

1 **Delivering behavioural change at scale: what conservation can learn from other**
2 **fields**

3 **Abstract**

4 Developing interventions to change human behaviour at scale is critical to achieving
5 the new Global Biodiversity Framework goals. One strategy that conservation
6 practitioners can adopt in pursuing this ambition is to look for lessons from other
7 fields engaged in sustainable development, such as development economics and
8 behavioural science. Over the past twenty years, these fields have generated a large
9 and growing evidence-base of strategies for improving key sustainability indicators in
10 areas such as health, livelihoods, and education. This empirical revolution has been
11 accelerated by rapid advances in understanding the social and psychological
12 foundations of human behaviour. In this paper, we identify three areas that can help
13 conservation to bring behaviour change programmes to scale. First, conservation
14 practitioners should develop expertise in human behaviour developed in the social and
15 cognitive sciences. Second, conservation researchers should adopt empirical methods
16 widely practiced in development economics to rigorously identify whether, how and
17 why interventions work. Third, conservation should integrate with the policy
18 institutions and systems to facilitate learning and scaling.

19 **Keywords:** Biodiversity conservation, Behaviour change, Global Biodiversity
20 Framework, Scalable interventions.

1. Introduction

The UN sustainable development goals (SDGs; UN 2015) and the 2020 Zero Draft of the new Global Biodiversity Framework (CBD 2020) present ambitious blueprints that should put the environment at the heart of the global development agenda. Despite these high-level declarations however, previous targets such as the Aichi targets set in 2010 have not been achieved (Tittensor et al. 2014; IPBES 2019). Biodiversity indicators are getting worse, not better (Grooten and Almond 2018). This is not true for sustainable development goals in the areas of poverty eradication, public health, and education, for which outcomes have improved around the world (Pinker 2018). This improvement has been accompanied by the emergence of a rigorous evidence base to support the formulation of sound policy in fields such as public health, education, and social protection (Banerjee et al. 2020). A striking feature of this development is that social scientists and policymakers commonly work across a wide variety of policy domains, facilitating cross-fertilization of ideas and methods across policy areas (World Bank 2015; Duflo and Banerjee 2017). This strengthens the formulation of policy to address the SDGs, many of which are considered to be wicked problems requiring interdisciplinary approaches and a range of interventions.

With a strong historical focus on wildlife, biodiversity conservation developed independently to other sectors seeking to address the SDGs and has predominantly operated in a separate policy domain (Milder et al 2014; Reed et al. 2016). As a result, conservation is poorly integrated with the evidence-based policymaking community and has yet to establish a sufficiently broad or rigorous evidence base to inform policy decision-making (Ferraro and Pattanayak 2006; Junker et al. 2020). A prime example is the continued use of alternative livelihood interventions. These interventions have been widely applied with the aim of reducing exploitation of wildlife, particularly for meat, through the provision of alternative sources of income or protein. However, the implementation of alternative livelihood approaches often relies on weak – and *untested* – assumptions linking project activities to desired behaviour change (Wright et al 2016). A recent systematic review concluded that there was insufficient evidence to evaluate the effectiveness of such interventions in achieving either conservation or social outcomes (Wicander and Coad 2015). Where evidence does exist, decision-makers may not be aware or make use of it (Sutherland and Wordley 2017), contributing to conservation's widely identified research-implementation gap (Dubois et al. 2020). Finally, it is increasingly recognised that, if conservation is to contribute to global sustainable development, it must become more effective at identifying robust strategies to influence human behaviour (Balmford and Cowling 2006; Schultz 2011; Cowling 2014), and to do so at scale.

In this paper, we seek to address how conservation can learn from other public policy fields to change behaviours at scale. We argue that conservation should be viewed as a sub-field of public policy and seek to integrate the theory and methods from the social and cognitive sciences. This has three main implications. First, conservation must take account of the social and psychological foundations of human behaviour. Second, a cultural change is required within conservation to embrace methods that better identify interventions that work, including giving greater importance to understanding whether, how and why interventions impact conservation and social

outcomes. Finally, to bring ideas to scale, we need to build new institutions and systems that reward experimentation and develop sustainable solutions.

2. The social and psychological foundations of human behaviour

The fundamental challenge in changing behaviours at scale is to identify the causes of *aggregated* human action. This concern lies at the heart of social science. For over half a century, the framework for addressing this challenge has been built on the assumption that humans can be understood as self-interested and asocial utility maximisers and can objectively interpret unlimited information. At the heart of this framework – called the rational actor model – is the proposition that people respond to incentives. One implication of this approach, which continues to be a key starting point for policy analysis, is that the drivers of human behaviour can be reduced to a small number of institutional variables without ever taking psychology into account (Becker 1976; Stigler 1961). However, in recent years psychologists have shown that the core model can be enriched in a variety of useful ways by incorporating insights about how people think (Kahneman 2003). A vast literature has since emerged emphasising how psychology plays a much larger role in human behaviour than simple economic models recognised (Thaler 2016).

Policymaking was predominantly guided by the rational actor model for decades, but now also incorporates a broader view of human decision-making (World Bank 2015). Governments around the world – including the United Kingdom, Singapore, and Peru – are employing behavioural science in the design of policy at ever greater scales (Afif et al. 2018). Behavioural public policy has become a focus of international organizations such as the World Bank, UN, OECD, and the European Commission (OECD 2017). Moreover, the application of behavioural science has produced significant results in domains such as savings (Madrian and Shea 2001; Chetty 2015; Chetty et al. 2014), tax payment (Hallsworth et al. 2017), educational performance (Paunesku et al. 2015) and job-seeking (Abel et al. 2020).

While there is growing appreciation of the importance of this perspective in conservation too (see Reddy et al. 2017; Battista et al. 2018; Byerly et al. 2018; Cinner 2018; Martin et al. 2017), efforts to integrate behavioural insights into conservation practice remain at an early stage. In this section, we outline how the framework from the World Bank's *World Development Report* can be applied to conservation (World Bank 2015, see also Demeritt and Hoff 2018). We use examples from the harvesting and consumption of wildlife to illustrate how three aspects of human thinking - automatic thinking, social cognition, and mental models - can be applied to conservation issues.

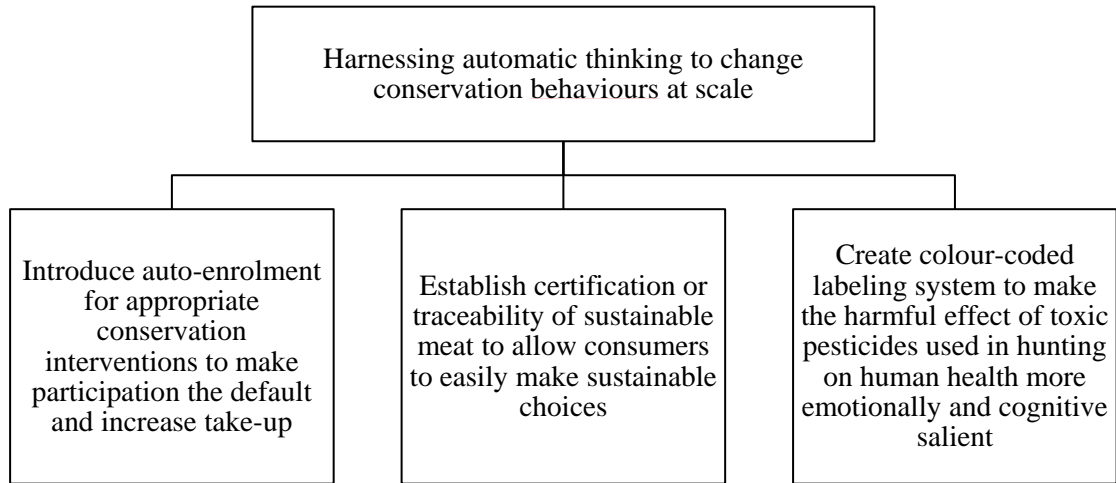
2.1. Automatic thinking

An implicit assumption in much of economics and policymaking is that people have the mental capacity to process and consider all the information at their disposal (Camerer and Loewenstein 2004). However, this is not true - the vast majority of people's thinking is automatic, beyond conscious control (Bargh 2017). To make practical use of information, people use heuristics. Most of the time, these are well adapted to the situations people find themselves in (Gigerenzer 2000), but they also lead to systematic biases (Gilovich et al. 2002). This feature of cognition is often preyed upon by companies seeking to profit from individuals' cognitive

vulnerabilities (Akerlof and Shiller 2015), but well-designed policy can also ensure that the features of the environment driving people’s behaviour cohere with how they would behave if they had the capacity to deliberate on all their decisions (Thaler and Sunstein 2003; 2008).

One way in which trivial features of the environment can guide behaviour is by establishing defaults. Taking account of this, policymakers can make simple changes that have a large effect on behaviour. For example, countries that automatically enrolled people into organ donation programmes (i.e. people are by default assumed to consent to their organs being donated after death) had donation rates that were 25-30 percent higher than countries requiring explicit consent (Abadie and Gay 2006). While the application of defaults has so far been limited within conservation, the use of automatic enrolment may increase take-up in conservation programmes (e.g. incentive-based interventions aimed at reducing bushmeat hunting), particularly in contexts where disseminating information to prospective participants is challenging (Fig. 1). Similarly, taking automatic thinking into account can inform approaches such as certification schemes and ecolabels that help consumers make sustainable choices without having to read through information or conduct independent research (Crespi and Marette 2005; Leire and Thidell 2005). In the case of bushmeat, where wild and domestic meat can be easily confused, certification schemes could be used to give urban consumers confidence about the source of the meat they buy.

Figure 1. Examples that take account of automatic thinking to promote conservation.



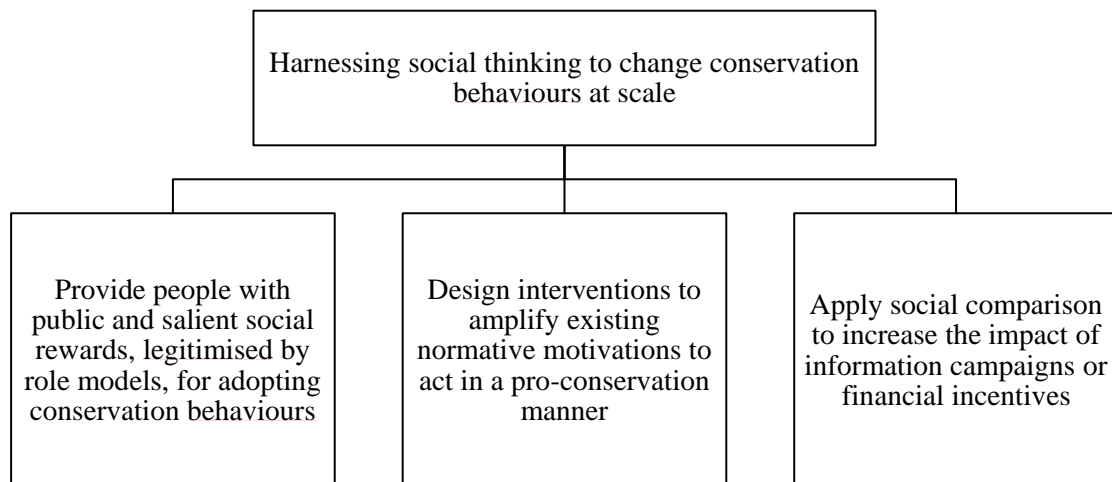
People act based on what comes to mind (Gennaioli and Shleifer 2010). Reminders can help people to sustain important behaviours. In Kenya for example, weekly text message reminders helped people sustain their HIV medication regimens, illustrating that seemingly trivial interventions can have consequences even for highly consequential behaviours (Pop-Eleches et al. 2011). This can be equally harnessed in conservation. For example, colour-coded hazard labels can be used to remind people of the toxic effects on human health if pesticides are used in hunting (a behaviour that can result in mass-mortality events of endangered wildlife; de Lange et al. 2020).

2.2. Social cognition

A second feature of human behaviour that has been underemphasised in policy design is the effect of social cognition. As humans, concern for esteem and belonging affects the decisions we make in our day-to-day lives and shapes our identities (Akerlof and Kranton 2000; Tajfel 1974). We make determinations about how to behave based on our perception of what is normal or expected of us (Bicchieri 2006; Bicchieri and Muldoon 2011) and punish those who deviate from what we expect of them (Fehr and Fischbacher 2004a; 2004b).

Well-designed policies can harness social norms to trigger behavioural change at scale and at low cost. For example, in Kenya, messages on stickers authorising bus passengers to reprimand their drivers for reckless driving reduced insurance claims involving injury or death by 50 percent compared to a randomly allocated control group (Habyarimana and Jack 2011). Similarly, messages emphasising socially acceptable water use have effectively been used to trigger social norms to reduce household water consumption (Ferraro and Price 2013; see Abrahamse and Steg 2013 for a meta-analysis on social influence and resource conservation). By generating, or emphasising, the esteem associated with conservation behaviours, policymakers may be able to trigger large scale behavioural change. An example of how this might be applied in conservation can be seen in Central Africa, where recent campaigns to reduce the consumption of bushmeat in urban centres have focussed on aligning an image of modern, cosmopolitan Congolese with the consumption of domestic, rather than wild, meat, based on findings in Chausson et al. (2019; Fig. 2).

Figure 2. Examples that take account of social thinking to promote conservation



The social meaning of actions often dominates people's decisions and behaviours, overshadowing even the financial incentives they face. A notable example comes from daycare centres in Israel. In an experimental study, economists Gneezy and Rustichini (2000) introduced fines for parents who failed to pick their children up on time from a day-care centre. Surprisingly, the fine was not perceived as a punishment. Rather, it was perceived as a *price*. The effect was that it legitimised late pick-ups. Such motivations may be relevant to conservation challenges. A recent study of observance of conservation rules among small-scale fishers showed that compliance heterogeneity existed between rule-types for individuals, between individuals and

between ports, and that normative motivations affected the level of compliance with externally imposed quotas (Oyanedel et al. 2020). Depending on the circumstances, interventions that amplify normative motivations may be more effective than financial incentives at driving behavioural change.

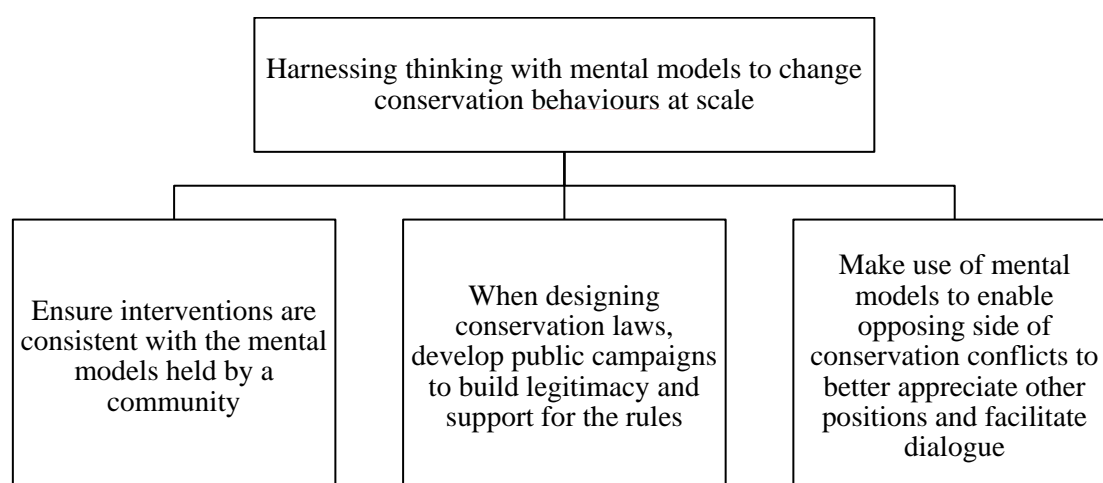
Social cognition can also play an important role in determining effectiveness of information campaigns promoting specific behaviours. Information strategies are often based on the principle that better information about the environmental impact of activities will encourage consumers to conserve. However, in many contexts information alone is insufficient to influence behaviour (Dunning et al. 2019). A common strategy for augmenting information is to make social comparisons. When researchers sent letters that compared people's energy use to their neighbours, their energy consumption fell by 2 percent (Allcott 2011). In conservation contexts where behaviours are already monitored (e.g. an incentive programme aimed at encouraging compliance of small-scale fishers with catch or gear restrictions), social comparisons can easily be added to interventions at low cost.

2.3. Mental models

The third feature of cognition that has traditionally been left out of policy analysis is that people do not perceive the world objectively. Rather, they draw on a repertoire of mental models to filter, process, categorise, and interpret information, and develop plans based on how they believe the world works (Sloman 2005). They employ scripts based on how they think they should behave (Schank and Abelson, 1977). Interventions that are inconsistent with the mental models of a community may be ineffective or even lead to backlash (Scholtz and Lubell 1998). A recent example of this comes from the 2013-16 outbreak of Ebola in West Africa, for which governments banned the hunting and consumption of bushmeat and promoted public health messages linking bushmeat to spread of the disease. This messaging contradicted people's own long experience of eating bushmeat without issue and only served to drive the trade underground, making monitoring and surveillance of markets more difficult (Bonwitt et al. 2018).

Policies oriented toward mental models represent new entry points and ways of approaching intervention design in conservation. For example, conservation relies heavily on legal enforcement for discouraging harmful behaviours. Despite this, many environmental laws remain widely disobeyed and are de facto defunct. Such legal approaches are based on the assumption that rule breakers base decisions on their expectations of getting caught and the sanctions they face if caught (Becker 1968). Lacking the resources to increase the likelihood that rule breakers are caught, conservation has often increased penalties to improve compliance. However, severe penalties may be counter-productive (Keane et al. 2008), especially if deemed to be illegitimate, as this can override rational considerations of risk and compromise the social acceptability of penalties. To make legislation effective, law and policy may also need to address how people culturally engage with the subjects of persecution (Hoff and Walsh 2019), whether those subjects are people or wildlife.

Figure 3. Examples that take account of mental models to promote conservation



Even when people intend to adopt conservation behaviours, they may not have formulated the mental roadmaps necessary to enact their goals. Behavioural scientists have identified similar “intention-action” gaps across a myriad of domains (see Datta and Mullainathan 2014 for early discussion). One way to address this is for conservation policymakers to co-create decision aids that walk people through the challenges they anticipate encountering as they aim to adopt a new behaviour. By developing “if-then” plans to address the obstacles they anticipate facing, people can develop more robust strategies for behavioural change. This has been applied in the fields of education and health to help students study and women to maintain healthy lifestyles (Stadler et al. 2009; Duckworth et al. 2013). Loy et al. (2016) found that individuals with moderate or strong intentions to reduce their meat consumption were significantly more likely to translate these intentions into practice when employing this self-regulation strategy. Biggs et al. (2017) recently pointed to mental models as a strategy for resolving the deadlock around international ivory policy, helping the opposing sides to better appreciate each other's position and paving the way for a more constructive dialogue and understanding of where each side's issues lie. Moon et al. (2019) suggest that this approach could be more widely applied in conservation, yet current empirical application of the approach is limited.

3. Finding out what works

Evidence plays a central role in good policy design. It enables decision-makers to navigate uncertainty by predicting what will happen if they employ particular strategies to achieve their goals. Without evidence, consequential decisions are made blindfolded. This is a particular concern in conservation where a number of recent systematic reviews have concluded that there is simply insufficient evidence to draw concrete conclusions on which approaches successfully achieve desired outcomes (e.g. Wicander and Coad 2015; Veríssimo and Wan 2019; Olmedo et al. 2020; Miller et al. 2021). In the absence of a strong push from donors, conservation organisations have faced few incentives to invest resources in evaluating their programmes. Consequently, the limited resources that conservation has at its disposal are invested in strategies that lack evidence.

To advance an evidence agenda in conservation, three areas need development. First, the conservation community must identify *whether* interventions work. To answer this

question, conservation researchers need to rapidly scale up the application of rigorous evaluations and implement them in diverse contexts. A second key question is *how* effective interventions work. With complex interventions, impacts can occur through a variety of potential mechanisms. Identifying these pathways is key to developing scalable and generalisable policies, helping to cut costs and enabling policymakers to assess whether evidence is appropriate for their context. To identify the mechanisms through which interventions are working, data should be collected on the potential causal pathways. Finally, answering *why* effective interventions work helps to link evidence together. To address this, interventions should be designed with a clear theoretical framework in mind.

Two specific methodological advances are key to supporting this cultural change and developing a robust evidence base in conservation. First, conservation researchers should improve data and measurement systems so that behavioural changes can be tracked across time as projects unfold. Second, conservation researchers should employ empirical tools to *causally* identify whether programs work. Both of these advances can be supported through the application of mixed methods approaches, in which both qualitative and quantitative methods are integrated.

3.1. Measuring the tricky things

Measurement in conservation is often a considerably challenging task for two main reasons. First, it is often logistically impossible to directly observe behaviours (e.g. where people's actions take place in private). Second, people may not be prepared to honestly report behaviours if they are illegal, culturally taboo, or they are unsure of the motivations of the questioner. As a result, decisions in conservation are often made – and interventions implemented - without the means of measuring the behaviours of greatest interest.

In recent years, innovative methodologies have been adopted to measure tricky behaviours. Such approaches have been widely applied in development contexts and, although there are an increasing number of examples in conservation, there is still significant scope for greater adoption. One such strategy is to conduct audit studies. This strategy has been employed for conservation in Chile, where researchers sent mystery shoppers to the fish markets to understand the impact of an intervention to tackle illegal fish consumption (Gonzalez-Lira and Mobarak 2019). Another strategy is to track online activity, which may be of special relevance now that much illegal trade in wildlife is conducted online (Hinsley et al. 2016). Studies of this kind have been used to detect racial bias among users of Airbnb (Edelman et al. 2017). A third strategy is to employ list experiments or other indirect questioning approaches to encourage respondents to answer questions more honestly by protecting their anonymity (Nuno and St John 2015). These have been used to estimate the prevalence of illegal activities such as bushmeat hunting in protected areas (e.g. Nuno et al. 2013; Harrison et al. 2015; Travers et al. 2019).

Policy researchers often care not just about behaviours but also about the beliefs and attitudes that underpin those behaviours. For example, policy researchers may seek to address hateful attitudes toward excluded groups (Brookman and Kalla 2016). Novel social science methodologies have been developed to understand these underpinnings, yet remain significantly underutilised in conservation. For example, a common way to measure perceived social norms is through an incentivised vignette. In this method,

researchers ask participants to report their own behaviour, and then ask them to predict the behaviour of other participants (Krupka and Weber 2013). Similarly, implicit association tests have been developed to test the strength of mental associations by measuring response time when participants categorise neutral target stimuli (e.g. race or gender) and value stimuli (e.g. positive or negative expressions) (Greenwald and Banaji 1995; Banaji and Greenwald 2016). Greater application of such methodologies to investigate difficult to measure behaviours, or the beliefs and attitudes that underpin them, would provide more reliable data for a given problem, enabling interventions to be better targeted and more effective.

3.2. Randomisation and causal inference

Another key component of the cultural change required in conservation is the greater use of methods for identifying the causes underlying changes. To identify the causal effect of a program, research designs should construct authentic counterfactual conditions (i.e., what would have happened had the intervention not been implemented) through exogenous variation. Interventions that are ineffective, but are nevertheless brought to scale or repeated elsewhere, will waste scarce resources.

Randomisation has long played a key role in understanding what works in medicine, and has become a common tool in development economics over the past 20 years (Jamison 2017). Despite repeated calls for greater use of methods that allow for causal inference (e.g. Ferraro and Pattanayak 2006), impact assessment in conservation has largely focussed on non-randomised, quasi-experimental methods (e.g. Clements and Milner-Gulland 2015). Randomisation is useful because it enables the assessment of whether interventions *cause* behavioural change - not just that they are correlated with it (Angrist and Pischke 2008). Conservation interventions are typically implemented in complex settings and specific locations (e.g. where threatened species still persist), making it difficult to identify causal effects and establish a valid counterfactual. In such circumstances, random assignment of interventions can be used to construct the counterfactual and, hence, estimate treatment effects. This gives policymakers a rigorous and intuitive sense of what strategies work and do not work (Glennerster and Takavarasha 2013).

Despite the widespread use of randomisation in other fields and promising signs of wider use in conservation (e.g. Jayachandran et al. 2017; Pynegar et al. 2018; Wilebore et al. 2019; Clements et al. 2020), the practice remains in its infancy within conservation. This is partly due to concerns raised about the extent of their applicability in conservation. One such fear is whether it is ethical to offer some people conservation-related benefits while excluding others (Pynegar et al. 2019), particularly in cases where the aim of an evaluation is to measure the effect of an intervention on conservation outcomes when the intervention is already known to benefit participants. While this is a legitimate concern, there are a number of factors that should be considered in this assessment. First, interventions in low-income settings rarely have the resources for *everybody* to benefit directly. Decisions must be made about who is eligible, and how to fairly allocate resources. Transparent lotteries, where everybody has an equal and fair chance of participating, can be seen as more legitimate than alternative methods of allocation. Where resources are available for the whole population, it is possible to phase in an intervention (Miguel and Kremer 2004). In this way all subjects will eventually receive a treatment but not at the same time. Encouragement designs are another way to create control and treatment groups

(Duflo and Saez 2003). In situations where everyone is entitled to a treatment (e.g. access to a voluntary incentive programme), researchers can randomly encourage half of the population to join. This group then acts as the treatment group and are compared to the remaining half who were not encouraged. Finally, if an intervention must demonstrate conservation benefit in order to ensure continued funding, random assignment to a control group may be justified in the short term, even in cases where there is a known social benefit to the intervention.

A second concern is whether the results of causal studies generalise to other settings (Rodrik 2009; Deaton 2010). If interventions contain highly idiosyncratic and context-specific content, it is impossible to interpret the implications of their effects for other settings. One way to address this is to design empirical studies to test underlying mechanisms (Ludwig et al. 2011). Such studies can follow a standard experimental design and may require significantly smaller sample sizes than large-scale evaluations. For example, there is significant debate among practitioners and scientists regarding the drivers of female genital cutting. This debate centres on whether parents have a preference for cutting their daughters or whether girls are cut to improve marriage prospects. In a lab-in-the-field experiment, Vogt et al. (2016) randomly assigned people to different treatments to test the importance of both individual preferences and the incentives to align with a social norm as drivers of female genital cutting. Interestingly, this experiment showed that both mechanisms drive the behaviour and are needed to trigger attitudinal change. The importance of testing mechanisms before taking an intervention to scale was also recently highlighted by Wilebore et al. (2019). Using an randomised control trial, the authors tested whether unconditional payments affected land clearance among the recipients of payments in Sierra Leone and Liberia. This study showed that, contrary to expectations, unconditional payments actually increased land clearance in the short term.

Even when studies focus on mechanisms, contextual features of the intervention may be necessary to activate those mechanisms. To understand why interventions work, as well as whether and where they may work elsewhere, it is often necessary to develop a broader description of the problem. Qualitative case studies can play an important role in this. By focusing on idiosyncratic aspects of the environment, capacity of programme implementors, and the trajectories of change that the interventions underwent, the generalisability of interventions can be better understood (Woolcock 2013). Another promising approach is a realist synthesis. This approach focusses on understanding the contexts that can promote or hamper mechanisms crucial to influence behaviour change. More specifically, it focuses on mechanisms that operate within a specific program and can show how the context affects the success or failure of a programme (Nilsson et al. 2016).

4. Building systems for scaling

The post-2020 agenda for the Convention on Biological Diversity (CBD) focuses on reversing threats to biodiversity and meeting people's needs through a series of policy solutions from promoting education and knowledge generation through to reforming economic systems (Leclère et al. 2018; CBD 2020). To achieve this, conservationists should foster a system that produces interventions that can be brought to scale, in order to achieve meaningful levels of behaviour change. Such a system should have three main features. First, conservation policymakers and researchers should develop

expertise in models of human behaviour in order to improve the design and outcomes of conservation programmes. Second, there should be mechanisms for converting marginal or localised changes into transformative change. Third, to ensure sustainability, opportunities to create sustainable endogenous change must be identified, (i.e. change that comes from within a society so that it is self-perpetuating; Young 2015; Efferson et al. 2020).

Until recently, conservation discourse has focussed more on implementing interventions with a simplistic logic (Larrosa et al. 2016), rather than thinking through the complexities of inducing sustainable, transformative behavioural change at scale. Correcting this shortcoming will first require acceptance of conservation as a field of public policy; this is a significant change in how conservation is perceived by those who work within and fund this field. This would allow for greater emphasis on identifying and diagnosing the behaviours that need to change to ensure positive outcomes, and would help to avoid the default implementation of interventions that may not be effective or suitable for scaling to other contexts (e.g. alternative livelihood interventions for bushmeat hunters; Wright et al. 2016). Such a change will not come easily and will likely be contingent on a demonstration that greater emphasis on behaviour, including investment in diagnostics in the early stages of intervention design and implementation, can lead to more effective interventions. In this regard, we advocate for stricter requirements from donors for proposals that include detailed behavioural justifications for why proposed interventions are expected to work at the scale to help drive this change.

Changing behaviour at the margins will not be enough. Scalable conservation policy requires transformative behavioural change. However, while some interventions, such as shifting defaults, have been demonstrated to achieve this in isolation (e.g. changing the default option for organ donation), such opportunities are rare. Similarly, although transformative change may also be brought about by exogenous shocks (e.g. ecosystem collapse, pandemics or global recessions), such events are often difficult to predict and there is often a strong desire to return to the status quo once shocks have passed. This leaves the challenge of how to achieve transformative change in the absence of policy silver bullets. Many single interventions only have small effects on behaviour. Indeed, as has become apparent since the evaluation revolution, many standard policy tools have *negligible* effects. In such circumstances, transformative change can only be achieved through increasing the effect of individual interventions or through integrating multiple interventions (either simultaneously or sequentially). One way to achieve this is to embed experimentation not just across projects (e.g. running multiple randomised studies on a topic of interest), but also within projects as a programme unfolds (Pritchett et al. 2013). Rigorously testing interventions in this way enables data to be fed back into programme design to adapt implementation in real time until marginal gains become economically, environmentally or socially significant. This is a common tool employed by technology companies, who iterate on design features to optimise user engagement. Interventions that naturally operate on iterative cycles, such as agricultural incentive schemes, are particularly suited to such an approach. This has been the case for the Ibis Rice programme implemented by the Wildlife Conservation Society in northern Cambodia, which has iteratively improved the design of the programme over a ten-year period (Clements et al. 2020).

There are, of course, limits to the level of change that can reasonably be achieved through behavioural interventions. Even when behaviour change programmes have large immediate impacts, they are often short-lived. An important consideration then is how interventions interact with endogenous changes within a population. A major goal for behaviour change programmes is to trigger social mechanisms within a population that then drive long-term change through endogenous processes (i.e. spillovers from one person to another, after an intervention has been implemented). This offers the potential for significant scaling as it enables resources to be allocated elsewhere once endogenous processes have taken over. However, designing interventions to trigger endogenous change is challenging and, under most circumstances, is unlikely to happen at all (Efferson et al. 2020). Unrealistic expectations in this regard may lead to waste of resources. Programmes to reduce female genital cutting are a good case in point. These programmes have often assumed that conformity pressures (i.e. the pressure within social groups to cut girls as a means of increasing their marriage prospects) would lead to endogenous elimination of cutting practices. The idea of these programmes has been to change the behaviour of a critical mass of families within a marriage pool to stop cutting their daughters. At some point, after a critical threshold of families has changed their cutting practices, social forces are then expected to drive further reductions in cutting (Efferson et al. 2015). However, in practice, population dynamics are more complex. Efferson and colleagues (2020) show that even if social forces support endogenous behavioural change after an intervention, the effect of these forces can range from negligible to indispensable. Prior understanding of the distribution of attitudes and behaviour in a targeted population is essential in order to design an intervention that can trigger endogenous change.

In reality, it is likely that many behavioural change programmes will be most successful when designed to achieve short-term incremental change in parallel with laying the groundwork for longer-term larger-scale endogenous changes within a population. The reduction in rates of smoking in developed countries provides a good example of how a series of regulatory and information-based interventions, coupled with changing attitudes, have slowly had a significant impact on a deeply entrenched behaviour (Wilson et al. 2012). In this case, interventions aimed at changing social norms within a wider population significantly increased the probability that individual smokers would attempt to quit (Zhang et al. 2010). Such an approach requires an appreciation that some deeply entrenched behaviours require a long-term commitment to achieving sustained change.

5. An ethical approach to behavioural change

In this paper we have signposted some key areas of weakness in conservation practice at the moment, which could be strengthened by drawing on experience and expertise from public. While conservation can learn from integrating with public fields, it nevertheless remains distinctive in a number of important ways. For example, while the objectives of development interventions are invariably aligned with the interests of beneficiaries, conservation interventions may be designed in such a way as to influence people to take decisions that are positive for conservation, but which may not be in their own best interests. This presents a number of ethical risks. It is important that such risks are avoided through transparent communication with the targets of behavioural programmes about intended outcomes, and that any trade-offs

between conservation and social outcomes are made explicit to the subjects of the intervention. This must be done in a manner that ensures that people's rights, autonomy, and dignity are protected (Newing and Perram 2019).

It is also important that the application of behaviour change principles is not just directed at the small-scale producers or consumers of natural resources in areas of high biodiversity that have traditionally been the targets of conservation interventions. Efforts to apply a cognitive approach at the local level must be accompanied by complementary interventions to address the underlying drivers of biodiversity loss, such as the growing demand for meat in developed and emerging economies and climate change. Not only will this ensure a more equitable approach to stemming the loss of biodiversity, but it will also maximise the chances for the conservation sector to be successful in working towards the post-2020 Global Biodiversity Framework (Mace et al. 2018).

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