Cultural Evolutionary Behavioural Science in Public Policy

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Abstract (150 words)

Interventions are to the social sciences what inventions are to the physical sciences—an application of science as technology. Behavioural science has emerged as a powerful toolkit for developing public policy interventions for changing behaviour. However, the translation from principles to practice is often moderated by contextual factors—such as culture—that thwart attempts to generalize past successes. Here we discuss cultural evolution as a framework for addressing this contextual gap. We describe the history of behavioural science and the role that cultural evolution plays as a natural next step. We review research that may be considered cultural evolutionary behavioural science in public policy, and the promise and challenges to designing cultural evolution informed interventions. Finally, we discuss the value of applied research as a crucial test of basic science: if theories, lab, and field experiments don't work in the real world, they don't work at all.

Keywords: cultural evolution, behavioural insights, behavioural public policy, endogenous change, behavioural economics, WEIRD, applied cultural evolution, behavioural science

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1. INTRODUCTION

Our psychology and behaviour are shaped by millions of years of genetic evolution, thousands of years of cultural evolution, and a short lifetime of experience (Muthukrishna et al., 2021). Dual inheritance theory describes how genes, culture, and individual learning interact to shape our behaviour, explaining how we evolved as a cultural species, how culture itself evolves, and how gene-culture coevolution has shaped our genomes and physiology (Boyd et al., 2011; Boyd and Richerson, 1985; Cavalli-Sforza and Feldman, 1981; Chudek et al., 2015; Henrich, 2016; Henrich et al., 2008; Uchiyama et al., 2021). Much of our behaviour is shaped by culture—the values, beliefs, behaviours, norms, skills, know-how, and technologies each of us possesses. Dual inheritance theory and cultural evolution, therefore, offers a framework for understanding and changing behaviour (Efferson, 2021; Muthukrishna, 2020a; Muthukrishna et al., 2021; Muthukrishna and Henrich, 2019).

Behavioural science is a powerful toolkit for addressing global challenges in areas such as public health, economic development, and environmental policy (Ruggeri, 2021; World Bank Group, 2015). The behavioural science toolkit draws primarily on cognitive psychology, social psychology, and economics, and has typically exploited empirically discovered biases and heuristics without worrying too much about why these exist. However, as a result, it has inherited the challenges of these parent fields, such as the replication crisis—many findings failing to replicate (Camerer et al., 2018; Open Science Collaboration, 2015)—and the WEIRD people problem—overreliance on findings from Western contexts and lack of attendance to cross-cultural and contextual differences (Apicella et al., 2020; Henrich et al., 2010b). Within behavioural science, cultural and other contextual heterogeneities are acknowledged as important (Bryan et al., 2021; IJzerman et al., 2020; Sunstein, 2021), but it remains unclear how to systematically incorporate these factors in a principled manner. And so it is difficult to know when we should expect findings and past successes to generalize (Deaton and Cartwright, 2018).

In this article, we discuss cultural evolution as a framework for addressing this contextual gap. We begin by describing the history of behavioural science and how cultural evolution offers the natural next step.

1.1. Social Science and public policy

Science and technology go hand in hand. Science opens new technological possibilities and technologies help us refine the science and understand how it works or even whether it works in the real world (Gibson and Reed, 2020; Hammond and Stewart, 2001; Muthukrishna and Henrich, 2016). The same is true of the social sciences. Some social sciences, such as economics, have a

longer history of policy application (Buyalskaya et al., 2021). Behavioural science is the latest wave of economic public policy application, in this case, applied to human behaviour. We can trace this history from neoclassical theory to the present day.

1. **Neoclassical theory:** Neoclassical economic theory emerged in the early 20th century with origins in philosophers like John Stuart Mill (Persky, 1995) describing people with rational preferences maximizing the satisfaction of these preferences as "utility". The lack of realism of these assumptions was debated, but as a prominent essay by economist Milton Friedman argued, models should not be judged by the realism of their assumptions, but only by the accuracy of their predictions (Friedman, 1953). These assumptions included axioms (Von Neumann and Morgenstern, 1953), such as completeness (people have clear preferences: $x \succ y$, $y \succ x$, or $x \sim y$), transitivity ($x \succ y$ and $y \succ z$ implies that $x \succ z$), continuity (if $x \succ y$, $y \succ z$, and $x \succ z$, then there exists a probability p such that: $px + (1-p)z \sim y$), and independence (if $x \succ y$, $px + (1-p)z \succ py + (1-p)z$). The behavioural economics revolution began with empirical challenging both predictions derived from these assumptions and the assumptions themselves (Camerer, 1989; Machina, 1987; Tversky et al., 1990; Tversky and Kahneman, 1992, 1989). Three key figures in this revolution were Daniel Kahneman, Amos Tversky, and Herbert Simon.

   The formal predictions of expected utility theory made them falsifiable (see Muthukrishna and Henrich (2019) for discussion on the importance of formal theory). Psychologists Daniel Kahneman and Amos Tversky realized that there was a mismatch between the predictions of expected utility theory and empirical findings in cognitive psychology (Lewis, 2017). They began a lifelong, productive research program modifying and challenging neoclassical theories by including *psychological realism*. For example, in contrast to the expectation principle which states the utility of a risky prospect is linear in outcome probabilities, Tversky and Kahneman's Prospect Theory states that the utility function is concave for gains and convex for losses—'losses loom larger than gains' (Tversky and Kahneman, 1992). For example, given a coin flip to lose or win $100, people require a much larger gain to accept the bet (Tversky and Kahneman, 1991).

   Herbert Simon similarly attempted to modify standard utility approaches by introducing psychological realism: cognitive limitations on time and computation, introducing the idea of *bounded rationality*—rationality within constraints, people *satisficing* rather than *optimising* for their preferences due to constraints such as limited information, limited computation, and limited

time (Simon, 1982, 1957). These kinds of challenges to neoclassical theory gave birth to the field of behavioural economics. However, this research was primarily conducted in WEIRD contexts and the heterogeneity created by social and cultural factors was still not on the research agenda.

2. **Behavioural Economics:** Cognitive psychology was used to correct assumptions in neoclassical economics to create behavioural economics. These were later formalized by including human psychology in economic models to create more realistic and predictive theories (Camerer et al., 2004; Fehr and Schmidt, 1999; Rabin, 2021). For example, empirical results using the public goods game suggested that people initially contribute more than the expected Nash equilibrium of no contribution. The payoff (π), equal to utility (u) is maximized when no contribution ($g_{it} = 0$) is made from the endowment (e) and instead the payoff is this endowment and a share of contributions made by the other $s - 1$ players multiplied by m and divided equally.

$$\pi = e - g_{it} + \left(\frac{m}{s_t}\right)\sum_{j=1}^{s_t} g_{jt} \quad (1)$$

$$u(\pi) = \pi \quad (2)$$

To resolve this behavioural deviation from the formal model whereby players typically contribute $g > 0$ in a way that reflects the contributions made by others also contributing $g > 0$, Fehr and Schmidt (1999) included inequity aversion in the utility model—the utility is not only positive with an increased payoff but reduced when you get more than me (weighted by α) or I get more than you (weighted by β). i.e., Equation 2 becomes:

$$u(\pi) = \pi - \alpha_i\left(\frac{1}{n-1}\right)\sum_{j\neq 1}\left[max(x_j - x_i, 0)\right] - \beta_i\left(\frac{1}{n-1}\right)\sum_{j\neq 1}\left[max(x_i - x_j, 0)\right] \quad (3)$$

In this same spirit, Kőszegi and Rabin (2006), developed a model on reference-dependent preferences. They show that under uncertainty, behaviour is influenced by a gain-loss utility, leading to unstable preferences—for example, changes in how much decision-makers are willing to pay for the same product, or in how much a worker is willing to work given a daily wage. Many prominent researchers contributed to the field with ideas and findings that were

radical for the economic literature at the time. Many of these findings had direct relevance for public policy. For example, modelling and experiments showed that in sequential decision-making, people's behaviour can converge on the wrong choice (i.e. "herding": people bulk buying toilet paper in the pandemic because others do the same), despite unbiased behaviour (Banerjee, 1992; Bikhchandani et al., 1992; Goeree et al., 2007; Weizsäcker, 2010). Another stream of work directly deals with the preferences of decision-makers, and how they can be skewed by psychological variation in aversion to risky choices (Charness et al., 2013; Gneezy and Potters, 1997; Loewenstein et al., 2001). Other works engaged with the social context of economic behaviour and specifically how we humans make altruistic decisions in sharing resources (Andreoni, 1990; Fehr and Fischbacher, 2003; List, 2007), how altruistic punishment evolves (Boyd et al., 2003), and how social norms can regulate behaviour (Bicchieri, 2005; Fehr and Fischbacher, 2004), how the zero-sum nature of status-seeking via, for example, the consumption of luxury goods, has provided insight on optimal taxation of such goods (Frank, 1985), and how groups solve the collective action problem (Ostrom, 1990). In addition to the social context, the personal context such as existing endowments (Apicella et al., 2013; Kahneman et al., 1991) and associated reference points (Abeler et al., 2011; Fehr et al., 2011) significantly influences behaviour. Economists also began synthesizing how contextual factors could affect behaviour across domains. A prominent example is resource scarcity, with poorer people doing less well than they could (e.g. in agriculture or parenting), when under the psychological and economic stress of scarcity (Mani et al., 2013; Mullainathan and Shafir, 2013). Among others, Ashraf et al (2006) went on to apply such insights and developed a savings tool, applying behavioural economics research to help people save money.

As behavioural economics began incorporating insights from other fields, it was often labelled under the more general term "behavioural science", although this term is also used for a broad range of fields studying human behaviour. This next wave applied the theoretical, lab, and field experimental insights gained in behavioural economics to interventions and public policy.

3. **Behavioural Science:** In 2008, Thaler and Sunstein summarized work in behavioural economics and behavioural science in their popular book "Nudge" (Thaler and Sunstein, 2008). The book gained a following among many politicians and policy makers. In 2010, the United Kingdom Cabinet Office commissioned a report on behavioural science and public policy interventions; the MINDSPACE report (Dolan et al., 2012, 2010). This report led to the creation of the Behavioural Insights Team (BIT), often referred to as the 'Nudge Unit'. BIT had several successes, notably garnering Her Majesty's Revenue & Customs (HMRC) an

additional £200 million in tax repayments through a small change in a tax letter that exploited social influence and norms (Cabinet Office Behavioural Insights Team, 2012; Hallsworth, 2014). The same strategy had similar success in other countries, including Costa Rica and Poland (Doshi, 2017) and so began to be applied to other contexts, such as Barack Obama's second bid for the White House (Carey, 2012). This later led to the creation of over 200 Behavioural Insights Teams around the world (Benartzi et al., 2017; Sunstein, 2020). In 2015, President Barack Obama signed an executive order for the incorporation of behavioural science insight in public policy (White House, 2015). In 2017, Thaler was awarded a Nobel Prize.

Nudging and behavioural insights interventions (Thaler, 2018, 2016), have now been applied to a wide array of domains, including health policy & vaccination (Milkman, 2020; Oakes and Patel, 2020; Patel, 2021), digital health (Yoeli et al., 2019), green behaviour and resource conservation (Allcott, 2011; Gravert and Kurz, 2021; Yamin et al., 2019), financial behaviour (Hirshleifer and Plotkin, 2020), and gender equality (Bohnet, 2016). The incorporation of psychological insights into the design of choice architectures, communications, policies, and interventions has proved to be a powerful tool in line with traditions of psychology in-field interventions (Cialdini, 2001; Cialdini et al., 2006). But the problems outlined in the opening on replication failures and the WEIRD people problem remain. For example, behavioural priming is often unreliable (Simons, 2014), behaviour in economic games such as the dictator game varies from 47% offers in the US to 26% offers among the Hadza (Henrich et al., 2010b). Similarly, a recent study found that extended dishonesty among bankers, may not generalize to other societies (Cohn et al., 2019, 2014; Rahwan et al., 2019). Returning to our opening example on fairness in the public goods game, cross-cultural research reveals that fairness preferences vary considerably - disadvantageous inequity whereby you receive less than others seems reliably developing, but advantageous inequity is not universal (Blake et al., 2015; House et al., 2020).

Cultural evolutionary researchers will recognize these three waves as an example of path dependence (Muthukrishna et al., 2021; Nunn, 2009; Page, 2006). Nineteenth-century philosophical positions on the nature of humans and human decision making led to formalizations of an arguably misspecified theory of human behaviour, which were then challenged and adjusted at the margins. The initial path-dependent solution involved retaining expected utility theory but adding "patches" based on empirical psychological research. This approach, however, failed to address the replication and cross-cultural generalizability of these patched solutions.

The most effective critique of a theory is a better theory. Such a theory has not yet emerged, but here we lay out a path in the context of public policy. We argue that the natural next step in this path is a formal theory that includes not just empirically discovered cognitive biases, social norms, and preferences, but the origins, variation, and dynamics of these—captured by models in cultural evolution.

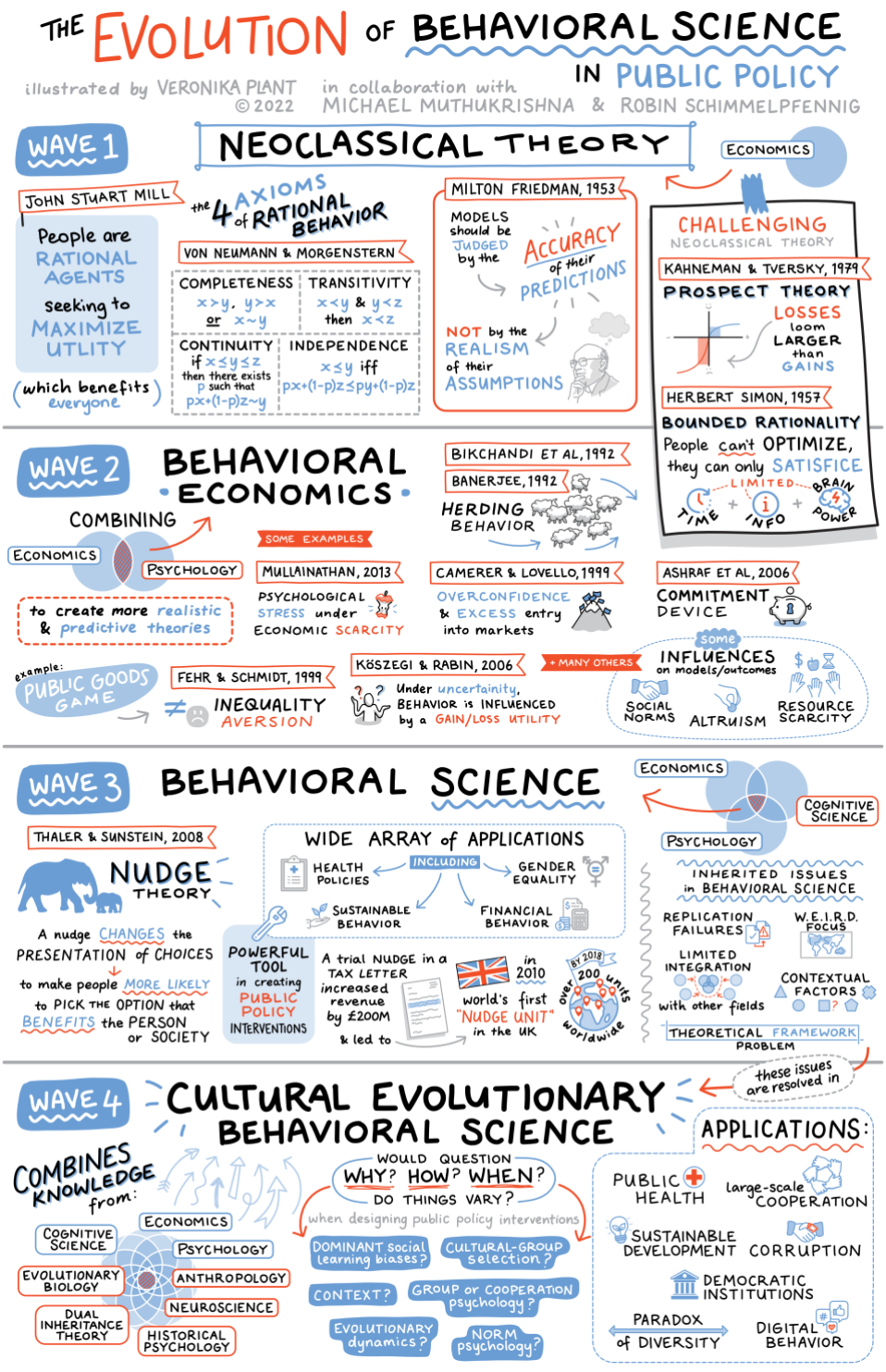

Figure 1: The evolution of behavioural science in public policy

1.2. The Fourth Wave: Cultural Evolutionary Behavioural Science

Just as biological evolution is mainly driven by the transmission of genes between generations, cultural evolution is driven by the transmission of social and cultural information through social learning. This social learning is not random but driven by several interacting learning biases (Kendal et al., 2018). For policy makers, this has important implications. Behaviour change at scale often depends on how information is transmitted within the population. A policy designed for a population in which prestige-biased learning dominates should be designed differently than in a population in which conformist-biased learning dominates (Glowacki and Molleman, 2017; Mesoudi et al., 2016; Molleman and Gächter, 2018; Muthukrishna and Schaller, 2020; Schaller and Muthukrishna, 2021). Indeed, the interaction of these learning biases remains a neglected, but powerful method for large-scale, endogenous behavioural change (Andreoni et al., 2021; Efferson, 2021; Efferson et al., 2020b; Nyborg et al., 2016; Young, 2015).

In addition to social learning biases (Kendal et al., 2018; Mesoudi, 2016; Muthukrishna et al., 2016), cultural evolutionary behavioural science can exploit research on (a) norm psychology (Chudek and Henrich, 2011), for example, what people perceive to be fair/unfair, (b) ethnic, group, or cooperation psychology (Henrich and Muthukrishna, 2021), for example, the scale of cooperation that dominates in a culture, such as kin, friends, or impartial institutions, (c) evolutionary dynamics, for example, how beliefs and behaviours endogenously spread in a population (Young, 2015), and (d) factors such as cultural-group selection (Francois et al., 2018; Richerson et al., 2016; Schimmelpfennig et al., 2022).

Incorporating cultural evolution forces us to consider not just differences in psychology, norms and preferences, but their origins and dynamics. For example, experiments with Swiss children reveal that pre-existing inequality concerns affect bargaining behaviour in subsequent games (Berger et al., 2022). Furthermore, contra Fehr and Schmidt's (1999) assumption of symmetric inequity aversion driving what is fair, children in Uganda, Canada, and the USA care about both disadvantageous and advantageous inequity, but children in India, Senegal, and Peru (at least in the communities studied) care mostly about whether they're on the losing end (Blake et al., 2015). Despite the cross-cultural variation in the content of social norms, there is a universal psychology for responding to social norms across society (House et al., 2020). House et al. find that by middle childhood, children have similar social norms as the adults in their society and develop a uniform tendency to respond to novel social norms across societies (House et al., 2020). So yes, context matters. But the question is when and why?

Cultural evolutionary research has shown that factors such as market integration (Henrich et al., 2010a), the presence of moralizing gods (Shariff and Norenzayan, 2007; White et al., 2019), historic exposure to the Catholic Church and their restrictive marriage and family program (Schulz et al., 2019), or kinship intensity and opportunities to cooperate with kin (Enke, 2019) can explain differences in fairness norms offering an exogenous explanation for why these differ around the world and how they may be changed (for review see (Henrich and Muthukrishna, 2021; Muthukrishna et al., 2021)).

The gaps in behavioural science that are resolved through integration with cultural evolution can be summarized as follows:

1. **Replication crisis.** As argued in Muthukrishna and Henrich (2019), methodological malpractice and statistical shenanigans have contributed to the replication crisis and may be resolved by open science methods such as replications and transparency in research, but a larger issue is the lack of a theoretical framework.
2. **Theoretical Framework Problem.** The list of heuristics and biases is enormous (Wikipedia, 2021) and, no doubt, several related biases masquerade under separate research programs. For example, the self-enhancement bias (Kwan et al., 2004), positivity bias (Mezulis et al., 2004), optimism bias (Sharot, 2011), and overconfidence (Johnson and Fowler, 2011) are at best strongly correlated and at worst linguistic noise describing the same concept. Identified biases such as these are a combination of genetic influences shared with other species, cultural influences through norms, and our lifetime of experience.

   Imagine walking through a forest thousands of years ago. You hear a rustle and spot something long and skinny on the forest floor. In all likelihood, it's just a stick, the odds that it is a deadly snake are not high, but you probably would not want to risk it and so make a detour. Note, that in this case, you have chosen to surely avoid the unlikely, costly error (walking over the skinny thing and being bitten by a poisonous snake), in favour of the likely cheap error (walking the detour although it was just a stick). Research on error management theory describes these situations of cost asymmetries that may be shared by other animals (the example above need not be a human). Research in error management theory argues that the human tendency to avoid losses and more costly errors has led to several adaptive cognitive biases (Haselton et al., 2015; Johnson et al., 2013), many of which interact with our social learning psychology (Park, 2022). Although loss aversion may be present in many lineages (McDermott et al., 2008), it can be difficult to separate the effects of cognitive biases and incentives (Efferson et al., 2020a; McKay and Efferson, 2010). In contrast, something like intuitive cooperation (Rand et

al., 2014) may differ based on life experience about whether those around you are typically cooperative or uncooperative. A world in which others are trying to exploit you should be a world of intuitive scepticism. These cultural biases are sometimes referred to as the *social heuristics hypothesis* (Rand, 2016). Similarly, a world of existential threat may be a world of tight norm following (Gelfand, 2018). Finally, overconfidence may be a mix of genetic and cultural—adjusted based on the individual and population-level reward to benefit ratio and affecting the rate and nature of entrepreneurship and innovation (Johnson and Fowler, 2011; Muthukrishna et al., 2018; Schimmelpfennig et al., 2022). Without a theoretical foundation, however, predicting possible cross-cultural differences, or detecting adaptive heuristics and biases is difficult. Such work is rarer still but does exist (e.g. on the cultural evolution of prosocial religions (Norenzayan et al., 2016), and variation in personality structure (Smaldino et al., 2019)).

3. **WEIRD People Problem.** The empirical basis for many behavioural insights, biases, heuristics, and assumptions about human behaviour are skewed towards WEIRD people who do not represent most people in most places (Apicella et al., 2020, 2020; Henrich, 2020; Henrich et al., 2010b). Cultural evolutionary insights can offer guidance as to which insights are likely to be universal (e.g. defaults, social influence) and which are likely to vary or not replicate (e.g. endowment effect (Apicella et al., 2013)). Much more cross-cultural research is required.
4. **Contextual factors.** Behavioural economics argues humans are contextually embedded decision-makers (for example on risk preferences (Imas, 2016) or incentives (Gneezy et al., 2011)), but often fail to answer *how context matters*? There are rarely strong predictions for how different internal, environmental, or social cues matter, even if these could be reliably measured. Some paths forward from a cultural evolutionary perspective include understanding how we integrate different social learning cues (e.g. what do we do if a prestigious person does one thing and the majority do another) and recognizing that culture is not just cross-national, but overlapping and embedded distributions of cultural traits within societies (Muthukrishna and Henrich, 2019; Uchiyama et al., 2021). Obvious examples include regional (Talhelm et al., 2014) and religious differences (White et al., 2021), but intersections are deeper. Holding the hand of a stranger will reduce neural activation in a case of a threat. The effect will be increased if those holding have a strong marriage (Coan et al., 2006). Or so it seemed, but a later study showed that the effect was only robust for well-educated, white women (Coan et al., 2017).
5. **Integration with other fields.** While not being a gap per se, cultural evolution has increasingly integrated with other biological sciences (Laland, 2018; Laland et al., 2011; Uchiyama et al., 2021), social sciences (Besley, 2020; Besley and Persson, 2019; Nunn, 2021),

and the humanities (for review, see Muthukrishna et al., 2021). It thus offers a pathway for behavioural science to derive insights beyond those in economics, psychology, and cognitive science.

There is much work to be done for a truly cultural evolutionary behavioural science for public policy, but emerging work reveals the promise and challenges.

2. THE PROMISE OF CULTURAL EVOLUTIONARY BEHAVIOURAL SCIENCE

Applied cultural evolutionary behavioural science is in its infancy. Empirical work is rare and applied theoretical work is rarer still. Here we review some examples of work in different domains that reveal the promise of cultural evolutionary behavioural science.

2.1. Public health

Public health initiatives are sometimes at odds with local culture and traditions (Cloward, 2016). Policy to improve public health may thus be subject to a backlash and non-compliance by at least some parts of the population. Female genital cutting (FGC) is one such example (World Health Organisation, 2008). The conflict is that from the perspective of universal human rights, FGC is harmful to the health and wellbeing of women but legislation to ban it would interfere with local cultural traditions.

FGC is still pervasive in many countries. For example in Egypt, UNICEF estimates suggest that 87% of females between 15-49 years of age are cut (based on data from 2004-2015; (UNICEF, 2016)). Although there is a slightly decreasing share of women being cut, overall population growth leads to a net increase in cut women. Furthermore, current approaches to eradicate FGC practices often fail. In some cases, exogenous attempts to change behaviour are perceived as intrusions that impose out-group values, leading to a backlash in the local population (Camilotti, 2016; Gruenbaum, 2015; Shell-Duncan and Hernlund, 2000; Vogt et al., 2016). That is, when attempts to reduce FGC are perceived as external, FGC rates can increase because not cutting girls is seen as Westernization and cutting girls becomes an ingroup ethnic marker (Cloward, 2016). Resolving the conflict between cultural sensitivity and female public health remains a challenge.

Policy interventions in this realm are often informed by the hypothesis that FGC, similar to foot binding, involves coordination incentives for families (Efferson et al., 2015; Mackie, 1996). That is, families with sons want cut wives because FGC is perceived as a sign of fidelity, tradition, and becoming a good mother. And so, families with daughters choose to cut their daughters to increase the chances of finding a good spouse, sometimes regardless of personal preferences. In a

population where the families with sons favour uncut wives, the families with daughters may choose to coordinate their decision and not cut their daughters (Cloward, 2016). How can a policy maker switch a population from the maladaptive (cutting) to the adaptive (not cutting) equilibrium?

One tantalizing possibility is behavioural change through endogenous spillovers by affecting a social tipping point (Andreoni et al., 2021; Nyborg et al., 2016). That is, could a policy maker run a minimal intervention with selective targets that then starts a chain reaction within the population tipping them from a cut equilibrium to an uncut equilibrium. Here, the policy maker can focus attention and resources on persuading just enough of the right people until the social tipping point is reached, and then the endogenous social influence mechanisms, such as conformity take over with people coordinating around the new social norm.

Formalizing this policy possibility, Efferson et al (2020b) developed a cultural evolutionary model informed by their previous empirical research (Efferson et al., 2015; Vogt et al., 2017, 2016), that captures the cultural evolutionary dynamics of harmful traditions. They model how behaviour spreads in a population via social influence after the population has been shocked by an external policy intervention. They show that the effectiveness of the policy, both in their size and target, depends on the distribution of attitudes in the population. An intervention will have a direct effect, and an indirect effect (see Figure 2).

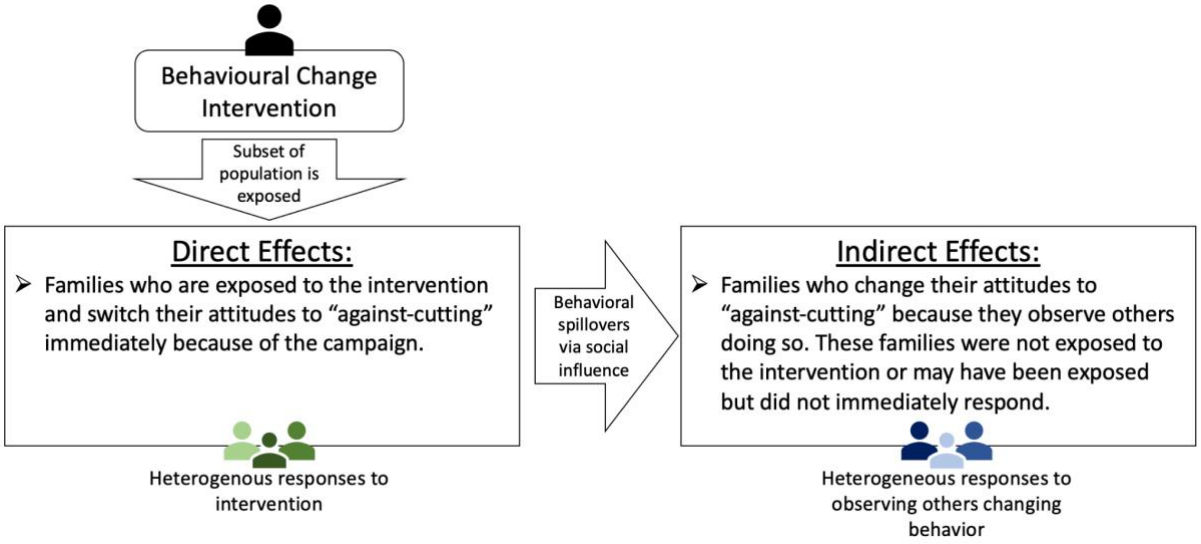

Figure 2. The direct and indirect effect of an intervention (adapted from Schimmelpfennig et al. (2021)

Perhaps counterintuitively, the results show that in a scenario where many in the population are resistant to the policy, policy makers can maximize the total effect of their policy by targeting not those most likely to change, but those most resistant to the policy (Efferson et al., 2020b; Schimmelpfennig et al., 2021). Convincing those resistant to change through an intervention—

perhaps one that exploits social learning biases (Kendal et al., 2018)—leaves the comparably "easy" cases for the endogenous spillovers via social learning.

Efferson et al argue that in scenarios where attitudes cannot be estimated, for example, because of concerns around social desirability of the response data (Krumpal, 2013), policy makers may instead opt to target a random sample, such as through "edutainment" (Vogt et al., 2016), rather than the most compliant, which may otherwise lead to polarization. This work may complement other evolutionary approaches to public health (Arnot et al., 2020; Gibson and Mace, 2006; Lawson et al., 2015; Wells et al., 2017), representing the cutting-edge of integration of cultural evolutionary theory and policy interventions, whose success and value will be known over the coming decade.

2.2. Corruption

A common assumption is that corruption is a vice and cooperation is a virtue. Corruption harms economic development and creates barriers and inefficiencies to competition in a free market. Interventions and media campaigns, often unsuccessfully, focus on portraying corruption as malicious, harmful, and unnatural. Cooperation, on the other hand, supports economic development and forms the backbone of democratic societies. But cooperation is no virtue in itself. Advances in technology and world wars, flourishing societies and genocides, our greatest achievements and our worst atrocities all require large-scale cooperation (Axelrod and Hamilton, 1981; Henrich and Muthukrishna, 2021). From a cultural evolutionary perspective, corruption is also a cooperative act (Muthukrishna et al., 2017a).

It's natural to want to help relatives—well explained by theories of inclusive fitness—but doing so at the expense of impartial institutions is nepotism. It's natural to want to help friends, friends of friends, or those in an exchange of some sort—well explained by theories of reciprocal altruism, direct and indirect reciprocity (see Yoeli et al. (2013) for applications)—but doing so at the expense of impartial institutions is cronyism. Reducing corruption requires undermining lower scales of cooperation or aligning them with higher scales such that what's good for family and friends is also good for everyone else. Transparency alone can backfire when norms support lower scales of cooperation (such as expectations for favouring friends or family (Abbink, 2006; Murray and Frijters, 2016; Muthukrishna et al., 2017a). Indeed, many empirically derived anti-corruption strategies (e.g. (Klitgaard et al., 2000)), implicitly change incentives and or move people around to disrupt these cooperative ties.

An example of how smaller scales of cooperation were undermined and norms around kin-based small-scale cooperation have changed to support states is the Catholic Church's change to traditional large kin-network family structures through policies such as banning cousin marriage.

This centuries-long program decreased the power of larger family clans, laying the foundations for large-scale societies supported by impartial institutions and what we now call WEIRD-psychology (e.g. individualism) (Henrich, 2020; Schulz et al., 2019). Places where these kin ties remain are dominated by tribalism, increased corruption, and more fragile democratic institutions (Akbari et al., 2019).

Developing policies that disrupt lower scales of cooperation and waiting half a millennium isn't likely to sway policymakers, but the same principle can be applied with more immediate results. One prominent problem in WEIRD countries is the "revolving door", whereby individuals seamlessly move between government and private sector positions. Vidal et al. (2012) reveal that 56% of the revenue by private lobbying firms in the US between 1998-2008 can be attributed to lobbyists with previous federal government experience. Furthermore, 34 of the 50 top lobbyists in Washington have previous federal government experience (Eisler, 2007). The prospect of future employment in the private sector may influence the behaviour of public servants (deHaan et al., 2015), to increase their employability. Banning the revolving door, or at least setting a long minimum time between switching from the public to private sector, may help to undermine such lower scales of cooperation (e.g., the "cooling-down" period for members of the European Commission has been increased from 12 months in 1999, to 18 months in 2011, to 24 months in 2016, after former President of the Commission Barosso joined Goldman Sachs, shortly after he had left office (Luechinger and Moser, 2020)).

Corruption is by no means restricted to the developing world, but plagues societies with less robust democratic institutions and norms. Indeed, corruption may have a greater absolute cost in the developed world, but a greater relative cost in the developing world. (Henrich and Muthukrishna, 2021; Muthukrishna, 2017; Muthukrishna et al., 2017b). Undermining informal tribal institutions is a difficult challenge for the same reasons that it's difficult to stop FGC. Aligning the societal institutions with local structures may be a less ambitious, more practical and effective approach. For example, a recent study in the Democratic Republic of Congo found that giving local chiefs the authority to collect state taxes increased property tax compliance by 3.3% (Balan et al., forthcoming). Although the chief still collected bribes, they were able to use local knowledge of whom to target with tax enforcement and thus increased the overall tax revenue by 43%. Their local knowledge allowed them to target high-income individuals reversing the inefficient and unfair, but common practise of targeting the more easily auditable lower income bracket. For example, in the United States, people earning less than $25,000 are at least three times more likely to be audited than partnership firms (Sorkin et al., 2021). Teaming up with bribe-collecting chiefs may not be the first choice for current approaches in public policy, but is a step in the right direction and sensible

from a cultural evolutionary approach, combining and aligning different scales of cooperation. Moreover, it allows us to move a society to an *adjacent possible* in the cultural space, where planned policies can continue to put a society on a path to a more efficient equilibrium (Muthukrishna et al., 2021; Muthukrishna and Henrich, 2016; Nunn, 2021).

2.3. Successful democratic institutions

Formal institutions can be thought of as hardened culture—written down to allow for easier coordination and application. But no institution can anticipate all possible behaviours. Thus successful institutions rest on necessary cultural norms. But unlike the explicit institutions, these norms are largely invisible to those who have implicitly internalized them since they were children. Therefore, foreign policy makers exporting successful WEIRD institutions, such as liberal democracies, have systematic blindspots that lead them to unknowingly ignore the invisible cultural pillars that support institutions.

Giuliano and Nunn's (2013) analyses reveal that where democratic institutions have been successfully transplanted are places where proto-democratic institutions (and presumably the requisite norms) already existed. They also offer an example of how cultural evolutionary behavioural science can be informed by historical data, building the Ancestral Characteristics Database (Giuliano and Nunn, 2018) using data from the Ethnographic Atlas (Murdock, 1967), Ethnologue (Lewis, 2009), and Landscan 2000 (Dobson et al., 2000). There is a historical path dependence of traditional local democracies on the beliefs and attitudes towards today's political institutions, robust to European influence and quality of land for agriculture among other controls.

As a contrasting example, the recent high-profile failure to implement liberal democratic institutions in Afghanistan can be at least partially blamed on differences in norms around rule of law and impartial rules applied impartially to all people. Afghanistan is high on strong kin-based cooperation; people rely on their kin for survival through support and favours, even marrying among their extended family (the rate of cousin marriage in Afghanistan is 46%; (Saify and Saadat, 2012)). Kin-based obligations undermine the kind of impartial institutions that liberal democracies are familiar with. Moreover, the exogenous laws borrowed from other cultures may be rejected by parts of the population with strong prior beliefs, such as those grounded in Islamic sharia law. A Pew survey (2013) suggests that 99% of Afghans favour making Sharia the official law of the land, 81% of Afghans favour corporal punishment (like lashings) for theft, 85% favour stoning as the punishment for adultery, 79% favour a death penalty for leaving Islam. It is important to consider how these numbers are affected by the timing of the survey, representativeness of the respondents,

and response biases, but it is critical to have at least some measure of such norms rather than relying on assumptions about human behaviour drawn from a WEIRD life experience. Such norms are critical to predicting whether an institution or policy will succeed and assumptions about what people want (e.g., freedom of speech, freedom in behaviour, impartial rules, rule of law, secular society, etc.) based on WEIRD life experience cannot be assumed to be human universals. Without appropriate cultural pillars, institutions such as democracy collapse.

Measuring norms is a first step, but policy makers may also wish to change norms. But norms can be self-sustaining equilibria that are difficult to move. For example, trust binds people into a society (Muthukrishna, 2021). The degree to which we trust each other is the degree to which we are a society. If we trust that everyone is subject to the rule of law regardless of who they are, or whom they know, or their station in life, and if we trust that governments represent common interests, then we can bypass the need to directly trust all the diverse groups that we live alongside. But when that government trust fails, we're forced to fall back on our individual in-groups—our extended family, our friends, our ethnic and religious communities—the local groups for whom trust comes more naturally. And shifting away from these towards impartial institutions becomes a chicken and egg problem: the institutions fail because of mismatched norms, but the norms exist because of failed institutions.

Finally, institutions interact with norms, mutually shaping one another. In 2011, the Supreme Court of the Canadian province of British Columbia ruled that the prohibition against polygamy was constitutionally valid. The case was in part decided by cultural evolutionary scientists, Joseph Henrich's primary expert witness on the role that monogamy has had in stabilizing society by solving the problem of young males who can't find a wife (Henrich et al., 2012). Henrich argued that "monogamy seems to direct male motivations in ways that create lower crime rates, greater wealth (GDP) per capita and better outcomes for children". In contrast, polygamy leads to a surplus of unmarried men, that may engage in high-risk strategies or criminal activities to secure sufficient resources to find a mate (BC Supreme Court, 2010; Bucci, 2010). Indeed, China's one-child policy combined with a cultural son preference temporarily led to a doubling of "surplus men". An analysis by Edlund et al (2013) suggested that for every 1% increase in male bias in the sex ratio, property and violent crimes rise by 3%. Similar data can be found in India (Drèze and Khera, 2000), where male-biased sex ratios are associated with murder rates across districts. The British Columbian Supreme Court decisions is an example of how institutions can be used to constrain and reinforce cultural practices that would otherwise undermine these institutions, and a policy decision informed by cultural evolutionary research.

2.4. Sustainable development

The world is heating, the oceans are becoming polluted, and biodiversity is decreasing. Behavioural science has been identified as an approach to support effective and efficient policy design for sustainable development (BIT, 2021; Yamin et al., 2019). While some behavioural science interventions, such as default settings, can have large effects, meta-analysis has revealed that nudges can, but may not, change behaviour at a large scale (Jachimowicz et al., 2019; Kraft-Todd et al., 2015; Mertens et al., 2022; Nisa et al., 2019; van der Linden and Goldberg, 2020). Indeed, evidence suggests that behavioural nudges may not be as effective as incentives especially over the longer term (Campos-Mercade et al., 2021; Efferson et al., 2020a; Gneezy et al., 2011). The primary challenge for sustainable development is that the speed and effectiveness of current approaches are not fast enough to change behaviour that affect climate change to avert disaster (Hoegh-Guldberg et al., 2018; Travers et al., 2021).

Taking a cultural evolutionary approach, Waring et al. (2017, 2015) identify four factors that academics and policy makers need to better understand to accomplish sustainability policy goals. First, policy needs to be informed by knowledge about the emergence and persistence of social-ecological states—how social and ecological factors relate and interact. Second, they need to account for endogenous cultural change. Third, they need to incorporate cooperation dynamics. And fourth, they need to address the complexities of social-ecological interactions over multiple levels (Waring et al., 2015). Waring et al. provide a cultural evolutionary framework that complements existing sustainability frameworks to develop institutions and behaviour that persist, generalize across different settings, and reveal how to design tools for designing and evaluating public policy. Based on this approach they derive several principles that can guide policy implementation. These principles include targeting the appropriate level of selection (e.g., targeting group vs. targeting individual), changing the level of selection pressure (e.g., change incentive structure to group-level payoffs), shifting trait variation across levels (between-group vs. within-group variation in cultural traits), leveraging the evolution of cooperation (e.g., creating infrastructure that allows for repeated interactions, reputational mechanisms, and peer punishments to increase prosociality), and avoiding ethnocentric solutions (e.g., counter the tendency for policies driven by social identity of groups). Waring's work is an example of the broader contribution of evolutionary anthropology to public policy (Alvard, 1998; Gibson and Lawson, 2014).

2.5. Summary

As the domains above illustrate, cultural evolutionary public policy sometimes suggests ways of solving a problem. But a cultural evolutionary approach also fundamentally shifts the approach

itself for how to go about designing a solution—a solution isn't always designed. An invisible cultural pillar of economic derived public policy is the assumption of a great planner or policy maker. This approach is akin to an intelligent designer's view of culture and institutions. We can contrast this with genetic evolution's blind watchmaker and cultural evolution's visually impaired watchmaker. Not designing but instead *evolving* good solutions through efficient selection between different approaches designed with partial causal models of the world (Muthukrishna and Henrich, 2016; Schimmelpfennig et al., 2022). A cultural evolutionary public policy isn't simply about designing efficient institutions but designing efficiently evolving institutions.

3. The Challenges of Cultural Evolutionary Behavioural Science For Public Policy

3.1. The challenge of understanding ultimate causes for application

Behaviours happen for a reason. Sometimes the causal pathways of those reasons are obscured by complex systems. Discovering ultimate causes of a behaviour is an important goal for the social sciences, though the focus is often on proximate explanations (Mesoudi, 2016, 2009; Tinbergen, 1963). Ultimate causes offer a more "upstream" policy lever since proximate causes may be replaced by a different proximate cause if the ultimate cause remains. As Pirsig (2006) put it, if a factory is torn down, but the reasons for the factory persist, a new factory will take its place.

For example, consider gender roles and gender inequality in societies. A proximate explanation may focus on attitudes, preferences, beliefs, or ideologies. At a proximate-level, one could explain gender inequality as a product of men perceiving themselves as superior. This may lead to policies, such as implicit bias training (Forscher et al., 2019; Pritlove et al., 2019), but ignores the underlying causes for the attitudes, preferences, beliefs, ideologies, and subsequent behaviours.

Discovering these underlying causes requires considering the cultural evolution of gendered perceptions and norms. Two influential hypotheses in this field stem from historical economics. Research by Alesina et al (2013), reveals that current-day gender norms covary with historical cultures, for example, traditional agricultural practices. Specifically, areas with higher intensity in the use of the plough (causally exogenously identified by land suitability to the plough) have less gender-equal norms—a product of the plough requiring greater physical strength the hoe giving males a comparative advantage and leading to a larger sex-based division of labour. These attitudes persist even after plough-based agriculture is replaced by machines and can be measured in attitudes toward gender roles and behaviour in participation of women in the workplace, politics, and

entrepreneurship. Moreover, these effects are measurable in second-generation immigrants that are not born in these regions but have family ties. In this case, these norms lead to other norms and infrastructure that reinforce gender inequality. In turn, these differences may be mitigated by policies that target not just gender norms, but the broader set of cultural norms and institutional infrastructure that reduce the unequal cost of childbearing and rearing borne by women (Kleven et al., 2021, 2019).

Further up the chain of ultimate explanations is tension created by differential parental investment in children (Trivers, 1972), whereby human females are biologically required to invest at least 9 months for reproduction and the long human childhood leads to greater reliance on support from others, including fathers. Human fathers are unusually involved in childrearing compared to other great apes and indeed even mammals (Kleiman and Malcolm, 1981). This cooperation requires paternal certainty. Societies where paternal uncertainty is higher tend to have norms that attempt to increase paternal certainty, such as through greater control over female freedom. For example, Becker (2018) finds higher levels of female genital cutting among other forms of control over female sexuality in pastoralist societies where men are often absent as they migrate with their cattle. Considering this ultimate level of explanation is critical to designing culturally-aware public policies. In 2005, India passed a law requiring equal female inheritance. This in turn led to increases in parallel cousin marriage and decreases in female labour force participation (Bahrami-Rad, 2021). This well-intentioned policy is a powerful illustration that people may not respond to incentives in a way that policy makers expect. Cultural evolution can offer an ultimate-level explanation for problems that get to root causes. In doing that, it can provide new solutions to problems that are often dealt with at a proximate-level.

As another example, the paradox of diversity refers to the inherent trade-off between cultural trait diversity's potential for recombinatorial innovation and division created by communication and coordination challenges (Muthukrishna, 2020b). Considering evolvability in cultural evolution offers a framework for resolving the paradox of diversity (Schimmelpfennig et al., 2022), moving the focus from norms and biases to factors such as zero-sum perceptions and reality in intergroup competition (Schimmelpfennig and Muthukrishna, 2021). Understanding ultimate causes offers new policy levers for tackling long-standing problems.

3.2. The challenge of knowing how context matters?

Context matters in behavioural science (Dolan et al., 2012; Michie et al., 2011; World Bank Group, 2015). But how does it matter? Consider research on dishonesty. Experiments reveal that a simple

change in framing can lead honest citizens to behave like dishonest bankers (Cohn et al., 2014). Professionals from a Swiss bank participated in a game to measure honest behaviour. They privately rolled a die a few times and afterwards reported to the experimenter how many times they rolled an even number (for each even number the participant received a payoff). Since the die roll was private, at an individual level it was impossible to know if participants were being dishonest or were just lucky, but at a group level, researchers could measure the degree of dishonesty based on deviations from the expected distribution of even numbers. The main treatment manipulated the context, by either priming a professional (e.g. talking about their job before the task) or a personal context (e.g. talking about hobbies). The researchers found that bankers primed to the professional context were significantly more dishonest, reporting 58.6 % even dice rolls (50% would be expected on a six-sided dice). One conclusion would be that the financial sector attracts dishonest people, but the bankers in the control group primed with a personal context did not significantly deviate from the expected frequency of even dice rolls (they reported 51.8%). These results suggest the importance of context and culture rather than types of people for creating dishonest behaviour (Cohn et al., 2014). But the conclusions are more complicated—the same prime may create different behaviours in different cultural contexts (Cohn et al., 2019; Rahwan et al., 2019) or in-person vs online (Maréchal et al., forthcoming). Participants are more dishonest (i.e., report more successful dice rolls than expected) when embedded in a digital context (i.e., when reporting results to a chatbot), compared to communicating their dice rolls to a human.

Understanding how context matters in complex systems is hard. Principles derived from cultural evolutionary research can help to make predictions which context matters, and how it matters. An ecologist trying to make sense of the complex systems in nature may be completely lost. With the rules of evolutionary biology at hand, she can at least start understanding and testing different hypotheses. A question policy makers need answers to is how context matters for the effectiveness of their policies. Cultural differences are low hanging fruit—the evidence for the impact of cultural differences on the replicability and generalisability of research in social science has grown in the past decade (Apicella et al., 2020; Henrich, 2020; Henrich et al., 2010b).

Cultural differences are important for a science of human behaviour and decisive for public policy. New advancements in the measurement of cultural differences offer new tools for policy makers. Muthukrishna et al. (2020) developed a cultural distance CFst scale revealing how cultural distance from the United States—which may serve as a proxy for a 'WEIRD scale'—predicts other cultural differences, from individualism to personality, pro-sociality, and honesty. Beyond documenting such differences, other research reveals the origins of differences in personality (Gurven et al., 2013; Smaldino, 2019), normative behaviours and prosociality (Henrich et al., 2001; Muthukrishna

and Schaller, 2020; Santos et al., 2017), and more broadly, in how our brain processes visual information (Dehaene et al. 2010, Han et al. 2013). These differences are increasingly important in interpreting research findings and possible heterogeneous treatment effects (Bryan et al., 2021; IJzerman et al., 2020; Sunstein, 2021).

3.3. The challenge of traditions and historical path dependencies

Societies do not emerge spontaneously, but evolve over decades and centuries – they are shaped by history (Henrich, 2020; Muthukrishna et al., 2021; Uchiyama et al., 2021). Genetic drift may play an important role in how societies develop, but the effect of cultural evolution is much larger (Bell et al., 2009; Uchiyama et al., 2021). Thus, cultural evolutionary public policy can use history to identify the ultimate causes of present-day psychology (Muthukrishna et al., 2021). This historical psychology matters for present-day policy interventions.

One dark example of historical path dependency is the effects of 'Tuskegee Study' on trust in public health services. The Tuskegee Study was a longitudinal study in the US between the 1930s and 1970s. Researchers wanted to better understand the health consequences of untreated syphilis. The participants, African Americans who had contracted Syphilis, were assigned to not receive available treatments against the disease. Worse still, participants were not informed about the nature of the experiment. Over 100 died as a result and many family members also contracted the disease. These historical events contribute to the mistrust of medical communities and public health in present-day African American communities (Corbie-Smith, 1999; Corbie-Smith et al., 1999; Thomas and Quinn, 1991). In an influential study, Alsan and Wanamaker (2018) offer support for this claim with an identification strategy using publicly available data. Using and interacted difference-in-difference-in-differences model, that compared older black men to other demographic groups before and after the disclosure of the study in 1972 (Alsan and Wanamaker, 2018). Their results reveal that exposure to the disclosure of the event is correlated with increases in medical mistrust and decreases in both outpatient and inpatient physician interactions for older black men. As a consequence, life expectancy fell by up to 1.5 years in response to the exposure. Although improving, health outcomes are still comparably worse for African American families, a tragedy reinforced by data from the COVID-19 pandemic (Price-Haywood et al., 2020). Similar decreases in medical mistrust have been attributed to medical campaigns in colonial Africa (Lowes and Montero, 2021) and a CIA staged vaccination campaign in Pakistan (Martinez-Bravo and Stegmann, 2021). A better understanding of historical psychology is thus an important part of cultural evolutionary behavioural science.

3.4. The challenge of modern technologies and online interactions

Getting into a stranger's car or spending the night in their empty home was once dangerous and ill-advised. Today it's commonplace thanks to companies like Uber and AirBnB. These platforms facilitate cooperation by brokering reputational information (Muthukrishna, 2021). Online reviews and ratings are an institutionally mediated form of indirect reciprocity and an example of cultural evolution interacting with modern technologies and online interactions. These institutions securitize and centralize trust, allowing us to scale up reputational cooperation through trust in the institution rather than several independent sources of reputational information. But that reputational information isn't always present, and we can't trust everything we find online.

The cultural cues we would normally use to distinguish truth from falsehoods are often missing online perhaps making us more susceptible to believing misinformation. Cultural evolution reveals that we learn what is right and true not through a deep causal understanding of information, but through trust in whom we receive the information from. We believe that the world is round and rotating around the sun in violation of our everyday experience because we trust those who told us and live in a world where everyone we trust also holds this belief. We believe that a virus caused the COVID-19 pandemic, and an mRNA vaccine can help mitigate it, not because we really understand germ theory or exactly what messenger RNA is or does, but because of whom we trust. Trust that the sources of information are knowledgeable, prestigious, sincere, and in the same cooperative group, such that actions are for our mutual benefit. But information on the Internet often lacks the signals we have evolved to pay attention to, such as cues of prestige, sincerity displays or credibility enhancing displays (CREDS) (Chudek et al., 2015; Henrich, 2016). Misinformation can undermine the foundations of our societies and so incorporating our understanding of our cultural learning psychology into the design of digital infrastructure is an important direction for applied behavioural science.

4. BEYOND THE SCIENCE

The application of cultural evolution to behavioural science in public policy has challenges beyond whether the science is correct and possible to apply. These include standard challenges such as the mismatched incentives between those in power and those doing the science, as well as ethical considerations, and heterogeneity in populations. Here we discuss these issues and also emphasize the importance and challenges of effective impact evaluation to improve the basic science.

4.1. Incentive structures for leaders and stakeholders

In principle, a scientist's key concern is getting the science right and in practice, an additional concern is being able to publish the science. It is critical to get the science right and have the support of peers via peer review. Overselling or getting the science wrong undermines trust in science and scientists. But for politicians and policy stakeholders the right science supported by peer-reviewed publication is barely the first step.

Politicians and policy stakeholders often have competing motivations and additional challenges. For example, a new approach may seem risky to career civil servants with little incentive to innovate and much incentive to not fail to ensure the next promotion in their career. A politician must be able to sell a new approach within their own party and to their broader constituency who may not fully understand the science. And mediating the relationship between science, politics, and the public are the media.

As an illustration, consider the default choice for organ donations. There is a shortage of organ donors around the world, and the evidence is clear that making it a default option for citizens to donate their organs after their death is an effective solution to increase the supply of donor organs (Davidai et al., 2012; van Dalen and Henkens, 2014). Changing the default to opt-out of organ donation is a highly effective method for increasing the number of organ donors without constraining choice. And yet, not all countries, have adopted this default. For example, in Germany and Switzerland, the default remains opt-in. The cited reasons include ethical and moral concerns, pressure from media and perceived pressure from different parts of the civil society (Hallam and Prange, 2020).

Thus, although science communication, managing media, and nurturing relationships with politicians and policymakers may not seem like a scientist's job, these are critical to successful behavioural science in public policy, even more so when dealing with a cutting-edge approach such as cultural evolutionary behavioural science. As cultural evolution would suggest, reputation and trust are critical. Scientific methods, such as experimentation and randomization, are poorly understood and sometimes aversive to some parts of society, perhaps in politics too. Meyer et al. (2019), for example, find that people are often averse to randomization, especially where health is involved. This aversion is true even when people have similar ratings for the options (Heck et al., 2020). A parallel aversion seems to exist for decisions made by algorithms (Dietvorst et al., 2018). These methods are banal for scientists, but of concern to stakeholders for whom public reactions are paramount to their personal success. Thus, the success of cultural evolutionary behavioural

science in public policy is contingent on overcoming these non-scientific barriers. In any case, informed consent is critical to the ethical application of behavioural science.

4.2. Ethics

The ethics of nudging and behavioural science interventions are actively debated and discussed in the discipline. Even if cultural evolutionary approaches to behavioural science are effective they may not be socially desirable or perceived to be ethical. In general, questions remain about whether it is ethical for researchers and policy makers to experiment with the public and manipulate behavioural change. These questions are perhaps even more pertinent for cultural evolutionary scientists dealing with what amounts to scaled cultural change.

These debates are not new (Gigerenzer, 2015; Sunstein, 2020, 2016) and interventions continue by those who argue that if a policy goal is socially desirable and the freedom of choice is not restricted, the intervention is ethical (Thaler and Sunstein, 2003). Lades and Delaney (2020) offer a more specific framework that goes beyond the question of choice restriction—FORGOOD.

Fairness	Does the behavioural policy have undesired redistributive effects?
Open	Is the behavioural policy open or hidden and manipulative?
Respect	Does the policy respect people's autonomy, dignity, freedom of choice and privacy?
Goals	Does the behavioural policy serve good and legitimate goals?
Opinions	Do people accept the means and the ends of the behavioural policy?
Options	Do better policies exist and are they warranted?
Delegation	Do the policy makers have the right and the ability to nudge using the power delegated to them?

Table 1. FORGOOD ethics framework for nudging and behavioural sciences based on Lane and Delaney (2020).

This framework equally applies to cultural evolutionary public policy, but there are additional concerns for cultural interventions. Here are a few:

1. It may be preferable and more ethical to aim for endogenous norm and behaviour change driven by existing variation and selective social learning and social influence (Efferson et al., 2020b) (Efferson et al, this issue).
2. Additional caution is required where cultural evolutionary processes can initiate long-enduring path dependencies. This is especially important as well-intended interventions can change adaptive cultural practices that seem maladaptive from the outside. For example, the Asian Development Bank changed the irrigation of rice fields in Bali that was, until then, dominated by cultural practices in which all rice farmers would irrigate their fields at the same time during a ceremony (Lansing, 2009). This traditional practice left little room for pests to develop, as all fields were flooded at the same time. After the implementation of the new uncoordinated

irrigation practice, pests flourished, leading to large losses in harvests. Similarly, transhumant pastoralism, which is often viewed as an archaic form of livestock farming (Mattee, 2006), may be adapted to the local circumstances, allowing livestock to flexibly move according to the environmental circumstances (FAO, 2018).

3. All policies are likely to affect the process of cultural evolution by changing the information landscape or the models from whom information flows. Cultural evolutionary scientists can and should be more aware and cautious of these effects. Managing cultural evolution can itself be an effective method for enhancing the ability of groups to evolve new solutions.

Overall, cultural evolutionary researchers should also be more acutely aware that societies are made up of embedded and overlapping distributions of beliefs, behaviours and other cultural traits and thus should be more acutely aware of the effects of possibilities created by this diversity.

4.3. Diverse populations

Behavioural experiments often assume homogenous populations, but recognizing, measuring, and developing interventions that incorporate the reality of heterogeneity can be an effective strategy (Bryan et al., 2021; Sunstein, 2021). Diverse populations are a natural consequence of cultural evolution and critical to continued adaptation. But diversity is a paradox: Diversity is the fuel for innovation through the recombination of ideas and traits but is also a source of division, communication, and coordination challenges (Bassett-Jones, 2005; Putnam, 2007; Schimmelpfennig et al., 2022). This is both a challenge and an opportunity for cultural evolutionary behavioural science.

Heterogeneity in beliefs and behaviours complicates large scale adoption of new policies (Efferson et al., 2020b; Muthukrishna et al., 2017a). Different people can react in different ways to the same intervention and these differences may even have unintended effects with negative behavioural spillovers (Efferson et al., 2020b; Schimmelpfennig et al., 2021). As more and more culturally distant humans live side by side, an individual-level approach to nudging becomes less tenable and even harmful. For example, targeting the wrong part of a society without prior measurement can lead to reactance. This may explain why an intervention to reduce female genital cutting in Kenya actually increased the cultural practice (Thomas, 2000). Similarly, polygyny is often seen as harmful to a society and health outcomes (Omariba and Boyle, 2007; Smith-Greenaway and Trinitapoli, 2014). Indeed, at a country level, polygynous groups appear to have worse outcomes than others, but (Lawson et al., 2015) have argued that this is due to an ecological fallacy: polygynous groups have worse health because they are poorer. Of course, they may be poorer because they are

polygynous. However, within the ethnic groups, the negative effect of polygyny on health disappears and is even reversed. As such, without resolving the causality and recognizing the heterogeneity, interventions designed to reduce polygynous marriage as a public health intervention may backfire under some conditions. All of this not only reinforces the need to measure and understand your population before intervening, but also the importance of effective impact evaluation for improving the basic science.

4.4. Impact Evaluation

Measuring the impact of a public program is a cornerstone of an evidence-based approach to policy. Impact evaluation of cultural evolutionary public policy is likely to encounter two key challenges:

1. Data collection is difficult and unattractive to many stakeholders: Cultural evolutionary behavioural science requires large datasets that can detect contextual factors and cultural differences within populations. Sampling data in a population is often difficult, expensive, and creates no immediate payoff for policy makers. Furthermore, measurements will often feature selection biases, as relatively amenable subjects self-select into the sample (Berk, 1983; Heckman, 1990), or provide socially desirable responses (Krumpal, 2013). More efficient methods of data collection, such as random sampling, may be more likely to be implemented.

2. Evaluating out of sample and across time: Cultural evolution can play out over long periods, but the time horizon of policies and politicians is often driven by shorter cycles of elections and media attention. Moreover, public programs directed at a subset of a population are likely to have effects beyond the group targeted by the policy. Thus, the impact assessment of the policy must continue over a period of time and go beyond the targeted population to detect possible spillovers.

Despite these challenges, impact evaluation is critical to not just applied cultural evolutionary behavioural science, but the basic science of cultural evolution.

5. IF IT DOESN'T WORK IN THE REAL WORLD, IT DOESN'T WORK AT ALL

As scientists, our goal is to develop theories and models to explain the world (Muthukrishna and Henrich, 2019). Often the methods we use to test these models and theories are not in the world but in a more constrained lab or online setting. But of course, the ultimate test of our theories is the real world. If our theories don't work in the real world, they don't work at all. Thus, cultural

evolutionary behavioural science in public policy is not just a useful extension of the cultural evolutionary framework and research program, it is essential to the development of the science. It offers a true test of cultural evolution as a theory of human behaviour. Basic and applied science go hand in hand. Electrons and molecules behave the same way in a lab as they do in the real world. People do not.

In this chapter, we have introduced the marriage of cultural evolution and behavioural science as a more effective method for developing public policies. We've shown how this combined approach can guide researchers and practitioners in designing legitimate, ethical, and sustainably effective policies and programmes. But the intersection of cultural evolution and public policy isn't just a useful approach for policy makers. Cultural evolutionary public policy is critical to the future of the discipline.

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