

Concluding Analysis



Conclusion from:

The Science of Changing Behavior for Environmental Outcomes:

A Literature Review

STAP SCIENTIFIC AND TECHNICAL
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Concluding Analysis

- Analysis of the Strength of Evidence for Interventions
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Concluding Analysis

This review included behavior change interventions across five environmental topic areas: biodiversity conservation, climate mitigation, water management and conservation, waste management, and land management and climate adaptation. In this section, we provide a synthesized analysis of these interventions from three perspectives: the strength of the evidence, the integration of insights from behavioral science, and the integration of insights from social science. We then conclude with a framework for understanding how behavioral and social sciences can be effectively integrated into behavior change programming to improve environmental outcomes further.

Analysis of the Strength of Evidence for Behavior Change Interventions

The strength of evidence for behavior change in the environmental field is varied. We identify four ways where the evidence for behavior change interventions differ in strength:

- Internal validity, or whether interventions show a clear and causal impact;
- Ecological validity, or whether interventions represent the natural context;
- Evaluation of durability, or whether interventions persist over time; and
- Geographic generalizability, or whether interventions can provide supporting evidence for their generalizability across geographies.

Internal Validity

Internal validity describes the extent to which we can confidently attribute changes in outcomes to the intervention. This causal attribution is critical for our ability to determine whether an intervention was effective and critical for making programming recommendations.

The interventions reviewed differed in their degree of internal validity, largely predicted by the environmental problem they were designed to address. Poaching and transportation interventions, in particular, tended to have lower internal validity. This is largely due to their reliance on pre-post comparison without randomization to treatment or other methods for statistical control. We saw a similar pattern with regards to plastic bag taxes and bans in the topic on Waste Management, and as demonstrated in River's et al.'s (2017) analysis of Toronto's plastic bag tax, these techniques can result in large over-estimates of an intervention's effectiveness.

Interventions that focused on sustainable farming practices, engagement in conservation, water conservation, energy conservation, water management, and waste management (minus plastic bag taxes) tended to have a higher degree of internal validity. Interventions in these sections were often evaluated in controlled lab experiments or randomized field experiments, so we are more confident in the average effect of the intervention.

Gaps and Future directions

The common reliance on pre-post evaluations requires the assumption that no other influences would affect the target behavior during the intervention period. That assumption is rarely, if ever, justified. Alternative quasi-experimental designs, such as matched trials and difference-in-difference, provide more robust evidence but are still subject to untestable assumptions.

To increase internal validity, environmental interventions that rely heavily on pre-post metrics for evaluation would benefit from adopting alternative strategies. Randomized controlled trials are not perfect but present the strongest opportunity to evaluate field interventions. They have been widely adopted in the evaluation of development economics interventions (Deaton & Cartwright, 2018). Many of the studies using pre-post evaluation have interventions that are administered to a *group* rather than an *individual*. This means that if such interventions were

to be evaluated through randomized trials, they would need to be *cluster* randomized trials. This type requires evaluators to recruit a sufficient number of groups to be confident that changes observed are not just because certain groups were assigned to certain interventions (Hayes & Moulton, 2017). When cluster randomized trials may be infeasible, intervention designers may consider modern causal inference techniques like synthetic controls (Abadie et al., 2010). Regression discontinuity analysis may also provide more convincing estimates when sufficient pre- and post-intervention data is available (Imbens & Lemieux, 2008).

Ecological validity

Ecological validity describes the degree to which study results can be generalized to real-world behaviors. Studies conducted in the real context of the intervention have the highest degree of ecological validity. Laboratory studies, particularly those involving hypothetical choices, require substantial assumptions to be considered ecologically valid. This form of validity is key for confidently recommending an intervention be adopted.

Studies of behavior change interventions reviewed here largely fall into three categories: those that measure the real target behavior in the field, those that measure the intentions of hypothetical behaviors in the field, and those that occur as laboratory or online experiments (with target population or non-representative populations like university students).

We find that those interventions targeting energy use, waste management, and those trying to promote sustainable farming practices generally observe the target behavior in the natural context. So did interventions on poaching. This results in a high degree of ecological validity, capturing the real motivations of actors as well as their actual socio-ecological context. Many of the studies we reviewed that focused on PES or agri-environmental schemes measured the efficacy of their interventions through hypothetical scenarios or intention surveys. The studies we reviewed that focus on water agreements, and food purchasing decisions often observed the effects of interventions in a simulated laboratory context or online, which offer a low degree of ecological validity.

Gaps and future directions

Topics lack ecological validity if they rely heavily on laboratory studies, hypothetical choices, and samples that do not represent the target actors or the context of interest. Topics supported by artefactual field experiments increase ecological validity by recruiting participants representative of target actors. Framed experiments design studies in terms of the actual environmental challenge, making them more likely to trigger real psychological responses. However, even these framed experiments generally fail to integrate the complex socio-ecological relationships that real participants have with those around them and the target behavior.

Laboratory experiments allow for strong internal validity at a low cost, making them an attractive first step in evaluating a new concept. Similarly, hypothetical and intention-based measures are often valuable indicators that an intervention concept may be worth pursuing. Accessing participants for interventions focused on low-to-middle income contexts is extremely costly. Convenience samples, such as university students, are an attractive substitute. However, when insights derived in these contexts are applied to ecologically valid contexts, their effects are often substantially diminished (DellaVigna & Linos, 2020). While artefactual field experiments and framed experiments provide some degree of ecological validity, they are not as accurate as natural field experiments. Therefore, laboratory techniques, artefactual field experiments, and framed experiments should be seen as lower-cost, initial steps on the way to natural field experiments, rather than sufficient evidence to justify the large-scale implementation of an intervention. Instead, practitioners must develop a comprehensive understanding of the target socio-ecological context to assess the degree to which any laboratory insights would be applicable. Moreover, any field intervention based on those insights must be evaluated before we can be confident in its ecological validity.

Evaluation of durability

Durability refers to the persistent effect of a program. This can mean within the delivery period of a program,

determining whether the potency of an intervention declines over time. It can also mean after a program's delivery concludes, determining the degree to which a change in behavior is stable even without the support of the intervention. The evaluation of durability is critical for determining whether an intervention has achieved its intended outcomes, as well as for calculating an accurate estimate of the total benefit of the program for making further scaling out decisions.

It is important to recognize that assessing the ongoing durability of a program may not always be appropriate. This is dependent on the behavior change logic of the intervention. If an intervention is *only* intended to change a one-time behavior (e.g., encouraging someone to opt in to an environmental behavior), then durability is not a relevant concept. However, if the intervention aims to continue to influence behavior over time (e.g., encouraging compliance with an environmental behavior), then understanding the durability of that change in behavior is critical.

The interventions we reviewed that target energy and household water conservation are relatively unique in their assessment of durability. These programs often monitored their impact relative to controls for years after their initial introduction. This means we can be more confident in the long-term causal effect and benefit of the program. We find that agricultural and wildlife conservation interventions tend to be more mixed, with a sizable minority continuing to monitor the long-term state of community behavior. However, as pre-post interventions are generally not assessed relative to a control, it is difficult to make any claims about whether these changes can be attributed to the intervention. Lastly, we find that few waste programs monitor the durability of their effects other than behaviorally-informed policy interventions such as plastic bag taxes.

Gaps and future directions

We identify two gaps in the evaluation of durability. The first is that a number of interventions that require persistent behavior change are failing to monitor it. Energy and water conservation interventions are the best relative to other topics in measuring durability. This may be due to the availability of administrative records for utility use, whereas other durability assessments require ongoing data collection.

Secondly, while a number of programs collect data suitable for *monitoring* the behavioral state of the target community, they fail to collect data that allow for actual evaluation. This is common because these programs were often originally evaluated through pre-post comparison, with no control available for strong causal inference. While this poses a problem for the initial evaluation of a program (see the internal validity section above), the issue is only compounded as time passes. This is because more and more factors other than the intervention itself may come to influence the outcome variable being monitored for durability. As a result, implementors may mistakenly attribute a durable effect to their intervention when, in fact, the purported result is simply driven by changing higher-order trends.

To build a better evidence base around the durability of behavioral interventions, those designing and funding monitoring and evaluation programs should ensure that the evaluation program continues for as long as the behavior change takes to occur. While this may present up-front costs, the resulting data will be indispensable for decision making when considering whether a program should be scaled out more widely. Designers may consider various forms of remote sensing to reduce the cost of long-term evaluation of durability. Finally, future programs should ensure that long-term durability assessments do not involve merely assessing the state of target actors. Instead, they should also include a robust causal-inference framework to determine the causal impact of the intervention, rather than just general trends.

Geographic generalizability

Interventions are often developed in a particular geographic context. However, the degree to which that intervention can be scaled out to other geographies can be critical for applying the intervention to a range of environmental challenges and contexts.

We find that among the interventions reviewed, different environmental targets or behavior change strategies

tended to be clustered within particular dimensions of geography. For example, interventions on illegal wildlife trade operate in point-of-origin countries. Habitat degradation interventions operate where threats of ecosystem loss appear most urgent. Interventions focused on improving agricultural practices tend to focus on lower-income countries where agriculture is a primary livelihood. Interventions for water agreements are located near shared water bodies at local, regional, and international scales.

Interventions related to climate change mitigation, agri-environmental scheme adoption, engagement in conservation, and waste management are often located in higher-income countries, even though these topics apply to communities around the world. Across topics, we find that social comparisons and the use of injunctive norms tend to be used more in high-income regions (e.g., Europe and North America). Interventions that strive to create new social norms and empower communities tend to focus on low and middle-income regions (e.g., South East Asia, China, Africa, and South America).

Gaps and future directions

Across topics, interventions that have been scaled out tend to be scaled out to a particular geography. Some intervention types have been conceptually replicated across multiple countries to test the same psychological insights across populations. Even so, those replications are concentrated within particular geographic contexts. It is important to acknowledge that some of these limited geographic scopes are justifiable given the problem. For example, conservation interventions are often focused around the geographies where there are urgent conservation priorities. However, the particular focus of climate and waste management interventions in high-income countries is not similarly justifiable. Researchers have documented that behavioral insights developed among Western, Educated, Industrialized, Rich, and Democratic (WEIRD) samples are rarely generalizable to the majority of humanity (Henrich et al., 2010). Results developed exclusively among WEIRD samples are therefore unreliable for applications in other geographies.

Future interventions should be mindful of adapting studies based on WEIRD populations for non-WEIRD audiences. Behavior change findings that have replicated across geographic and cultural contexts should be prioritized when developing and scaling interventions. Similarly, interventions that work across contexts and share target cultural contexts should be prioritized. We should further elevate developing effective evidence that generalizes across geographies and cultures to the extent possible. It would also be valuable to understand which interventions interact with which features of a socio-ecological context to better understand where certain interventions may be applicable.

Behavioral Science Perspective on Behavior Change Interventions

The behavior change interventions identified in this review rely on a host of behavioral science insights and principles. These include strategies for applying social norms to overcome cooperative dilemmas, reducing risk and ambiguity aversion to adopting novel practices, and overcoming or leveraging cognitive biases to overcome the intention-action gap. Here we analyze the application of these strategies for achieving behavior change and identify new directions for increasing their effectiveness.

Shifting social norms to address cooperative dilemmas

The most common behavioral science-informed strategy for shifting behavior in this review involves social norms. These interventions are most commonly employed when a behavior results in group-wide benefits where the entire group would benefit if everyone complied. There are two main categories of social norm interventions in this review: those focusing on norm messaging, and those focusing on norm *shifting*.

Interventions focusing on norm messaging are most commonly found in household water and energy conservation, household waste reduction, and sustainable agriculture. These interventions rely on the behavioral insight that people tend to like to conform to what those in their social reference group around them are doing. Messaging based on this insight is known as descriptive norm messaging.

Descriptive norm messaging can occur in a variety of ways. The most straightforward method is to broadcast to all members of a group what the average person in that group is doing and what they expect others to do. This style of messaging fails to account for people who respond only to expectations about what their *reference group* is doing. Some interventions attempt to address this by providing more personalized social comparison by informing the target of what those in their immediate area are doing.

One concern with norm messaging is the risk of a boomerang effect. This effect occurs when people who are already engaging in the desired behavior see that they are exceeding the average and then do less of the desired behavior. Many of the interventions in this review have included injunctive norm messaging, which indicates what the community thinks is the right thing to do, as a method for mitigating the boomerang effect.

Interventions employing norm messaging are generally effective and surprisingly durable. However, their average effect is small, usually only shifting behavior an average of low, single-digit percentage points. Behavioral science identifies two related reasons for this small average effect. The first is that for behaviors that are observable, people are more likely to rely on their observations of those whom they care about rather than on abstract statistics reported to them. Secondly, while these strategies can report the state of the norm, people can also hold false beliefs about that norm. Norm messaging interventions do not aim to *change* the norm, meaning that they have little capacity to result in large shifts in group-wide behavior to a new equilibrium.

As an alternative, another set of interventions goes beyond simply messaging to *changing* the underlying norm. We find these interventions most commonly in community-based biodiversity conservation and illegal wildlife trade reduction. The behavioral science of norm change has identified a set of key elements. These include generating collective demand for change by increasing beliefs about desired behavior, coordinating a shift in behavior where everyone agrees to join in the new normative behavior, and strengthening the norm through community-based observation and enforcement. This style of intervention can experience a tipping-point effect, where early adoption may have minimal social influence, but after exceeding a particular threshold, adoption cascades throughout the remainder of the network.

As compared to norm messaging interventions, norm shifting interventions are far more intensive and costly to operate. However, we find that they result in far larger shifts in behavior. Behavioral science theory would also predict norm shifting interventions to be far more stable over time, as they inherently create self-reinforcing mechanisms that maintain the normative behavior even after the intervening party has left.

Reducing perceived risk and ambiguity to promote the adoption of novel practices

When practitioners ask actors to engage in environmentally-friendly practices, they may also be asking them to take on substantial risk. Moreover, these risks can be ambiguous, meaning that the actor may not even know how likely a good or bad outcome may be. In our review, we find that these challenges are particularly relevant in sustainable agriculture where farmers are asked to adopt entirely novel practices that they perceive to threaten their livelihood.

Recognizing these risk aversion-related barriers has a significant impact on programming. In particular, risk aversion has major implications for how extension agents can be most helpful in shifting agricultural practices. Agents need to provide clear and scientifically sound guidance as well as focus specifically on resolving these concerns over risk. One core behavioral science strategy in this review that resolves issues around risk perception is to provide *social proof*, highlighting those who have already succeeded while adopting the novel practice. Social proof is even more effective when those highlighted are in the target's reference network.

We also find creative interventions that reframe risk's relationship with novel practices. Some interventions present novel practices as ways of *reducing* other risks that the actor is already encountering: for example, describing new seeds as a way of reducing the risk of crop failure or using animal feed as a way of producing more consistent results.

Designing choice architecture to bridge the intention-action gap

A number of the behaviors addressed in this review embody what behavioral scientists have coined the *intention-action gap*. For many pro-environmental behaviors, actors desire and intend to engage in them yet fail to ultimately do so. We find this particularly common in those behaviors that are relatively low effort and target households or consumers, such as water and energy conservation and waste reduction.

Behavioral science can shed light on why people might not translate their intentions to action, especially when a behavior seems trivial. People have limited cognitive resources, and low-consequence decisions are often relegated to more implicit forms of decision making. This means those decisions are more vulnerable to decision biases that can lead the actor away from the desired choice.

We have identified various strategies in this review for overcoming the intention-action gap through the application of choice architecture. In these cases, decision biases are either eliminated or magnified to influence decision making. This can explain the effectiveness of green defaults, where a decision-maker retains the ability to choose the less environmentally-friendly option. However, if no choice is made, the green choice is automatically selected. The reason this style of intervention is so effective is also why people were failing to overcome their intention-action gap in the first place. While people might prefer the green option, they are not willing to devote the cognitive resources needed to make that decision actively. By making the green option the default, those cognitive resources are no longer required.

Interventions that exploit the *saliency* of particular information work similarly. For example, simplified labeling that highlights the environmental benefits of choosing a green option allows the actor to fulfill their intention *without* devoting additional cognitive resources to the decision. Salient labels do not shift any material costs or benefits but make it psychologically easier to incorporate the information, thereby nudging the actor into a green choice without restricting their options.

Gaps and future directions

The behavior change interventions identified in this review applied a variety of behavioral science insights. However, we found that very rarely was the problem systematically analyzed to determine *which* behavioral insight would be most applicable to the given situation. Instead, interventions often seemed to be developed either from the perspective that all behavioral science insights might be equally relevant to a given problem or that designers wanted to apply certain behavioral insights to a particular context. However, this review identifies the clear link between particular classes of environmental challenges and interventions: shifting social norms pairs with cooperative dilemmas; risk and ambiguity reduction pairs with adopting novel and costly practices; and choice architecture strategies pair with overcoming the intention-action gap in low-cost decisions. We recommend using a behavioral design approach to design interventions so that program designers will be better able to select behavioral insights best suited for their environmental challenge. A list and analysis of behavior change design approaches can be found in the *Review of Behavior Change Approaches in the accompanying Behavior Change Interventions in Practice* document.

We found that while a variety of behavioral science insights were incorporated into different interventions, few incorporated multiple behavioral science insights into a *single* intervention. We suspect this is due to the involvement of academic partners who may prefer a finding in which a change in behavior can clearly be attributed to a single psychological change. However, this is not the most effective strategy for those hoping to have the largest possible effect on behavior. Instead, multiple behavioral science insights should be leveraged in concert. This would address multiple motivations that an individual actor might have and how different groups of actors may have different motivations.

Environmental behavior change would also benefit from the adoption of recent methodological innovations in the behavioral sciences. Behavioral scientists have recently begun to adopt various open science practices to build a

more accurate understanding of the behavioral science landscape. These include pre-registration, where the study design and analysis plan are posted before administering the study, often with a commitment to publish the findings regardless of the outcome. This is widely practiced in other applied fields, such as medicine and public health (Lindsay, 2018). Unfortunately, pre-registration is rarely found in environmental behavior change studies, including the studies in this review. Pre-registration leads to less bias in published findings and more confidence in the results (DellaVigna & Linos, 2020; Kaplan & Irvin, 2015). Funders could be influential in requiring interventions to pre-register their design and analysis and mandating that researchers post their results.

Social Science Perspective on Behavior Change Interventions

For behavior change to be effective, it is critical to recognize that every behavior occurs in a socio-ecological context. This context shapes the abilities and motivations of the actors we seek to change, who, in turn, dynamically shape their socio-ecological context through their actions. Social scientists have identified a number of broad recommendations to improve behavior change programming: build an enabling socio-ecological system for the direct actor; design for social differences within a target set of actors; and address ethical concerns and intervention power dynamics. In this section, we analyze how interventions in this review incorporated these dimensions and how these dimensions can more broadly improve program effectiveness.

Build an enabling socio-ecological system for the direct actor

We find that the large majority of behavior change interventions exclusively focus on changing the behavior of the actor whose behavior directly contributes to the environmental challenge. Identifying that direct actor and the behaviors they would need to change is an important step. However, we find that interventions commonly make the mistake of maintaining a myopic focus *solely* on those direct actors. This design fails to appreciate the degree to which others affect the direct actor's ability and motivation to engage in the desired behavior.

Influential actors can appear at various levels in the direct actor's social system. For example, when programs fail to address government officials' behavior, these programs also reduce the effectiveness of PES schemes that operate under restrictive land tenure rules (To et al., 2012). We observe the same theme in both marine and terrestrial ecosystem management. Behavior change is more likely to occur when government officials devolve authority to local communities (Alimi et al., 2018; Muntifering et al., 2015). Community members can also create this enabling environment at the local level and apply social pressure to direct actors (Gillingham & Bollinger, 2017; Pickering et al., 2017). This dynamic can even be found in the household where within-family social roles can substantially shape behavior (Fielding et al., 2012; Lowassa et al., 2012).

A traditional method for providing structural support to farmers in an agricultural setting is through extension agents. The role of extension agents has generally been to provide information. However, frequently farmers do not simply lack information (Bernier et al., 2015). Instead, extension agents can most effectively encourage adoption by providing social proof of others' success with new practices and targeting influential members of the community (Kwayu et al., 2014; Wossen et al., 2013). This means that shifting the behavior of the extension agents *themselves* is a behavior change challenge, focusing on their role as social change agents rather than information providers.

The few programs that successfully create an enabling environment for the direct actor take a community-based approach. In studies of marine and terrestrial conservation, the national government, subnational government, local government, and the wider community contribute to fishing sustainably and abstaining from poaching (McDonald et al., 2020; Muntifering et al., 2015). In green energy interventions, the local government, suppliers, and community members support the installation of rooftop solar (Gillingham & Bollinger, 2017). And in sustainable agriculture solutions, the regional government, local government, and community members support runoff reduction practices (Pickering et al., 2017).

Design for social differences within a target set of actors

Social scientists recognize that within a given group of target actors, they may differ dramatically in their identities and social roles. Across the behavior change interventions reviewed, nearly none address that these different identities and social roles present unique barriers and motivations to action and require a segmented approach to reach the entire population.

There are a number of relevant social identities for behavior change across the environmental topics we reviewed. Gender was a commonly identified social difference, with men and women having different motivations to conserve water (Tong et al., 2017), conserve energy (Permana et al., 2015), and partake in bushmeat hunting (Lowassa et al., 2012). These roles are also related to positions of power. For example, women have limited access to participation in water management bodies (Eder, 2010; Singh, 2008) or less ability to choose when to plant crops (Tall et al., 2014). Gender roles also shape patterns of behavior. For instance, women may be unable to control their own time and less able to be available for climate information broadcasts (Archer, 2003). Additionally, women are more commonly expected to serve in the role of the caretaker (Wilkowska et al., 2014).

These social differences are not only relevant for improving program effectiveness; they are critical for ensuring an equitable distribution of program benefits. For example, when a PES scheme fails to deliver benefits to poor farmers because they lack land tenure, this not only results in a less effective program, it entrenches existing social inequalities (Figueiredo et al., 2013; To et al., 2012).

Address ethical concerns and intervention power dynamics

A social science analysis is particularly well-positioned to investigate the power dynamics and ethics involved in implementing behavior change interventions as well as their unintended consequences. We find that behavior change interventions largely fall into two broad categories regarding ethics and power. The first is overt community-based approaches. These strategies tend to rely heavily on leveraging existing social institutions and power for effective change. In some ways, we can celebrate communities taking control of change rather than external actors. However, interventions did not address how community-led solutions may entrench existing power hierarchies.

The second category of interventions largely focuses on changing the choice environment without restricting choice. These strategies are sometimes referred to as ‘nudges’; they preserve choice while still moving people in what is seen as the normatively ‘correct’ direction (Thaler & Sunstein, 2009). However, critics have observed these strategies exploit massive power discrepancies between the implementor and target actors. They substitute the implementor’s preferences for those of the target. Even more problematic is that those in poverty must use precious cognitive energy to notice and avoid nudges (Mani et al., 2013). The few disaggregated results in this review demonstrate these troubling effects. For example, default nudges to pay more for green energy are most likely to affect the poor, despite them being the least interested in those contracts (Ghesla et al., 2020). Designers may have good intentions with employing environmental nudges, but they still wield great power when making a decision for those whom the intervention affects.

Finally, evaluations of behavior change interventions tend to solely focus on behavioral outcomes and rarely assess whether any unintended consequences of the intervention may have occurred. This is surprising given a large body of social science literature has found that negative or harmful effects are common in environmental work (e.g., Beall, 2010; Ferguson, 1994; Jeffrey, 2010). We speculate that designers fail to measure unintended side effects because they do not have a robust understanding of the social context to predict them and then do not include those in the program’s evaluation design.

Gaps and future directions

Despite some bright spots, we largely find the behavioral interventions in this review lack a social science lens in program development, implementation, and evaluation. Interventions commonly fail to address a broad system of

actors, account for social differences among target actors, or explicitly address power and ethical concerns.

Future behavior change interventions can embrace a number of practices that better address these concerns, both to make programs more effective as well as ethically sound. The first is to ensure that a clear understanding of the socio-cultural context is established *before* a program is designed. Common tools to do so include interviews, focus group discussions, and observation. In addition to these techniques, designers can build intervention with the target actors and stakeholders to ensure their local knowledge is incorporated into any program. Social science researchers have developed innovative techniques for identifying possible relevant stakeholders, such as applying quantitative social network analysis to ensure that all relevant parties are represented (Prell et al., 2009).

To account for social differences among target actors, intervention designers must use their understanding of the social context to determine how actors with different identities interact with the target behavior. These differences should be considered as separate variables to ensure each group's needs are adequately addressed and equitably represented in program design.

Creating an enabling socio-ecological system means treating the various actors as more than targets for behavior change. Instead, effective programming treats the various stakeholders as participants in the development and implementation of the intervention. This can be achieved through sustained multi-stakeholder dialogue (MSD) (Ratner & Smith, 2020). Importantly, MSD implies far more than consolation and advisement. It means collaborative action throughout the intervention lifecycle.

Designers must explicitly grapple with and justify the ethical position of their intervention as a core part of its success metrics. Behavioral interventions without top-down bans and mandates can still have significant unintended consequences. Designers cannot assume that because an intervention is community-driven or preserves free choice that it is inherently ethical. Instead, designers should explicitly propose possible ethical risks and incorporate their risk assessment into their overall program evaluation. This includes reporting disaggregated results across social differences to ensure that a program is delivering program benefits equitably.

These proposed future directions represent significant efforts on the part of program designers, implementers, and evaluators. However, these costs return significant benefits in terms of more successful programs delivered in an ethical manner. Funders can serve a critical role in aligning the incentives of program staff with local communities' interests and needs.

Conceptual Framework for Advancing Social & Behavioral Science Informed Interventions for the Environment

Through our analysis of the behavior change interventions in this review, we identified three main ways to improve the integration of behavioral and social sciences into environmental behavior change programming: learn the socio-ecological context, use well-documented and evidence-based behavioral insights, and engage target actors throughout the socio-ecological system. Designers who adopt these practices will build interventions that are more effective, durable, and consistent with the needs and values of the communities they serve.

Learn the socio-ecological context

Our review of environmental behavior change interventions demonstrated that they consistently do not incorporate an understanding of the relevant socio-ecological context. Moreover, our review of social science findings identified numerous cases in which the failure to address these socio-ecological factors would lead to either ineffective or less effective behavior change interventions.

This context is important for several reasons. Individuals do not make decisions in a vacuum. Their decisions are influenced by their social network who may restrict or support their ability to act. Within a given socio-ecological context, people who take on different identities are afforded different abilities and responsibilities. Without accounting for these social differences, interventions may only address the needs of the most visible actors. This is ineffective at addressing everyone's needs and also inequitable in elevating the needs of a subset of the target population.

As a result, program designers must proactively develop an understanding of the socio-ecological context *before* they develop an intervention. Interventions should be developed from the ground-up to fit the needs of the target population. Previously published literature may provide a good starting point for this information but is unlikely to cover the specific needs of the target population. Instead, intervention developers will need to analyze the behavioral context to identify relevant social dynamics. This can involve a variety of techniques, including observation, focus group discussions, interviews, and surveys. It may also include stakeholder dialogue, which further builds community buy-in for the intervention. Here are several strong examples from biodiversity conservation where program designers incorporated the socio-ecological context:

Conserving Spiny Lobster in the Bahamas (Green et al., 2019)

The program designer conducted surveys, interviews, and observations of community members in local fishing villages. This included fishers but also others in the community who also make up the fishers' reference network. The campaign managers then used the information to create a campaign called "Size Matters." The campaign recognized that fishers were already motivated to reduce their catch of immature lobsters but lacked the support to do so. The campaign provided a simple, easy-to-use measurement tool so fishers could quickly assess whether a lobster was large enough to keep. This campaign resulted in the Bahamas spiny lobster fishery being the first in the Caribbean to receive the Marine Council Stewardship certification.

Establishing Reciprocal Water Agreements in Peru (Martinez et al., 2013)

The campaigners used sociological surveys to develop a program that relied on existing local social norms of reciprocity. They also recognized the low financial status of upstream farmers that limited their ability to participate in the scheme. As a result, farmers received in-kind payments that were consistent with conservation, such as beekeeping equipment and fencing to keep cattle from encroaching on riverbanks. The intervention designer also recognized that the farmers made their decision within the larger social environment of their communities. Social marketing campaigns built social pressure from other community members to create an enabling social environment. The program resulted in farmers signing 25 reciprocal water agreements and the protection of more than 360 hectares of forest.

Protecting Rhinos in Namibia (Muntifering et al., 2015)

The program designers conducted a series of socio-ecological surveys of those living on communal land to identify key aspects of the relevant socio-ecological context. The intervention was then co-developed through a partnership between community members, government representatives, and NGOs. Intervention designers needed to address conventional models of conservation that had created distrust within the community. This resulted in a combination of policy and programming that returned the rights of wildlife management to local rangers and community members (see Ostrom's design principles for effective community property management). Rangers also received all of the resources, tools, and social support they needed to do their jobs effectively. Under this program, the benefits of rhino conservation were retained by the community through tourism revenue, which both relied on and strengthened local values and institutions.

Use well-documented, evidence-based behavioral insights

We identified various applications of behavioral insights throughout our review. Many interventions rely on their preconceived notions and assumptions of target actors' behavioral challenges, motivations, and context. Instead, we encourage a deliberate approach where designers map the barriers and motivations of target actors to evidence-based behavioral insights. This allows for programs to be designed to most efficiently address the needs and decision-making processes of the target actors and their context. Here are several examples from our review of climate mitigation interventions that included robust behavioral insights:

Increasing Enrollment in Green Energy in Germany Through Default Effects (Ebeling & Lotz, 2015)

Program designers identified that green energy is not commonly considered by consumers and that they generally keep their current contract subscriptions. This made the behavioral challenge a clear candidate for changing the default enrollment to green energy, thereby relying on consumers to opt-out rather than opt-in to green energy. This program resulted in a tenfold increase in green energy enrollment.

Reducing Energy Consumption in The United States by Appealing to Existing Values (Asensio & Delmas, 2016)

Program designers identified that the cost savings from energy reduction were insufficient to motivate their target actors. They appealed to actors' existing values of health rather than purely financial incentives with messaging that linked energy use and pollution to childhood asthma and cancer. The program reduced energy consumption by 8% and nearly 20% among households with children. The intervention relied on the behavioral principle of appealing to existing values, resulting in a sustained energy reduction.

Increasing Participation in Energy Reduction Programs in the United States Through Observability (Yoeli et al., 2013)

Program designers identified that reducing energy consumption during peak periods was a public goods problem: everyone was better off reducing their air conditioning usage to stabilize the electric grid, but each individual did better free-riding on the reduction of others. In creating an energy reduction program, designers found that increasing observability increased participation because others would know whether or not each actor participated. They designed an intervention that made sign-ups to the program public rather than private. This led to a threefold increase in participation.

Reducing Energy Consumption in the United States Through Descriptive and Injunctive Norms (Allcott & Rogers, 2014)

These program designers took a different approach to address energy consumption as a public good. They identified norm messaging as a relevant behavioral strategy because people tend to believe others are contributing and that they expect people to do the same. The designers developed an energy report that provided social comparisons between one's energy consumption, similar others, and "efficient neighbors" who consume little energy. They also provided injunctive messaging, giving a smiley face to those who consumed less energy than average. This intervention was able to reduce energy usage by almost 2% across thousands of residents over a multi-year period and at nearly no additional cost.

Engage actors throughout the socio-ecological system

All actors are embedded in a larger socio-ecological system that can enable or restrict their ability to adopt the target behavior. The large majority of behavior change interventions in this review only target the actor whose behavior is directly responsible for the target ecological outcome, rather than those who create the environment to support them. Interventions should be designed to influence not only the behavior of the direct actor but also all the indirect actors elsewhere in the socio-ecological system. This includes treating actors throughout the socio-ecological systems as not only targets for behavior change, but also as active participants in the design and implementation of the intervention through sustained multi-stakeholder dialogue (Ratner and Smith, 2020). Here are two examples from this review that leverage a system of actors:

Increasing Sustainable Sugar Cane Farming in Australia (Pickering et al., 2017)

The program designers recognized that sugar cane farmers existed in a complex agricultural and social system. They developed Project Cane Changer, which aimed to increase the uptake of sustainable behaviors and change the poor reputation of farmers who were perceived to be polluting the Great Barrier Reef. In addition to working with sugar cane farmers directly, the program targeted the behavior of politicians, encouraging them to lend public support to the program to increase positive social pressure for farmers to adopt the target behaviors. After three years of the program, sustainable agricultural accreditation increased by over 300%.

Increasing the Adoption of Rooftop Solar in the United States (Gillingham & Bollinger, 2017)

Program designers identified a variety of psychological and structural barriers reducing the adoption of rooftop solar in the United States. These included solar panels' high upfront cost, the complexity and ambiguity of the decision, and customers' status quo bias of preferring to stay with their current energy source. Solarize overcame these barriers through a multi-level strategy, organizing local government and solar contractors to support a community-led outreach campaign. Solarize worked with vetted suppliers to provide time-sensitive discounts on purchase costs. Local government and community leaders organized to reassure prospective participants in their decision to adopt solar and provide positive social recognition. The implementation of the Solarize program led to the three-fold increase in rooftop solar adoption.

Together, these dimensions can guide designers, program implementers, and funders towards interventions that are more likely to have significant, durable impacts and be supported by the individuals and communities who participate.

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