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Nudge for environmental protection

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ABSTRACT

One relatively new approach for influencing human behavior, that is based on insights from psychology, that could complement or possibly replace some of the current environmental policies, is to rely on so-called *nudges;* that (sometimes) tiny push that 'nudges' someone into a desirable direction. Attention in research has certainly grown (along with the public interest) the last few years, but skeptics also intensify their voices. For a more systematic use of nudges in environmental policy, are there today enough sound scientific grounds for policy makers to base their policies on? What lessons can we learn from past experiences and what are the biggest caveats in our current knowledge on nudging?To be able to speak about the best suit of environmental policies and specifically to determine if nudges should be part of it we believe it is crucial to explore these issues. We conclude that scientific research to support the implementation of nudges is lacking. We emphasize the need for a more systematic approach involving careful planning and monitoring (long-term). We also call for interdisciplinary approaches, e.g. the combination of insights from ecology, economics and psychology.

Keywords: Environmental policy; behavioral economics; psychology; consumer behavior

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1 INTRODUCTION

Mounting scientific evidence suggests that human activities have become a main driver of global environmental change (Steffen et al. 2011). Moreover, if the impacts of human activities cross certain critical thresholds, there is a risk of unpredictable, abrupt and perhaps even persistent environmental changes on local, regional *and* global scales (Rockström et al., 2009). These potential future changes will occur in a world where we also experience a technical revolution, human population growth and migration, cultural diversity and weak international institutions, which will add to the complexity and difficulty of *managing* human impacts. To cope with these complexities and in order to avoid potentially irreversible damage and catastrophic collapses to the environment, many (as do we) argue that it is pivotal to move beyond current approaches for influencing human behavior (Rosser, 2001). Some of the these approaches, e.g. administrative and marked-based instruments, have for example proven to be ineffective, costly, and too inflexible to deal with the uncertain, nonlinear and sometimes irreversible nature of the environment (Hatch, 2005; Pindyck, 2006; Levin et al., 2012). Moreover, they are often met with public resistance (making implementation difficult), and some behaviors are challenging if not even impossible to target through such traditional instruments. One way to deal with this policy failure is to modify existing policy measures, adapting them and changing them to increase implementation efficiency or overall policy effectiveness. Another approach is to explore the development of new policy instruments alongside existing. These new instruments can enhance and complement current policy instruments by adding a completely new and innovative way of policy-thinking.

For some time, environmental economists have acknowledged that particularly behavioral "failures" exists[2] which alters the content of our predictions and the extent to which we can make predictions about human behavior and that these "failures" can interfere in the functioning of regulatory and market-based approaches to environmental policy. Thus, insights from behavioral economics, which is basically psychology applied to economics, have been called for to help tackle environmental issues. Over the last decade or two, behavioral economics has had a significant impact on environmental economics e.g. in the field of non-market valuation, for understanding how people make choices under risk and

[2] People are generally boundedly rational, do not have perfect computational abilities or perfect memory, have bounded will-power and *do* care about the well-being of others (Mullinathan and Thaler, 2000).

uncertainty, and for exploring the social elements necessary to sustain cooperation and collective action (Shogren and Taylor, 2008).

One relatively new approach for influencing and changing human behavior, that *also* rests on psychological insights, that could complement or possibly replace some of the current environmental policies, is to rely on so-called *nudges.* Nudging is not about prohibition, but about small changes in the environment of the decision-maker; that (sometimes tiny) push or pull that 'nudges' someone into a desirable direction (Newman, 1997). In words of Thaler and Sunstein (2008), a nudge is "*any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives*" (p. 6).

It is necessary for us humans to use heuristics, fallacies and cues from our environment in decision making processes, because we often lack time and capacity to process everything around us (Thaler and Sunstein, 2008). This so-called automatic system of thinking is quick, crude and intuitive. The opposite –reflective – system is deliberate, slow and rational, and is put to work only when people have time and capacity to think. Such a distinction between systematic and heuristic processing is not new; many cognitive and social psychologists described such dual-processing or dual-system models (for an overview: Evans and Frankish (2009)). Typical in these models is that the rational system requires effort, or *cognitive capacity*, as well as *willingness* to elaborate upon a topic. In absence of such capacity or willingness, a subject is more inclined to use the automatic processing approach, and consequently is more susceptible to attitude changes (Kruglanski et al., 1999). The novelty of nudging lies in its emphasis on *choice architecture*, rather than on cognitive capability and willingness to process. Choice architecture constitutes the environment or 'presentation of a choice' which influences a decision-making subject. Nudging is about using choice architecture to seduce people to perform a certain behavior, *when* they are relying on their automatic system. It is precisely because – for many of our daily choices – we rely on our automatic system that makes us nudge-able. Perhaps the most striking example of a powerful nudge is the fly that was put in men's urinal in the Amsterdam Airport Schiphol, which elicited 'aiming' behavior and resulted in far fewer 'spills', and consequently cleaner toilets (Thaler and Sunstein, 2008).

People nudge each other all the time and marketing strategies often resort to nudging as well. But explicit implementation of such techniques by governmental organizations is not equally

common. Thaler and Sunstein argue that nudging can – and should – be used by governments in order to assist people in adopting a better way of living. Nudging by governments and other public organizations is considered *libertarian paternalistic*; libertarian because it allows people to make their own decisions, and paternalistic in a sense that it carefully suggests or 'nudges' people into a desirable direction. Indeed, policy makers, insurance companies and others[3] are showing an increased interest in using such nudges to persuade people to change their behaviors (Blumenthal-Barby and Burroughs, 2012), also at national levels. In July 2013, a White House senior advisor sent a request to some members of the academic community to provide input and ideas on how behavioral insights could help the US federal government to help people to achieve their goals (Lott 2013). In the request the advisor referred to the success of the UK behavioral insights team (BIT) or the 'nudge squad' as some put it, which was commissioned in 2010 by UK Prime Minister David Cameron to use insights from behavioral economics to persuade citizens to behave in a more socially integrated way (Wintour, 2010).

Although most of the nudging efforts by governments and organizations have so far largely been concentrated to increase retirement savings, increase tax compliance and to promote healthier lifestyles[4], it is possible that environmental policy instruments can also be strengthened and complemented by nudging techniques, because like in the health-field, the behavior of ordinary people can be pivotal in environmental issues. One of the most urgent threats to the environment is the rising level of consumption, and accompanying production levels (Steffen et al., 2011). With the final ideal of reduction in mind, at least limiting the increasing trend of consumption is one necessary step towards a sustainable future. Now, nudges can be particularly influential when people are not attentive or cognitively capable of intensively contemplating the issue at hand. Most consumer decisions and behavior are done in such an unthinking 'automatic' state of mind. This 'mindless' behavior is particularly sensitive to environmental cues, and consequently there is room here for nudging to make a difference. As a matter of fact, the European Commission recently expressed an interest in the use of nudging as a way of eliciting ´green´ behaviors among its citizens (EC, 2012).

[3] See for example the initiative of the non-profit organization *iNudgeyou* (www.inudgeyou.com) in Denmark dedicated to improving decision making about wealth, health and happiness or *Greenudge* (www.greenudge.no) in Norway with the goal to initiate, fund and promote research into behavioral change as a climate measure.
[4] Visit for example www.behaviouralinsights.co.uk

Attention in research on nudges has also grown (along with the public interest) the last few years, but at the same time, skeptics intensify their voices and arguments. Some people argue for example that 'nudging assumes that a small group of people in government know better about choices than the individuals making them', or that 'governments cannot be hold democratically accountable for them (because people do not know they are being nudged)'. Some also argue that 'nudges can backfire and that there may be unintended consequences of using them'. Whereas the former argument really applies to all kinds of government activity, the second and thirds arguments raise more specific concerns. For example, for a more systematic use of nudges in environmental policy, are there today enough sound scientific grounds for policy makers to base their policies on? What is really the current state-of-the art on nudging research, what lessons can we learn from these past experiences and what are the biggest caveats in our current knowledge on nudging? What areas are covered and what areas do we still need to venture? To be able to speak about the best suit of environmental policies and specifically to determine if nudges should be part of it we believe it is crucial to explore these issues, which is exactly the purpose of this review.

Many behavioral topics that could be seen as 'nudges' have been studied over the last decades without the term 'nudge' being used. The phenomenon is broad, since any aspect in someone's direct choice architecture is (can be) a 'nudge'. However, the art of using nudges, by a 'nudger', which requires not only knowledge of the nudge, but also intent of using it for a specific goal, is quite new. Here we give an overview of research into *this* new field of research of nudging. Scientific database Ebscohost and Scopus were used to search for the articles for the actual. The search word nudg* was used, to incorporate both nudging and nudges. Consequently, we went through the findings and incorporated the articles that were explicitly about nudges.

2 NUDGING, STATE OF THE ART

We first explored the fields that were covered and then looked into the various methods that were employed. When it comes to actual evaluation of nudges (experimental evaluations) we also looked into the specific nudges that were used. In this section, we discuss our findings and highlight a few illustrative studies. Since the purpose of this paper is to present the reader with an overview only, we do not dive *deeply* into any of the mentioned articles but only present brief descriptions. The individual articles can be consulted for more in depth information.

2.1 GENERAL OVERVIEW OF TOPICS

To get an overview of the areas covered we categorized the 76 articles according to the following topics: 1) general overviews, (e.g. reviews and ethical enquires), 2) individual health (e.g. oral health and healthy food consumption) 3) environment (e.g. food waste, water consumption and energy consumption) 4) public policy (e.g savings and voting) 5) pro-social behavior (e.g. charitable giving). We could categorize all but two articles (that were on employee evaluation and professional forecasting) according to these topics. The result can be found in Figure 1.

Many of the articles (14) are either general overviews, ethical enquiries, or politically oriented reviews focusing on the ethical side of applications of nudges in governmental plans and policies. For instance, Menard (2010) investigates the viability of libertarian paternalism and the use of nudges, as a framework for ethical analysis in the health sector. Menard concludes that although not usable as *independent* overarching framework, paternalism is still a valuable contribution to public health ethics. Blumenthal-Barby and Burroughs (2012) mention several processes underlying nudge techniques, and discuss their respective ethical issues when employed by private or public agencies (see also Hansen and Jespersen, 2013 for a nice discussion on ethics related to nudges).

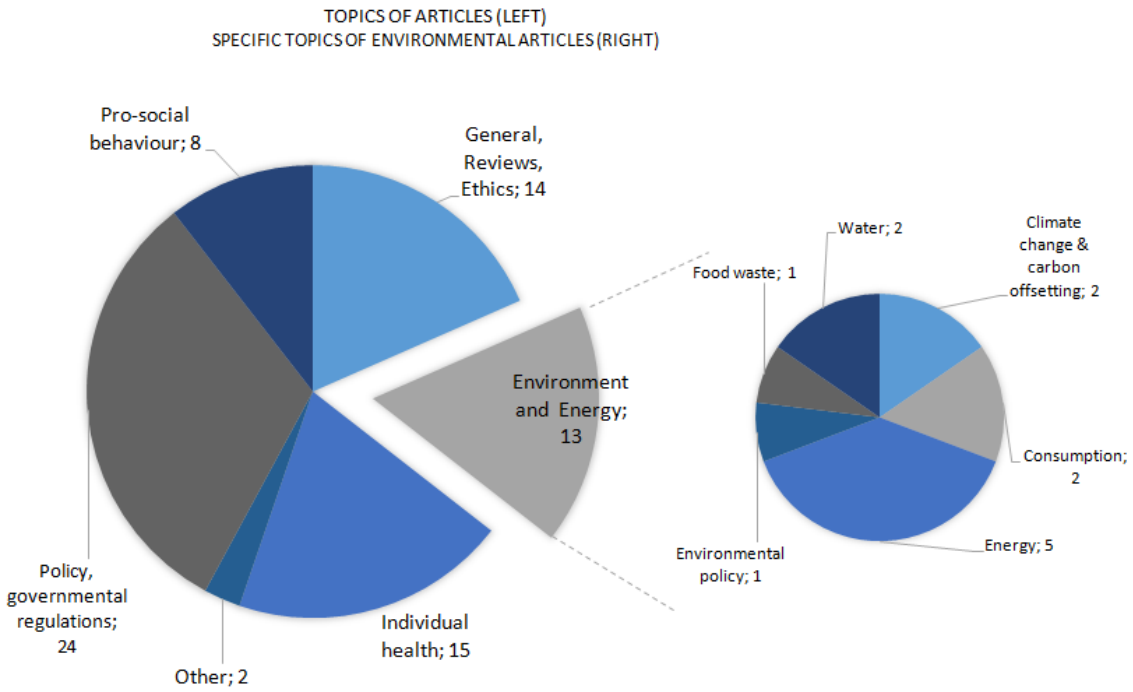

FIGURE 1: AN OVERVIEW OF THE TOPICS COVERED, N=76.

Most articles fall in the category public policy. Nickerson and Rogers (2010) explore for example how facilitating the formation of a voting plan can increase voting turnout among people. Handel (2011) study the welfare impact of an information provision policy that nudges insurance consumers toward better decisions by reducing switching costs and find that such a policy can increase welfare, but only when insurance plan prices are held fixed.

In the individual health category we find quite a few studies related to food consumption. Skov et al (2013), report the results from a meta analysis of 12 studies to investigate the current evidence base for the use of choice architecture as a means to change eating behaviour in self-service eating settings, hence potentially reduce calorie intake. The evidence indicates that (i) health labelling at point of purchase is associated with healthier food choice, while (ii) manipulating the plate and cutlery size has an inconclusive effect on consumption volume. Finally, (iii) assortment manipulation and (iv) payment option manipulation was associated with healthier food choices.

Nudges can also work to increase donation behavior. Apizar et al. (2008), for example investigate the role of anonymity, reciprocity, and conformity for voluntary contributions to a national park in Costa Rica. Contributions made in public in front of the solicitor are 25%

higher than contributions made in private. Moreover, when the subjects are told that the typical contribution of others is $2 (a small contribution), the probability of a contribution increases but the conditional contribution decreases, compared with providing no reference information. Providing a high reference level ($10) increases the conditional contributions. Shang and Croson (2009) study the effect of social information on the voluntary provision of public goods. They find a positive social information effect on individual contributions and that the most influential level of social information is drawn from the 90th to 95th percentile of previous contributions but that this effect is only significant for new members.

Of the 13 articles on environment and energy, nearly half were about energy conservation (five in total). For example, Kallbekken et al., (2013) show how nudges can promote consumption of more energy efficient appliances, Allcott and Mullainathan, (2010) show how nudges can reduce general energy use. We also found studies that showed how nudging can promote water savings (Ferraro et al. 2011), reduce food waste (Kallbekken and Sælen, 2013), and reduce the amount of papers printed (Egebark and Ekström 2013).

Although we find quite a few studies related to the environment we can see a caveat in studies that investigate behaviour related to people's everyday consumption behaviour (see introduction on the importance of reducing consumption). For example, only two studies were about sustainable consumption (e.g. buying 'green' products (Cason and Gandadharan, 2002) or buying eco-labelled products (Carlsson et al, 2010)). We conclude therefore that the possibilities to use nudges in this field are probably even broader than what the studies we found suggest. One of the most important drivers of environmental degradation coupled to food consumption is diet changes (an increase in demand for meat, dairy products and luxury food) which is strongly positively tied to urbanization (Cirera and Masset 2010, Reisch et al, 2013). In Europe, 75% of the population is urban and urban expansion is taking place at a rate more than 10 times higher than any other land use change (Nilsson et al., 2011). It is clear that the daily dietary choices made by urban citizens are crucial for determining sustainability outlooks. Moreover we have not seen any nudge studies on transportation e.g. to reduce car traffic (by increase the use of public transportation, car-pooling, increase bicycling and/or walking), or on waste management e.g. to increase recycling.

2.2 EVALUATION OF NUDGES

To make evidence-based recommendations, evaluation studies are key. Turning the attention to the method employed, we see that approximately one third of the articles reported *experiments*, often field experiments (sometimes combined with laboratory experiments)[5]. In total we found 30 evaluation studies focusing on one or a few nudge techniques. We briefly discuss these techniques here, first explaining how they work, and consequently what research has found, particularly when it comes to environmental behavior. Whenever possible, we will use examples from environmentally oriented studies.

Social norms are rules people impose on themselves because they believe they should uphold such rules as others uphold as well. Such norms are sustained by feelings of guilt, shame and embarrassment when not adhered to or even at the prospect of non-conformance (Elster, 1989). *Information disclosure* as a nudge means giving people just the right piece of information that may make them more likely to do one behavior rather than another. For instance, eco-labels are visual nudges that might just provide the nudge for some people to buy a particular brand of coffee. Both information about what others are doing (descriptive social norms) and what others think we ought to do (injunctive social norms) strongly influence what people actually do (Cialdini et al., 1990). A practical example is disclosing information on the donation behavior of others (informing about the social norm). This influenced Swiss students' willingness to also contribute to a charitable fund (Frey & Meier, 2004) and increased monetary contributions of visitors to a National Park in Costa Rica (Alpizar et al., 2008). Also, providing US households with information on their own and peers' home electricity usage induced electricity conservation, although only among liberals (Costa and Kahn, 2010). Providing people with information on household appliances also helped them in buying more energy efficient machinery (Kallbekken et al., 2013). Ferraro et al. (2011) found that combining appeals to people's pro-social behavior with social comparison to others' behavior produces a long-term effect on patterns in water-use.

Another nudge-technique that was investigated was making *changes in the direct environment, the tools or equipment* people use for certain behavior. In other words, the *physical* choice environment is manipulated. For instance, changing the size of restaurant

[5] Laboratory experiments are typically performed in a classroom with a standard pool of subjects (university students) and with a neutral, context-free task-description. In a natural field experiment subjects from a non-standard pool take decisions in their natural environment without knowing that they participate in an experiment (Harrison and List 2004).

plates reduced the amount of food waste (Kalbekken & Sælen, 2013), and changing the money collection basket in churches so as to show the contributions by direct neighbors increased the amount of donations slightly (Soetevent, 2005). In total six articles talked about changes in tools or the physical choice environment, and all of them reported at least small effects on behavior of participants.

Changing default options is another nudge that works on account of people being loss averse. According to Johnson and Goldstein (2003) a default is "*the condition that is imposed when an individual fails to make a decision*". It is the result or choice that is made for people if they do not explicitly chose something else (Brown & Krishna, 2004). This can partly be ascribed to the fact that people are loss averse; *Loss aversion* implies that people are more hurt buy losses than they benefit from gains (Kahneman & Tversky, 1979). Therefore, the best approach may seem to stick to the status-quo, the so-called *status-quo bias* (Samuelson & Zeckhauser, 1988). You pick an insurance policy, a retirement savings plan and then you stick to it. The combination of loss aversion and mindless choosing implies that a *default option* will attract a large part of the market share. One of three articles investigating changes in defaults found that sometimes nudges are not effective – in this case the default setting of automatically directing tax refunds to the U.S. Savings Bonds among low-income tax filers in the US had no effect on saving behavior (Bronchetti et al., 2011). Another study found that default effects were attenuated among experts – environmental economists were not significantly affected by pre-set default options when asked for compensation for flying to a particular conference (Lofgren et al., 2012). However, two field experiments and two laboratory experiments, all reported in one article of Pichert and Katsikopoulos (2008) did find significant results for the effects of changing default settings – with more participants choosing green energy options when it was default rather than the grey alternative. Moreover, Egebark and Ekström (2013) showed that a two-sided pre-set default option at a large Swedish University reduced the daily paper consumption by 15 percent. Another striking example in of the potential of changing defaults – although not particularly focused on environmental issues – is the default setting on organ donation. In countries as Austria, France and Poland, the default setting is 'organ donor' and people have to actively opt out in order to become a non-donor. This results in donor coverage of around 90 to 100 % of the population, rather than the 5 to 30 % in countries where the default option is non-donor ship. (Johnson and Goldstein 2003).

Asking people to commit to a particular plan or action can also help in ascertaining particular behavior. *Commitment* is said to work because people seek to be consistent (Cialdini, 2003), when people make and commit to an *implementation plan*, the chances of them being consistent with it is raised. Implementation plans are intentions that "*specify the when, where, and how of responses leading to goal attainment*" (Gollwitzer, 1999, p.494), and are assumed to work for situations where people want to perform a certain behavior in order to obtain a goal, but have difficulty in performing the right behavior in the right time[6]. Such *implementation plans* were investigated in two studies where participants were asked to make specific plans to execute particular behaviors. Using commitment in this way was effective in raising turnout for voting in single-eligible-voter households in the US (Nickerson and Rogers, 2010) and it significantly increased vaccination rates among employees when these were asked to write down a date and time to undergo this vaccination (Milkman et al., 2011). No studies were found that focused on using commitment nudges in environmentally oriented behavior, though.

Salient thoughts are those thoughts that are prominent when people make a decision (Schenk, 2011). Recency and primacy, as discussed above, are reasons why certain topics are salient above others. *Novel*, *personally relevant* and *vivid* stories and narratives also influence people more than cold hard facts; vivid images are more salient than numbers and data. Changing what thoughts are salient, therefore, is a strong influence on behavior and choices; for example putting mirrors near the dessert department in a store could help people remember to cut down on the high-fat cheese-cake when they are tempted by it in the supermarket (Blumenthal-Barby and Burroughs, 2012). One article investigated that unpacking the long-term future into more salient proximal futures substantially mitigated the overconfidence professional forecasters had in forecasting (Bearden et al., 2011). Apart from this study, however, no other investigations were found into use of salience as a nudge, particularly not towards more environmentally friendly behavior.

[6] A well-known Internet-based tool that has already helped many people make such commitments is www.stickk.com. Here visitors can postulate a goal, and stipulate incentives or rewards for success, in a way forming an implementation plan.

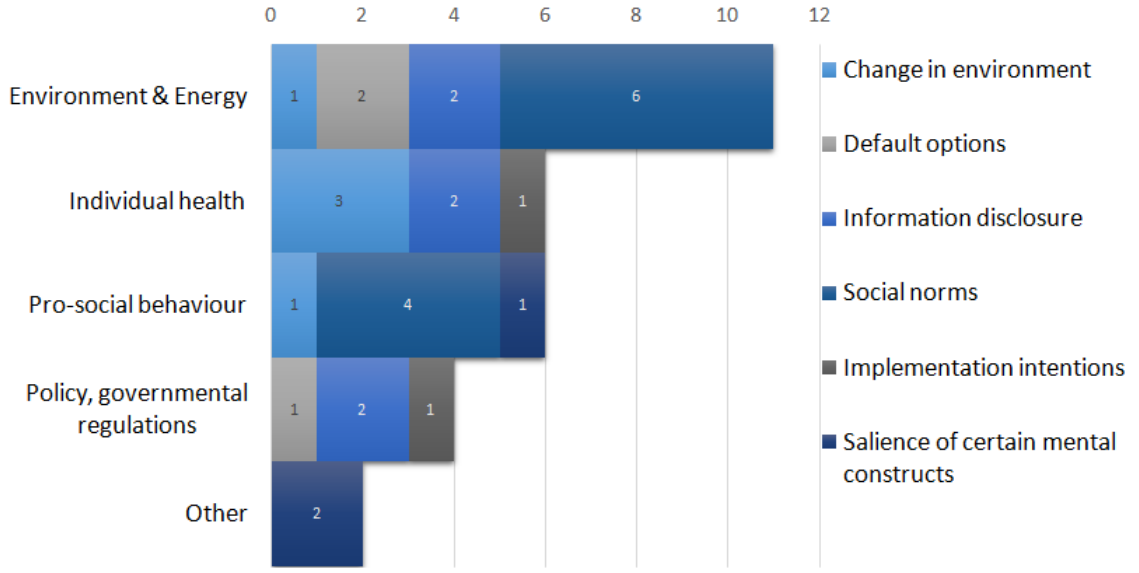

FIGURE 2: AN OVERVIEW OF THE EVALUATION STUDIES WE FOUND CATEGORIZED ACCORDING TO TOPIC AND NUDGE TECHNIQUE, N=30.

See Figure 2 for an overview and summary of the evaluation studies we found. In the category individual health, half the articles used a 'change in the environment' as a nudge technique. In other pro-social behaviour related research articles, again social norms were most prevalent. For experiments related to policy or other governmental regulations, information disclosure was most prevalent. Most articles discussing experiments were actually about energy and environment. Of these, almost half (six) used social norms as a nudge method.

Have the nudges been successful? Actually we found that most studies experimenting with nudges were (partially) successful. However, three studies were not (see Figure 3 below). Two were field experiments (one on using default options among experts in a climate change conference (Lofgren et al, 2012) and one on using defaults in savings plans among low-income people (Bronchetti et al, 2011). The third was about information disclosure on restaurant sanitation (Ho, 2012).

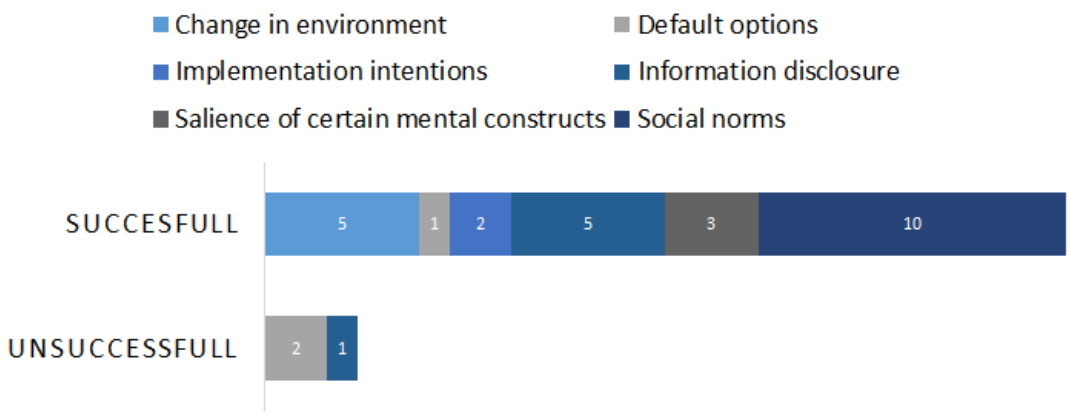

FIGURE 3: OVERVIEW OF EXPERIMENTAL STUDIES (N=30) THAT REPORTED SUCCESS OR FAILURE IN OBTAINING THE DESIRABLE BEHAVIOUR CHANGE.

Reviewing articles that specifically mention the process of nudging reveals that this is a field of study that is currently in a process of exploring various mechanisms for performing a nudge, as well as discussing the ethical and practical applicability of such nudges. However, less than half of the articles (30/76) we found are actually evaluating specific nudges and about one third of these (11/30) are environmental or energy related. When it comes to the specific nudge used, most environmentally related evaluations used social norms. A recent review by Sunstein and Reisch (2014) discusses the potential for such 'green' defaults to have an impact on environmental outcomes without affecting people's freedom of choice.

3 CAVEATS AND AREAS FOR FUTURE RESEARCH

Environmental behavior is well suited for nudging interventions. For one, most consumer decisions are done in the kind of unthinking state of mind that nudging requires. Second, the environment can often benefit from small changes in the every-day consumption behavior of people. A Future brief of the European Commission emphasizes that application of nudging as an alternative or complementary means of current policy instruments can be *promising*, as long as such applications are evidence-based (EC, 2012). Although there is a fair coverage of environmentally relevant fields, most of them were related to energy and most of them relied on social norms (sometimes in combination with information disclosure) to implement a behavioral change. Therefore we have to conclude that the basis for policymakers to implement environmental nudges for environmental protection is still somewhat weak.

We have identified a gap in research on nudges (that actually applies to all topics). Most evaluation studies check only for short term changes. If we want to be serious accomplishing

behavioral changes towards more sustainable choices we need to make sure that the positive behavioral changes we promote through nudges are more than just short term changes. Nevertheless, we found only one study that looked into longer-term behavioral changes. In their study on social comparison-based home energy reports, Hunt and Rogers (2014) found that consumers were slow to habituate: they continue to respond to repeated treatment even after two years. Thus pessimistic predictions made, based on the high-frequency action and backsliding cycles found in the short term, clearly under-estimated the cost-effectiveness of the program. Their results clearly show how empirical estimates can optimize nudge program design which emphasizes the need for additional long-term studies.

Furthermore, we need to understand how these positive patterns and processes can be maintained also at an aggregate level. What is the synergistic potential of nudges? Informal interventions like nudges that rest on voluntary behavioral changes may have the potential to achieve significant aggregate effects at larger scales, depending on the rate and level of diffusion of the desired behavior. Understanding how we can make sure that such small incremental changes at the individual level can lead to large and systemic changes will be a key research area to explore within this context, linking for example to literature on innovation and diffusion (Rogers 2003) and social learning (Grusec, 1992).

Nudging is a promising tool that can complement or even replace some of the current environmental policy instruments, but there may be potential problems that need to be addressed. Nudges are for example sensitive to potential backfiring and not always as effective as we hope them to be. For instance, information about what other people do (social norms) may increase rather than decrease undesirable behavior. Social norm-disclosure on small road-signs in the Petrified Forest National park on amount of people taking away petrified wood from the Park resulted in an *increase*, rather than decrease of people taking further pieces of petrified wood (Cialdini, 2003). Another way a nudge can backfire is when the nudge does effectively change behavior, but not the total consumption. For example, changing a default computer setting from printing papers double-sided versus one-sided can potentially reduce the amount of printed sheets. However, such an effect may be reduced or even eliminated if people, because they feel less guilty for printing now, increase the amount of documents they print. A social psychologist would after observing this type of behavior refer to *moral self-licensing* (Merritt et al. 2010)*:* which occurs when people allow themselves to indulge after doing something positive first. Often, such backfiring cannot be predicted

beforehand, but during an intervention nudges and their effects should be carefully monitored and evaluated in order to adjust and redress where possible.

One issue often raised by nudge-skeptics are related to the wrongful application of nudging. We agree with those opposing paternalistic libertarianism, that nudging does allow for abuse. However, so does legislation, or other market-based instruments. When nudging is applied correctly, thus without taking away a person's own autonomy in choosing any of the alternatives available, nudging is a *less* paternalistic option compared to other solutions, in that people are influenced, but not required to move in certain directions. Moreover, nudges are by definition indirect. Thus, when a person is being nudged, they don't know whom to complain to. They might not even know that they have been nudged. Thus, it is not clear who should be held democratically accountable. In this respect, nudges differ from other types of policy interventions. This is a fair concern, and we agree with Sunstein (2014) who insist that for exactly these reasons all nudges should be transparent.

Based on these issues raised we believe that it is not advisable for environmental policy to blindly implement nudging techniques. Besides identifying the "right" nudge we recommend and emphasize the need for a systematic approach to applying nudging techniques to environmental issues. In a systematic approach it is pivotal to first identify behavior that is 'problematic' and define the 'right' behavior, which would here translate to identifying unsustainable (consumption) behavior. Of course one would also have to make sure that the behavior identified is 'nudge-able'; that the behaviors identified will change significantly when nudges and thereby have a significant positive effect on the environment. For these purposes we clearly need to rely on an interdisciplinary approach by combining insights from ecology, economics and behavioral sciences. As far as we understand, when speaking about green nudges this is rarely - if at all – the case today. Interventions would then preferably follow a schematic and evidence-based approach, such as the intervention-mapping (IM) protocol, a step-wise approach that has been used extensively in health behavior interventions (Bartholomew et al., 2011).

As a final note we want to point out this review is based on a literature search of articles that specifically used the term nudge in the title, abstract or in the main text. We made this restriction because we assessed that making a full review with the purpose to include all relevant articles would be an astronomical task because we realize that there are many studies out there evaluating a nudge but that is not referring to the term nudge. For example the

famous hotel towel experiment where, Goldstein and co-authors, use (successfully) social norms to motivate environmental behavior among guests in hotels (Goldstein et al., 2008). For policy purposes we therefore suggest that when collecting evidence on experiences with nudges it could be wise to collect studies on the particular nudge(s) of interest, such as for example social norms, or default options.

To summarize: Our main conclusion is that nudging is a promising new tool that can complement or even replace some environmental policies in many ways, yet it requires careful planning, monitoring and supporting research before absolute claims to its effects can be made and before it can be applied effectively. We uncovered a need for more environmentally oriented and long term studies covering various nudging techniques.

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