when do they need to work in tandem with more traditional policy tools? The world of academia, and beyond, has critically examined the effectiveness of nudges (House of Lords, 2011; Marteau, Ogilvie, Roland, Suhrcke, & Kelly, 2011), discussed the ethical concerns they raise (Sunstein, 2016), and criticized the psychological assumptions underlying them (Gigerenzer, 2015; Grüne-Yanoff & Hertwig, 2015; Osman, 2016). Surprisingly, there has been little systematic examination of the wider environment in which choice architectures are embedded—and how the environment determines when and why nudges may succeed or fail (Szasz, Palinkas, Palfi,

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Szollosi, & Aczel, 2017; see also Sunstein, 2017). The motivation for this piece is to spell out the factors that should be considered to determine a good fit between particular behavioral interventions and the structure of the environment they are embedded in.

First, we aim to show why successful interventions, nudge-like or otherwise, require a comprehensive analysis of the environment in which a social problem is situated. This closely corresponds to a body of work in the behavioral change literature which has argued that consideration of a wider array of factors is critical for designing and implementing sustainable interventions (Michie, van Stralen, & West, 2011). Without looking beyond the immediate choice architecture, researchers and practitioners risk misrepresenting the source of the problem and designing interventions that may ultimately fail. The second aim is to provide a candidate taxonomy that helps identifying critical environmental factors when designing and assessing behavioral interventions, in order to provide clarity when interventions might succeed or fail.

2. Beyond the confines of choice architecture

Nudge-like interventions typically focus on the immediate choice architecture, namely the set of options available to the decision maker. They aim to overcome limiting factors that inhibit positive behavioral change (e.g., distracted attention, conflicts of interest, shifts in value assignment, motivation, emotional involvement). This is commonly done by framing, highlighting, or redesigning particular options (Thaler & Sunstein, 2008). To illustrate: One way to increase the number of potential organ donors is to implement default systems that automatically enroll every citizen into an organ register system as a potential donor, unless they explicitly opt out (Johnson & Goldstein, 2003; Shepherd, O'Carroll, & Ferguson, 2014). This is an important first step to overcoming psychological barriers that might prevent people from registering as donors (e.g., avoidance of thoughts of death and unpleasant emotional experiences). The intervention targets the immediate choice situation by highlighting a particular option that is deemed “better” from a social welfare perspective.

However, while able to increase the number of potential donors, the intervention will not necessarily lead to an increase in actual organ donations unless the medical infrastructure can cope with the increased supply of organs (Rithalia, McDaid, Suekarran, Myers, & Sowden, 2009; Rudge & Buggins, 2012; Willis & Quigley, 2014). One such example is Croatia, which introduced an opt-out system by law in 1988, but for several years this had little impact on donation rates because the necessary medical infrastructure was not in place (Živčić-Čosić et al., 2013). Only when improvements to the environment were made by establishing a network of transplant coordinators across the country's hospitals and improving transplant protocols, did rates of organ donations increase. Another important factor was the proactive communication with donors and their families, since organ procurement is commonly conducted only in agreement with the donor's relatives, irrespective of whether the donor implicitly or explicitly gave their consent (May, Aulisio, & DeVita, 2000). Thus, societal and cultural factors can be critical for the success of a behavioral intervention, as can other environmental factors that constrain the immediate and long-term consequences of a decision-maker's choices, such as economic, political, and legal factors (Kirchhoff, Lemos, & Dessai, 2013; Lin, Osman, Harris, & Read, in press; Pratt et al., 2015; Swinburn, Egger, & Raza, 1999).

Automatic enrollment onto organ donation registers is just one example where focusing exclusively on the choice architecture targets only one component of the actual social problem the policy maker is trying to solve (Lin, Osman, Harris, & Read, 2018). Underlying each social problem is a causal structure that extends beyond the confines of the choice architecture. Without a full analysis of the social problem within its environment, the scope of an intervention can thus be severely limited. Of course, the environment can be characterized in a number of ways and will likely involve non-trivial interactions at different times along the history of the social problem. In the case of organ donation, the environment also includes the political and economic backdrop (Goyal, Mehta, Schneiderman, & Sehgal, 2002; Roth, 2007), cultural norms and value systems (Crowley-Matoka & Lock, 2006; Lock & Crowley-Makota, 2008), legal systems (August, 2013; Smith, 2008), family veto rates (Lin et al., 2018), as well as criminal or black-market economies (Scheper-Hughes, 2004), all of which have been shown to have a bearing on organ donation rates. Yet there is no easy way out: Any comprehensive characterization of a social policy problem needs to consider which factors in the wider environment are contributing to it. This provides the starting point for identifying interventions that are tailored to the problem and are able to overcome obstacles that otherwise inhibit or countervail the intended behavioral change.

The importance of analyzing and designing behavioral interventions on different levels has been stressed for quite some time by the literature on behavioral change, with different proposals for integrating structural-environmental, psychological, and behavioral factors (e.g., Abraham & Michie, 2008; Loewenstein, & Chater, 2017; Michie, Ashford et al., 2011; Michie, van Stralen et al., 2011). In stark contrast, the primary focus of research rooted in behavioral economics has been on the particular set of options that decision makers face, without acknowledging and explicitly specifying the environment in which a particular choice architecture is implemented (Osman, 2016). As a consequence, there is little guidance for policy makers or researchers on how to build interventions for different kinds of problems. Clearly, the importance of a comprehensive analysis is not limited to nudges (Michie, West, Campbell, Brown, & Gainforth, 2014). For an effective and sustainable policy recommendation designed to target a social policy at different time horizons (i.e., short, medium, or long term), there needs to be an examination of the environmental factors beyond the immediate choice architecture (French et al., 2012); what behavioral economics refer to as *structural causes* (Bhargava & Loewenstein, 2015), and what public health researchers and sociologists call *socio-ecological frameworks* (Pratt et al., 2015).

3. The critical role of the environment in policy making

In this section, we describe several interventions targeting a variety of social problems and the different environments they are located in. The first goal is to illustrate why characterizing the environment is a necessary starting point in designing an intervention.

The second goal is to provide a first pass at a taxonomy of environmental factors that are critical to successful interventions. We present five types of environments: underutilized environments, unprepared environments, counteracting environments, compensatory environments, and heterogeneous environments.

3.1. Underutilized environments

Behavioral change may fail if people overlook affordances in the environment. In this case, targeting the mind of the individual alone through choice architecture can be sufficient. For instance, many governments have identified public littering as a significant problem. In England, the direct costs alone for cleaning streets and other public spaces are estimated to be almost £1 billion a year (Keep Britain Tidy, 2013). A large proportion of littering behavior occurs despite a sufficient number of litterbins in public areas (Schultz, Bator, Large, Bruni, & Tabanico, 2012). Thus, often the main cause of littering is not a lack of facilities, but rather that people either actively avoid using the facilities, or passively litter by forgetting to use them (Schultz et al., 2012; Sibley & Liu, 2003). This means that behavioral change doesn't necessarily require structural changes to the environment (e.g., providing more litter bins), but rather interventions that target psychological barriers such as lack of attention, lack of motivation to change behavior, and poor habits.

Governments like Singapore have responded to the social problem of littering with standard policy making tools like mandates and heavy fines. Other governments have turned to behavioral interventions. For instance, supported by a pilot study in Copenhagen (iNudgeyou, 2012), painting footprints on sidewalks that lead up to litter bins has been considered as a means to encourage people to reduce their littering behavior. While environmental factors such as cultural norms and social values effect levels of littering (Ong & Sovacool, 2012; Steg, Bolderdijk, Keizer, & Perlaviciute, 2014; Torgler, Frey, & Wilson, 2009), the main cause of littering seems to be psychological, so solutions are needed that treat this as the primary cause (Almosa, Parkinson, & Rundle-Thiele, 2017; Schultz et al., 2012).

Another illustration of an underutilized environment is the irregular or infrequent use of fitness and wellness centres to improve public health (Pope & Harvey, 2015). The problem is persistent and not explained through a lack of available facilities, particular not in developed countries (Downward, Dawson, & Mills, 2015). Rather, it may be better characterized as resulting from psychological factors such as a lack of motivation to regularly commit to self-set fitness goals (Prestwich, Lawton, & Conner, 2003). To inspire people to use existing fitness centers, one successful strategy has been the provision of monetary incentives (Charness & Gneezy, 2009; Pope & Harvey, 2015). Success depends on a good match between the root of the problem, in this case psychological, and the target of the intervention, in this case the value of a particular behavior (Hansen, Skov, & Skov, 2016). However, educational campaigns designed to increase awareness of the mental as well as physical health benefits resulting from regular exercise have had mixed success (Milton & Bauman, 2015). One reason may be that information about the importance of exercise is often generic. Promoting the merits and values of fitness is not tied to a particular fitness activity, to which incentive schemes are often directly connected. This means that even when there seems to be a reasonable match between an intervention and the social problem (i.e., improving fitness through promotion via educational campaigns), success can be limited if the intervention is ambiguous or too generic for an individual to identify what behavior to specifically change.

3.2. Unprepared environments

If an environment lacks the facilities to support the intended behavior, solely targeting the choice architecture is insufficient. For instance, over the past few decades city dwellers have become ever more motivated to bike ride rather than drive to work (Pucher & Buehler, 2016; Pucher, Dill & Handy, 2010). The advantages are not only personal, namely improving fitness, but also social, in that it can reduce traffic build up in congested areas (Tolley, 1990). However, cyclists' major concerns in cities are road safety and bike thefts. In this case, the problem of how to increase cycling behavior in cities is not solely rooted in the individual (e.g., motivation to cycle, individual safety measures like helmets or safety lights) but primarily in the lack of infrastructure in the environment, such as the lack of dedicated cycle lanes and bike-sharing systems (Pucher & Buehler, 2016; Pucher & Dijkstra, 2003). Therefore, any intervention that treats the problem as purely psychological, for instance by targeting the mind of the individual through educational campaigns about cycling safety, is not sufficient to translate into meaningful behavioral change (Debnath, Haworth, Schramm, & Williamson, 2016) unless the environment is targeted, too.

An example of an intervention designed to address such environmental factors involved increasing available bike lanes that protect cyclists from car traffic (Frank & Engelke, 2001). Research shows that with extensive improvements to infrastructure comes increased bicycle use in cities and countries (Pucher & Buehler, 2008; Saelens, Sallis, & Frank, 2003; for a review see Pucher et al., 2010). Another infrastructural change to the wider environment, accompanying the existing positive demand for cycling, is increased investment in bike-sharing systems that provide people with easy access to bicycles on an "as-needed" basis: As of 2014, more than 800 cities worldwide have established bike-sharing facilities, comprising almost a million bikes (Richter, 2015).

A second policy issue, which is characterized by unprepared environments, concerns the need to increase physical activity at the population level. On the one hand, research suggests that psychological barriers curb interest in physical activity (Kohl, 2012). On the other hand, evidence also shows that multiple factors in the environment limit efforts to increase fitness. In response, governments recognize that an increase in motivation to exercise needs to map onto improvements to the local ecology in which the physical activity can occur (Pratt et al., 2015). Thus, several countries (e.g., Brazil, Finland, Colombia, UK) have improved public parks and plazas by providing better access to them, upgrading their facilities, and improving signage (Cohen et al., 2013; Pratt et al., 2015). By starting with infrastructural changes that create attractive and safe environments to interact with, positive behavioral change then

seems to follow. The lesson from this example is that interventions targeting the environment first (or at least simultaneously) create the necessary affordances in order for behavioral change to emerge.

3.3. Counteracting environments

Opposing forces in the environment can diminish or neutralize the effect of a behavioral intervention. That is, despite the fact that an intervention might be effective in targeting the main factors contributing to a social problem, environmental factors exist that prohibit or counteract the intended effect. An illustrative case from the financial domain is a governmental default policy intended to protect consumers from overdrafting fees on their personal accounts. Until 2010, financial institutions in the U.S. were allowed, at their discretion, to charge customers a substantial fee (Willis, 2013). Overdrafting fees created several billions of dollars in revenue, and overwhelmingly affected the most vulnerable low-income and minority group of customers, who accrued more than 90% of the fees (Federal Deposit Insurance Corporation, 2008). To address the issue, regulators changed the banking default system for overdrafting in 2010. Under the new default, account holders were prevented from automatically overdrawing unless they explicitly opted into overdrafting (Code of Federal Regulations, 2009). The hope was that consumers would stick with the new default, thereby going overdrawn less often, and in turn incurring fewer fees.

Did the new default work? The available data suggests that the policy achieved limited success. A study by the Consumer Financial Protection Bureau (2013) found that only a few months after the new default was introduced, about 45% of consumers with a prior heavy overdraft history had reverted to the old default and opted back into overdrafting. Other estimates are even higher, reporting rates of up to 98% for these types of consumers; with overall rates for some banks assumed to be approximately 90% (Kapner, 2011). Researchers from the Federal Reserve Bank of Boston compared data from 2009 (under the old default) with that of 2014 (under the new default). Their conclusion was sobering: “These findings are statistically significant, but the economic impact is small. The data do not show a strong and immediate response to the implementation of the opt-in rule [into overdraft coverage].” (Greene & Luo, 2015). One explanation for this failure is that banks actively counteracted the regulators’ efforts by minimizing the cost of retracting the new default (Willis, 2013). For instance, they provided customers with quick ways to retract overdraft protection by pushing a button on an ATM, or directly approaching customers to convince them of the supposed benefits of allowing overdrafting. Ironically, some banks even used nudge-like interventions relying on social comparison to signal the “better” option to customers, such as informing them that “The majority of our members prefer having this service to avoid the embarrassment of having their debit card purchase denied.” (ABCO Federal Credit Union, 2013). In this case, targeting the choice environment by changing the default had only limited success because the banks themselves counteracted the behavioral change policy. As a consequence, customers frequently failed to stick to the new default introduced by the government for their protection.

A parallel example within the same domain is the U.S. Credit Card Accountability Responsibility and Disclosure Act of 2009 (“CARD Act”). One of its goals was to reduce the fees incurred to customers if they exceeded their credit line. Similar to the case of defaults limiting access to overdrafting on personal accounts, the regulatory bodies changed the default, requiring card issuers to obtain explicit consent before allowing customers to conduct transactions that would exceed their credit limit. Importantly, the introduction of the new default was supported by limiting the fees for overdrafting to \$25 for the first transaction that exceeded the limit, and then to \$35 for each violation in the next six months (Consumer Financial Protection Bureau (2013). This difference in implementation turned out to be critical, leading to more promising results than the efforts made for limiting overdrafting on personal accounts: “It is clear that the CARD Act has effectively eliminated overlimit fees as a source of cost to consumers and revenue to issuers.” (Consumer Financial Protection Bureau, 2013, p. 21). One explanation for the success of the CARD Act is that due to the cap on fees it wasn’t worth the cost for credit card issuers to counteract the new default (Willis, 2013).

The upshot is that the same type of behavioral intervention can lead to strongly diverging results depending on the structure of the environment in which it is implemented (e.g., presence of opposing parties, such as banks). Defaults are speculated to be successful in increasing retirement savings (Benartzi & Thaler, 2013; Madrian & Shea, 2001) and organ donation rates (Shepherd, et al., 2014), but the same tool has had virtually no effect when attempting to protect people from overdrafting their personal accounts. Here, regulators and policy makers need to be aware of counteracting forces (e.g., financial institutions who make money from overdrafting fees) that may introduce contradictory methods of behavioral change (e.g., making it easier to opt-out of a default) that will inevitably limit any targeted positive behavioral change.

3.4. Compensatory environments

Compensation effects can undermine the success of an intervention in an even more subtle way than counteracting environments. One example is the persistent global social problem of rising obesity levels resulting from poor dietary habits, as well as through lack of exercise, which we have discussed already. To address this issue, one of the most often referred to nudges is the re-arrangement of items in food establishments to help people making better dietary choices (Thaler & Sunstein, 2008). The aim of the intervention is to influence food choices in particularly common contexts such as cafeterias in schools and the workplace (e.g., Rozin et al., 2011). The intervention targets the choice architecture by changing the ordering or presentation of food items in ways that direct attention explicitly towards the “better” (healthier) options, while at the same time deflecting attention away from tempting healthier options (for reviews see Hollands et al., 2013; Nornberg, Houlby, Skov, & Perez-Cueto, 2016). Yet even when people choose a low-calorie option in these particular contexts, the overall reduction in calories can be offset by compensatory choices of other unhealthy items (e.g., sugary drinks and side-dishes; Wisdom, Downs, & Loewenstein, 2010).

Other limiting factors include an abundance of cheap, energy-dense food (Hill & Peters, 1998), and the social norms that influence

food choices in the presence of companion diners (Dallacker, Hertwig, & Mata, 2018; Herman, Roth, & Polivy, 2003). These along with other physical, economic, and socio-cultural factors contribute to the idea of an *obesogenic environment* (Swinburn et al., 1999), which provides innumerable occasions for compensating smaller or healthier meals with unhealthy food consumption (e.g., due to self-licensing, Brañas-Garza, Bucheli, Paz Espinosa, & García-Muñoz, 2013, or social influence). This puts in perspective reasons for why behavioral interventions, as well as other conventional policy tools, such as media advertising, educational campaigning, or nutritional labels (Patterson, Bhargava, & Loewenstein, 2017) have generated mixed results (Wakefield, Loken, & Hornik, 2010). Only targeting a small part of the choice environment ignores a vast number of factors within the wider environment that will undermine behavioral interventions, unless accompanied by “hard” policy tools (taxes, bans, mandates) that more directly target compensatory factors in the environment.

3.5. Heterogeneous environments

Behavioral interventions are typically designed to target the largest number of people in one go. This often comes at the expense of sensitivity to the varying backgrounds, values, and preferences of that population. For instance, while automatic enrollment is argued to increase retirement savings (e.g., 401(k) participation), it tends to anchor participants at a low savings rate and in a conservative investment strategy (Choi, Laibson, Madrian, & Metrick, 2004). The supposed high participation rate resulting from automatic enrollment reduces the fraction of employees with zero contributions, but at the same time it reduces the contributions of employees who would have contributed *more* without automatic enrolment. As a consequence, while one part of the population benefits, namely those who would not have saved without automatic enrolment, this is at the cost of those who would otherwise have chosen higher contribution rates.

Analogous examples can be found in other domains. For dietary behavioral change, one focus should to reduce calorie intake among people who are overweight or obese. Wisdom et al. (2010) compared two interventions, one based on providing calorie information and one nudge-like intervention that made ordering healthier options slightly more inconvenient. They found that while providing calorie information did reduce calorie intake, it was ineffective for overweight people—who responded better to the reordering of food. In a similar vein, blanket media campaigns designed to encourage smoking cessation tend to be less effective for particular subgroups, such as socioeconomically disadvantaged populations (Niederdeppe, Kuang, Crock, & Skelton, 2008). It is worth highlighting this because the prevalence of smoking is higher in this group. Importantly, for these subpopulations media campaigns tend only to be effective if combined with other interventions (e.g., free nicotine replacement therapy, telephone counseling, community mobilization). Thus, a social problem can result from a variety of factors reflecting heterogeneous populations, and so effective behavioral change requires different interventions, or else combinations of interventions, to tackle the same problem in different subgroups of the population (Osman, Lin, & Ashcroft, 2017).

4. Environment is key: lessons for policy making

We have proposed that a comprehensive analysis of the environment in which a problem is situated is crucial for guiding policy making: What needs to change behaviorally cannot be isolated from understanding the types of environments the problem is situated in (Fig. 1). In line with this, researchers and policy makers alike have emphasized that many social problems require a multiple intervention approach to have significant impact (Abraham & Michie, 2008; Bhargava & Loewenstein, 2015; Loewenstein & Chater, 2017; Michie, van Stralen et al., 2011). This not only means specifying the conditions that lead to success for different kinds of behavioral interventions (Hertwig & Grüne-Yanoff, 2017; Hertwig, 2017; Sunstein, 2017), but also combining behavioral interventions with more traditional policy-making tools that target a wide and diverse environment, as summarized by the Science and Technology committee of the U.K. House of Lords: “...non-regulatory measures used in isolation, including “nudges”, are less likely to be effective. Effective policies often use a range of interventions.” (House of Lords, 2011, p. 5).

Our discussion of the importance of the broader environment in policy making and designing behavioral interventions resonates with related proposals in the behavioral change literature. For instance, Michie, van Stralen et al. (2011) proposed a general framework for characterizing behavioral change interventions, which is applicable to a wide array of behavioral interventions and other policy-making tools. Their system focuses on three factors and how they interact to produce behavior: capability, opportunity, and motivation. In fact, our discussion on the importance of affordances provided by the physical and social environment neatly complements the concept of opportunity, which draws attention to external factors that are not under the control of the individual decision maker. The taxonomy presented here helps to distinguish between different types of environments in more detail as an approach for capturing why the same intervention in two different contexts can yield entirely different results (e.g., defaults on overdraft limits vs. defaults on credit card limits).

Characterizing any social problem and identifying an appropriate starting point for any policy intervention requires carefully considering the relevant factors in the environment (John, 2018; Spotswood, 2016). By doing so, researchers and policy makers should also answer three important questions (Table 1). First, *what is the ultimate goal of a policy intervention?* In the case of organ donation, for instance, the problem is a gap between the number of people on waiting lists for organ donations and the available number of donated organs. The ultimate goal is to increase the number of actual organ donations. Increasing the number of potential donors, for instance by enrolling people automatically as donors unless they explicitly opt out is only one proximal goal to achieve this. In the end, sustainable change has to be judged by the ultimate goal of an intervention.

Second, *what are the sources of the problem?* An analysis of the environment helps to avoid misattributing the problem to the individual decision-maker, when the problem is either partially or exclusively attributable to the environment. For instance, several

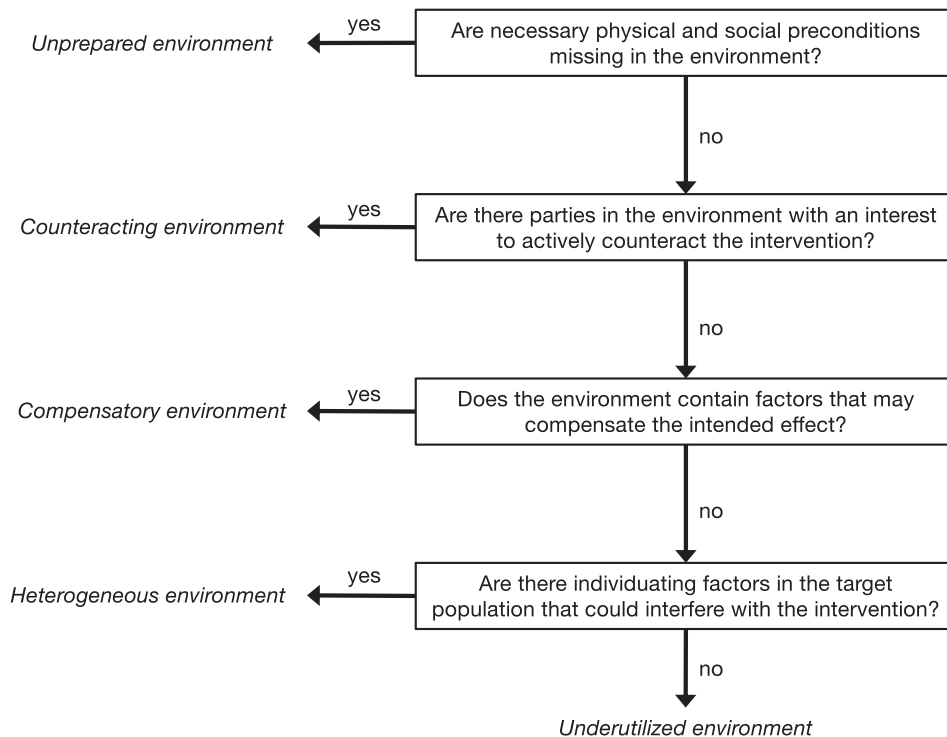


Fig. 1. How is a social policy problem situated within the context of its environment? Different questions can be asked to help identifying environmental factors that are critical to successful interventions (note that these factors are not necessarily mutually exclusive). Only if the answer to all questions below is “No”, we face the case of an “underutilized environment” where focusing on the choice architecture only might be sufficient. Otherwise, targeting relevant factors in the environment with a combination of behavioral interventions and more traditional policy-making tools may be indispensable.

Table 1
Key questions for characterizing behavioral interventions.

Q1: *What is the ultimate goal of the policy intervention?*

- Define the ultimate success criterion independent of any planned intervention (e.g., increase actual organ donations rather than the number of registered donors; lower obesity levels rather than having more people attending the gym)
- Define the proximal goal and its relation to the ultimate goal (e.g., increased physical activity can help losing weight, increasing the number of potential organ donors can help to increase actual donation rates)

Q2: *What are the sources of the problem?*

- Explicate the causal chain from individual behavior to the success criterion: What are necessary physical or social conditions for the intended effect to emerge (e.g., infrastructure or social support by families)?
- Can you confidently attribute the primary cause of the policy problem to purely psychological factors?

Q3: *What are the potential interactions between the interventions and the environment?*

- Are there parties with an interest to actively counteract the intervention?
- Are there alternative opportunities that may compensate the intended effect (e.g., abundance of easily accessible energy-dense food)?
- Are there social, economic or other differences that could interfere with the intended effect for larger subpopulations (e.g., cultural eating traditions or low socioeconomic status)?

countries have introduced financial subsidies for electric vehicles to promote environmentally friendly transportation. This policy directly targets the choice architecture by increasing the value of a particular option. While the purchase price is a key issue for many customers, other practical factors are highly relevant to consumers, too, such as driving range and electric recharging capabilities (Krupa et al., 2014). Financial incentives may support increasing sales, but this needs to work in tandem with building up an electric charging infrastructure, a crucial aspect of preparing the wider environment. A policy that only targets one of these factors is likely to be insufficient in addressing the target problem: consumers may not purchase electric vehicles if they are too expensive, even if the right battery charging facilities are in place; conversely, if there is an insufficient number of electric charging facilities, consumers may be dissuaded from purchasing electric vehicles even if they are more affordable.

Third, *what are the potential interactions between the interventions and the environment?* Even if an intervention is successful in modifying the choice architecture, this may not serve to achieve the ultimate goal because its effectiveness depends on additional factors in the environment. In the case of retirement saving plans, the environment (e.g., the investment vehicle and the economic development) constrains the extent to which higher enrolment rates through defaults translate into greater savings at the point of

retirement. In other cases, counteracting or compensating forces or the heterogeneity of the environment may offset the intended effects, such as when financial institutions engage in maneuvers to revert a new default, when an obesogenic environment neutralizes any isolated efforts to improve people's diet, or when an intervention has differential effects on subpopulations. All three cases require combining behavioral interventions with more traditional policy-making tools targeting critical factors in the environment. Moreover, identifying these factors in advance also helps to temper the expectations of choice architects as to what could be achieved by a set of interventions, however well designed they are to meet the ultimate goal.

To conclude, we have argued that successful policy making requires a good fit between behavioral interventions and the environment a problem is situated in. Sometimes, a simple nudge-like intervention may be sufficient to promote a certain behavior because the environment is prepared for the intended behavior to emerge, and counteracting or compensatory factors are negligible. At other times, nudge-like interventions may fail because they require additional measures that target the environment as well, or because of a heterogeneous target population that does not respond unanimously to the intervention. Despite the hope for effective behavioral change without changes in incentives or regulations, policy makers are warranted in their concern that nudges on their own – like any other intervention – are rarely the single best response to improving decisions about health, wealth and happiness. To build a more systematic understanding of the scope of behavioral interventions, a better characterization of social problems beyond the confines of the choice architecture is indispensable.

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