TOPIC 1:

Biodiversity Conservation

Chapter 1 of 5 from:

The Science of Changing Behavior for Environmental Outcomes:

A Literature Review

STAP SCIENTIFIC AND TECHNICAL ADVISORY PANEL
An independent group of scientists that advises the Global Environment Facility

gef UN environment programme

rare CENTER FOR BEHAVIOR & THE ENVIRONMENT

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Recommended citation:

Bujold, P. M., Williamson, K., & Thulin, E. (2020). *The Science of Changing Behavior for Environmental Outcomes: A Literature Review*. Rare Center for Behavior & the Environment and the Scientific and Technical Advisory Panel to the Global Environment Facility.

Acknowledgments:

We would like to acknowledge the valuable review and comments on this report from Edward Carr (STAP), Graciela Metternicht (STAP), Mark Stafford Smith (STAP), Guadalupe Duron (STAP secretariat), Christopher Whaley (STAP secretariat), and Kevin Green (Rare BE.Center); research by Milan Urbanik (London School of Economics), Ganga Shreedhar (London School of Economics), Madhuri Karak (Rare BE.Center) and Kate Heller (Rare BE.Center) in study identification and analysis; and Corinn Weiler (Rare) and Kyla Timberlake (Rare) for graphic development and document design. Cover photo by Jason Houston.

This report was commissioned and funded by the Scientific and Technical Advisory Panel to the Global Environment Facility.

Introduction

Introduction

The environmental challenges facing us are striking. Whether it is the threat of the sixth mass extinction or global climate change, these challenges can seem fundamentally intractable. What links nearly all present environmental problems is their root cause: human behavior (Foley et al., 2005; IPCC, 2018). Yet this cause also presents a solution: to address these challenges, humans must act differently (Schultz, 2011). In other words, environmental problems are behavioral problems, and environmental solutions must also be behavioral solutions. Whenever one approaches developing an environmental program, what they are doing is developing a behavior change program (Cowling, 2014).

Behavior Change Levers for the Environment

Even when not explicitly identified, changing behaviors have long been at the core of delivering environmental programs. Historically, there have been three main levers pulled for changing behavior: shifting material incentives, promulgating rules and regulations, and providing information to actors.

Shifting material incentives involves increasing or decreasing the costs, time, or effort for doing a behavior. This lever has its roots in neoclassical economics, where an actor is assumed to respond to only the material incentives for engaging or not engaging in a specific behavior. Standard methods for shifting incentives include enforcing penalties for non-compliance with rules, providing rewards for positive behavior, or making a target behavior materially easier, such as removing time friction or promoting substitute actions.

Passing rules and regulations that promote or restrict a behavior is perhaps the most commonly used strategy for achieving environmental outcomes. Rules and material incentives often work together, but each can exist without the other. For example, a seller might offer an incentive to purchase a product without any legal requirement. Similarly, laws and rules can be passed without their enforcement shifting the material incentives. Even without enforcement, rules can shift behavior due to people having a general preference to conform to rules even without positive or negative sanctions (Funk, 2007) or where rules convey factual or social information (Sunstein, 1996).

Figure 1. Rare's Levers of Behavior Change Framework (Rare, 2020)

Providing actors with information has also been a common tactic in traditional environmental programming, including explaining what the desired behavior is, why it is important, and how to engage in it. Informational programs implicitly assume something similar to the information deficit model; the lack of change in someone's behavior is assumed to be because they do not know key information, rather than psychological or socio-contextual factors (Burgess et al., 1998).

While these levers can be successful at changing behavior, they have also been well-documented as generally insufficient for changing behavior on their own (Cinner, 2018). Environmental behavior change program designers have recently expanded their toolkit to include a more comprehensive set of levers for shifting behavior and achieving environmental outcomes. These levers are choice architecture, emotional appeals, and social influences. These three novel levers, along with the three traditional levers, represent the Behavioral Lever Framework for categorizing behavioral interventions in the environmental field (Rare, 2020).

Using choice architecture means constructing an actor's choice environment without changing the value of said actor's underlying options. This lever deviates from the more traditional levers by not assuming that actors are solely

influenced by their rational deliberation, but also how a choice is presented to them. There are many ways in which a designer might construct the choice environment. These include prominent strategies such as directing attention by increasing salient features or changing what outcome occurs by default, using timely moments to prompt action, and providing decision aids that encourage short- or long-term decision making.

Emotional appeals function differently by changing how an actor feels about a set of options. Humans like to believe that they deliberate over all of their decisions, yet emotions often drive our decisions. Emotional appeals can include messaging that makes the behavior feel consistent with the target actor's core identities and values or encourage the actor to experience a particular emotion known to result in a particular behavioral pattern.

Finally, leveraging an actor's social networks and influences is an effective behavior change strategy. Social influence strategies involve understanding how an actor relates to others in their social system, including those with power and prestige, and leveraging these dynamics to support changes in the actor's behavior. Changing behavior in this way often includes social learning, making behavior more observable, or shifting social norms by changing an actor's expectations for what others in their reference network are doing or think is right or wrong.

These novel strategies complete the six levers of the Behavior Levers framework. These levers provide a typology for categorizing the majority of existing behavior change interventions, often delivered in combination rather than isolation.[1]

The logic, ethics, and effectiveness of behavior change programming across these levers have been an intense subject of research. This work has mainly been conducted from the behavioral science perspective, which focuses on the cognitive processes affecting how individuals make decisions, and the social science perspective, which focuses on how social structures shape an actor's capacity and interest in adopting a behavior.

The Behavioral Science Perspective

While there are many different definitions of behavioral science, we focus on the systematic study of human judgment and decision making. This research has been conducted by those working in several fields but is most commonly associated with psychology and behavioral economics. This perspective tends to take the individual actor as the central unit for analysis and understanding behavior.

The roots of what is now commonly known as behavioral science can be traced to rational choice models in neoclassical economics and the inability of those models to account for the decisions people often make. These systematic deviations from rational choice models are known as biases, which result from people applying cognitive heuristics to solve real-world decision problems (Tversky & Kahneman, 1974).

Research in this field focuses on the decision processes that affect how an actor is making a particular decision. These processes are often described as falling into two broad and simplified categories. The first mode is quick and automatic and is more likely to be driven by an emotional reaction. The second mode of thinking more closely approximates rational choice models. This way of thinking is often slow and deliberate, and the decision-maker is generally conscious of this mode. These two groups of processes are often labeled as System 1 and System 2 (Stanovich & West, 2000). Research in the behavioral sciences primarily focuses on documenting the mechanisms underpinning System 1.

Researchers have documented a host of deviations from rational choice models in decision making and the cognitive processes underpinning them. The most extensive set of this work has been conducted in contexts where people face some risky decision, where an outcome could end up going better or worse than their current state.

1 For a more exhaustive list of the strategies in each of lever category, refer to Rare, 2020.

One pattern is loss aversion, where people feel a loss more strongly than a similarly sized gain. Another is risk aversion, where people prefer a sure thing over a risky proposition, even when the risky proposition is likely to return even more. A third is ambiguity aversion, where people prefer to choose options where they know the likelihood of the different outcomes, even when they are guaranteed to do worse. Many of these findings have been replicated frequently and cross-culturally (Ruggeri et al., 2020).

This research has also documented an effect called status quo bias, a general tendency for people to keep doing what they have previously done, even when not in their best interest (Kahneman et al., 1991). This bias describes how habitual behaviors persist but also why it is difficult to form new habits that are inconsistent with one's previous status-quo.

While behavioral science researchers generally take the individual as their unit of analysis, this does not mean researchers ignore social influences. A large body of work on social preferences has documented how people—unlike what would be predicted by a selfish economic model—care deeply about what those in their social network do, believe, and receive. While early research attempted to identify universal social preferences (Fehr & Schmidt, 1999), these social influences differ dramatically across cultural contexts (Henrich et al., 2005). Behavioral scientists now primarily focus on the cognitive mechanisms that result in a particular pattern of behavior within a social context. For example, social norms describe where an individual's actions are influenced by their beliefs of what others are doing and what others think they should be doing (Bicchieri, 2016). The fact that these expectations may be different for different social groups, and different for individuals having different reference networks within a social group, allows for the varied social preferences we see among people of different social groups.

Behavioral science insights have recently been deliberately incorporated into behavior change program design, including at the bilateral, national, and regional levels of government and non-government entities (Whitehead et al., 2019). Many applications of behavioral science have been to design a choice environment to nudge people to perform behaviors in their interest (Thaler & Sunstein, 2009). Nudges are intended to be consistent with libertarian paternalism, where each person's actual choices are not restricted, but their environment is designed to encourage a particular behavior. Nudges are often subtle changes, such as shifting the default offering or making one choice more salient. However, nudges represent only one area of the application of behavioral science to behavior change. Other applications of behavioral science incorporate rich insights from the program's target actors. They also often involve shifting entrenched social norms, such as encouraging the adoption of toilets (Ashraf et al., 2020), reducing female genital cutting (Evans et al., 2019), or encouraging treatment adherence to painful drug regimens like those used to treat tuberculosis (Yoeli et al., 2019). This latter set of interventions differs from traditional uses of nudges by addressing actors as members of a community rather than narrowly as individuals, being more overt about the intervention itself, and often targeting socially constructed practices.

In summary, the behavioral science perspective has studied how individuals make decisions, concentrating on the ways human behavior deviates from the predictions of rational choice models. The field has documented various biases that result from people relying on cognitive heuristics for making decisions, many of which are the result of quick, implicit, and sometimes emotional processes rather than slow deliberation. While this work analyzes decisions from the perspective of the individual, it also investigates social influences, showing how people process their social environment and then apply it to their choices. This work has recently been adopted into behavior change program design across various institutions and levels of decision-makers, sometimes within the framework of nudges and larger-scale behavior change campaigns that often target more entrenched behaviors.

The Social Science Perspective

While there is no single definition of social science, in this review, we take it to be the study of the relationship between social structure and decision making. The fields most associated with this research include anthropology, sociology, political science, and human geography.

This perspective recognizes that individuals do not make their decisions in a vacuum. Instead, social science puts social structure into primary focus. This includes how that social structure defines an individual's social identities and social roles, as well as how an individual's actions can feedback into shaping the social structure for themselves and the network in which they are embedded. From this perspective, this feedback system of socially defined identities and roles create the foundation for individuals to make choices (Popitz, 1972). While identity is often thought of as how individuals see *themselves*, the social sciences point to an even more critical component: the bidirectional relationship between how others perceive an individual and how that individual behaves. Common identities and accompanying roles addressed in the social sciences include gender, race, ethnicity, socio-economic status, and various culturally specific positions of power through prestige and authority. Both formal rules, such as laws, and informal rules, such as social norms, can dictate directly and indirectly how individuals of certain identities can or must behave, with that behavior then feeding back into socially defining those same rules (Hechter et al., 1990).

It is important to note that an individual can rarely, if ever, be reduced down to a single identity. For example, an individual might be both a woman and of a particular ethnicity. Their sum identity is reflected in the intersection of these various identities (Crenshaw, 1989). Understanding what intersections an individual inhabits is critical for understanding their behavior, as the social rules governing their actions apply differently for different intersections. For example, while women might generally be given minimal autonomy to make farming decisions, older women might have significantly more independence, pointing to the possible importance of the intersection of age and gender in understanding an individual's ability to act (Carr & Owusu-Daaku, 2016). There are various combinations of identities, and researchers have cautioned against the essentialization of an individual through a particular identity.

Much of the research in the social sciences has focused on how these various instances of social difference affect how a social group may restrict or enable agency through different forms of rules, and how those rules are socially constructed. Agency can be defined as the ability to make decisions to achieve one's current and future goals (Petesch et al., 2018). Indeed, agency is not distributed equally across populations; marginalized and lower-status groups experience less agency and decision-making power in society. This further results in groups having different abilities to make changes in their own lives or affect broader social systems. Some of these effects may be obvious on first observation, such as only men allowed in a particular space. Others may be far more subtle but can have major implications for behavior change. For example, female farmers in South Africa have less autonomy in setting their schedules, meaning they cannot make time to listen to scheduled radio broadcasts for agricultural forecasts (Archer, 2003). While research into the relations between different identity groups often focuses on where they "result in contradictory interests, imperatives and expectations" (O'Shaughnessy & Krogman, 2011), differing social groups may also mutually reinforce each other in complementary ways. For example, in eastern African bushmeat hunting, women reinforce hunting by men through encouragement and praise, plus benefit from their successes (Lowassa et al., 2012).

Scientists across the social and environmental sciences have been expanding the models we use that incorporate agency by going beyond individual actions to include strategic, political, and collective agency. This also aligns with shifts away from purely rational-actor models or Integrated Assessment Models that rely on narrow assumptions about human behavior. Such concepts help researchers explain and operationalize the influences humans can have on transforming systems, such as those required for global environmental change. For example, groups with greater agency tend to be those with greater wealth and those contributing more greenhouse gas emissions in daily activities. This has implications for how designers and scientists perceive leverage points within a system to change existing structures (Otto et al., 2020).

While different forms of relations exist, social scientists have found power between individuals of different social roles to be a particularly strong explanatory force for understanding human behavior. While analyzing these power dynamics within a community can be a fruitful lens, social scientists have also frequently applied this lens to the wider social system outside a given community. This often includes power dynamics between the behavior change implementer, such as a government agency, and those impacted by it. A social science lens can shed light

on phenomena such as why communities surrounding natural reserves area may refuse to comply with hunting regulations (Strong & Silva, 2020), or why someone might comply with an intervention designed to preserve free choice, even when the individual would not otherwise wish to comply (White, 2013).

Social scientists recognize that individuals are not just subject to social structures, but that they *constitute* those social structures as well. This creates feedback loops where one actor's behavior makes up another's social context. This can result in systems-level emergent properties, where the behavior of each individual can fundamentally only be understood by taking into account the behavior of the other actors in the system. This includes social tipping points, where changes among a minority can result in rapid group-wide changes in beliefs or behavior (Granovetter, 1978; Schelling, 1978). This work has been extended to understand how behavior adoption diffuses through social networks, in which each individual adopts a behavior only when a sufficient set of surrounding connected others do the same (Centola & Macy, 2007).

Taking this social-systems viewpoint often highlights the unintended consequences of a behavior change intervention that an individual-focused standpoint might miss. For example, interventions might have achieved their intended behavioral and environmental impacts but had negative impacts as well. Social scientists have pointed to unintended effects of strengthening bureaucracies (Ferguson, 1994), creating informal lines of employment such as interpreters and fixers (Jeffrey, 2010), or even undermining traditional authority structures (Beall, 2010). Understanding the totality of consequences has implications for how social scientists approach program assessment. They focus not only on the behavioral and environmental outputs but also on assessing any social impacts, intended or not, positive or negative, that may result.

The social sciences present a unique opportunity to evaluate the ethics of behavior change programming. One common but ethically questionable element of behavior change programming is its often top-down nature, where local stakeholders have no input into the programs they experience. As a result, programs can fail to recognize local communities' rights or simply be ineffective. A designer's lack of local knowledge results in a program being ill-suited for its target actors (Hansen, 2018). Because of their rich focus on the various identities among target actors, the social sciences have raised ethical concerns over the equitable distribution of a program's costs and benefits. While programs are often evaluated by estimating the average treatment effect for the entire population, the social sciences have focused on disaggregating these results to reveal disparate impacts.

Social scientists have further found justification to criticize the ethical nature of "nudge" style behavioral interventions, which are often invisible to target actors. Designers of this style of intervention often argue that their solutions preserve free choice and are not coercive. However, social scientists have pointed out that those subject to these interventions find a lack of disclosure to violate their autonomy, whether or not the designer finds it free-choice-preserving (White, 2013). Social scientists have also identified that these interventions rarely change the root structures of systems and problems they seek to address, even when they account for the social system in which they are deployed (Feitsma, 2018).

In summary, the social science perspective focuses on the actor as both the product and creator of their social context, rather than as an individual. This view recognizes the importance of the various social identities that an actor might have and how those identities dictate their position in the social system that defines their ability to adopt a behavior. By analyzing this system as a whole, a social science perspective can identify various ways in which actors might influence each other. These include power, allowing some to restrict the choices of others, or reinforcement, where some support others' ability to act. In the context of behavior change programming, this view can provide a critical lens on how powerful organizations, such as governments or NGOs, may, sometimes inadvertently, coerce target actors into compliance, which is ethically dubious. By looking at the total social system, this view recognizes the commonly inequitable distribution of costs and benefits from behavior change programming, often tying those inequalities to existing inequalities in the social system.

Review Focus and Scope

Presented this way, behavioral science and social science may appear quite different. However, both disciplines aim to explain human behavior and interaction. Instead of seeing them as fundamentally different, we argue that behavioral science and social science are best understood as two levels of analysis that exist on a spectrum (See Figure 2). This spectrum ranges from the most cognitive explanations of decisions existing entirely within the individual to the most abstract descriptions of social interaction focused solely on the system in which those individuals are embedded. Many sub-disciplines exist closer to the middle of this spectrum, blending these two perspectives, such as social psychology, cultural psychology, cognitive anthropology, and network analysis. By embracing this entire spectrum of behavioral and social science, we better understand human behavior as a whole.

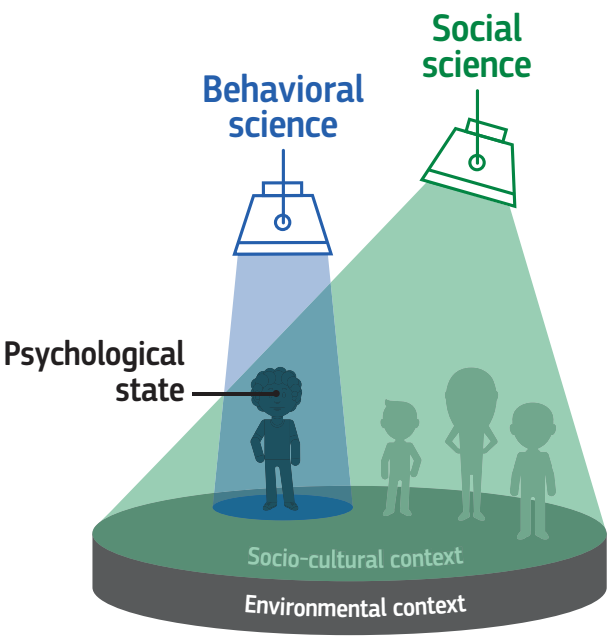

Figure 2. The interaction of behavioral and social science in understanding human behavior. Behavioral science focuses on understanding an actor's psychological state, whereas social science focuses on understanding the socio-cultural context for that actor. Both are necessary for understanding an actor's behavior within a given environmental context. Changes to the socio-cultural context, environmental context, or actor's behavior create feedback loops with one another.

In this review, we aim to identify how these perspectives can be applied to understand existing behavior change interventions designed to address biodiversity conservation, climate mitigation, water management and conservation, waste management, and land management. For each of these topic areas, we review empirical evidence for behavior change programs targeting behaviors in each of these areas. We include evidence that provides empirical analysis on the effect of interventions designed to change these behaviors, as well as evidence for the psychological, material, and socio-cultural barriers and motivations for their adoption. This includes evidence from the behavioral and social sciences, as well as non-disciplinary evaluations, and consists of both qualitative and quantitative analysis across a variety of measurement paradigms.

We then provide an analysis of that evidence in three areas. First, we review the evidence's strength for changes in the target behavior, including the internal validity, external validity, and geographic spread of the interventions. Then, we identify behavioral science insights demonstrated in the interventions or gaps in the intervention logic that behavioral science may elucidate. Last, we similarly identify social science insights in the interventions, including insights to help identify opportunities and gaps. After conducting this analysis for the five topic areas, we provide an overall summary of these analyses to identify trends across the environmental field. We conclude by proposing a framework for understanding how behavioral and social sciences can most effectively integrate into behavior change programming to improve environmental outcomes further.

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Biodiversity Conservation

- Poaching & Wild Meat Consumption
- Overfishing
- Deforestation & Habitat Degradation
- Engaging with Conservation

Introduction

Researchers estimate that the rate of biodiversity loss has increased by 1,000 times over pre-human levels. Without intervention, these rates are expected to soon exceed 10,000 times background loss rates (Vos et al., 2015). Direct exploitation, particularly of marine ecosystems, is a significant contributor to these outcomes. Beyond its intrinsic value, biodiversity conservation provides livelihood, security, resiliency, social relation, and health benefits to dependent communities (Millennium Ecosystem Assessment, 2005), including reducing the emergence of zoonotic infectious diseases (Keesing et al., 2010). This section presents a summary and analysis of behavior change interventions that have a direct impact on biodiversity protection and preservation as well as interventions that have indirect but important effects by strengthening the public's engagement with conservation. Specifically, we cover the findings of interventions that target illegal wildlife trade, habitat degradation, and encroachment, as well as those that use various messengers and messages to engage the wider public best.

Analysis Highlights

- Many interventions aiming to protect biodiversity require difficult levels of individual coordination and cooperation. These are strong candidates for norm-shifting campaigns, which operate within the social fabric of the target community. Indeed, the evidence base identifies these interventions to be particularly effective.
- Social norm interventions increase the social cost of not adopting the target behavior, whereas other levers of change (e.g., choice architecture, regulation, or incentives) reduce the cost of adopting the new behavior. Using these levers in combination is likely to ease a community's shift to a novel behavior.
- The evaluations of biodiversity interventions heavily rely on pre-post comparison, significantly weakening the strength of evidence. More advanced evaluation techniques, which may involve randomization or greater reliance on econometrics, are required to build a strong understanding of what works to encourage biodiversity conservation.
- Biodiversity interventions largely focus on single actors in the system, especially suppliers. However, there are many other important actors, including those demanding wildlife products. Interventions would improve by addressing the behavioral system cohesively, shifting the supply and demand behaviors together.

Poaching & Wild Meat Consumption

Around the world, poaching and wild meat consumption continue to put pressure on many species (both flora and fauna), some to the risk of extinction. Rosewood, elephants, rhinos, pangolins, reptiles, eels, and big cats are currently among the most vulnerable species and represent the most seized wildlife in recent years (UNODC, 2020). This section comments on effective interventions to combat behaviors such as wildlife poaching, harvesting, and trade in addition to consuming and selling wild meat.

Reducing poaching: Social norms, incentives, and appealing to local values

In South-East Asia, poaching is generally practiced by a small-subgroup within a community (Rao et al., 2010). However, the behavior is tacitly endorsed by the wider community who expresses indifference to the practice,

resulting in minimal social pressure on poachers to stop. WWF Thailand and Thailand's Department of National Parks ran a community outreach program aimed at reducing poaching in and around the Kuiburi National Park (Steinmetz et al., 2014). Program designers identified six psychosocial factors known to influence behavior: trust, public support, motivation, ethics, self-efficacy, and confidence. Based on these findings, they built a program to create the opportunity for the wider community to organize and collectively express that poaching was detrimental to their livelihoods and that they had the power to act against it. Activities included four years (from 2008 to 20011) of village meetings, school games, musical performances, and education workshops across 24 villages. By 2011, poaching pressure had dropped by a factor of four across the park, with five of the six focal species increasing in abundance across monitoring sites. Just as importantly, by the conclusion of the intervention, 90.5% of the community supported wildlife recovery. Community member's top reason for the decline in poaching was park outreach rather than patrolling. Through the collective action of their outreach events, the program created a new norm within the community of poaching being seen negatively, providing a social rather than formal determent.

Interventions can also highlight how a community can directly benefit from conservation efforts and then use these benefits to establish new patterns of behavior. In Namibia, for example, the 'Rhino Rangers' program stands as a model of community-based conservation through supporting wildlife-related livelihoods and self-efficacy resulting from their stewardship of rhinos. The program supports local communities in choosing rhino custodians from within their communities and then trains and equips these 'rangers' to carry out rhino monitoring (Muntifering et al., 2015). The positions became high social status, and in the span between 2012 and 2018, the number of rhino rangers jumped from 18 to 62. Rhino sightings are at a record high of 918 separate events, and in just five years, poaching has declined by 83% (Muntifering & Rhino Pride Campaign, 2019). A similar program in Madagascar creates social pressure against poaching by empowering local communities to establish their own salaried park ranger positions with the ability to fine poachers and to collect those fines and pay them back directly to the community (Randriamanampisoa & Adams, 2015).

Where creating new roles and incentive structures may be impractical, another way of discouraging the illegal harvest of wildlife is to simply institute conservation rules that act as incentives themselves while avoiding the common presupposition of human-wildlife "conflict." Along Guatemala's Hawaii beach, turtle eggs make for an important source of subsistence and help locals supplement their incomes and diet—still, overharvesting poses a real threat to the many turtle species in the area. In partnership with local hotels, the NGO ARCAS introduced a community engagement scheme that sought to encourage the sustainable harvesting of turtle eggs to address those concerns (Muccio, 2015). Though the scheme bans egg collection for most turtle species, it explicitly allows for the harvest of Olive Ridley turtles, as long as egg collectors who donate at least 20% of the harvested eggs to hatcheries. As it is in the community's interest to continue harvesting turtle eggs in the future, members assist in enforcing the donation scheme. Since the scheme was introduced, the number of eggs rescued nationally has increased from 60,000 in 2003 to 270,000 in 2015, with the number of turtles nesting on Hawaii beach doubling.

Reducing wild meat consumption: Incentives, social norms, and appealing to local values

Norm shifting strategies can be combined with other behavior change levers, such as incentives. This can be seen in a Brazilian amazon campaign which aimed to reduce the consumption of bushmeat by encouraging the substitution of bushmeat for domestic meats, like chicken (Chaves et al., 2017). Researchers randomly selected and assigned 157 households to one of three treatments that included a combination of different behavioral strategies: public information (e.g., visual media, mass media, giveaways, church visits, print media), community engagement strategies (e.g., door to door visits, commitments/pledges, cooking courses), and economic incentives (discount coupons for chicken in the intervention condition and coupons for cleaning products as the control condition). The researchers compared the effects of a community engagement strategy in which people received public information, community engagement strategies, and chicken discount coupons; a coupon strategy in which people received discount coupons for chicken and public information; and a control in which people received public information and discount coupons for cleaning products. The researchers found that information or incentives

alone were not enough to change people's norms and influence behavior: though coupons had increased chicken consumption, the uptake in chicken had not translated to a reduction in wild meat consumption. In contrast, households who were in the community engagement treatment reducing their bushmeat consumption by 62%. For the material incentive to be effective, households first had to understand and feel socially pressured to adopt the new norm in addition to feeling able to cook domestic meats successfully.

Across several countries, bushmeat consumption is embedded deeply into the socio-cultural context. Morsello et al. (2015) found that the best predictor of bushmeat consumption in Brazil and Colombia is its social and cultural value, rather than economic value. In these communities, bushmeat consumption is tied to local beliefs and social norms and suggests the importance of understanding the greater socio-cultural context in which individuals choose this behavior. A study in Ethiopia and Tanzania further examined the gender dynamics around bushmeat hunting and consumption. In this case, researchers found that women reinforce men's hunting routines with praise and encouragement, which drive men's hunting behavior (Lowassa et al., 2012). In the Republic of Congo, bushmeat is perceived as "natural, tasty, and healthy," and the perception that bushmeat is high status can underpin the social dynamic where not providing bushmeat is seen as a social slight or an indicator of low status (Chausson et al., 2019). Similar status benefits of consuming illegal wildlife have been documented through qualitative interviews in Vietnam (Drury, 2009).

Beyond field experiments, simulated interactions, such as themed behavioral games, can allow for observation of how participants understand and discuss the complex social dynamics in wildlife conservation. We find an example of this in the Republic of Congo, where a team of researchers gathered 150 Congolese bushmeat hunters from 10 villages to play a repeated common pool resource game, where each person's payoff depended on the actions of others (Marrocoli et al., 2018). In the game, individuals made decisions about the time they allocated to either hunting or farming under three different conditions: i) without communicating with other group members, ii) with communication, or iii) with communication and a self-monitoring system (i.e., a system where resource use and group trends are recorded and shown to individual players). The researchers found that the combination of communication and self-monitoring led to both a decrease in hunting rates and an increase in the returns from their common-pool resource. In fact, when individuals both self-monitored and communicated with each other in the game, it reduced the likelihood of them choosing to spend time on hunting over-farming by 43%. Such games can serve a dual purpose: first, they can provide program designers with critical insight into the social context, allowing for later interventions to be better tailored to that context; and second, they can serve as a key intervention component themselves, demonstrating to members of a community the dynamics at play in their socio-ecological system, and leading them to share beliefs about others' behavior that they might otherwise keep private (Thulin, 2020).

Anti-poaching and anti-bushmeat programs are often described as addressing "human-wildlife conflicts." However, anthropologists have noted that the framing of these interactions tends to reinforce the perception of conservation as a zero-sum competition over limited resources—one where either humans or non-human species must ultimately end up on top (Cassidy, 2012). However, when the interests of the broader community are brought to the forefront, the dynamic is rarely, in fact, zero-sum. The community may well benefit from the protection of their resources. This situation is far more consistent with the framework of "human-animal relations," emphasizing that the well-being of humans, animals, landscape, and climate are always already inter-related.

Helping communities realize alternative livelihoods is an often-celebrated method for behavior change. However, unlike the interventions illustrated above that are grounded in the conservation efforts of local communities, sometimes alternative livelihood schemes fail to serve as beneficial substitutes to the problematic behaviors we are trying to address or make large assumptions about the motivations for adopting a different livelihood. Alternative livelihoods are not just about financial gains or resiliency but instead confer social and cultural changes to everyday practices (Wright et al., 2016). For example, a scheme in Tanzania aimed to reduce wild meat consumption by increasing the availability of chickens (Knueppel et al., 2009). Unfortunately, though the intervention was successful in increasing the availability of chicken meat, a decrease in bushmeat consumption did not follow. Likewise, an

intervention in Gabon, the Congo, and Cameroon found mixed success in disincentivizing bushmeat consumption through encouraging cane rat farming ('farmed' wild meat). In the author's words: "The Gabonese [were] not naturally livestock rearers, and even less rearers of wildlife" (Wicander & Coad, 2014, p.28)—selling livestock was therefore not a simple or autonomous economic activity for the Gabonese, nor was it for the Congolese. Implementors were also fighting against cultural norms whereby the rearing of 'mini-livestock,' things like rabbit, chickens, or cane rat, is seen as an activity for women. All of the program's participants dropped cane rat rearing within the year following the project's completion. Cameroonians, on the other hand, were far more receptive to the intervention because bushmeat was less readily available and so they had previous experiences rearing chicken and rabbit. The rearing of cane rats required only small modifications to an already established system (Wicander & Coad, 2014).

Tackling the Demand for Exotic Pets

Though efforts to curb wildlife crime primarily focus on illegal wildlife consumption, the illegal pet trade stands as a significant threat to conservation efforts. Between 2014 and 2015, the website 'www.exoticpetmatch.com' allowed members of the public to be 'matched' with their ideal exotic pet. After answering a set of questions, potential buyers were presented with their ideal pet and information about that pet, before being prompted to rate the likelihood with which they would buy the animal. Buyers either received information about dietary requirements, potential zoonotic diseases, animal welfare, the legality of owning such a pet, or the consequences of purchasing on the species' long-term survival. The study found that disease or legality information could reduce the interest in purchasing by 39%. Information on welfare and conservation impacts was comparable to giving buyers the animal's dietary requirements, having no statistical effect. Despite focusing on intentions, the results raise key points for investigations in future campaigns to reduce the purchasing of exotic pets (Moorhouse et al., 2017).

Preventing illegal wildlife trade: Social norms and expectations

Interventions to address wildlife conservation have also worked by targeting different actors throughout the social system. For example, poachers are only one part of a larger system supporting the illegal use of wildlife. As a result, TRAFFIC recruited traditional medicine practitioners to publicly pledge to refrain from using rhino horn (Offord-Woolley, 2017; TRAFFIC, 2015). By socially 'binding' these practitioners to their commitments, as well as to making the new norm more visible in the practitioner community, the program has already led to a measurable reduction in the use of illegal wildlife products. Unfortunately, work remains to understand and shape the demand for rhino horn at the client level. For their client users, demand is almost exclusively driven by the behavior of their peers, unaffected by any campaign or behavioral intervention on intermediaries like traditional medicine practitioners or local leaders (Vu et al., 2020). Many do not trust the implementers of such demand-reduction interventions—something that careful qualitative and quantitative studies could help address and alleviate.

Norm shifting programs can also be augmented with supporting technological solutions. After a successful social marketing campaign in Laos that shifted community norms around the illegal hunting of tigers, state officials introduced a wildlife crime reporting hotline. In the six months when the hotline was operational, state officials

received 250 citizen calls that led to 22 arrests (Saypanya et al., 2013). In Tanzania, researchers and Tanzania's Wildlife Tourism Department created and broadcast a 25-episode radio drama called Temboni ('the voice of the elephant'). Temboni's protagonists would face issues of illegal hunting and wild meat consumption, getting either rewarded or punished depending on their actions related to the topic of the episode (Veríssimo et al., 2018). However, due to limited radio penetration in the region, the implementation challenges of the intervention highlight the difficulties in delivering mass media campaigns, particularly when that intervention relies on creating common knowledge around norms.

Preventing poaching: The limitations of incentives and rules and regulations

The strategies described above, including the changing of norms, giving community members the capacity to act on their values, and providing alternative livelihoods, fundamentally work because they work *with* rather than *against* the will of the community. They diverge from the zero-sum framing of human-wildlife conflict. This can be contrasted with the common policy intervention of bans on wildlife trade, which can often show the opposite dynamic. Interviews with those living within and near protected areas in southern Africa found that bans negatively affect those most impoverished. This financial loss cascaded into a psychological loss of well-being. Respondents reported feeling that the regulations humanized animals, while *de*-humanizing actual people. This feeling of outrage made respondents even angrier with local restrictions, making them even less interested in complying (Strong & Silva, 2020). These results highlight the need to qualitatively understand the needs of a community before developing an intervention, whether it be a ban or a community-based program. Bans alone are unlikely to address the socio-ecological factors that drive wildlife consumption and can even be counterproductive when that context is accounted for. Instead, the behaviorally and socially informed strategies above, perhaps accompanied by a ban when supported by the local community, is far better positioned to drive actual changes in behavior.

Overfishing

Fishing is a primary source of food and income for millions around the world. Coastal fishing communities, in particular, rely on sustainable fish stocks, yet many of the world's fisheries are at risk of overfishing and degraded marine ecosystems. This section covers interventions that increase sustainable fishing behaviors.

Reducing overfishing: Social norms

As part of a global fisheries program, from 2010 to 2012, the NGO Rare worked with local leaders to run a social marketing campaign that aimed to reduce destructive fishing inside the Dongzhaigang National Nature Reserve in China. Simultaneously, the campaign implemented a community co-management committee and trained the monitoring teams on patrolling the area and enforcing fishing bans. Over the period of the campaign, the proportion of fisheries who believed that destructive fishing should be illegal increased from 48 to 82%. Further, the percentage of those who had ever reported an infraction more than tripled, growing from 9 to 30% (Butler et al., 2013). Rare also partnered with the World Wildlife Fund to launch a campaign around Mongolia's Onon River to increase catch-and-release practices for taimen. By creating fishing clubs among fishers, boosting a sense of belonging, and training on sustainable fishing practices, there was a greater awareness and new norms around fishing laws. In the first two years of the campaign, the taimen population had grown by 48.7% (Tully, 2018).

More recently, Rare worked with local partners to encourage local communities from three countries to develop and comply with community-based territorial use rights systems for fishing coupled with no-take marine reserves known as TURF reserves. Campaign leaders recognized that these reserves were the crucial foundation for realizing behavior change and socio-economic benefits. Rare's team launched (and are still active today) social marketing campaigns across 41 sites in Brazil, Indonesia, and the Philippines. They used these campaigns to create new social norms that reinforce fishers' compliance with TURFs. Compared with pre-intervention levels, communities in all three countries significantly increased their support for sustainable fishing practices and have reduced overfishing

behaviors. These results suggest that these communities not only developed new social norms around expected fishing practices but that these new norms drive and maintain sustainable practices even prior to realizing the long-term benefits livelihood benefits (McDonald et al., 2020). Ecological surveys indicate a mean fish biomass increase in the campaign reserves of 390% and a 110% increase in the surrounding waters over six years (Alimi et al., 2018).

Other reviews of community-managed resources further support the benefits of this type of approach. The community-based management of Brazil's Juruá River saw the world's largest scaled freshwater fish (*Arapaima gigas*) dramatically rebound from an average of 9.2 fish in open-access lakes to 304.8 in community-protected ones (Campos-Silva & Peres, 2016). A review of three ethnographies of fishing communities in the Philippines identified various ways in which social complexity affected marine conservation and protected areas. Without understanding the different motivations and barriers of fishers, campaigns can create unfair access to participation and resources (Fabinyi et al., 2010). Other work in the Philippines reinforces the importance of working with local people to determine how institutions like a fisheries management group can incorporate real participation across those in a low power position in the community. Participatory processes must be mindful of local power dynamics and ensure that all feel involved and consulted in decisions to build investment in new programs or rules (Eder, 2010).

When norms already exist, some interventions have focused on reminding key actors to comply with them. Researchers in Tasmania tested whether timely messages might be used to increase regulation compliance in a simulated laboratory setting (Mackay et al., 2019). They presented university students with a common-pool resource game where some players were given information about other people's behavior: 'According to last year's data, the average fisher chose to catch only one (1) fish.' Compared with participants who did not receive the information, those students that had received the descriptive norm message were 10% more likely to comply with the 'maximum catch' rule imposed by the game (two fish maximum). Another finding from this study was that the reminder was far more effective if paired with weak deterrents (5% chance of having your catch inspected) compared with strong deterrents (20% chance of having your catch inspected). Interestingly, while this effect was true of risk-averse individuals, risk-seeking ones were more responsive to deterrents and less to the social nudge.

Reducing overfishing: Decision aids

Interventions that reframe choices—in tandem with social marketing campaigns—have also been effective in curbing overfishing. Decision aids, for example, are cheap and efficient tools that can be distributed and that significantly simplify choices for decision-makers. In the Bahamas, for instance, Rare ran a behavior change campaign from 2009 to 2010, where they also provided fishers with a tool to easily measure the tail size of spiny lobsters (Green, Williamson, et al., 2019). The goal was to prevent fishers from harvesting immature lobsters and allow the spiny lobster population to grow. After the 'Size Matters' campaign was put in place, one of the biggest processors in the Bahamas recorded close to zero undersized lobster for the first time in over 40 years. In 2018, the spiny lobster fishery in the Bahamas received Marine Council Stewardship certification—a testament to the campaign's durability.

Similar size gauges have also made an appearance in Tasmania, where the Inland Fisheries Service distributed a special ruler to measure Tasmanian trout. There are several short and playful messages to gauge size along the ruler, starting with "It may be to size but do you really want it?" at the legal minimum size (220 mm) to "Not bad!" "Impressive!" "Worth bragging about!" and "Officially a monster!" Tasmania also encourages fishers to release undersized fish with the slogan, 'Gently put the little ones back' (Mackay et al., 2018). While these decision aids appear promising from a design perspective, to date, neither researchers nor government has evaluated their effectiveness.

Deforestation & Habitat Degradation

As populations expand, so do human settlements that encroach on forests and other habitats. Deforestation may occur due to natural resource extraction or clearing land for development or agriculture. This section explores interventions designed to change behavior to reduce deforestation and habitat degradation.

Preventing deforestation: Limits of incentives

For decades, a common intervention for slowing deforestation has been the Payments for Ecosystem Services (PES) scheme: a market mechanism by which those damaging an ecosystem are incentivized to shift their behavior, often by those harmed by that damage. While PES schemes have been deployed in various geographic, social, and environmental contexts, there is still much debate as to their effect and cost-effectiveness (see Pattanayak et al., 2010; or Romero et al., 2013).

In Uganda, for example, a PES scheme was successful in reducing deforestation rates on privately-owned lands (Jayachandran et al., 2017). Keeping forests intact reduces atmospheric CO_2 and increases biodiversity, which is an important source of income for Uganda's tourism sector; but these schemes recognize that individual landowners personally gain much more from chopping down those forests for timber or agriculture. To match the value of keeping the forest intact with the individual material value of clearing it, researchers offered landowners yearly payments of 70,000 Ugandan shillings per hectare of conserved forest. After two years, they found that tree cover decline had slowed in those villages where well-calibrated PES schemes were offered. Comparing 61 control villages to 60 villages where forest owners received PES payments, the team found that deforestation rates were almost 4.9% slower in those communities that received payment from 9.1% of tree cover disappearing to 4.2%. In terms of the social cost of carbon emissions, the program's benefits were estimated at more than 2.4 times its cost, although this result is highly dependent on the particular social discount rate assumed.

Although widely deemed a success, the PES scheme above also demonstrates the possible social consequences. While the program had been efficient in encouraging forest owners to reduce their tree-cutting (often to clear land for agriculture or to collect timber and charcoal), it also led owners to stop allowing poorer neighbors to gather firewood or building materials. Though conservationists might rejoice at the 4.9% change in deforestation, a critical eye would identify the missing social costs of the program. Because the evaluation failed to account for the socio-ecological context, the welfare of the low-power neighbors was neither accounted for nor compensated. This resulted in not only an inequitable distribution of burdens but also an incomplete tally of the cost of the program.

Another cause for concern is the possible 'rebound effect' of such schemes. In Cambodia, a team of researchers examined how PES schemes might crowd-out the intrinsic motivation that people have to protect the environment. This crowding out might occur if households previously identified intrinsic value in forest resources, but by framing those resources in monetary terms, those administering the scheme may undermine that original motivation. To test this, researchers compared survey responses of households who were currently enrolled in a PES scheme to the responses of matched controls (Chervier et al., 2019). They found that, while the PES scheme did increase the value that participants placed on forest resources, this value was money-related as oppose to subsistence-based. They also found that those who emphasized money-related benefits more strongly were also more likely to report that they would stop conserving if the program ended.

Recent work in geography and political ecology similarly notes that purely market-based approaches like the PES model can modify human ways of relating to nature, to the detriment of conservation goals. A suggested alternative might be to frame conservation as joyful and sustaining, instead of as a burdensome activity that requires compensation (Singh, 2015).

Preventing deforestation: Incentives, social norms, and appealing to local values

Behaviorally-informed approaches are in the ideal position to suggest complements to traditional PES strategies or to suggest alternative means of getting forest conservation to 'stick.' For example, one study in Mexico used social marketing tactics to change norms and persuade landowners to register for PES schemes (Green et al., 2013). Working with a local partner, Pronatura Veracruz, Rare ran a pride campaign whereby posters and billboards displayed a specific call to action for the community: Certifica tu Tesoro or 'Register your treasure.' This message, along with a unique theme song, appeared in radio and television stations as well as schools. The campaign also included a community visit to a local bird observatory where individuals could directly observe the species that the program wanted to conserve: the peregrine falcon. Once there was sufficient buy-in in the community, Rare turned to making adoption as easy as possible. They organized a series of meetings to teach landowners how to register their land with the scheme and encouraged participants to share their experience with others. The campaign ran from May 2009 to July 2010. In that time, 14 landowners decided to sign-up and protect what amounted to 1584 hectares of land, more than three times the predicted 500. A survey of households in the area revealed that before the campaign only 36% of landowners understood deforestation as a threat to local ecosystems. After the campaign, that proportion rose to 63%. A new norm had been created in the community, one that encouraged PES adoption without the need for implementers to increase payment amounts.

Similarly, Andersson et al. (2018) investigated the motivation of forest users from Bolivia, Indonesia, Peru, Tanzania, and Uganda to participate in this type of scheme to reduce forest harvesting on communal land through a framed field experiment. By testing a series of different hypothetical PES schemes, the researchers found that making a payment conditional on having achieved a low harvest rate was more effective than simply allowing participants to communicate. However, once the scheme was removed, simulating the common reality of most schemes' conclusion, those groups who had the opportunity to communicate rather than be financially incentivized conserved the greatest amount. Trust among the community was also a significant predictor of the maintenance of conservation efforts post-PES. Andersson et al. suggest that "policy actors may be able to increase PES program effectiveness on forest commons by promoting interventions that facilitate interpersonal communication among forest users, and by prioritizing implementation in contexts where users enjoy high levels of trust" (p.133).

Other than direct payments, a successful approach to reducing deforestation has been to incentivize sustainable behaviors by providing resources that directly address the cause of deforestation. For example, the Health in Harmony initiative in Indonesia provides individuals with healthcare and training in organic farming practices; in exchange, participants hand in their logging equipment (Karak, 2020). Over 13 years, the program has led to a 90% decrease in logging, a 67% decrease in infant mortality, and 52,000 acres of secondary forest regeneration. The true accomplishment of the program, however, was how it was able to address both the cause of logging and replace the behavior permanently through intensive co-design with the community stakeholders. By consulting communities about what they needed to protect the forests of Gunung Paung National Park, Health in Harmony recognized that the real cause of illegal logging was the high cost of healthcare for villagers. Instead of providing extra cash, the initiative therefore provides villagers with affordable healthcare. At the same time, Health in Harmony also teaches communities how to maintain both their livelihood and the rainforest around them—ensuring that the change is not only meaningful but permanent.

Rare adopted a similar approach in the Gansu Province of China, using a social marketing campaign to promote the use of fuel-efficient stoves as a way to reduce deforestation in the area (Dewan et al., 2013). Since most of the illegal logging in the area was tied to the low-efficiency of firewood stoves—rather than simply providing cash to delay forest harvest, the campaign promoted the use of newer, more efficient stoves. After 2.5 years, 43% of the treated population adopted fuel-efficient stoves; and for those households that had adopted fuel-efficient stoves, wood consumption and gathering time expectedly decreased by 40% and 38%, respectively. At the forest level, the intervention led to a 24% reduction in the number of newly felled trees in those areas where fuel-efficient stoves were adopted by more than half of the community.

Reducing habitat degradation: Social norms

Beyond PES schemes, some interventions have applied various social norm-based strategies to promote conservation on private lands. Byerly et al. (2019) ran an intervention with Maple producers in Vermont, USA, aiming to encourage participation in a conservation program called the Bird-Friendly Maple Project. In this program, participants acknowledge and adapt their practices to make bird habitat protection a priority. After sending a variety of solicitation letters to participants, the researchers realized that they had not fully understood existing norms in the area. The researchers predicted that sharing a descriptive norm of what other farmers were doing would increase participation (i.e., "Many of your fellow sugar makers are part of the program"), but this instead slightly decreased interest in the program. For Maple producers who did not directly know anyone participating in the Bird-Friendly Maple Project, this norm message conflicted with their reality of seeing very few sugar makers participating. As a result, they were less likely to feel compelled to sign up.

Norm messaging was also found ineffective in a study by (Metcalf et al., 2018), where Pennsylvanian landowners received mailers that asked them to conserve their riparian land. The intervention tested two things: first, whether micro-targeting landowners based on a model predicting their likelihood of participating would increase uptake relative to farmers randomly selected; and second, whether normative messaging would further boost interest in the program. Those selected through micro-targeting were significantly more likely to take a follow-up survey about land conservation as compared to those who were not micro-targeted (20% vs. 12%). However, the inclusion of the normative appeal that "most landowners like you invest in riparian buffers" had a small effect, and only on randomly selected landowners. While micro-targeting was a successful strategy and interesting for future application, both studies demonstrate how norm messaging can be ineffective when inconsistent with observed practices, and how actors rarely rely on a single source for normative signals (Prentice & Paluck, 2020).

Engaging with Conservation

While addressing overfishing, deforestation, and habitat degradation help to overcome direct threats biodiversity, increasing fundraising and relationships to nature can also have indirect benefits. In this section, we focus on social marketing campaigns, fundraising campaigns, and communication strategies that have helped to create regular and safer interactions with wildlife.

Promoting conservation messaging and fundraising: Social norms and appealing to local values

While many of the interventions targeting biodiversity conservation work with different communities, geographies, and even problem areas, many of these efforts were successful because they apply similar overarching strategies—particularly when it comes to social marketing. For example, Rare's deforestation interventions in Mexico and China both centered their campaigns around flagship species—peregrine falcons in Mexico (Green et al., 2013), and the golden snub-nosed monkey in China. In 2015, Rare published an analysis of 64 of its social marketing campaigns and found that those centered around a recognizable, mascot species had 21% higher adoption of target behaviors (Hayden & Dills, 2015). And in 2018 Rare published a meta-analysis of 84 social marketing campaigns across 18 countries and concluded there was an increase in knowledge, attitudes, interpersonal communication, behavior intention, and behavior indicators from an average of 16.1 to 25.0 percentage points following the campaigns (Green et al., 2019).

Pairing conservation messaging with specific species is a common strategy in the field, and not just to engage actors in point-of-origin countries. To improve this messaging, researchers have tested a number of attributes. Unlike with human beneficiaries, people appear to be no more likely to donate when there is a single identifiable animal beneficiary rather than a group. Yet there is a significant increase in donations when a campaign highlights flagship over non-flagship species (Thomas-Walters & Raihani, 2017). There is also evidence that highlighting the anthropogenic cause of a species' plight leads to more engagement (Bulte et al., 2005). In an interesting nuance,

fundraising campaigns featuring flagship species appear to increase the *probability* of someone donating, but highlighting the human causes of species decline or publicly recognizing donors for their contributions leads to increased donation *amounts* (Shreedhar & Mourato, 2019). Another common strategy employed by NGOs is to use celebrities as campaign messengers. While celebrities do tend to increase engagement with a campaign, they have the negative side effect of reducing people's recollection of the campaign's specific messages (Duthie et al., 2017).

Building new interactions with nature: Appealing to values

Regular interactions with nature can also drive engagement. A 2018 study found that people who experience nature as part of their daily routine were more connected to nature and more likely to act in ways that protect and support biodiversity conservation efforts (Prévot et al., 2018; Whitburn et al., 2020; Zaradic et al., 2009). For those for whom nature is more difficult to access, researchers increasingly suggest that practitioners recruit mobile technologies and augmented reality software (e.g., *iNaturalist, Seek*, and *Pokemon Go*) as a means of facilitating interactions with nature (Bamesberger, 2020; Colléony et al., 2019; Dorward et al., 2017). Of course, there are other limitations to the accessibility of different technologies, and practitioners should also be mindful of how such software ascribes to a Western valuation of nature (Altrudi, 2020).

Stick to the Path: Protecting Protected Areas

Off-trail hiking in National parks is an example of how 'recreational' activities can damage even those areas that are otherwise protected from more traditional sources of harm. In Washington DC's Chesapeake and Ohio National Historical Parks, authorities tested the efficacy of different strategies (and their combination) in the hope of reducing the problem (Hockett et al., 2017). They tested a combination of the following strategies: i) signs that made visitors aware of their impact on the park), ii) symbolic "no hiking" signs across informal trails, iii) placing leaf litter and branches along initial sections of informal trails, iv) restoring and fencing selected trails, and v) placing trail stewards at trailheads that personally communicate the information that was on trailhead signs. Of all these tactics, they found that the contact with trail stewards had been most effective in reducing visitor reports of off-trail hiking from 70.3% to 43.0%. Direct observations of specific problem areas saw a reduction in off-trail hiking from 25.9% to 6.5% after the addition of trailhead signs, and further to 2.0% when trail stewards delivered the message. Renaturalizing parts of the path (i.e., placing leaves and branches to cover informal trails) was also effective—bringing self-reports of off-trail hiking from 70.3% to 60.2%, and 58.6% in the case of those parts that were fenced off. By providing visitors with salient reminders of their impact on the park, increasing the effort needed stray from the path, and having contact with key messengers, this intervention demonstrates how to address a range of different motivations and barriers for behavior change.

People's interest in getting close to wildlife can put both wildlife and people at risk if people fail to act appropriately. National parks are a setting where people are eager to explore the natural world and even encounter rare animals they would not see at home. A study by Abrams et al. (2020) tested ways parks could reduce wildlife-caused injuries to visitors through different park communication messages in four U.S. national parks. Typically, parks highlight the importance of wildlife protection, but this intervention explored whether focusing on the visitor

experience could make a difference instead. At three of the four parks, campaigns that promoted the visitor's experience led to fewer visitors putting themselves an unsafe distance to wildlife. Due to the number of national parks and protected areas worldwide, further research on visitor behavior would be valuable in honing these messages. For example, a landmark study by Robert Cialdini and colleagues (2006) aiming to dissuade visitors from taking petrified wood from an Arizona park tested various social norm messages. They found emphasizing the prevalence of the undesired behavior (i.e., stealing petrified wood) backfired in increasing the behavior, whereas focusing on social disapproval of the behavior decreased undesired behavior.

Finally, it is important to consider that the amount of interactions that a community has with nature does not directly translate to more connectedness. For example, when an intervention's target population is wholly dependent on natural resources, they have less positive feelings of connectedness with nature (Marczak & Sorokowski, 2018). This is also true for people for whom interactions with wildlife and human-wildlife conflict are frequent. One strategy is to promote the benefits of having different species within a community's territory, as well as to highlight those specific actions that people can take to avoid conflicts with said species (Slagle et al., 2013).

Analysis

Overall, the behavioral interventions for biodiversity conservation have a lot in common. Whether it is to combat poaching, overfishing, illegal logging, or engage more people with conservation activities, most of the published evidence relies on social influences. More specifically, social interventions work to spread information and shift norms in communities that live in (or around) protected zones. These interventions highlight the positive externalities that can arise from a community's relationship with nature. By building a sense of self- and collective-efficacy in target populations, biodiversity interventions align community expectations with new, sustainable behaviors.

Review of the strength of the evidence

Behavioral solutions for biodiversity form a cluster around geographies where there are the greatest threats to natural resources and wildlife. Many insights are strong and promising for future interventions. However, interventions on illegal wildlife trade or deforestation focus mainly on the supply side of protecting endangered fauna and flora. Very few interventions address Western populations or the demand side of resource depletion (Wallen & Daut, 2018; Chaves et al., 2017; Moorhouse et al., 2017; TRAFFIC, 2015).

Conversely, studies that focus on actors' engagement with conservation are restricted to western Europe. Future studies could explore how related insights might apply to campaigns in other countries and contexts, mainly testing local communities' sense of connectedness with nature and wildlife (Prévot et al., 2018; Whitburn et al., 2020). Many modern conservation campaigns focus on reconnecting people with nature, and evaluations of such efforts could be implemented at scale (e.g., Barrera-Hernández et al., 2020; Richardson et al., 2016).

It is further important to consider the methodological limitations that may undermine the validity and generalizability of interventions' results. Most of the reported results on poaching, overfishing, and deforestation stem from quasi-experimental evaluations. These are often pre-post studies, where behaviors are compared before and after an intervention happens. The results show a measure of the change in the field but often without an appropriate control or the randomization of the intervention's delivery. Therefore, there is an unfortunate lack of *internal* validity in this evidence-base, particularly for interventions that rely on the social marketing work of NGOs.[2] Exceptions do exist (e.g., Byerly et al., 2019; Chaves et al., 2017; Jayachandran et al., 2017), but the real result of behavior change interventions that focus on poaching, overfishing, and deforestation could be smaller or non-significant if appropriate controls or randomization were in place.

2 A recent review on the impact of over 280 wildlife demand-reduction campaigns found that 85% of these were led by NGOs. Only 43 of those had attempted an evaluation of their impact, and only 5 made direct observation of changes in behavior as an outcome metric (Veríssimo and Wan 2018).

Fortunately, most interventions are tested directly in a natural field setting with real-world behavior change outcomes. Field studies provide a high degree of ecological *validity*, and we can be confident that the results apply to the behaviors we seek to change. The reverse is true for the smaller set of online or laboratory-run studies in the overfishing and conservation engagement sections (e.g., Duthie et al., 2017; Mary Mackay et al., 2019; Shreedhar & Mourato, 2019). These interventions provide tight controls of internal validity but often require many more assumptions to conclude that the same effect would occur in a real-world (or even offline) context.

Review of the application of behavioral science

Social influences are the most common behavior lever applied to biodiversity conservation interventions. Most interventions find that individual decision-making is highly dependent on the decisions of others. As a result, solutions aim to create norms or make existing norms more salient in target communities and ensure that a majority of the community conforms to these norms.

Behavioral scientists often think of social norms as collective patterns of behavior that result from people conforming to others' beliefs and expectations (Bicchieri, 2016). This tendency to conform is deeply rooted in humans' unique evolutionary history (Henrich & Boyd, 1998). Norms define behaviors that are appropriate in a community and define the socio-ecological boundaries of that community (Hogg & Reid, 2006; Young, 2015). Interventions that successfully create or modify existing social norms inherently leverage our evolved preferences for conformity, and the accompanying social emotions, such as pride, admiration, envy, and shame (Fessler & Haley, 2003).

The real benefit of leveraging social norms is that they become self-enforcing once a community expects a given set of behaviors. This is unlike rules and regulations, which require formal and dedicated enforcement (Nyborg et al., 2016). Interventions focusing on shifting norms tend to move through three behavioral science-informed phases: generating collective demand, coordinating a shift in behavior, and strengthening that norm (Thulin, 2020). Generating collective demand involves encouraging actors to recognize the positive outcomes of their actions and noticing that everyone else recognizes these outcomes as well. For example, community activities like games, parades, or other convenings bring together large groups of community members to engage with the challenge (e.g., Dewan et al., 2013; Green et al., 2013). These community gatherings allow participants to test their new beliefs and expectations, making them confident that others have a similar perspective (Prentice & Paluck, 2020). Generating collective demand for change is critical but insufficient for behavior change because people prefer to conform to what others are doing. The second phase of change is a coordinated shift in behavior, where the community changes as a group. Activities like public pledges help to signal this shift (e.g., Chaves et al., 2017; Steinmetz et al., 2014; TRAFFIC, 2015). Finally, for the new norm to be stable, members of the community need to believe that their conformity to the norm will be observable. Activities such as community patrols reinforce norms and punish transgressors (e.g., McDonald et al., 2020; Muntifering et al., 2015).

Given these conditions, norm-based interventions can have significant and durable impacts; it is the community, not practitioners, that maintains behavior change (Chudek & Henrich, 2011). Unfortunately, norm-based interventions are rarely monitored for extended periods after implementers leave. There is evidence that some programs are durable when norm change is paired with other behavioral levers. For example, Rare's Size Matters campaign and ARCAS' egg harvesting scheme both combine social influences with choice architecture to reinforce social expectations and make conservation behaviors simpler. Both interventions have been shown to be effective and durable (over ten years in the Bahamas case). They also highlight that these solutions must communicate the benefits of behavior change to the community, signal expected behavior change by others, and make the new behavior unambiguous and straightforward (in these cases via the use of decision aids and categorical rules; see, Yoeli & Rand, 2020).

Review of the application of social science

Compared with the other topic areas, interventions on biodiversity conservation take the most care in understanding communities' cultural norms and values. Pride campaigns, for example, rely on social marketing tactics that are

unique to each of Rare's target communities (Butler et al., 2013; Dewan et al., 2013; Green et al., 2013; McDonald et al., 2020). The Kuiburi National Park program on poaching reduction (Steinmetz et al., 2014), Laotian authorities' work on tiger poaching (Saypanya et al., 2013), and ARCAS' efforts in Guatemala on turtle egg harvesting (Muccio, 2015) are also strong examples of developing customized campaigns. With these strengths, there are a few major weaknesses of biodiversity interventions. They need to target both supply and demand reduction for wildlife products, develop a more nuanced set of interventions for different groups within communities, and be more proactive in incorporating community voices during program development.

Similar to the process described in the behavioral science application section above, social scientists have identified similar themes in social norm adoption. While values themselves may be deeply internalized early in development, how a value is expressed in a particular context is far more socially mailable (Lincoln & Ardoin, 2016; Stern, 2000). It is at precisely this level that successful norm change interventions in this section tend to operate. Rather than attempting to change deeply held values, they change the way the perception of a behavior is socially constructed such that a behavior is seen as consistent (or inconsistent with those values), and therefore deserving of positive or negative social sanction.

The social norm processes highlighted in the interventions in this section implicitly rely on an understanding that social context is not a static environmental influence, but rather a dynamic cause and product of human behavior. Social science reveals that these dynamic change processes are often non-linear, with "tipping point" inflections (Granovetter, 1978; Schelling, 1978). Understanding these non-linear dynamics gives greater insight into the total impact of a program, as it must account for not only the direct effect of an intervention, but also the social multiplier. While some work in this space attempts to estimate a generalizable tipping point for social change (Centola et al., 2018), it is important to recognize that the distribution of individual thresholds for change, as well as the configuration of the social network has a significant effect on where the emergent community tipping point might be, and indeed whether any tipping point exists at all (Bentley et al., 2014; Novak, 2020). While the measurement of these individual thresholds is in its infancy (Bicchieri, 2016), it presents significant applied value for biodiversity conservation programming.

We find very few efforts targeted at the demand side of illegal wildlife trafficking behaviors (cf. Chaves et al., 2017; Moorhouse et al., 2017; TRAFFIC, 2015). Even those that do have this focus could benefit from a better understanding of the socio-ecological dynamics and variables that drive demand. For example, though TRAFFIC's intervention on rhino horn demand targeted traditional medicine practitioners (a proximate demand actor), the end-user might not be deterred by such efforts. Those using traditional medicine seem to be unaffected by what traditional medicine experts say and almost entirely driven by their network of peers (Vu et al., 2020). Unless interventions target every practitioner or change the underlying norms within the community, practitioners still providing these treatments will have a business. A systematic approach that examines the full supply and demand system might be more successful.

The second area that we find biodiversity conservation interventions lacking is in recognizing social complexity. An otherwise well-designed behavior change intervention can fail without incorporating insights from the socio-ecological system. Practitioners should aim to disaggregate existing norms relative to biodiversity conservation and identify specific social variables. For example, researchers in Tanzania and Ethiopia have found that targeting men in the fight against bushmeat hunting is interconnected with women's behavior. Men were motivated to hunt by women's encouragement, and women benefitted from the material and symbolic rewards of men's hunting outings (Lowassa et al., 2012, p. 628). In Brazil and Colombia, the best predictor of bushmeat consumption is its association with cultural identity, particularly for urban consumers (Morsello et al., 2015). Our analysis reveals little effort in addressing these more nuanced beliefs and behaviors.

Beyond norms and gender roles, different identities in a community may also lead to unforeseen effects of interventions. For instance, one study showed older Filipino men prefer low-risk, low-return fisheries, while younger

fishers prefer high-risk, high-return activities, which are tied to illegal fishing practices (Fabinyi et al., 2010). These two groups diverge in their willingness to participate in marine conservation efforts, which then results in disparate impact for these two groups. A failure to attend to complexity can lead to inaccurate targeting, unfair outcomes, and heterogeneity of needs that are largely left unaddressed.

Similarly, though some behavioral efforts to reduce wild meat consumption have been effective (Chaves et al., 2017), others have failed because they misinterpreted community needs and capacity (Knueppel et al., 2009; Wicander & Coad, 2014). We highlight Health in Harmony's approach as a model of how this can be achieved. Through their 'Radical Listening' approach, they ask communities what a 'thank you' for engaging in conservation would be. These responses allowed them to target the drivers of biodiversity loss at the source (Karak, 2020). Community members told the NGO that they engaged in illegal logging largely to pay for expensive medical care, so Health in Harmony subsidized healthcare. For loggers, who instead sought alternative livelihoods, Health in Harmony offered sustainable farming training in exchange for no more logging. A deeper understanding of the socio-ecological context underlying unsustainable behavior is an overlooked but crucial tool in the behavior change toolbox. Even so, interventions should aim to help communities build local capacity in addressing their challenges once NGOs and other authorities leave.

Moreover, alternative livelihood projects (ALPs) have had mixed outcomes in terms of their effectiveness in conservation programs (Wright et al., 2016). Program designers assume ALPs will work because they will reduce the need to exploit a given resource, that one ALP will work for all members of a community, or that one individual's success with modifying their livelihood will lead to scaling up within the community. In reality, the adoption of alternative livelihoods is much more complicated by social and economic context. Alternative livelihoods are not just promoting financial security but sometimes very different skills, interests, traditions, or expectations. For a household to substitute or replace one type of income for another, that substitute must meet the same needs and goals (whether they be economic, social, cultural, etc.) as the original. The cases with cane rat farming help to demonstrate when and where this is effective. In Gabon and the Congo, cane rat farming would have required significant training in raising small animals as well as changes to social and cultural norms, whereas farmers in Cameroon had pre-existing experience with small animals. As a result, cane rat farming was more successfully adopted in a place where there were already the skills and norms to support it (Wicander & Coad, 2014). In other cases, alternative livelihoods become a complementary rather than substitute source of income when they are introduced, which may still benefit overall household resilience, yet not be the goal of the program (Wright et al., 2016).

Additionally, members of a community, with different identities, statuses, have differing ability and willingness to adopt a new livelihood (Wright et al., 2016). Some people may see ALPs as proactive or innovative opportunities where they are coping mechanisms for others. The ability to scale ALPs is also dependent on external forces such as population growth or market shifts that could make some activities more or less attractive. Ultimately, designers will be most successful in implementing ALPs if they are based on locally-determined needs and fully recognize the socio-ecological system in which they operate (Wright et al., 2016). The Health in Harmony and Rhino Rangers cases are strong examples of successful projects that did intentional research into local interests (Muntifering et al., 2015; Muccio, 2015).

Finally, biodiversity conservation practitioners often pride themselves on their engagement with local communities and environmental outcomes yet fail to address inequitable power dynamics. PES schemes are inherently tied to land tenure, for instance, and thus may provide disproportionate benefits to those already in positions of power (Knox et al., 2011; Robinson et al., 2018). Social norm-based interventions also fundamentally rely on a powerful group, usually a majority, placing social pressure on those in a less powerful position. The threat of social sanctions is inherent to the effectiveness of any such intervention (Bicchieri, 2016; Chudek & Henrich, 2011). This dynamic can result in inequitable outcomes, particularly if those in lower status positions are not involved in designing the behavioral solution (e.g., Eder, 2010). Applying more social science methodology and concepts in intervention design could start to address these issues. Practitioners should also be mindful that communities may feel alienated

by conservation efforts (Cassidy, 2012). Traditional models of conservation have often prioritized endangered species' survival over human wellbeing and livelihoods (e.g., Barbora, 2017; Jalais, 2005). Here the Rhino Rangers program, community conservation on the Juruá River, and Madagascar's efforts to reduce ploughshare tortoise poaching exist as counterexamples. All of these programs alleviate concerns by both empowering communities to maintain and benefit from their conservation efforts (Campos-Silva & Peres, 2016; Muntifering et al., 2015; Randriamanampisoa & Adams, 2015).

Further Readings

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