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ARTICLE

Behavioural public policies for the social brain

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Abstract

Behavioural public policy is increasingly interested in scaling-up experimental insights to deliver systemic changes. Recent evidence shows some forms of individual behaviour change, such as nudging, are limited in scale. We argue that we can scale-up individual behaviour change by accounting for nuanced social complexities in which human responses to behavioural public policies are situated. We introduce the idea of the 'social brain', as a construct to help practitioners and policymakers facilitate a greater social transmission of welfare-improving behaviours. The social brain is a collection of individual human brains, who are connected to other human brains through 'social cues', and who are affected by the material and immaterial properties of the physical environment in which they are situated ('social complex'). Ignoring these cues and the social complex runs the risk of fostering localised behavioural changes, through individual actors, which are neither scalable nor lasting. We identify pathways to facilitate changes in the social brain: either through path dependencies or critical mass shifts in individual behaviours, moderated by the brain's property of social cohesion and multiplicity of situational and dispositional factors. In this way, behavioural changes stimulated in one part of the social brain can reach other parts and evolve dynamically. We recommend designing public policies that engage different parts of the social brain.

Keywords: critical mass; path dependency; scaling up; social brain; social cohesion

Introduction

Behavioural public policy is increasingly interested in scaling-up experimental insights to deliver systemic changes (Al-Ubaydli & List, 2017; Al-Ubaydli *et al.*, 2017a, 2017b; 2017c, 2019, 2021; John, 2021). Recent evidence shows some forms of individual behaviour change, such as nudging, are limited in scale (DellaVigna & Linos, 2022; DellaVigna *et al.*, 2022). A nudge for good, and in the right direction (Thaler and Sunstein, 2008, 2021), once considered to be cost-effective (Benartzi *et al.*, 2017; Tor & Klick, 2022) and attractive to organisations globally (Insights & Policy, 2017; Ball & Head, 2021), is now proving to under-deliver on its goals.

Some relate these shortcomings to the design of these interventions (Hertwig, 2017; Mongin & Cozic, 2018; Tor, 2020; Banerjee & John, 2021). Others, for example, Chater & Loewenstein (2022) conclude, our focus on individual behaviour change ('i-frame') rather than systemic changes ('s-frame') has led behavioural public policy astray. While we agree on the need to scale-up and deliver systemic changes, we believe attention should continue to be given to the 'i-frame'. In fact, we suggest using tools of the 'i-frame', like nudges, better – by accounting for nuanced social complexities, that is properties of the physical environment in which such nudges are delivered, and the social cues between different actors who receive the nudge. This is the objective of this paper. We outline behavioural public policies for the 'social brain', which refers to a collection of individual human brains, each of which is connected to the other human brains in the collection through social cues and is affected by the social complex. Using these cues and the social complex can improve the targeting of nudges, in turn scaling-up human behaviour change, both vertically (across wider populations) and horizontally (over time and space) to reach the 's-frame'.

The 'social brain' construct considers human behaviour change holistically, not simply as an artefact of individuals' own biases or heuristics. Understanding individual behaviours, either strategically as a response to the actions of other humans, or in association with the physical environment in which they develop, has been widely studied in many applications of *economic sciences*, such as behavioural game theory (Camerer, 2011), market behaviour in social environments (Becker & Murphy, 2009), and in *social psychology*, such as installation theory (Lahlou, 2018) and other social systems approaches (Carter, 2013), notably. Nonetheless, in recent years, applied behavioural science and public policy has pushed many of these general socio-contextual considerations to the side-lines with contemporary applications of nudging. There have been conceptual problems with the definition and remit of the nudge – many different definitions have been proposed (Banerjee & John, 2022) – this has further led to the challenge that nudges have been blindly targeted to many different settings without really thinking of its underlying mechanisms and/or mediators[1] (Marteau *et al.*, 2021). It's vital we consider the influence of the social context and interrelationship between actors going forwards.

Our critique, and consequently our suggestion of the social brain, therefore, relates widely to recent developments in behavioural insights which is an 'inductive approach to policy making' to understand human behaviours that is data-driven at its core (https://www.oecd.org/gov/regulatory-policy/behavioural-insights.htm). Our intention is to direct the attention of the policymaker, applying such an inductive process, to the role of the social complex and cues. The social brain becomes

[1]See Marteau *et al.*, who write "In recent years, catalysed by the influential book *Nudge*, this has commonly included 'Nudging' and 'Choice Architecture'. However, it is important to stress that these terms were originally developed within a general guiding framework that sets out underlying (philosophical) principles – libertarian paternalism – that can be applied to real-world problems. This framework was not intended to delineate the specific ways in which its principles can be applied to certain contexts… Inevitably, this means that the use of the terms has been nebulous, and the original concepts obfuscated. The resulting lack of conceptual clarity when these terms have been applied to interventions to change behaviour, has led to a fragmented and uncertain evidence base" (2021, p3).

particularly relevant to the current debate in behavioural public policy that suggests many nudge findings are insubstantial (Maier *et al.*, 2022; Szaszi *et al.*, 2022 in response to Mertens *et al.*, 2022) due to publication errors. There is also growing consensus that much is unknown about nudging (see Marchiori *et al.*, 2017; Beshears & Kosowsky, 2020), such as their mechanisms and underlying heterogeneity. Here, using elements of the social brain, for example, identifying which individuals should be targeted to receive a behaviour change intervention, either to increase its desired effectiveness or decrease its reactance and backfire effects, can help us advance the scope of nudging.

Using the social brain construct, it is possible to show that most tools of behaviour change have attempted to identify and correct human biases by putting an undue emphasis on only one aspect of the social complex – reframing choices, using a nudge, often referred to as the 'choice architecture' (Thaler & Sunstein, 2008). Yet, there remains much more to explore. For example, Hollands *et al.* (2017) suggest a *typology of interventions in proximal physical micro-environments* (TIPPME) which systematically identifies and characterises different micro-physical interventions to change food, alcohol and tobacco related behaviours. Furthermore, Johnson *et al.* (2012) describe different tools of choice architecture, which go beyond simply nudging behaviours. As these studies suggest, the scope of the social complex is wider than it has been assumed and ignoring its diversity runs the risk of not adapting behavioural tools to relay ecological rationality (Todd & Gigerenzer, 2012). For example, a nudge that fails in one physical environment can work in another, with relevant modifications to suit the social complex. Besides this social complex, it is also possible to use human interrelationships as a medium of change, not just in isolation, but in conjunction with the complex itself. So, if we capitalise on social cues, the drivers of these human interrelationships, and alter the delivery points of these interventions, we might be able to facilitate greater behavioural shifts. While such ask for behavioural public policy is reasonable, engaging in these localisations can become a daunting task without a construct. We contribute here, as we theorise about the social brain to reconcile different behavioural pulleys that can motivate and direct individual behaviour changes collectively to deliver maximum scalable impact.

However, the idea of this construct is not completely new. We have seen fragmented applications of the social brain, albeit not formally. For example, Michie *et al.* (2013) and Michie & West (2013) have reviewed behaviour change theories that encompass the role of social and physical environments, applications of which have shown how these environments can prime people to perform certain behaviours (Kay *et al.*, 2004) or affect human well-being (Bitner, 1992; Stedman, 2003; Chu *et al.*, 2004; Vischer, 2007; Lee & Brand, 2010), sometimes by fostering smarter heuristics (Gigerenzer & Gaissmaier, 2011). There is also work acknowledging the role of contextual factors and situated environments in changing human behaviours (Rauthmann *et al.*, 2015a, 2015b; Lahlou, 2018; Lades *et al.*, 2021; Laffan *et al.*, 2021a, 2021b). Recently, Schmidt has pointed that using a systems approach 'can support the development of improved choice infrastructure, contributing to BPP problem-solving efforts by helping practitioners create conditions that are more conducive to the success of behavioural solutions' (2022, p1). Similarly, scholars have also turned towards a discussion of how human emotions drive behaviour change (Laffan

et al., 2021a, 2021b; Rela, 2022) or how interpersonal relationships and social cues affect behaviour (Heider, 2013; Ju *et al.*, 2021). This growing evidence base points towards the importance of the 'social complex' – which we use throughout to refer to material and immaterial properties of the social environment which surrounds us. While these developments in behavioural public policy speak to the merits of recognising a social brain, there lacks a coordinated effort to develop and direct interventions that systematically accounts for its complexities. Consequently, our work is motivated by this gap (see Hallsworth, 2023) to formalise a construct which gives us opportunities to employ means of behaviour change that facilitate a greater social transmission of welfare-improving behaviours.

The rest of the paper is set out as follows: we motivate the idea of the social brain by briefly reviewing competing theories in social sciences. We then provide a comprehensive definition of the social brain and outline its properties and constituents. We analyse behaviour change through the lens of the social brain and explain how we can use different parts of this social brain – the wider social complex and social cues – to promote scalable good behaviours. Set up this way, we deduce testable hypotheses in using the social brain to improve the delivery of individual behavioural change strategies. Finally, we outline an approach to treat the social brain in different socio-economic contexts. There remain limitations to how much of this can be realised just at once. But when this is done, we will rely not only on changing individual human behaviours, as if it were the result of their own biases, but also devise forms of change that consider the wider social complex and cues in which such behavioural responses are situated.

Competing theories of holistic behaviour change

Social brain as an evolutionary hypothesis

The social brain, first seen as an evolutionary hypothesis relating to the biological chain of cognitive development (Dunbar & Shultz, 2007; Dunbar, 2009), lacks a robust definition (Alós-Ferrer, 2018). In its earliest exposition, it represented the social correlate of primate cognition, quantified as the size of the brain. In essence, to accommodate complex 'Machiavellian' relationships, our brains grew in size. More recently, however, this definition has expanded to accommodate 'any set of brain structures and functions [that are] related to the perception and evaluation of the social environment and how that perception and evaluation affects social decision making' (Alós-Ferrer, 2018, 246–247). The relationship between human behaviours, realised from the social brain, and the social complex is thought to be bidirectional, with forces at play that shape and reinforce each other.

Social brain as the extended mind hypothesis

The social brain construct has close overlaps with the extended mind hypothesis (Clark & Chalmers, 1998). Consider, for instance, the idea that our mind can be influenced by factors that reside outside the human body, in the socio-physical environments around us, which has been centrepiece to the theory of the extended mind hypothesis. In this theory, it was suggested that the mind and external factors create

a two-way interaction, a coupled system of some sorts. Cognitive processes, as such, are defined over the extended mind, rather than what one has bodily control over. In recent times, technology has made such an idea more relevant, with techno–human interactions being proposed as modes of behaviour change (Krpan & Urbaník, 2020). In addition, theories of situated cognition (see Lindblom & Ziemke, 2003) have resonated similar ideas of extrinsic influences, albeit from the actions of other human beings. In this way, our mind can anticipate and respond to other actors. These theses of the extended mind form a natural basis to conceptualise our social brain. We think of the brain to encompass linkages with extrinsic entities, such as other human actors, or the social and physical environments, or even both, that can influence the mind.

Social brain in contemporary theories of social behaviour change

The importance of a wider social complex, as identified in the social brain construct, has also been noted in different theories of social behaviour change. For example, the idea of the social complex relates to Opportunities in C(apability) O(pportunity) M(otivation) B(ehaviour) model of behaviour change put forward by Michie *et al.* (2011, 2014) in their wheel of behaviour change. Opportunities in the behavioural change wheel refer to physical opportunities, made available through environmental context and resources, or social opportunities that reflect social influences and norms (Cane *et al.*, 2012). In a recent review of restructuring-built environments, Wilkie *et al.* (2018) finds such physical opportunities facilitate the transmission of healthy behaviours, enabled by behavioural policy interventions. Similarly, the idea of the social complex is also motivated by 'situation of situations' research (Rauthmann *et al.*, 2015a, 2015b; Rauthmann & Sherman, 2021), which suggests that different situations – 'a set of fleeting, dynamic, and momentary circumstances that do not lie within a person but rather in their surroundings' (Rauthmann & Sherman, 2020, p1) – provide different kinds of information to people and shape their behaviour, in turn. Furthermore, the idea of social behaviour change also overlaps with ideas of *societal construction and regulation of behaviour*, put forward by Lahlou (2018). Lahlou (2018) systematically analyses the role of installations – given to mean different physical frames or behavioural settings – in predicting the formation of human behaviours. It is important to note that the choice complex does not refer to choice architecture simply. While elements of choice inhibit some behaviours and motivate others in individuals, physical and social opportunities help diffuse intended behaviour changes to more than one individual at a time, much like population-based intervention strategies.

Such a population approach, where interventions are designed to target groups wholly, rather than individually, to become beneficiaries of the treatment, was introduced by Rose (2001) in applications of preventive medicine. In his conceptualisation of delivering improved public health outcomes, often considered as one of the 'absolute truths' (Adams & White, 2005), he thought of altering social contexts to minimise underlying health risks to all members of the population. These population approaches, in addition to individual behaviour change strategies, have been effective in changing diets, increasing levels of physical activity and curbing smoking rates (Mozaffarian *et al.*, 2012).

The review of these competing theories points towards the relevance of a construct – like the one we are about to propose – that will identify multiple facets of social behaviour change. The individual mind and its extensions, in its social and physical surroundings, with cues to relay information, are building blocks of such a construct. In what follows next, we will outline the idea of the social brain with these elements and discuss its properties.

The social brain

A comprehensive redefinition

The conventional definition of the social brain points to the human brain's neurocircuitry for processing social cues (Lieberman, 2013). These can be verbal and non-verbal social cues, such as speech, body language and expressions. The perception of these cues through human senses and their processing in the brain thereafter occupies a significant chunk of a human's waking and non-waking hours. As Lieberman (2013) suggests, these social cues not only produce pleasure and pain in the individual but are a major conduit for influences, generating changes in behaviour and acceptance of new ideas.

Each human brain, therefore, can be considered as an emitter and receiver of social cues. Just like an ant releases pheromones to signal and interact with fellow ants, we humans use non-chemical social cues, an outcome of chemical activity in the brain, to behave around and influence one another. When viewed spatially, humans form a network through which ideas, influences and moods (anger, sorrow and happiness) traverse in the society, with significant implications for the welfare of its corresponding social groups. Thus, it is possible to use this network to catalyse behavioural improvements thought the regulation of these cues, among others, till these improvements acquire the critical mass for their more universal adoption.

Turning to the cues as forces operating in the social brain, almost no idea or thought generated by an individual can be completely original: received ideas (or cues) are treated as inputs and processed by the brain to generate an output which is then passed onto other human brains. This process can be conscious or not. Thus, the society or the relevant collection of individuals, other than the considered one, influence the ideas and behaviours of an individual. Everyone, as a processor of such influences, contributes potentially to the modification of a social influence: by processing information available in neurons, establishing neural connections inside the human brain, which yields an influential thought as an addition to the flow of social communication. This spreads through the network that is the social brain.

But this network of human brains is embedded in a physical environment, natural and man-made, which, in turn, has implications for the functioning of the individual brains and therefore the network. This is the wider social complex, and what has been traditionally considered, in parts[2], as the 'elements of choice', which the choice architect manoeuvres. When viewed as a whole, the idea being conveyed through the social brain as a construct is that individual actions and behaviours depend on many factors

[2]In traditional "i-frame" based choice architecture, social planners focus on the immediate environment of the individual.

located outside the confines of themselves, and beyond their immediate choice architecture. Realisation of this often-forgotten truism can help us to fix sub-optimality in human behaviours and welfare levels without unnecessarily blaming human actors, whose actions are driven by their histories of origin (genes), nurture and social interactions, by tinkering with the nature of their social groups and location of the objects around them, and by undertaking appropriate servicing of these factors. Changes in objects or their design, often an artefact of tools of behaviour change like nudges, have featured prominently. But this is only one dimension of change. We need to focus on the social groups and factors that define their relationships, conditional on these objects: the choice architecture.

Consider, for example, a thought experiment below. Sam (Samuel/Samuela) is a fitness enthusiast and believes in maintaining a good and healthy lifestyle. Sam eats healthy food, except for the occasional times, when Sam finds themselves to be in a certain context, such as when they meet a friend or go out on a vacation.

The policymaker notices Sam only during these specific contexts when Sam indulges in unhealthy (say, junk food) choices. If the policymaker decides to nudge Sam's behaviour unilaterally, without an explicit understanding of the contextual factors around Sam, scaling-up the nudge is limited in its future applications. And in the event, it fails, is it reasonable to blame the nudge? No, it's not. Why? There is a wider social construct around Sam which tempts and influences Sam's behaviours. Behaviour change interventions should be mindful of these social complexities. Consider another example. Travellers are often in a bind. They want to travel sustainably, but the price of sustainable transport might be higher than non-sustainable alternatives. Tools of behaviour change might fade in effects compared to the strong (dis)incentive imposed by these high prices. In this situation, is it reasonable to conclude, based on their actions (un)altered by the nudge, that the traveller does not have environmental preferences? A behavioural public policy that does not recognise this social construct will also be limited in its impact. Even further, consider, all our actions which result jointly as interactions with other human actors, or due to the environment (not simply choice architecture) we happen to be in. Adopting the social brain acknowledges these influences which are important for 'horizontally' and 'vertically' scaling-up behaviour change (Al-Ubaydli *et al*., 2021). More importantly, it gives policymakers an opportunity to design more effective interventions to begin with that suit the social complex people find themselves in.

The social planner must, therefore, assume the role of a visionary[3] in acknowledging these different dimensions to behaviour change, just like a pool shark, who in stroking a single ball on the billiard table is able, because of their clarity of vision in the sport, to correctly anticipate the resulting interaction of all the balls on that table and the consequent outcomes. In billiards (planning), the skill and awareness of the player (planner), in anticipating the movements of various balls (humans) through the chain reaction triggered by a given stroke and then choosing and executing the optimal stroke among various alternatives, matters significantly. Modifying behaviour at the level of the individual, a unit of the social brain, necessarily forms the basis for wider changes within the social brain, given the inter-relatedness of

[3]This is a conventional welfarist argument, for details see Sugden (2013).

human behaviour. As such, we envisage new form of behavioural spillovers, not simply between actions of the same human, but between actions of different human actors, which then reinforces the system of behaviour change. These are important feedback loops that the policymaker must account for when thinking of delivering scalable, systemic changes.

To summarise, the social brain refers to a collection of individual human brains, who are connected to other human brains through social cues, and who are affected by the social complex. Set up this way, the network of individuals bears an uncanny resemblance to the neural network inside a human brain, hence the name 'social brain'. For a more formal analysis, see Supplementary Appendix A. We visualise this construct in Figure 1. Each node in social brain is analogous to individual human actors in our society, exemplified by persons A and B, such that one person is connected to many others. The effect of these actors on each other, in turn, are determined by the proximity of the nodes at which they are located, though given the state of modern technology, the correct reference would be a measure of connectedness by social, familial or ideological proximity rather than physical proximity only. These invisible cues, the visible thread between the nodes in Figure 1, are channels of communication between human actors. For example, the red line demonstrates the connectedness between person A and B. These are the social cue transmitters that link these actors together. Together with these strong human influences, is the physical and social environment, which not only affects and relays the cues but also affects the processing of cues in the social brain, modifying behaviours and moods and catalysing ideas. All of it taken together makes up the social brain.

Take, for example, the connotation of A and B lying at the same altitude on the social fabric. It can signal similar reference points on stratas of human society, which would be different if they were at different heights, such as A on a peak and B in a valley. Such differences could embody differences in socio-economic statuses. In turn, these differences would affect how cues might travel between them when a behaviour change is initiated, for ultimately, we want to see a population-level change.

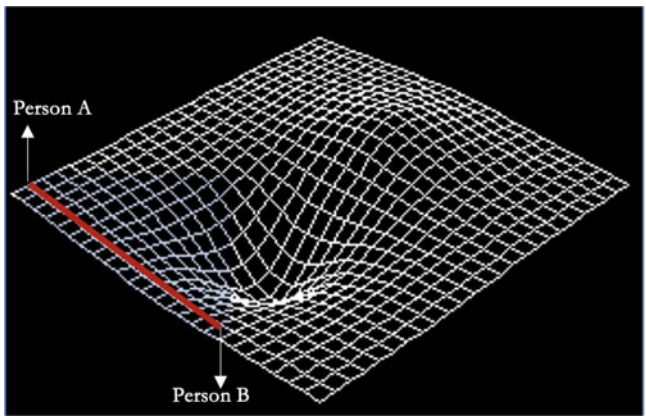

Figure 1. The social brain fabric.

The strength of their interpersonal relationships also matters when we want to scale-up behaviours. A behavioural intervention that ignores these features of the social brain fabric risks failure to deliver meaningful behavioural change or suffers from unwanted distributional consequences.

Properties

The social brain construct draws our attention to (1) the importance of ordering of actors in the brain; (2) the role of cues between actors who are linked to one another and (3) the importance of the material and immaterial properties which make up the choice complex in which these actors are situated. We argue that when a behavioural policy is targeted at one node of the social brain, without acknowledging these invisible cues, its other nodes, or the social complex the outcomes can be misleading. For example, not all social cues between similar actors are that of equal intensity. Feelings of love or hate, significantly differ in regard to mobilisation, an instrument of social change. Or partisan beliefs imply that people cannot come together on issues of common interest to effectuate change. A social planner must not only acknowledge these forces in trying to deliver change but also distinguish between them, prioritising some, based on their significance and need. This would help the social planner to trace the path of an intended stimulus through the social brain and determine how and when an intervention will lead to a scalable behavioural change in the population. As we show, understanding these hinge on the properties of the social brain, which we outline next.

Path dependence

The social brain can be path dependent in determining its social linkages. When individual actors receive new information, through tools of behaviour change (see John, 2013), they process it, based on what they already know. At times, they process it based on how they think they would like to use it (for details, see Wickens & Carswell, 2021). Simply delivering new information might not help facilitate behaviour change, if we do not recognise the ways in which humans react to them.

Even worse, sometimes, too much information can be welfare-reducing (Sunstein, 2020). As such, policymakers working in this social brain need to understand what norms and values are acquired by and are instilled in people before they deliver interventions. They further need to evaluate how information from others is received, including positions in the social hierarchy, reliability and responsiveness (Lieberman, 2013). All of this will reduce frictions from the social complex of the brain, in overcoming barriers from inefficient path dependencies to scale systemic changes (Schreyögg *et al.*, 2011; Barnett *et al.*, 2015; Bednar & Page, 2018). Since, the past has a prominent place in determining human behaviour and cues, and instils inertia in the behaviour of individuals, care must be also taken in not prescribing alterations to the choice architecture, ignorant of these path dependencies in social linkages, because unlearning changes can become equally difficult.

Critical mass effects

In direct contrast to path dependence is the theory of critical mass (Oliver, 2013b). While path dependence, through inertia, locks-in human actors into certain

behaviours; there are a few small fissile reactions, characterising the functioning of the social brain, which endow it with a certain dynamism and capacity for fast and sweeping radicalism. Such ideas of critical mass shifts have been explained as availability cascades by Kuran and Sunstein, whereby it leads to a 'self-reinforcing process of collective belief formation by which an expressed perception triggers a chain reaction that gives the perception increasing plausibility through its rising availability in public discourse' (1998, p683).

Examples relate to the fast adoption of the motor car which replaced horses and horse drawn carriages as the primary means of road transport towards the beginning of the 20th century: some bold humans (the pioneers) introduced and adopted this innovation which then led to its use by some almost equally enterprising individuals (the imitators). Together these two developments implied that a critical mass of people had quickly adopted the innovation and was sending out social cues encouraging people to purchase motor cars, thus revolutionising this aspect of consumer behaviour.

The computer revolution also reveals the importance of the critical mass: slow adoption to begin with and then an explosion in the developed world in the 1980s and then in the developing countries in the beginning of the 21st century. This economic dynamism, as theorised in creative destruction (Schumpeter, 1942), is nothing but a behavioural property of the social brain. More recently, social media trends, such as TikTok, display similar vigour. When a cue in the social brain reaches its critical mass, it can lead to domino effects, a rapid spillover among individuals. More complicated models of attainment of critical mass are possible: for example, what happens if a person embracing the change is in many cases not that enthusiastic about sending the 'message for change' to others? Social policy planners need to be aware of the parameters[4] characterising models of 'critical mass' in planning behavioural change in a society. Designing interventions that stand to facilitate the domino effects can be key to treating the social brain.

Dynamic evolution

The social brain, defined by its path-dependency or critical mass effects, is constantly changing. A good way to visualise the activity within the social brain is to see it as a dynamically evolving unit, one embodying a continuum of dose-response feedbacks between the actors, the social cues and its social fabric. As such, any behaviour observed for a particular human at a given node in the social brain appears to be nothing short of randomness. If this behaviour is viewed in isolation, it can appear to be misleading and noisy (Kahneman *et al.*, 2021), just like the policymaker watching Sam make one-off unhealthy choices. But on careful introspection, they should be able to find contextual evidence, and systematic, unidentifiable patterns, like the

[4]Let us assume that each human is in touch with n more and that a proportion of these humans responds positively to a request for change sent over a period. Then, we see that $\alpha^t n^t$ individuals respond positively over t time periods to a message originally sent out in the first of these t periods, given that those who embrace the change always send out messages to others. Of vital importance is the magnitude of α, which depends on the nature of the request and how well the message is crafted, as well as the size of n, which depends on the state of technology as well as population density and literacy. If n and α are large, fast and sweeping changes are possible as the system reaches a critical mass quickly.

influence of Sam's friends or the vacation in tempting these behaviours. Collectively, these behaviours are informative of a wide array of changes that are happening in the social brain. It is here that policymakers need to repeat experiments, to see temporal effects, not only with an eye for replication, but also to make sense of differences that arise as time passes by (Kahneman, 2014; Feest, 2019), for the social brain has dynamically evolved. Theories of human behaviour change must, therefore, be able to account for these changes. A sequence of behaviours resulting in the social brain can then inform policymakers of the behavioural trends to be influenced, rather than one-off changes which cannot be sustained if left alone.

What influences the social brain?

Next, we turn to the factors that influence the social brain and its constituents, namely, the actors, their social cues and the social complex. These are explained below.

Social cohesion

The impact of any behavioural activity on the actors in the social brain is influenced by the degree of the social cohesion between them. Studies have shown that a greater cohesiveness is often related to a greater tendency to perform related behaviours (Beal *et al*., 2003). In other words, if some cues are relayed faster than others, cohesiveness could be one of the facilitators. Furthermore, cohesion can also motivate habit formation, good or bad (Van der Weiden *et al*., 2020). Consumption of unhealthy food when friends get together in pubs, like with Sam, for example, is a result of social cohesion among the cohort members. This cohesion amplifies the perceived social approval of the behaviour and hastens its evolution into a habit, repeated by the individual automatically without thought. Hence, when looking to enforce a change in the social brain, social cohesiveness can be used for traction. Using behavioural interventions in conjunction with such cohesion will scale-up treatment effects.

Situational and dispositional factors

A human actor, in the social brain, is a node with access to a fraction of the multiple nodes in a setup. On receiving a cue, the human brain processes it using its powers of analysis to make sense of it and add value to it. The individual can react to stimulus received, a process that has been referred to as 'perspective transformation' in driving behaviour change (Banerjee & John, 2021). This, however, depends on the level of situational and dispositional factors accessible to humans. These factors, therefore, stand to influence the properties of the social brain. The situational factors refer to influences in the local social and physical environment, beyond the control of the actors. Sometimes, this can involve elements of choices, such as those tweaked by a nudge. The dispositional factors are merely one's own preferences or inherent nature and qualities: socio-economic preferences could be an example (Bernheim & Rangel, 2009).

Let us see how these might work. In formulating a cue, the reflective capacity of the individual, in turn affected by their intellectual and emotional intelligence, matters. The influence these individual exercises through their cues would also

depend on many factors in the social surroundings, an artefact of the social fabric. Nonetheless, it is the interaction of these situational and dispositional factors which dynamically determines factors influencing the social brain. An example is the socio-economic status of an actor in society, which is often inherited and not earned, combined with reputation, which is an outcome of past deeds. For example, reconsider Sam who is also risk-averse (dispositional) and finds themselves in a race-course (situational), and whose nature and class determines who they befriend at that point. Any behaviour undertaken by Sam would be influenced by these factors, independently, and in interaction with each other. Thus, influencing the social brain can also be facilitated by designing interventions which act on these situational and dispositional factors. It is mostly here that nudges and related behavioural cues, like boosts and nudge+ have been conceptualised to work.

Testable hypotheses

Set up this way, we now put forward three testable hypotheses of generating scalable behaviour change by relying on the properties and influences of the social brain.

Hypothesis 1: A behaviour change intervention targeted at a population will lead to significantly larger treatment effects when social cohesion between human actors in the social brain is stronger.

Hypothesis 2: A behaviour change intervention targeted at a population will lead to significantly larger treatment effects when the social complex is conducive for diffusion of cues such that there are fewer path-dependencies.

Hypothesis 3: A behaviour change intervention that is targeted at nodes which are conducive to deliver critical mass shifts will lead to significantly larger treatment effects than nodes which are stagnant.

The first hypothesis highlights the role of greater social cohesiveness among human actors in the social brain. Scaling-up behaviour change (horizontally) will be faster when nodes in the social brain are connected by stronger forces (such as social cues) within themselves. Thus, similar forms of behaviour change interventions will have varying effectiveness when applied to different nodes of the human brain. The social planner must exercise caution in targeting optimal nodes of application. Alternatively, social planners must also pay attention to increase social cohesiveness at a given node to increase the transmissibility of any human behaviour change. Next, hypothesis 2 highlights the role of situational factors in facilitating human behaviour change. A tool of behaviour change will be more effective when the social complex in which such tools are situated are conducive to the change. If the neighbouring social complex does not accommodate new reformed human behaviours, actors will find it hard to sustain them. Thus, reducing costs of frictions within the social complex will increase effectiveness of behaviour change. Alternatively, social planners must attend to tailoring contextual factors so that behavioural changes introduced by behavioural tools are reinforced in the local environment, enabling mass shifts and adoption. In our example of sustainable transport decisions, this will imply subsiding sustainable

modes of transport. Finally, hypothesis 3 highlights the modality of effecting behaviour change. Given priors about human actors, and their social cues, it is easier to deliver critical shifts at some nodes than others. Social planners must therefore account for intensive and extensive margins of change and deliver behavioural interventions while being mindful of nodes which can be most conducive to reach critical masses.

Policies for the social brain: applications

The social brain construct highlights the fact that human behaviour is not isolated to the individual, but rather influenced by the interactions and social environment in which they are situated. This understanding is important for policymakers seeking to bring about positive social change, as it suggests that targeting different aspects of the social brain may be necessary. Here are a few examples to demonstrate the usefulness of the social brain construct, for example, the behaviour of one person can be influenced by the actions of others in their social group, or the properties of the social complex (e.g. culture, norms, values) can shape individual behaviour. Thus, holistic approaches to social change may be necessary, as different parts of the social brain can impact behaviour. We outline these behavioural public policies for the social brain.

Behavioural public policies for individual actors: nodes of the social brain

The most commonly used set of contemporary behavioural public policies are those that are targeted at the nodes of the social brain. In other words, these behavioural public policies are directed at changing individual human behaviours (hence, the name 'i-frame' by Chater & Loewenstein, 2022). These policies have been classified in many ways in the public policy literature, but most comprehensively by Hood and Margetts (Hood, 1983; Margetts, 1998; Hood & Margetts, 2007) using the NATO acronym, which refers to four main types of public policies to regulate human behaviour: nodality or network tools, authority like command-and-control regulation, treasury tools and organisational ones. Later, behavioural tools which seek to provide information to people have been also classified as a fifth form of tool to regulate these individual behaviours (see John, 2013).

While the NATO tools are conceptualised based on rational theory of human behaviour, the behavioural tools represent a significant departure from this – for example, Oliver (2017) proposes a behavioural policy cube that maps these different tools using three different dimensions, one being the degree of rationality presumed in the design of these tools. Behaviourally designed tools, nonetheless, were taken to refer to nudges mostly at the beginning of the last decade (Banerjee, 2021), but increasing applications of behavioural science have added more and more toolkits to this set. For example, Peter John and colleagues have proposed using citizen-led deliberations (called 'think') to drive individual behaviour change. These educative policies have also resonated with ideas of a system-2 nudge, proposed by Sunstein (2016), which suggests a reflective cognitive route to effectuate behaviour change. Later, Hertwig (2017) and Herwig and Grüne-Yanoff have proposed boosting individual capacities as a way to drive individual behaviour change. Boosts are inspired by the need to maintain human agency – ability to form intentions and act freely

on them. Here, recently, they have been joined by a new category of tools called the nudge+, which proposes to encourage people to reflect alongside nudge to improve the uptake of the nudge (Banerjee, 2021; Banerjee & John, 2021). While many of these behavioural policies are seemingly libertarian in nature, it is also possible to develop more paternalistic behavioural public policies, such as shoves and budges, as proposed by Oliver (2017).

Applications of these behavioural public policies for the social brain node abound in the literature. There is a growing effort to systematise into their effectiveness such as by DellaVigna & Linos (2022) who assemble 126 RCTs covering over 23 million individuals to show an average impact of the nudges at 1.4%. Similarly, Mertens *et al.* (2022) analyse more than 200 studies to show that the average effectiveness of these BPPs targeted at the social brain node vary between small and medium sizes – but these findings have been challenged recently by Maier *et al.* (2022) and Szaszi *et al.* (2022) who show that controlling for publication errors nullifies the effects of these policies.

Behavioural public policies for a network of actors: social cues in the social brain

Although there is an abundance of behavioural public policies that target the individual nodes of the social brain, there are limited policies that attend to wider network of people who receive these policies and the social cues between them. The social brain construct indicates the need to develop behavioural public policies that improves the social cohesion between actors. This can be done in many different ways, such as by reducing frictions to path dependencies and facilitating greater critical mass shifts. We highlight two examples of effectuating behavioural public policies which seek to improve the social cohesion.

Our first example relates to improving social cohesion by regrouping these individual nodes to improve the flow of social cues between them. Consider the following thought experiment. Have you ever wondered, what were to happen if academic members of a research discipline, say Economics, were made to collaborate on one joint research project? Are we to lose gains to be made from the solitude of the lone genius when they are working in groups? Assuming away all differences in research specialisation(s), it would not be surprising to find limited to no academic output from this cohort. Academic disenchantment (Blackmore, 2014), wastage of talent resulting from a quest for superiority (Vugt & Ronay, 2014) and dehumanisation of academia (Cornelis, 2014) might be to blame. And this is not true only for academics. Workplace revenge (Tripp & Bies, 2009) has been well documented. In these settings, what matters, therefore, is not how we can steer these individuals to their welfare-improving choices but how we can re-frame the social brain to maximise the overall output from the cohort. Perhaps, even a group of low-merit workers can engage to produce better output than this cohort of high-performing academics. Let's formalise this.

Imagine being assigned as the head of Academia. In the simplest world, Academia has only two tenure-track staff members, call them High-performing (H) and Low-performing (L). H and L are appointed to produce novel, high-impact research for their department. Both have a fixed amount of labour at their disposal, which they

can use to produce new research (R) or demotivate the other using verbal cues (D). Demotivation by one translates into reduced research output for the other since it involves some emotional costs to it. Let D indicate the net demotivation, accounting for any positive interaction spillovers between H and M. As a newly appointed head, you are tasked to either assign H and L to a shared office space or allow them to hot desk. Hotdesking involves lost time in output produced for any absent staff but saves on the emotional costs of demotivation. What do you do?

Let us consider the possibilities under hot desking. For convenience, we will assume some production functions ($R_H = 20T_H$; $R_L = 10T_L$; $T = T_H + T_L$), but this simple exercise is self-contained in itself. As the production functions indicate, when made to hot desk, by putting in time T, H and L produce research work, in a ratio of 2:1 indicating their differences in merit. Both together can invest resources up to T units as available to hot desk in Academia. There is no demotivation produced since H and L do not interact with one another. Optimality warrants an entire office space allocation to H to maximise output produced. On ground of fairness, if office space is equally allocated (T/2), we end up with a sub-optimal research output (=15 T). Understanding how people communicate and affect each other in the social brain can, therefore, improve overall output. Choice architects might also propose changes to what the office orientation might look. If the social fabric changes, the outcomes are bound to change. For example, under diminishing marginal productivity of labour, it might be optimal to allocate a positive number of hours to both H and L, but in different portions of the day to avoid demotivation.

It is also possible to consider cases when there are different levels of demotivation induced by each of these agents. While we do not pursue this example any further, it is easy to anticipate when one worker demotivates the other, while also producing the highest output of research. In this case, it is best to re-group these actors so that their social connections are limited. Our example here highlights the role of social cues between nodes which are often seen to influence many decisions. These have been discussed in a wide range of setting such shifts in socially embedded preferences and norms to tackle fertility behaviours (Dasgupta & Dasgupta, 2017), understanding market reactions by studying human pro-social feelings (Dasgupta & Dasgupta, 2017; Smith & Wilson, 2019; Oliver, 2021).

Our second example relates to the better targeting of different nodes of the social brain, based on the expected social cohesion that can maximise the desired impact of the policy and lead to critical mass shifts. Consider the problem caused by low levels of female literacy, empowerment and education in many developing countries which has adverse implications for the status and welfare of women as well as the state of the economy, given that women potentially constitute ≈40% of the workforce of the economy. For example, in India, the government has recently undertaken a programme for education, empowerment and security of women and girls, called Beti Bachao Beti Padhao which translates into 'Educate the Girl to Save Her' scheme. The programme was motivated by the continuous decline in the Child Sex Ratio (CSR), the number of girls per 1,000 of boys in the 0–6 years age category, since 1961. Between 1991 and 2011, this ratio has shown alarming decrease from 945 to 918, an indicator of female dis-empowerment; and a consequence of pre-birth discrimination, manifested in gender-biased sex selection, and post-birth discrimination

against girls. Therefore, the Government of India has devised a programme that would attempt to drastically reduce this discrimination by fostering attitudinal changes in adult men and women towards girl children as well as educate and empower the girl child.

The success of a programme such as this depends on the content of messaging and the channels chosen to convey messages. In regard to this programme targeting female literacy, it is important to realise that India is marked by diversity in languages spoken, religions and faiths followed and the compartmentalisation of the society into castes. Thus, the idea would be to consider the society (social brain) as carved into different sub-categories, with each such sub-category characterised by commonality in language, caste and religion. Sub-categories so defined can be expected to have high social cohesion: a member chosen from each part as an ambassador for the female literacy campaign would be acceptable to all other members, and therefore, their messages to other members will be understood well and quickly without any misunderstandings. On the other hand, if an ambassador to a sub-category is chosen from outside that sub-category – for example, a high caste ambassador to a low caste group – the messaging from that ambassador to the group will not be able to take advantage of the social cohesion within the group. There might be problems relating to comprehension of the message, both in regard to speed and accuracy.

While there exist different possibilities, other than the ones noted above, to leverage the social cues in a social brain, we believe that these examples provide sufficient rationale adjust the delivery of these policies to maximise the social cohesion glue of the social brain.

Behavioural public policies for the physical environment: social complex of the social brain

The final set of behavioural public policies, as noted from the social brain construct, refers to those which improve the social complex of the social brain. These policies refer to changes in broad physical environments, whose material and immaterial properties, affect individual nodes of the social brain and the relay of social cues between different nodes in it. We highlight a few example that speak to the merits of these types of BPPs for the social complex.

Consider the problem of sustainable dietary consumption. Most BPPs aimed at fostering climate-friendly diets relate to targeting individual biases and heuristics, such as defaulting people into non-meat menus, commitment pledges to climatarian diets, labels to educate citizens about the carbon content of diets and so on (Byerly *et al*., 2018). However, there is little discussion of broader systemic policies which can modify physical environments in people often make these dietary choices. One example is IKEA's modern plant-based food hall, which aims to develop a Nordic culture to serve 80% or more plant-based food in *Saluhall* (Starostinetskaya, 2022). Another example of changing the social complex for fostering better diets relates to a futuristic kitchen design by the Swedish company Electrolux, based on the EAT-LANCET guidelines, to reduce meat storage and food waste in home kitchens (Hamilton & May-Boyd, 2022). Similarly, the growth of meat alternatives, such as lab-grown meat and/or that produced by 3D printers, also changes the social complex to facilitate a greater adoption of plant-based diets.

Consider the related problem of fostering workplace sustainability. Here, BPPs designed for the node would suggest incentivising individual behaviours such as providing financial incentives for making more planet-friendly decisions or nudging workers towards sustainable choices, like setting printers to a default duplex printing mode, setting temperature defaults and so on. Nonetheless, there also exist many structural solutions to change the social complex, which can prompt pro-environmental behaviours. Some of these changes include choosing post-consumer waste or recycled paper for printing which has been shown to be more sustainable, bring your own coffee cups and not providing plastic or paper cups in cafeterias, changing to electricity conserving appliances and so on.

It is important to note that most of these changes to the wider social complex of the social brain refer to broader structural changes which are often beyond the remit of an individual. However, using the social better, there remain possibilities to identify and modify aspects of these social complexes which need changes, further facilitating behaviour change directed at the nodes.

Treating the social brain: a general guide

In many ways, the social planner is a doctor who is entrusted to treat and cure the society of its social ills. These practitioners, like our doctors, have tools at their disposal to change human behaviours (Hood, 1983; Hood & Margetts, 2007; Oliver, 2013a). However, like every sensible doctor, they must understand the cause of an ill, before identifying the best way to start treating it. A successful prognosis of the disease rests on whether it is localised or not, for the spread can also determine appropriate interventions and treatment channels. And that's not all, for they must ensure that it simply does not come back once the diagnosis and treatment is over.

To extend this analogy further, recently, we have seen many treatments which have failed to deliver this persistence. Ultimately, the social ill has returned, partly or fully. We need to scale-up our treatments. We also need to think about persistence of these treatments. It is here that our construct of the social brain can work as a guide for policymakers to warrant appropriation of behavioural treatments beyond individual actors of change and their physical environments. We put forward three general recommendations for a BPP planner:

1. *The BPP planner* must consider different actors and their roles and position in the society when designing behavioural interventions for a node (i.e. an individual). Understanding these nodes of the social brain facilitates better targeting of individual BPPs and increases their desired effectiveness while reducing their unintended effects.
2. *The BPP planner* must adopt a data-driven, inductive approach that considers the role of social cues in the network of different human actors. This will allow policymakers to better understand the mechanisms that relay behaviour change across actors in the society. Improving the social cohesion glue between actors, reducing frictions among actors to make better use of path dependencies will generate possibilities for critical mass shifts.
3. *The BPP planner* must design policies for the social complex. In other words, planners must be attentive to details of the physical environment in which

behaviour change strategies for the individual are delivered. They should be aware of their limitations as well and consider other approaches, such as BPP for a network of actors or for the social context, that may be more effective in certain contexts.

While we have no qualms with the current surgical toolkits of effecting change – there are ample, albeit it's an important discussion to ascertain which works best (Johnson *et al*., 2019; Banerjee *et al*., 2022) – however, what we feel has been missing in practice is the attention to the wider factors that influence many of these behavioural public policies and human behavioural responses to them. The context of initiating behavioural change matters, a point that was raised by Hallsworth & Kirkman (2021) in their discussion of a standard behavioural problem-solving exercise. As our social brain posits, there are channels, human interrelationships and social cues, which can amplify or dampen the effects of standard behavioural tools. The policymaker, therefore, must carefully inspect these. We list a set of guiding questions for the BPP planner to ask, before delivering a behaviour change strategy for the individual:

Question #1. What is the appropriate node to initiate behaviour change?

The node is important because it denotes the position of actors in a society who will be key to receiving behavioural change and transmitting them in the form of social cues, enabling critical shifts for population masses. The policymaker can avail statistics to inform their choice. For example, the reach of the node can be measured by their social network, *per se*. Similarly, the rate of transmission of social cues can be measured by numbers of trickle down, a function of the social network too. It might be a case that different nodes must be targeted to begin this chain reaction. However, it might also be a case that nodes need regrouping, just like our example in Academia showed. Rearranging social networks to increase social cohesion is a way to diffuse any treatment quickly.

Question #2. Who constitutes these nodes in the social brain? How is this network arranged? What social cues exist within this network of actors?

Their characteristics, mainly in their situational and dispositional factors, will yield information on their capacities to facilitate social cues. Sometimes, specific needs for social cue transmission will determine the appropriate actors to target in the social brain, such in our example of building social and human capital with children. Moreover, the social brain is characterised by human interrelationships that are based on communication signals. Manifesting social cues, therefore, can engage right channels of transmission, through role models or messengers, that will match the nodes where change in being initiated. This was shown in our example with the girl child education policy in India.

Question #3. What is the nature of the social complex? Is it conducive for the said public policy? Does it facilitate existing path dependencies or prevent it? Can it lead to a critical mass shift?

Finally, our physical environment, with its objects, also plays an important role. We have discussed ways in which this social complex can be restructured to facilitate behaviour change by amplifying the effect of public policies.

A lot of what is proposed in the social brain needs vast amount of data, a limitation we face currently. It is for the same reason, other desirable changes are still waiting in line to take off, such as personalisation to improve the delivery of micro-based behavioural interventions (Mills, 2022). Knowing about all the actors, which form these nodes, their social networks and how they communicate with cues, and their social and physical environments in which they are based in, are fundamental requirements to corroborate the social brain. With data limitations we face, we can simply think of aggregate statistics, sample-based measurements, which can inform the application of any tool of behaviour change. Fundamentally, thinking about the social brain can move us towards ways of designing public policies that go beyond individuals solely. In scaling them up, the scope of behavioural public policies can be increased by tapping into connections that humans share with each other, the relationships they have and the social complex in which they respond to these public policies.

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References

Adams, J. and M. White (2005), 'When the population approach to prevention puts the health of individuals at risk', *International Journal of Epidemiology*, **34**(1): 40–43.

Al-Ubaydli, O. and J. A. List (2017), 'Field experiments in markets', in E. Duflo and A. Banerjee (eds), *Handbook of Economic Field Experiments*, Vol. 1. North-Holland: Elsevier, 271–307.

Al-Ubaydli, O., J. A. List and D. L. Suskind (2017a), The Science of Using Science.

Al-Ubaydli, O., J. A. List and D. L. Suskind (2017b), 'What can we learn from experiments? Understanding the threats to the scalability of experimental results', *American Economic Review*, **107**(5): 282–86.

Al-Ubaydli, O., J. A. List, D. LoRe and D. Suskind (2017c), 'Scaling for economists: lessons from the non-adherence problem in the medical literature', *Journal of Economic Perspectives*, **31**(4): 125–44.

Al-Ubaydli, O., J. A. List and D. Suskind (2019), *The Science of Using Science: Towards an Understanding of the Threats to Scaling Experiments* (No. w25848). National Bureau of Economic Research. https://www.nber.org/papers/w25848

Al-Ubaydli, O., M. S. Lee, J. A. List, C. L. Mackevicius and D. Suskind (2021), 'How can experiments play a greater role in public policy? Twelve proposals from an economic model of scaling', *Behavioural Public Policy*, **5**(1): 2–49.

Alós-Ferrer, C. (2018), 'A review essay on social neuroscience: can research on the social brain and economics inform each other?' *Journal of Economic Literature*, **56**(1): 234–64.

Ball, S. and B. W. Head (2021), 'Behavioural insights teams in practice: nudge missions and methods on trial', *Policy & Politics*, **49**(1): 105–120.

Banerjee, S. (2021), 'Rethinking the Origin of the Behavioural Policy Cube with Nudge Plus', in V. Mihaila (ed.), *Behavioral-Based Interventions for Improving Public Policies*, IGI Global, 1–16. https://doi.org/10.4018/978-1-7998-2731-3.ch001

Banerjee, S. and P. John (2021), 'Nudge plus: incorporating reflection into behavioral public policy', *Behavioural Public Policy*, 1–16.

Banerjee, S. and P. John (2022), 'Nudge and Nudging in Public Policy', https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4314881

Banerjee, S., M. M. Galizzi, P. John and S. Mourato (2022), 'What works best in promoting climate citizenship? A randomised, systematic evaluation of nudge, think, boost and nudge+', *Research Square preprints*. Available here: https://doi.org/10.21203/rs.3.rs-1534312/v1, available at SSRN: https://ssrn.com/abstract=4093689 or http://dx.doi.org/10.2139/ssrn.4093689

Barnett, J., L. S. Evans, C. Gross, A. S. Kiem, R. T. Kingsford, J. P. Palutikof, C. M. Pickering and S. G. Smithers (2015), 'From barriers to limits to climate change adaptation: path dependency and the speed of change', *Ecology and Society*, **20**(3): 1–11.

Beal, D. J., R. R. Cohen, M. J. Burke and C. L. McLendon (2003), 'Cohesion and performance in groups: a meta-analytic clarification of construct relations', *Journal of Applied Psychology*, **88**(6): 989.

Becker, G. S. and K. M. Murphy (2009), *Social Economics: Market Behavior in a Social Environment*. Cambridge, MA and London: Harvard University Press.

Bednar, J. and S. E. Page (2018), 'When order affects performance: culture, behavioral spillovers, and institutional path dependence', *American Political Science Review*, **112**(1): 82–98.

Benartzi, S., J. Beshears, K. L. Milkman, C. R. Sunstein, R. H. Thaler, M. Shankar, W. Tucker-Ray, W. J. Congdon and S. Galing (2017), 'Should governments invest more in nudging?', *Psychological Science*, **28**(8): 1041–1055.

Bernheim, B. D. and A. Rangel (2009), 'Beyond revealed preference: choice-theoretic foundations for behavioral welfare economics', *The Quarterly Journal of Economics*, **124**(1): 51–104.

Beshears, J. and H. Kosowsky (2020), 'Nudging: progress to date and future directions', *Organizational Behavior and Human Decision Processes*, **161**: 3–19.

Bitner, M. J. (1992), 'Servicescapes: the impact of physical surroundings on customers and employees', *Journal of Marketing*, **56**(2): 57–71.

Blackmore, J. (2014), '"Wasting talent"? Gender and the problematics of academic disenchantment and disengagement with leadership', *Higher Education Research & Development*, **33**(1): 86–99.

Byerly, H., A. Balmford, P. J. Ferraro, C. Hammond Wagner, E. Palchak, S. Polasky and B. Fisher (2018), 'Nudging pro-environmental behavior: evidence and opportunities', *Frontiers in Ecology and the Environment*, **16**(3): 159–168.

Camerer, C. F. (2011), *Behavioral Game Theory: Experiments in Strategic Interaction*. Princeton, NJ: Princeton University Press.

Cane, J., D. O'Connor and S. Michie (2012), 'Validation of the theoretical domains framework for use in behaviour change and implementation research', *Implementation Science*, **7**(1): 1–17.

Carter, I. (2013), *Human Behavior in the Social Environment*. New York: AldineTransaction.

Chater, N. and G. Loewenstein (2022), The i-frame and the s-frame: how focusing on the individual-level solutions has led behavioral public policy astray. Available at SSRN 4046264.

Chu, A., A. Thorne and H. Guite (2004), 'The impact on mental well-being of the urban and physical environment: an assessment of the evidence', *Journal of Public Mental Health*, **3**(2): 17–32.

Clark, A. and D. Chalmers (1998), 'The extended mind', *Analysis*, **58**(1): 7–19.

Cornelis, G. C. (2014), It Is About Time We Put an End to the Dehumanisation of the Academic World.

Dasgupta, A. and P. Dasgupta (2017), 'Socially embedded preferences, environmental externalities, and reproductive rights', *Population and Development Review*, **43**(3): 405–441.

DellaVigna, S. and E. Linos (2022), 'RCTs to scale: comprehensive evidence from two nudge units', *Econometrica*, **90**(1): 81–116.

DellaVigna, S., W. Kim and E. Linos (2022), Bottlenecks for Evidence Adoption.

Dunbar, R. I. (2009), 'The social brain hypothesis and its implications for social evolution', *Annals of Human Biology*, **36**(5): 562–572.

Dunbar, R. I. and S. Shultz (2007), 'Evolution in the social brain', *Science*, **317**(5843): 1344–1347.

Feest, U. (2019), 'Why replication is overrated', *Philosophy of Science*, **86**(5): 895–905.

Gigerenzer, G. and W. Gaissmaier (2011), 'Heuristic decision making', *Annual Review of Psychology*, **62**: 451–482.

Hallsworth, M. (2023), 'A manifesto for applying behavioural science', *Nature Human Behaviour*, **7**(3): 310–322. http://dx.doi.org/10.1038/s41562-023-01555-3.

Hallsworth, M. and E. Kirkman (2021), *Behavioral Insights*. Cambridge, MA: MIT Press.

Hamilton, E. and K. May-Boyd (2022), *To Solve Climate Change, It's Not Only What We Eat, But How We Eat*. Fast Company. Retrieved from: https://www.fastcompany.com/90794903/to-solve-climate-change-its-not-only-what-we-eat-but-how-we-eat

Heider, F. (2013), *The Psychology of Interpersonal Relations*. New York: Psychology Press.
Hertwig, R. (2017), 'When to consider boosting: some rules for policy-makers', *Behavioural Public Policy*, **1**(2): 143–161.
Hollands, G. J., G. Bignardi, M. Johnston, M. P. Kelly, D. Ogilvie, M. Petticrew and T. M. Marteau (2017), 'The TIPPME intervention typology for changing environments to change behaviour', *Nature Human Behaviour*, **1**(8): 1–9.
Hood, C. (1983), *Tools of Government*. London: Macmillan International Higher Education.
Hood, C. C. and H. Z. Margetts (2007), *The Tools of Government in the Digital Age*. London: Macmillan International Higher Education.
Insights, O. B. and P. Policy (2017), *Lessons from Around the World*. Paris (FRA): OECD Publishing.
John, P. (2013), 'All tools are informational now: how information and persuasion define the tools of government', *Policy & Politics*, **41**(4): 605–620.
John, P. (2021), 'Let's walk before we can run: the uncertain demand from policymakers for trials', *Behavioural Public Policy*, **5**(1): 112–116.
Johnson, E. J., S. B. Shu, B. G. Dellaert, C. Fox, D. G. Goldstein, G. Häubl and E. U. Weber (2012), 'Beyond nudges: tools of a choice architecture', *Marketing letters*, **23**(2): 487–504.
Johnson, S., *et al.* (2019), 'What works: when and why are nudges sticky, scaleable and transferable?' *Journal of Behavioral Economics for Policy*, **3**(S): 19–21.
Ju, I., J. Ohs, T. Park and A. Hinsley (2021), 'Interpersonal communication influence on health-protective behaviors amid the COVID-19 crisis', *Health Communication*, **38**(3): 468–479.
Kahneman, D. (2014), 'A new etiquette for replication', *Social Psychology*, **45**(4): 310.
Kahneman, D., O. Sibony and C. R. Sunstein (2021), *Noise: A Flaw in Human Judgment*. Boston, MA: Little, Brown.
Kay, A. C., S. C. Wheeler, J. A. Bargh and L. Ross (2004), 'Material priming: the influence of mundane physical objects on situational construal and competitive behavioral choice', *Organizational Behavior and Human Decision Processes*, **95**(1): 83–96.
Krpan, D. and M. Urbaník (2020), 'From libertarian paternalism to liberalism: behavioural science and policy in an age of new technology', *Behavioural Public Policy*, 1–27.
Kuran, T. and C. R. Sunstein (1998), 'Availability cascades and risk regulation', *Stanford Law Review*, **51**: 683.
Lades, L. K., K. Laffan and T. O. Weber (2021), 'Do economic preferences predict pro-environmental behaviour?' *Ecological Economics*, **183**: 106977.
Laffan, K., C. Sunstein and P. Dolan (2021b), 'Facing it: assessing the immediate emotional impacts of calorie labelling using automatic facial coding', *Behavioural Public Policy*, 1–18.
Laffan, K., *et al.* (2021a), *Counting Contexts that Count: An Exploration of the Contextual Correlates of Meat Consumption in Three Western European Countries*. Technical Report.
Lahlou, S. (2018), *Installation Theory: The Societal Construction and Regulation of Behaviour*. Cambridge, UK: Cambridge University Press.
Lee, S. Y. and J. L. Brand (2010), 'Can personal control over the physical environment ease distractions in office workplaces?' *Ergonomics*, **53**(3): 324–335.
Lieberman, M. D. (2013), *Social: Why Our Brains Are Wired to Connect*. Oxford, UK: OUP Oxford.
Lindblom, J. and T. Ziemke (2003), 'Social situatedness of natural and artificial intelligence: Vygotsky and beyond', *Adaptive Behavior*, **11**(2): 79–96.
Maier, M., F. Bartoš, T. D. Stanley, D. R. Shanks, A. J. Harris and E. J. Wagenmakers (2022), 'No evidence for nudging after adjusting for publication bias', *Proceedings of the National Academy of Sciences*, **119**(31): e2200300119.
Marchiori, D. R., M. A. Adriaanse and D. T. De Ridder (2017), 'Unresolved questions in nudging research: Putting the psychology back in nudging', *Social and Personality Psychology Compass*, **11**(1): e12297.
Margetts, H. (1998), 'Computerising the tools of government', *Public Administration in an Information Age: A Handbook*, **6**: 441.
Marteau, T. M., P. C. Fletcher, M. R. Munafò and G. J. Hollands (2021), 'Beyond choice architecture: advancing the science of changing behaviour at scale', *BMC Public Health*, **21**(1): 1–7.
Mertens, S., M. Herberz, U. J. Hahnel and T. Brosch (2022), 'The effectiveness of nudging: a meta-analysis of choice architecture interventions across behavioral domains', *Proceedings of the National Academy of Sciences*, **119**(1): e2107346118.

Michie, S. and R. West (2013), 'Behaviour change theory and evidence: a presentation to government', *Health Psychology Review*, **7**(1): 1–22.

Michie, S., M. M. Van Stralen and R. West (2011), 'The behaviour change wheel: a new method for characterising and designing behaviour change interventions', *Implementation Science*, **6**(1): 1–12.

Michie, S., M. Richardson, M. Johnston, C. Abraham, J. Francis, W. Hardeman, M. P. Eccles, J. Cane and C. E. Wood (2013), 'The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: building an international consensus for the reporting of behavior change interventions', *Annals of Behavioral Medicine*, **46**(1): 81–95.

Michie, S., L. Atkins and R. West (2014), The Behaviour Change Wheel: A Guide to Designing Interventions.

Mills, S. (2022), 'Personalized nudging', *Behavioural Public Policy*, **6**(1): 150–159.

Mongin, P. and M. Cozic (2018), 'Rethinking nudge: not one but three concepts', *Behavioural Public Policy*, **2**(1): 107–124.

Mozaffarian, D., A. Afshin, N. L. Benowitz, V. Bittner, S. R. Daniels, H. A. Franch, D. R. Jacobs, W. E. Kraus, P. M. Kris-Etherton, D. A. Krummel, B. M. Popkin, L. P. Whitsel and N. A. Zakai (2012), 'Population approaches to improve diet, physical activity, and smoking habits: a scientific statement from the American Heart Association', *Circulation*, **126**(12): 1514–1563.

Oliver, A. (2013a), *Behavioural Public Policy*. Cambridge, UK: Cambridge University Press.

Oliver, P. (2013b), 'Critical mass theory', *The Wiley-Blackwell Encyclopedia of Social and Political Movements*, 1–4. https://doi.org/10.1002/9780470674871.wbespm059.pub2

Oliver, A. (2017), *The Origins of Behavioural Public Policy*. Cambridge: Cambridge University Press. doi:10.1017/9781108225120

Oliver, A. (2021), *A Little Give and Take*. LSE Public Policy Review. ISSN 2633-4046.

Rauthmann, J. F. and R. A. Sherman (2020), 'The situation of situation research: knowns and unknowns', *Current Directions in Psychological Science*, **29**(5): 473–480.

Rauthmann, J. F. and R. A. Sherman (2021), 'Conceptualizing and Measuring the Psychological Situation', in D. Wood, S. J. Read, P. D. Harms, and A. Slaughter (eds), *Measuring and Modeling Persons and Situations*, Academic Press, 427–463.

Rauthmann, J. F., R. A. Sherman and D. C. Funder (2015a), 'New horizons in research on psychological situations and environments', *European Journal of Personality*, **29**(3): 382–432.

Rauthmann, J. F., R. A. Sherman and D. C. Funder (2015b), 'Principles of situation research: Towards a better understanding of psychological situations', *European Journal of Personality*, **29**(3): 363–381.

Rela, N. (2022), 'On nudges that fail', *Behavioural Public Policy*, 1–15.

Rose, G. (2001), 'Sick individuals and sick populations', *International Journal of Epidemiology*, **30**(3): 427–432.

Schmidt, R. (2022), 'A model for choice infrastructure: Looking beyond choice architecture in Behavioral Public Policy', *Behavioural Public Policy*, 1–26. doi:10.1017/bpp.2021.44

Schreyögg, G., J. Sydow and P. Holtmann (2011), 'How history matters in organisations: the case of path dependence', *Management & organizational history*, **6**(1): 81–100.

Schumpeter, J. (1942), 'Creative destruction', *Capitalism Socialism and Democracy*, **825**: 82–85.

Smith, V. L. and B. J. Wilson (2019), *Humanomics: Moral Sentiments and the Wealth of Nations for the Twenty-First Century*. Cambridge, UK: Cambridge University Press.

Starostinetskaya, A. (2022), *IKEA's New Plant-Based Food Hall Is Coming to These 3 Cities*. VegNews.com. Retrieved from: https://vegnews.com/2022/12/ikea-plant-based-food-hall

Stedman, R. C. (2003), 'Is it really just a social construction?: The contribution of the physical environment to sense of place', *Society & Natural Resources*, **16**(8): 671–685.

Sugden, R. (2013), 'The behavioural economist and the social planner: to whom should behavioural welfare economics be addressed?' *Inquiry*, **56**(5): 519–538.

Sunstein, C. R. (2016), 'People prefer system 2 nudges (kind of)', *Duke LJ*, **66**: 121.

Sunstein, C. R. (2020), *Too Much Information: Understanding What You Don't Want to Know*. Cambridge, MA: MIT Press.

Szaszi, B., Higney, A., Charlton, A., Gelman, A., Ziano, I., Aczel, B., Goldstein, D. G., Yeager, D. S. and Tipton, E. (2022). No reason to expect large and consistent effects of nudge interventions. *Proceedings of the National Academy of Sciences*, **119**(31), e2200732119.

Thaler, R. H. and C. R. Sunstein (2008), Nudge: Improving Decisions about Health, Wealth, and Happiness.

Thaler, R. H. and C. R. Sunstein (2021), *Nudge*. Yale University Press.

Todd, P. M. and G. E. Gigerenzer (2012), *Ecological Rationality: Intelligence in the World*. Oxford University Press.

Tor, A. (2020), 'Nudges that should fail?' *Behavioural Public Policy*, **4**(3): 316–342.

Tor, A. and J. Klick (2022), 'When Should Governments Invest More in Nudging? Revisiting Benartzi et al. (2017)', *Review of Law and Economics* (Forthcoming), U of Penn, Inst for Law & Econ Research Paper No. 22-36, Available at SSRN: https://ssrn.com/abstract=4189136 or http://dx.doi.org/10.2139/ssrn.4189136

Tripp, T. M. and R. J. Bies (2009), *Getting Even: The Truth About Workplace Revenge – And How to Stop It*. John Wiley & Sons.

Van der Weiden, A., J. Benjamins, M. Gillebaart, J. F. Ybema and D. De Ridder (2020), 'How to form good habits? A longitudinal field study on the role of self-control in habit formation', *Frontiers in Psychology*, **11**: 560.

Vischer, J. C. (2007), 'The effects of the physical environment on job performance: towards a theoretical model of workspace stress', *Stress and Health: Journal of the International Society for the Investigation of Stress*, **23**(3): 175–184.

Vugt, M. V. and R. Ronay (2014), 'The evolutionary psychology of leadership: Theory, review, and roadmap', *Organizational Psychology Review*, **4**(1): 74–95.

Wickens, C. D. and C. M. Carswell (2021), 'Information processing', *Handbook of Human Factors and Ergonomics*, 114–158.

Wilkie, S., T. Townshend, E. Thompson and J. Ling (2018), 'Restructuring the built environment to change adult health behaviors: a scoping review integrated with behavior change frameworks', *Cities & Health*, **2**(2): 198–211.

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