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Editorial introduction

David Samways – Editor

The question of how to achieve environmental sustainability inevitably raises a host of conceptual and philosophical problems. Not least amongst these is defining what sustainability itself actually means. Any investigation of this question soon throws up a myriad of other questions regarding the understanding of other ideas and concepts such as nature and wilderness but also of autonomy, the good life, global justice and so on. I will not attempt the somewhat Sisyphean task of defining sustainability in this editorial, but the papers in this edition of the JP&S, although tackling quite different subject matter, nonetheless contain themes, issues and questions which relate directly to this conceptual conundrum. In particular, questions of autonomy and behaviour change, resource distribution and equity, as well as different conceptions of a good life are apparent. These questions are deeply ethical and value dependent and go to the core of the discussion of population and sustainability – making it inescapably political in nature.

In Becky Blackford's paper sustainable food consumption (SFC) is the matter under discussion. Her contribution considers how personal food choices might be influenced to reduce environmental impact and meet demand as the global population grows. As she notes, food security is not a question of agricultural sufficiency since at present more than enough grain is produced to adequately nourish the current world population and possibly accommodate future growth. At base, the persistence of the best part of a billion people living with food insecurity is a distributional issue caused by the growing demand for meat and dairy foods which effectively price the poor out of the global food market. However, the environmental sustainability of the global food system at current levels of resource use is questionable - especially as this relates to the consumption of animal products. Blackford's paper reviews the use of nudge theory in changing food consumption behaviour toward more sustainable choices such as plant-

based and locally sourced products. She concludes that various types of nudges may be effective tools in changing food choices, but that the type of nudge and context are important. Perhaps most interestingly, Blackford's review shows that the most effective nudges are those which target so called "System 1 thinking", the non-deliberative, automatic and intuitive part of consciousness – what the sociologist Anthony Giddens (1984) calls "practical consciousness".

Blackford's paper raises some important issues for those concerned with behaviour change as a factor in environmental sustainability. Many, especially those on the political left (for example Monbiot 2019; Klein, 2014), have argued that, rather than concentrating on individual behaviour-change, only structural systemic transformation can prevent ecological catastrophe. Such arguments are not without merit and draw on a long-standing left-wing intellectual tradition focussed on the institutional or structural level rather than the individual agent. However, the problem with such approaches is that they tend to underestimate the role of individual choices in social structural reproduction and reduce consumer preferences and life-style choices to ideological effects of capitalism or consumerism. From this perspective, much of what people regard as choice is an illusion since the pervasiveness and power of the prevailing ideology manipulates behaviour to serve the interests of the system or of the powerful elites who benefit from it. This is an attractive approach since it focuses on power and the structural constraints upon individual behaviour. However, such arguments also generate some consternation regarding individual responsibility for consumption choices and are in danger of regarding agents as structural dopes unable to reflect upon and change their actions. This is related to a much wider discussion in the social sciences regarding the relationship between structure and agency, a full discussion of which is well beyond the space available here. However, it is clear that while there are social structural constraints upon consumption choices, and ideologies such as consumerism play their role, environmental discourses which challenge the status quo are widespread and, in many cases, individuals are capable of reflecting upon their choices and exercising agency. Nudging might play a role in assisting the breaking of habitual choices with high environmental impacts. Indeed, the fact that the ideas about autonomy and self-determination are valued in western discourses is reflected in Blackford's noting of the ethical qualms expressed about behaviour manipulation via measures such as nudges – especially when operating at the level of practical consciousness.

Food security is perhaps the oldest population growth concern and is inescapably political in nature. When Thomas Malthus wrote *An Essay on the Principle of Population* (1998 [1798]) he was responding to William Godwin's and the Marquis de Condorcet's writings on the "perfectibility of society". Malthus argued that, since population grew geometrically while agricultural production could only grow arithmetically, in a society without inequality the population would grow at an unprecedented rate and quickly outstrip food production. Thus, Malthus argued even in a society where "benevolence had established her reign in all hearts", food scarcity would eventually result in "violence, oppression, falsehood, misery, every hateful vice, and every form of distress, which degrade and sadden the present state of society, ...generated... by laws inherent in the nature of man" (p.60). Where Godwin (1793) had reasoned that human nature could be transcended and the urge to procreate diminished by the development of the intellect, Malthus insisted that, inevitably, human nature and the limits of the natural world would prevail, leading to immiseration as demand outstripped food supply.

Malthus' argument that there were natural impediments, both in the natural environment and in human nature, which thwarted the eradication of want was rejected by left-leaning progressive and socialist thinkers. Perhaps most powerfully in the writings of Marx and Engels, it was argued that there is nothing "natural" about poverty and scarcity, that they are a product of exploitative social systems and can be solved through system change, technical progress and equitable distribution. Indeed, as we have seen, the food supply has not been determined by fixed natural laws of linear growth but has been continuously expanded well beyond the needs of the population by technological means – although the environmental sustainability of this expansion is highly questionable.

In the late 60s environmental arguments featuring population growth captured the public imagination with books such as Paul and Anne Ehrlich's *Population Bomb* (1968) and The Club of Rome's *Limits to Growth* (Meadows et al., 1972) becoming best sellers. While the accuracy of the "Neo-Malthusian" epithet they attracted is debatable, their general thrust was interpreted as such and although initially embraced by the environmental movement, the idea of tackling population growth as a means of averting ecological crisis came under increasing criticism. In particular, environmental activists on the left were uncomfortable with the political tone of population control discourses from the early 20th century and later the abuses of human rights in India and China.

A significant split emerged in the environmental movement around the issue of human numbers, with eco-socialist thinkers such as Murray Bookchin (1987) rejecting arguments in favour of population control from Deep Ecologists and groups such as Earth First! who, it was argued, espoused an eco-fascist and anti-human ideology. Bookchin traced the misanthropy of Deep Ecology to its division between biocentric (ecocentric, nature centred) and anthropocentric (human centred) thinking. For Deep Ecologists biocentrism or ecocentrism is a recognition of the equality between all living things. Such a position gives equal status to species as diverse as whales and the small-pox virus – the latter of which might be regarded as an endangered species. More importantly, Bookchin insisted, Deep Ecological thinking sees modern human society as having become separated from nature and believes that famine and disease should be left unchecked to reduce human "overpopulation".

Like many others who have followed, Bookchin laid the cause of the ecological crisis squarely at the feet of modern industrial capitalism. Population growth, he argued was a consequence of imperialism and capitalism:

> Smash up a stable precapitalist culture and throw its people off the land into city slums, and due ironically to demoralization, population may soar rather than decline. As Gandhi told the British, imperialism left India's wretched poor and homeless with little more in life than the immediate gratification provided by sex and an understandably numbed sense of personal, much less social, responsibility. Reduce women to mere reproductive factories, and population rates will explode. (p.15)

However, despite Bookchin's criticisms of Deep Ecology being largely well grounded, while accusing the movement of misunderstanding demography, he himself reproduces common demographic misunderstandings and gives a specious account of population growth, stabilisation and decline. While he correctly asserts that population stabilisation and falling fertility are associated with development, education and the empowerment of women, his suggestion that population growth in the industrial age has been the result of increases in fertility is wide of the mark. In fact, as far as can be determined, fertility rates remained largely unchanged and decreases in mortality, due to improved

nutrition, better personal hygiene, public health measures and advances in medicine, are the cause of population growth (Kirk, 1996).

One of the problems with reductionist arguments regarding capitalism and ecological degradation is that they fail to acknowledge that social systems of all kinds have environmental impacts and that the size and power of the system is a critical factor in its environmental sustainability. Moreover, capitalism and imperialism cannot be reduced to a single ideology and the existence of a multitude of other discourses, such as humanitarianism, produce unintended consequences which exacerbate structural inequalities. Thus, despite the exploitative nature of global capitalism and imperialism, due to the factors listed above, mortality rates across the world have declined – especially infant mortality – which, in the absence of access to modern contraception, has led to population growth. The question of intervention into fertility outcomes becomes all the more fraught for the modern left since liberal notions of autonomy have been absorbed without much reflection upon the implications for sustainability within finite bounds. Writers such as Diana Coole (2018) and Julian Roche (2020) have tackled the question of reproductive autonomy arguing that the prevention of the degradation of the natural environment is a condition of possibility for all other forms of autonomy. From such a perspective, autonomy is not reducible to the individual but must be seen in the collective material context.

Bookchin provides a powerful critique of what I have referred to as "eco-fundamentalism" (Samways, 1996) and in particular the muddled and dualistic conceptions of nature and human nature inherent in such a position. The idea of "human exceptionalism" is frequently seen as interchangeable with that of "anthropocentrism", which for many is seen as the root-cause of the environmental crisis. Bookchin provides good reasons for a version of the human exceptionalist argument which recognises culture as human "second nature" avoiding any hard cut-off point between humans and other species whilst rejecting narrow anthropocentrism. This is an important argument since, as Bookchin points out:

> ... what is particularly unique about human societies is that they can be radically changed by their members – and in ways that can be made to benefit the natural world as well as the human species. (1987, p.8)

It is the self-conscious reflection upon our behaviour and our ability to change it that is at the centre of political action – including that required to avert ecological catastrophe. For Bookchin and others it is social hierarchy in all its forms that is problematic, but in particular the effect of the destructive forces of capitalism and imperialism on social relations and on the environment.

However, while Bookchin's pro-human and, I would argue, ecologically enlightened anthropocentric argument, is to be welcomed, in common with other environmental perspectives from the left, its focus on reprehensible, oppressive and politically offensive instances and arguments concerned with population control blind it to human numbers as part of anthropogenic environmental change. Such a position is analogous to the claims of those who instance the oppressive regimes of the Soviet Union, China or North Korea as demonstrations of why collectivism, socialism or communism is fundamentally flawed and morally objectionable – an argument which presumably Bookchin would have rejected. Yet this is precisely what Bookchin and others on the left do when they equate all forms of population concern with discredited and abhorrent population discoures.

In his commentary piece published in this issue, Chris Tucker explores how the dark history of these population control discourses was instrumental in the removal of concern about population growth from the so called "Cairo Consensus" which has informed UN policy on reproductive health over the last 30 years. These are the same discourses which Bookchin and left-leaning environmentalists also cite in their rejection of concerns around population growth. Tucker shows how the close association of the idea of population control with eugenics and human rights abuses has resulted in discussion of population growth becoming taboo - despite its widely acknowledged environmentally unsustainability. Tucker argues that the taboo around population control has led those embedded in the Cairo Consensus to be unwilling to reopen discussion about the adverse effects of population growth. Indeed, a faith in the sanguine view, typical of figures such as the late Hans Rosling, that population growth would sort itself out, coupled with a lack of acknowledgment of the contribution of human population size to the transgression of planetary boundaries, has further discouraged debate. Moreover, especially in relation to greenhouse gas emissions, many have pointed out the inverse relationship between fertility rates and environmental impact, with the correct implication that tackling the climate emergency must be focussed on

rich-world consumption rather than population growth. However, Tucker notes that while this is true, in the longer-term, as they develop, the environmental impact of high fertility countries will also grow.

Tucker argues that despite its silence on population growth, the Cairo Consensus contains much of what is required, in the form of greater female empowerment, reproductive rights, and the welfare of women and girls, to bend the projected population curve toward a sustainable level. He advocates an aspiration of achieving a total fertility rate, through equitable, just and empowering means, of 1.5 by 2030 in order to move toward a sustainable population by the end of the century, thereby averting enormous human suffering. To this end, Tucker proposes not only revisiting the Cairo Consensus, but also the introduction of an eighteenth Sustainable Development Goal concerned with population, and the creation of a United Nations Framework Convention on Population Growth.

While Malthus argued that Godwin's and de Condorcet's utopian societies would degenerate due to features of external nature and human nature, the majority of contemporary concern about population growth is actually motivated by the opposite sentiment. At one level, those, like Tucker, who are concerned with the consequences of population growth agree with Malthus that external nature is a critical limiting factor. However, modern population concern departs from the accepted reading of Malthus, typified in Marx's (1954 [1890]) critique, where the resulting misery of the poor consequent of population growth is inevitable and natural. For Marx, it was not abstract laws of nature which produced an immiserated "surplus population" but the capitalist mode of production:

> The labouring population therefore produces, along with the accumulation of capital produced by it, the means by which it itself is made relatively superfluous, is turned into a relative surplus population; and it does this to an always increasing extent. This is a law of population peculiar to the capitalist mode of production. (Marx 1954 [1890] p.591).

Marx saw population growth as a systemic outcome, favouring and reinforcing existing capitalist social relations and resolved by the eventual and inevitable change in the mode of production. The character of the communist society in which all contradictory relations of the capitalist mode of production would be

resolved was only hinted at by Marx. Moreover, there is little to show what he thought would happen to economic and population growth. Authors such as Saito (2017) have somewhat undermined the claim that Marx thought there were no natural constraints on the human enterprise, but apart from a few comments about the dispersal of the population between town and country Marx is quiet on the subject of population in communist society. Indeed, the only visions of life in communist society are utopian and bucolic (for example Marx 1972 [1846] p.33) and imply a low population density.

Present-day authors concerned with human population size may well advocate political transformation of the global socio-economic system, consisting of the establishment of an alternative economic system, the reduction of global inequality, and the empowerment of women. However, rather than the achievement of utopia, it is the avoidance of a dystopia that is the principle concern. Such writers generally maintain that human population size and growth will push already breached planetary boundaries beyond recovery resulting in suffering and misery which will afflict not only a large part of humanity but devastate the other species and ecosystems upon which we ultimately depend.

It is the examination of possible dystopian futures with which David Wadley's essay is concerned. In his book *The City of Grace* (2020), Wadley models an eco-tech city which rather than being utopian is anti-dystopian, a sustainable haven situated in a surrounding sea of dystopic neoliberal globalisation. In the paper presented here, Wadley considers, from the perspective of systems, complexity and chaos theories, this dystopic environment in terms of population and sustainability. Questioning accepted notions of rationality, he explores two possible failure modes connected by demographic factors: the first, capital-labour dynamics, is within the social sphere, while the second concerns the human-environment nexus. Somewhat echoing Marx's position regarding population, capitalist social relations and labour supply, Wadley argues that the continuing substitution of capital and management for labour could suppress the demand for labour in developed countries. At the same time, in less developed nations the global displacement of labour by technological innovation could result in devastating underemployment of the large labour forces produced by population growth. This first failure mode articulates with what Wadley identifies as a second dystopian contingency, unconstrained growth exceeding planetary boundaries. Employing

a systems approach to the IPAT equation, he argues that too much faith is placed in the development of environmental technical fixes, and that curbs on affluence, as well as the substitution of technology for labour, will produce social disquiet. Wadley concludes that to achieve long-term sustainability at good standards of welfare, population size must be tackled. Avoiding these two dystopian failure modes, he contends, requires an abandonment of the obsession with economic growth and a refocussing on labour and population issues to achieve sustainable and equitable real per capita wealth. However, given the pervasiveness of irrationality in human affairs, Wadley is not convinced that a dystopian future can be avoided.

In contrast, Doug Booth's follow-up to "Achieving a post-growth green economy" published in the last issue of the JP&S strikes a more optimistic note. In his previous paper Booth argued that the combination of a trend toward post-materialism and the establishment of a "Green New Deal" could offer considerable hope in tackling the environmental crisis. Here, Booth further explores what he calls the "post-material silent revolution" providing detailed empirical evidence showing that post-materialists: are less orientated to material consumption; are more likely to choose to live in denser, more energy efficient urban environments; have fewer children; and, through political action, support the environment. The analysis of the Wave 6 World Values Survey confirm that post-materialism is positively correlated to younger and more educated groups, who are likely to belong to voluntary organisations, work in the creative and independent sectors and be politically engaged. Post-materialism is also positively associated with higher social class membership.

Perhaps most significantly, Booth notes that post-materialism is intrinsically anti-capitalist in orientation and that taken to its logical conclusion leads to a dampening of demand growth for consumer goods, ultimately undermining the expansion of capitalism's global influence. It is also interesting to note that both middle-class post materialists and those in the very lowest socio-economic classes share common interests in the reformation of the economic system. For post-materialists this interest relates to their value objectives, while for those at the bottom of the socio-economic system greater economic security and a fairer share of material pie eclipses their support for the environment. However, Booth argues that the institution of a Green New Deal will create a convergence of the

interests of post-materialists and working-class materialists as the decarbonisation of the economy creates well-paid jobs and a sustainable global economy.

The papers in this issue of the JP&S have covered a wide range of issues relating to the "population-consumption-technology-environment nexus". From the granular level of nudging food choices, through to the macro-level of systems theory and dystopia, at one level or another all are concerned with population and sustainability from both a behavioural-agentic and a systemic-structural perspective. All demonstrate how population and sustainability issues require an approach which understands the relationship between our everyday practices and choices and wider structural systemic factors. Most importantly perhaps, all of the papers in this issue grapple with autonomy and power and show that attention must be simultaneously paid to both individual social practices and the social structures which both enable and constrain them.

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PEER REVIEWED ARTICLE

Nudging interventions on sustainable food consumption: a systematic review

Becky Blackford[1]

Bournemouth University

Abstract

As population growth continues, sustainable food behaviour is essential to help reduce the anthropogenic modification of natural systems, driven by food production and consumption, resulting in environmental and health burdens and impacts. Nudging, a behavioural concept, has potential implications for tackling these issues, encouraging change in individuals' intentions and decision-making via indirect proposition and reinforcement; however, lack of empirical evidence for effectiveness and the controversial framework for ethical analysis create challenges. This systematic review evaluated the effectiveness of nudging interventions on sustainable food choices, searching five databases to identify the effectiveness of such interventions. Of the 742 identified articles, 14 articles met the eligibility criteria and were included in this review. Overall, the potential of certain nudging interventions for encouraging sustainable food choices were found in strategies that targeted 'system 1' thinking (automatic, intuitive and non-conscious, relying on heuristics, mental shortcuts and biases), producing outcomes which were more statistically significant compared to interventions requiring consumer deliberation. Gender, sensory influences, and attractiveness of target dishes were highlighted as pivotal factors in sustainable food choice, hence research that considers these factors in conjunction with nudging interventions is required.

1 blackfordbecky@gmail.com

Keywords: nudging interventions; sustainable food choice; food security

Introduction

Population growth, increased per capita global affluence, urbanisation, increased food productivity and food diversity, decreased seasonal dependence, and food prices have caused major shifts in global dietary and consumption patterns (Lassalette et al., 2014; Tillman and Clark, 2014; Davis et al., 2016). Westernisation of food consumption has occurred in population growth regions over the last 50 years, increased demand for meat and dairy, empty calories and total calories has altered the global nature and nutrient transition scale of food consumption (Kearney, 2010; Tillman and Clark, 2014). The Food and Agriculture Organisation of the United Nations (FAO) suggest that food production will have to increase by 70% to feed an additional 2.3 billion people by 2050, with the majority of this population growth occurring in developing countries (FAO et al., 2020).

The 2019/20 annual global production of cereal grains (2.7 billion tonnes) alone is capable of providing adequate nutritional energy to 10-12 billion people (Cohen, 2017; FAO et al., 2020). However, issues surrounding the allocation and utilisation of cereal grains has led to 43% being used for human food consumption, 36% for animal feed and 21% for other industrial uses such as biofuels. This utilisation can price the most vulnerable people out of the world grain market, limiting food choices, purchases, and human wellbeing (Cohen, 2017). The FAO estimate that 8.9% (690 million) of the global population are undernourished and 9.7% (750 million) are exposed to severe levels of food insecurity (FAO et al., 2020).

Global food production is a significant driver in the anthropogenic modification of natural systems, causing burdens and impacts on both the environment and human health. Externalities including environmental impact (e.g., climate change, biodiversity loss, and natural resource depletion), and negative impacts on human health and culture (e.g., obesity, cancer, diabetes, loss of cultural heritage, impacts on rural businesses, access to green spaces) are generally not included in the price of commodities (Lassalette et al., 2014; Beattie and McGuire, 2016; Benton, 2016; Notarnicola et al., 2017; Schanes et al., 2018; Sustainable Food Trust, 2019; Taghikhah et al., 2019; Viegas and Lins, 2019). Encouraging consumers to adopt more sustainable food behaviour, such as locally sourced foods or diets containing less meat, is essential to reduce the impact of food production and

consumption, especially in developed countries (Kerr and Foster, 2011; Schoesler et al., 2014; Hartmann and Siegrist, 2017; Ferrari, et al., 2019; Hedin et al., 2019; FAO, 2019; de Grave et al., 2020).

Sustainable consumption (SC) was first highlighted in the 1992 United Nations Conference on Environment and Development, chapter 4 - Agenda 21 (UNCED, 1992), and defined in the 1994 Oslo Symposium on Sustainable Consumption as:

> the use of services and related products which respond to basic needs and bring a better quality of life while minimising the use of natural resources and toxic materials as well as emissions of waste and pollutants over the life cycle of the service or product so as not to jeopardise the needs of future generations. (United Nations, 2020, p.8)

The 2018 Third International Conference of the Sustainable Consumption Research and Action Initative (SCORAI) in Copenhagen highlighted the role of behavioural economics and related strategies on consumption routines to assist SC (SCORAI, 2018). Hence it is vital to understand human behaviour as complex and influenced by cognitive bias and heuristics (Fischer et al., 2012; Lehner et al., 2016).

Kahneman (2011) proposed that human thinking is driven by two systems:

- system 1- automatic, intuitive and non-conscious, relying on heuristics, mental shortcuts and biases

- system 2-intervening, deliberate and conscious, relying on the availability of information and cognitive capacity to process information to make rational choices

Both are susceptible to 'nudges' that encourage behavioural change within civil society (Allcott and Mullainathan, 2010; Kahneman, 2011; Fischer et al., 2012; Marteau, 2017). Richard Thaler and Cass Sunstein first popularised the term 'nudge' in the book *Nudge: Improving Decisions About Health, Wealth, and Happiness* (2008), in reference to any characteristic of the decision environment "that alters people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives" (Thaler and Sunstein,

2008, p.6). Sunstein (2013) further suggested that nudges can be promising tools for promoting a broad range of pro-environmental and sustainable consumption behaviours (Sunstein, 2013).

Nudging interventions can play an important role in sustainable food consumption (SFC), helping change consumers food habits in a non-obtrusive, cost-effective manner by modifying the choice architecture in which consumers operate - thus steering their behaviour in preferred directions (Torma et al., 2018; Kácha and Ruggeri, 2019; Vandenbroele, et al., 2019). Hence nudges are the opposite of coercive policy tools which tackle behaviour change through fines or bans (Ferrari, et al., 2019). Blumenthal-Barby and Burroughs (2012) describe the ethical issues surrounding the MINDSPACE framework and identify six principles that can be used to nudge people: defaults (D); ego and commitment (EC); incentives (I); messenger and norms (MN); priming (P); and salience and affect (SA) (BIT, 2010; Blumenthal-Barby and Burroughs, 2012). Descriptive norms, such as incentivising tools for online shopping, can help encourage pro-environmental behaviour and the purchasing of green products (Demarque et al., 2015) whilst social norm interventions, such as those around the use of reusable cups, can help customers avoid wasteful disposable items (Loschelder, et al., 2019). D and P nudges, such as visibility, positioning, display area size and quantity, can shift consumers' purchase behaviour towards more sustainable choices (Coucke, et al., 2019), whereas environmentally friendly food packaging can produce overall positive impacts on consumers' sustainability choices (Ketelsen, et al., 2020).

Nudging is still in its infancy. The UK established the Behavioural Insight Team in 2009 to help develop the concept of nudge units, initiatives and networks, whilst The World Bank, OCED and the EU have supported research to further examine the potential of nudging (Hansen, 2016). Policymakers utilise nudges to help design, implement and evaluate the appropriate policy instruments to assist in devising effective policies to enhance sustainable behaviour and counteract the negative impact of other actors who encourage 'undesirable' behaviours (Lehner et al., 2016; Marteau, 2017). However, nudging has been challenged and criticised on a number of grounds, including the lack of empirical evidence proving its effectiveness, the difficulty in putting theory into practice, and for ethical reasons – i.e. paternalism and reduced human autonomy (Hansen, 2016; Kasperbauer, 2017).

Existing systematic reviews (SR) undertaken on nudging interventions on food choices have mainly focused on human health and diet (Bucher et al., 2016; Wilson et al., 2016; Broers et al., 2017; Bianchi et al., 2018; Taufika et al., 2019; Vecchio and Cavallo, 2019), and the environmental impacts on the supply chain (Ferrari et al., 2019). For example, Ferrari et al. (2019) showed that 'green nudging', especially D, NM, P and SA, has the most significant effect on leveraging more sustainable practices and behaviours of both farmers and consumers, having the potential to be used as tools for environmental policy formulation (Ferrari et al., 2019). Bucher et al. (2016), Broers et al. (2017) and Bianchi et al. (2018) illustrated how altering placement of food items can produce a moderate significant effect on promoting healthier eating behaviours through healthier food choices. Bucher et al. (2016) further suggested that the strength of the nudge depends on the type of positional manipulation, the magnitude of the change and how far away foods are placed (Bucher, et al., 2016; Broers et al., 2017; Bianchi et al., 2018). Bianchi et al., (2018) additionally demonstrated that SA, I and P could increase consumers plant-based choices by 60-65% (Bianchi et al., 2018). Wilson et al. (2016) illustrated that the combination of P and SA enable consistent positive influences on healthier food and beverage choices, making healthier options easier to choose both mentally and physically (Wilson et al., 2016). Furthermore, Taufika et al. (2019) illustrated that the combination of SA and MN could be associated with the reduction of meat consumption (Taufika et al., 2019). Vecchio and Cavallo (2019) suggested that, overall, nudge strategies successfully increased healthy nutritional choices by 15.3% (Vecchio and Cavallo, 2019).

Although these results show that nudges are generally effective in promoting healthier food choices and sustainable practices and behaviours, none of the studies examined the effectiveness of nudging interventions on SFC. There is a knowledge gap on the effectiveness of nudging interventions on sustainable food choices. The goal of this systematic review is to synthesise the empirical findings of existing published academic literature that has investigated the effect of various nudging interventions on these choices and therefore upon SFC in real-life contexts. This paper will:

- examine the evidence around the effectiveness of interventions for SFC

- show the factors that influence the effectiveness of interventions
- help identify research gaps in current understanding of the field (Peričić-Poklepović & Tanveer, 2019; CEE, 2020)

Methodology

A search was conducted to identify published literature that utilised interventional and experimental studies to examine nudging interventions to encourage SFC. The studies were identified using the search strategy and analysed against inclusion criteria, those studies that met these criteria were further synthesised by analysing abstracts and full texts. Type of nudges applicable were D, EC, I, MN, P and SA.

Search strategy

This systematic review was conducted in September 2020. The search terms used to identify literature from data sources were:

"nudge*" OR "nudging" OR "nudging theory" AND "sustainable* consumption" AND "food" OR "diet" AND "consumer".

Using these search terms, published literature were retrieved from online databases, Web of Science, Scopus, ScienceDirect, EBSCO (Bournemouth University Library) and Google Scholar[2]. The title and abstracts of the retrieved articles were screened for relevance. The potentially relevant articles were examined for their eligibility to be included in the review, whilst the references of the eligible literature were screened to identify any additional eligible literature.

Language and date restrictions

Publication dates were restricted to between 2010-2020 in order that only material released after the publication of Thaler and Sunstein's (2008) techniques was considered. Only literature published in English were included.

2 "effectiveness" AND "interventions" included for ScienceDirect and Google Scholar due to large size of articles found. ScienceDirect did not accept wildcards (*).

Selection criteria

The inclusion criteria for selecting eligible literature were:

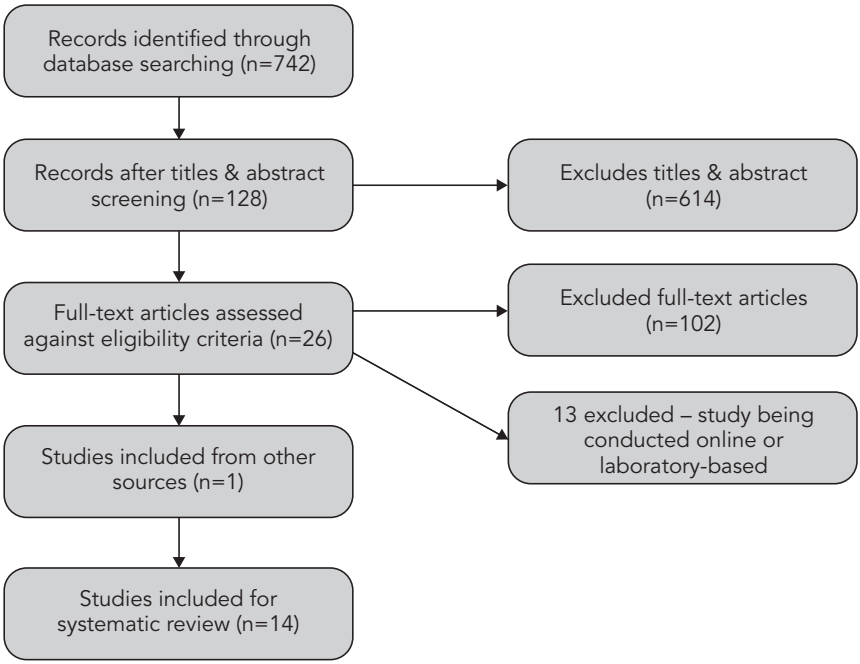
- Full test peer-reviewed studies in English language
- Primary studies between 2010–2020
- Studies should examine the effectiveness or impact of nudges on sustainable food choices
- Randomised control trial studies or have a 'control' to ensure empirical evidence
- The study should measure sustainable food choices as one of its outcomes via dietary choices i.e., less meat more vegetables

'Grey' literature such as reports and letters were excluded as they were not peer-reviewed.

Selection process

A total of 742 eligible studies were retrieved from the data sources using the aforementioned search strategy, 6 from Web of Science, 338 from ScienceDirect, 9 from EBSCO (Bournemouth University Library), 379 from Google Scholar and 8 from Scopus. After reviewing titles and abstracts, 614 were excluded (Fig 1). The remaining 128 studies were assessed against the inclusion criteria, resulting in exclusion of 102 studies, leaving 26 for further review. 12 articles were further excluded owing to collection of empirical evidence being conducted in a laboratory setting or online surveys, holding the potential for behavioural bias, resulting in 14 articles that were based in a naturally occurring setting i.e., supermarket/canteen. Searching reference lists of the remaining 13 articles, 1 further article was obtained, creating a total of 14 articles for the SR (Fig 1).

Figure 1: ROSES Flow Diagram – illustrating search progression and elimination of literature for SR (Haddaway et al., 2017)



Data extraction and synthesis

From the 14 eligible articles basic descriptive data were recorded to ensure quality assessment, including study design, year of data collection, country of residence, target subjects, sample size and intervention setting. More detailed data extraction included: intervention strategy; outcome measured; data analysis method; main findings; and effectiveness of intervention when evaluated against sustainable food choices i.e., less meat more vegetables.

The simple mnemonic MINDSPACE framework was utilised to identify the nine robust nudges that can influence behaviour: messenger; incentive; norms; defaults; salience; priming; affect; commitments; and ego – MINDSPACE (BIT, 2010). For this SR, they have been grouped into six categories – D, EC, I, MN, P and SA (Table 1) (Blumenthal-Barby and Burroughs, 2012).

Table 1: Description of six categories of nudges

Nudge	Description
Messenger & Norms	To affect decision behaviour, people are heavily influenced by who communicates.
Incentive	To motivate change in behaviour by predictable mental shortcuts, such as strongly avoiding losses or rewards.
Default	To cultivate behaviour that encourages "go with the flow" of pre-set options.
Salience & Affect	To influence behaviour and decision making by bringing attention to what is novel and seems personally relevant, triggering emotional associations which can shape actions.
Priming	Utilising subconscious cues to influence behavioural strategically.
Ego & Commitment	Achieving long-term behavioural change by utilising public promises, reciprocate acts, self-esteem and self-image.

There are many frameworks that help identify key concepts and nudges to influence behaviour towards healthier choices. The TIPPME framework (Typology of Interventions in Proximal Physical Micro-Environments) aims to reliably classify, describe and enable more systematic design, reporting and analysis of interventions in order to help change behaviour across populations utilising nudges D, P, SA to change selection, purchase and consumption of foods (Hollands et al., 2017). Applying EC, MN, SA nudges, the SHIFT framework aims to encourage consumers into pro-environmental behaviours when the message or context influences psycological factors, such as social influence, habit formation, individual self-feeling, cognition and tangibility (White et al., 2019). Chance et al.'s (2014) The 4P's framework aims to integrate nudges within a dual-system model of consumer choice by targeting possibilities, process, persuasion and person, using nudges D, EC, MN, P, SA. Kraak et al. (2017) extend this framework by suggesting a marketing mix and choice architecture 8P's framework, highlighting the potential to promote and socailly normalise healthy food environments. This works by utilising nudges D, EC, I, MN, P, SA encouraging voluntary changes made to the properties of the environment and food being sold (place, profile,

portion, pricing, promotion) and volunatry changes made to the placement of food sold (healthy default picks, priming/prompting, proximity (Kraak et al., 2017).

Study quality assessment

To assess the quality of data obtained from the eligible studies a rating scheme was utilised, ranging from weak (*) to very strong (****). The principles of the ratings were based on study design, selection bias, sample size, duration of study, and risk of bias from missing information (Table 2). The rating scheme was adapted from a previous study undertaken by Nørnberg et al. (2015) who successfully utilised this method to rate and assess the effectiveness of interventions on vegetable intake in a school setting.

Table 2: Definition and explanation of study quality assessment (Nørnberg, et al., 2015)

Rating	Definition	Study Description	Design & Methods
*	Weak	Three of more of the following details are missing: intervention setting, design, duration, RCT or control, statistical analysis.	Design of intervention or statistical methods are flawed.
**	Moderate	One or two missing details and satisfactory presentation.	Small sample size (<50) and/or short duration (<1 week).
***	Strong	One or two missing details and clearly presented.	Large sample size (>100) and/or longer duration (>1 week)
****	Very Strong	All details evident and clearly presented.	Large sample size (>100) and/or longer duration (>1 week). Includes any or all of the following: population randomly allocated or matched for intervention or control and validated assessment.

Results

Overall effectiveness of nudging interventions on SFC

The 14 articles included in this SR all focused on SFC in the form of food choice behaviour and were conducted in North America and Europe. Interventions were conducted at supermarkets, canteens, cafeterias, restaurants or cafeterias at

universities, workplace, senior activity centres and the Institute Paul Bocuse. The subjects consisted of students, university staff, workplace employees, retirees, and the general population. Five studies used SA as the core nudge, three used a P/SA combination, two used a D/P combination, one used P, one used D, one used D/SA combination and one used I/MN/SA combination. The intervention strategies, intervention duration and sample sizes were largely heterogeneous across all studies (Table 3).

The different strategies and methods applied to implement the varying nudges illustrated differing effectiveness (Table 4). The studies utilising nudges SA (Gravert and Kurz, 2019; Kurz, 2018), P (Garnett et al., 2019), D/P combination (Coucke et al., 2019; Vandenbroele et al., 2018) and D/SA combination (Campbell-Arvai et al., 2014) provided statistically significant impact for increasing sustainable food choices. However, studies that implemented D (Zhou et al., 2019), P/SA combination (McBey et al., 2019) and SA (Piester et al., 2020; Salmivaara and Lankoski, 2019; Slapø and Karevold, 2019) were not statistically significant. One study which utilised P/SA combination (Ohlhausen and Langen, 2020) showed statistical significance with regards to SA but not P, whilst a P/SA combination (Kaljonen et al., 2020) and I/MN/SA combination (Becchetti et al., 2020) illustrated marginal statistical significance, highlighting the potential use of these combinations.

Data quality assessment

Twelve studies were randomised control trials (RCT), duration of interventions varied considerably, ranging from 1 day to 3 years, three studies did not specify the intervention duration. All studies, bar one, had a large sample size (>100) and one lacked sufficient statistical analysis. The quality rating of the included studies was strong to very strong with a mean rating of 3.2 and standard deviation of 1.08 (Table 5).

Sustainable food choices

In total, five of the studies utilised the nudge SA to encourage SFC (Kurz, 2018; Gravert and Kurz, 2019; Salmivaara and Lankoski, 2019; Slapø and Karevold, 2019; Piester et al., 2020). The main strategy utilised consisted of signage, ranging from descriptive menus to visual environmental information. Gravert and Kurz (2019) suggested that introducing two different menus, 1 x meat and fish dishes 1 x vegetarian and fish dishes – meat or vegetarian choices were available upon

Table 3: Intervention description of the included studies (n 14)

Author(s)/ Year(Data)/ Country	Study Design	Study Setting/ Participants	Sample Size	Nudge[#]	Intervention Strategy
Campbell-Arvai et al., 2014 Midwestern USA	Phase 1: cross sectional survey Phase 2: RCT 2x2x2 between subjects factorial design	University canteens (randomly selected) Undergraduate students	320 students	D SA	2- phase intervention Phase 1: rating of vegan/ vegetarian meals from unappealing to appealing Phase 2: providing 4 different menu types (default, default + information, information only & control)
Coucke et al., 2019 European City (unknown)	RCT	Supermarket – butcher counter General population[$]	Not specified	D P	Enhance visibility of poultry via 1. enlarging the display area size 2. increasing quantity of displayed poultry products
Kaljonen et al., 2014–2017 Finland	Cohort study Qualitative	Finnish Environment Institute (SKYE) restaurant Employees	188 – climate label 16 – recipe development	P SA	1. climate label: informing employees of most climate-friendly lunch choices 2. food order: positioning vegetarian food first on buffet line

			No data for number of lunches sold		3. tinkering: developing and increasing diversity, taste and appearance of vegetarian meals
Piester et al., 2019 USA	Cohort study RCT	University café Undergraduate/ graduate students, faculty staff and other	Study 1 – 228 Study 2 – 228	SA	1. sustainability labels: indicating the degree of environmental impact of each food item 2. one item targeted (veggie burger) for sustainability and taste by using sustainability
Slapø & Karevold 2019 Norway	RCT	University cafeteria Undergraduate/graduate students & staff	228 observations	SA	Simple labels: three different labelling systems 1. traffic light labels 2. single-green label 3. single- red label
McBey et al., 2019 Scotland	Cross sectional survey Qualitative	Focus groups at various sites Parents with young children, undergraduate students, working class men, gym users, retirees & cohabiting couples no children	60 participants	P SA	1. simplification and framing of information: environmental labelling of meat products 2. changes to physical environment: positioning in supermarkets

Author(s)/ Year(Data)/ Country	Study Design	Study Setting/ Participants	Sample Size	Nudge[#]	Intervention Strategy
Gravert & Kurz 2016 Sweden	RCT	Restaurant White collar employees	2776 meals eaten	SA	Customers randomly presented with one of two menus 1. meat and fish dishes 2. vegetarian and fish dishes meat or vegetarian dish was available upon request
Kurz 2015–2016 Sweden	RCT	Two university restaurants 1 x control 1 x treated Students and staff	53,537 meals eaten (average)	SA	1. visibility of vegetarian dishes equally visible to the other two meat dishes 2. vegetarian dishes brought to position 1 in menu order
Becchetti et al., 2016 Italy	RCT	12 Coop Italia General population[$]	3,212 items purchased	I MN SA	3 x small posters displayed in shops promoting importance of buying environmentally responsible products, strategically placed to replace the traditional price tag on shelves

					1. LABEL: poster only 2. LABEL5: poster with 5% price increase 3. LABEL10: poster and 10% price increase
Vandenbroele et al., 2018 **Belgium**	RCT	Retail store General population[$]	161 participants	D P	Altering options sizes of sausages at point of purchase 1. large default portion size (150g) 2. medium in-between portion (125g) 3. small portion (100g)
Ohlhausen & Langen 2016 **Germany**	Cohort study RCT with factorial design	Several university canteen & business canteen Students & staff Employees	1340 participants	P SA	Combining and comparing two nudge interventions in two different settings: 1. descriptive name labels (DNLs) for most sustainable dish of a choice set menu 2. decoy effect (DE), supplying unattractive decoy meal choice

Author(s)/ Year(Data)/ Country	Study Design	Study Setting/ Participants	Sample Size	Nudge#	Intervention Strategy
Garnett et al., 2017 United Kingdom	RCT With-in subject crossover experiment	University Cafeterias (A, B, C) Students and staff	94,644 meals	P	1. doubling the proportion of vegetarian meals available from 25% to 50% 2. fortnightly alternations between 1 (control) and 2 (experiment) vegetarian options
Salmivaara & Lankoski 2016 Finland	2x2 between-subject factorial Cluster randomized design	19 workplace restaurants Employees	1,289 participants	SA	Implementing and activating four injunctive norms message signs on roach fish patties 1. control 2. promotes wellbeing of Baltic Sea. 3. promotes increasing supply and consumption of ethical local food 4. combination of 1 & 2

Zhou et al., 2016–2017 **Denmark, France, Italy, United Kingdom**	Quasi-experimental study RCT	Denmark: senior activity centre, and University of Copenhagen France: living lab of the Institute Paul Bocuse Italy: The Club in Pian di Mungnone UK: restaurant at Bournemouth University Urban dwellers over 65 years old	348 participants Denmark – 97 France – 118 Italy – 46 UK – 87	D	Implementing a plant-based 'Dish of the Day': 1. fish cakes 2. meat balls 3. veggie balls (Dish of the Day)

[$] General population assumed (not specified by study)

[#] Nudge: SA – Salience & Affect, P – Priming, MN – Messenger & Norms, I – Incentive and D – Default

Table 4: Nudging intervention findings of the included studies (n 14)

Author(s)/ Year (Data)/ Country	Outcome Measured	Data Analysis Method	Main Findings	Effectiveness
Campbell-Arvai et al., 2014 Midwestern USA	Phase 1: the relative appeal of meat-free default food options for experimental menus Phase 2: food choice – item purchased	Phase 1: 7-point semantic differential scale (-3 to +3) Phase 2: binary logistic regression (BLR)	1. the appeal factor was a significant predictor of food choice 2. default menu increased the probability of meat-free choices 3. presence of information on menu was not a significant factor 4. gender was a significant factor (female)	p<0.001 p<0.001 p=0.534 p=0.02
Coucke et al., 2019 European City (unknown)	Food choice: item purchased	Three-way ANOVA and post hoc contrast tests	1. sales of poultry were significantly higher than sale of other meat(s) 2. significant increase in amount of poultry sold in treatment store 3. revenue from poultry was significantly higher than revenue for other meats 4. significant decrease in amount of poultry sold when nudge removed	p<0.001 p<0.05 (+13%) p=0.001 (-18%) p<0.001
Kaljonen et al., 2014–2017 Finland	Food choice: items purchased	Focus groups – qualitative data	1. climate label produced no significant results	1. 42% looked at label and purchase the labelled lunch 'now and then'; mainly women

		Foodweb tool for estimation of GHG emissions of food items	2. food placement made vegetarian option easier to choose and helped change daily eating habits 3. menu planning and recipe development played a key role in tinkering solutions for problems encountered	2. vegetable intake increased by 10% 3. use of pulses per meal served increased by a third from 2014–2017
Piester et al., 2019 USA	Food choice: item purchased	ANOVA	1. intention-behaviour gap was prominent 2. women purchased more sustainable labelled food items 3. study 2: women more likely to purchase veggie burger when given extra information alongside the labels	45% bought what they intended p=0.11 (38% over the control group) p=0.23 (19%)
Slapø & Karevold 2019 Norway	Food choice: items purchased	Ordinary Least Square regression (OLS)	1. traffic light labels marginally reduced sales of meat dishes in period 1 but not in period 2 2. single green and red labeling had no effect on sales of meat, fish or vegetarian dishes	p=0.10 (7%-9% {period 1}) p=0.38 (period 2) p>0.1

Author(s)/ Year (Data)/ Country	Outcome Measured	Data Analysis Method	Main Findings	Effectiveness
McBey et al., 2019 Scotland	Changes in hypothetical behaviour	NVivo 11 used for analysis of audio recordings	1. how information is framed is crucial due to the disconnection between food choices and environmental impact 2. the physical layout of a supermarket, can promote perceived notions on how alternative products are accepted by consumers i.e. not for them if placed in rarely visited aisles	1. evidence for the efficacy of nudges is limited, especially in-regard to pro-environmental behaviour 2. qualitative research may be partially salient in reducing meat consumption, as what can appear as simple solutions often breakdown as individuals' lived experiences with food choice are better understood
Gravert & Kurz 2016 Sweden	Food choice: item purchased	χ^2	1. meat dishes chosen reduced in intervention period 2. vegetarian dishes increased in the intervention period 3. intervention had no lasting effects but no evidence for compensational behaviour	$p<0.01$ (-38%) $p<0.01$ (+200%) $p<0.01$

Kurz **2015–2016** **Sweden**	Food choice: items purchased	OLS DiD estimation	1. experiment did not allow for disentanglement of which nudge caused what impact 2. at the treated restaurant, vegetarian dishes increased significantly after nudge implementation 3. size of treatment effect increases over time, possibly from exposure to nudge and network effects 4. when nudge interventions removed, vegetarian dishes still proceeded to be purchased at a higher rate	p≤0.01 (~+40%) +6 points p≤0.01 (+0.8-0.9% each week) p≤0.01 (+4 points higher than the baseline period)
Becchetti et al., 2016 **Italy**	Food choice: items purchased	Econometric	1. overall effect of the nudge is positive 2. LABEL5 and LABEL10 provided significant promise, increasing sales and supporting the theory that higher environmental concerns induce the purchase of organic foods, albeit expensive, making some consumers price inelastic	p≤0.01 (+2%) (10%-50% of the market share) p≤0.01 (+5% & +4.3% respectively)

Vandenbroele et al., 2018 **Belgium**	Food choice: units purchased	Two-way ANOVA	1. over half of the units sold were the smaller/ medium portions 2. customers didn't purchase more packages of the smaller/medium portions (backfire effect) 3. compensatory purchases of other meats did not differ among buyers of smaller, medium and large sausage portion size	52% (13% less meat (kg) sold) p=0.001 p=0.62
Ohlhausen & Langen **2016** **Germany**	Food choice: meals purchased	Voting system BLR Mann Whitney U-test	1. preferred DNLs: 'seasonal ingredients'; 'traditional style';'organic (dish)' & 'sustainable agriculture' 2. targeted DNLs dishes were favoured more than competitor dishes 3. no significance for targeting DE on choice 4. combination of DNLs and DE have a significant impact. (DNLs most influential)	64.0%, 63.5%, 35.5% & 22.5% respectively p≤0.001 (+10% equating to 50.8% of purchases) p=0.266 p≤0.001

Garnett et al., 2017 **United Kingdom**	Food choice: meals purchased	Binomial generalized linear mixed models	1. vegetarian meals increased in all cafeterias significantly 2. largest effects found in diners who had lowest previous levels of vegetarian choice selection 3. serving more vegetarian options had little effect on overall sales, no rebound effect	University Cafeterias (A, B, C) 61.8%, 78.8%, 40.8% respectively p≤0.001
Salmivaara & Lankoski **2016** **Finland**	Food choice: units purchased	ANOVA QCA (quality comparative analysis)	1. no significant differences in roach fish patties choice amongst control and treatment groups 2. activating norms with a message that include a combination of two injunctive norms was not significant	p=0.6263 p=0.7320 (wellbeing Baltic Sea) p=0.2638 (local food)
Zhou et al., **2016–2017** **Denmark, France, Italy, United Kingdom**	Food choice: meal purchased	Pearson's chi-square test BLR	1. no statistical significance found for an increase in participants' choice of a plant-based dish when set as a default across countries 2. males are less likely to choose a plant-based dish compared to female 3. security and universalism main factors for choosing default dish	p=0.109-0.865 47.7% of males p=0.011 + p=0.008 respectively

**p value of p<0.05 statistically significant

Table 5: Data quality assessment (mean = 3.2, standard deviation = 1.08)

Author(s)/ Year Country	Sample Size	Duration (pre and post intervention excluded)	Control Group	Random Allocation	Missing Information	Rating
Campbell-Arvai et al., 2014 USA	Large (>100)	2 weeks	Yes	Yes	–	****
Coucke et al., 2019 European City	–	4 weeks	Yes	Yes	Country unknown and sample size not specified	**
Kaljonen et al., 2020 Finland	Large (>100)	3 years	No	No	Unknown sample of size for intervention	**
Piester et al., 2020 USA	Large (>100)	–	Yes	Yes	Unknown duration of intervention	***
Slapø & Karevold 2019 Norway	Large (>100)	6 weeks	Yes	Yes	–	****
McBey et al., 2019 Scotland	Medium (<100)	–	No	No	Unknown duration of study	*
Gravert & Kurz, 2019 Sweden	Large (>100)	3 weeks	Yes	Yes	Some limited statistical analysis	****
Kurz 2018 Sweden	Large (>100)	17 weeks	Yes	Yes	–	****

Becchetti et al., 2020 Italy	Large (>100)	9 weeks	Yes	Yes	–	****
Vandenbroele et al., 2018 Belgium	Large (>100)	–	Yes	Yes	Unknown duration of intervention	***
Ohlhausen & Langen 2020 Germany	Large (>100)	8 weeks	Yes	Yes	–	****
Garnett et al., 2019 United Kingdom	Large (>100)	9 months	Yes	Yes	–	****
Salmivaara & Lankoski 2019 Finland	Large (>100)	1 day	Yes	Yes	Long-term viability of results	**
Zhou et al., 2019 Denmark, Italy, France, United Kingdom	Large (>100)	5 months	Yes	Yes	–	****

request. Meat dish choice decreased by 38% with the vegetarian and fish menu and vegetarian choices increased (3.9%) with the meat and fish menu – no compensatory effect was monitored ($p<0.01$). Kurz (2018) found that by changing the position of vegetarian dishes in a menu order, and allocating equal visibility of vegetarian dishes with meat dishes in the purchasing environment, purchase of vegetarian dishes increased by 40% ($p \leq 0.01$). Weekly sales of vegetarian dishes increased by 0.8%-0.9% after the intervention ceased ($p \leq 0.01$) (Kurz, 2018).

Slapø and Karevold (2019) found that impementing traffic light labelling (red, yellow, green) on dishes to indicate the environmental friendliness of a dish, encouraged a 7%-9% reduction in meat sales ($p=0.10$), although having just singular green or red labels had little to no impact ($p>0.1$). Salmivaara and Lankoski (2019) indicated that activating injunctive norm message signs at point of purchase had no significant effect on sustainable food choice ($p=0.6263$), whilst Piester et al. (2020) found that implementing sustainability labels on menus marginally influenced women's uptake of more sustainable choices ($p=0.11$) but not for men ($p=0.23$). Piester et al. (2020) identified the intention-behaviour gap, highlighting that only 45% of people bought the items they intended to purchase.

Three studies utilised P/SA combination (McBey et al., 2019; Kaljonen et al., 2020; Ohlhausen and Langen, 2020), applying signage with availability and accessibility to help encourage more SFC. Kaljonen et al. (2020) suggested that increasing the availability and accessibility of vegetarian dishes in a buffet line, placing vegetarian dishes at the front, increased sales by 10%. Climate labels attached to the dishes had limited effect, although women were more susceptible (42%). Ohlhausen and Langen (2020) found that DNLs were statistically significant when in combination with a DE (unattractive meal dish) ($p \leq 0.001$), while DNLs were 10% more influential than the DE. McBey et al. (2019) proposed that environmental labelling is crucial for framing the disconnection between food choice and the environmental consequence, and the physical layout of retail stores can be a powerful tool in promoting SFC to consumers.

A D/SA combination (Campbell-Arvai et al., 2014) which implemented 'appealing' vegan/vegetarian dishes on a menu assisted significantly with the prediction of food choices made by consumers ($p<0.001$), and when applied into a default menu (appealing dishes positioned at top) sales increased significantly ($p<0.001$); however

providing information-only menus promoted a decrease in meat-free purchases (p=0.534). Becchetti et al. (2020) utilised a combination of I/MN/SA, implementing three small posters/labels in-store, one promoting environmental responsibility and two labels implementing a 5% and 10% price increase on organic items. Overall, the intervention increased sales by 2% (p≤0.01), with the 5% and 10% labels increasing sales of organic items by 5% and 4.3% respectively, supporting the theory that higher environmental concern can induce the purchase of organic foods, and can induce the purchase of organic food despite its greater cost.

Garnett et al. (2019) utilised P, doubling the quantity of vegetarian dishes (25% to 50%) available in three university cafeterias. The intervention increased vegetarian dish uptake by 60.4% across the three cafeterias, positively impacting consumers whom previously had low levels of vegetarian purchases (p≤0.001) with no rebound effect. Zhou et al. (2019) used 'Dish of the Day' as a D intervention, providing statistically insignificant results (p=109-0.865). However, they highlighted that the default dish was chosen when concerns such as security (e.g., safety, harmony, and stability of society, of relationships, and of self) and universalism (e.g., understanding, appreciation, tolerance, and protection, for the welfare of all people and for nature) were strong (p=0.11 and p=0.008 respectively). D/P combination (Coucke et al., 2019; Vandenbroele et al., 2018) provided statistically significant results. Couke et al. (2019) increased sales of poultry by 13% (p<0.05) and decreased sales of other meats by 18% (p=0.001) via enhanced visibility and quantity of poultry available at a butcher's counter. When the intervention ceased, poultry sales decreased significantly (p<0.001). Vandenbroele et al. (2018) illustrated that altering the portion sizes of sausages (150g, 125g, 100g) increased the purchase of 125g and 100g portions marginally (52%), with no compensatory effect on customers purchasing extra portions of the same size (p=0.001). The intervention decreased overall meat (kg) purchased by 13%, however compensatory purchases of other meats did not differ amoung buyers of all portion sizes (p=0.62).

Discussion

Effectiveness of nudging interventions on SFC

Out of the 14 studies reviewed, ten provided statistically significant results, supporting the positive effectiveness of nudging interventions in encouraging sustainable food choices (Table 6).

Table 6: Effectiveness of nudging interventions on SFC

Reference	Intervention	Food Choice
SA		
Gravert & Kurz, 2019	Two different menu's: 1 x meat & fish; 1 x vegetarian & fish – both indicating that vegetarian or meat options were available upon request	Meat choice decreased 38% with vegetarian & fish menu and vegetarian choices increased by 3.9% with meat & fish menu ($p<0.01$)
Kurz, 2018	Changing menu position of (vegetarian dishes – top) and ensuring equal visibility of vegetarian dishes	Menu positioning and dish visibility increased vegetarian dish choice by 40% and increased weekly sales by 0.8-0.9% ($p\leq0.01$)
Piester et al., 2020	Sustainability labels attached to dishes on menu and additional information	Vegetarian dish selection slightly increased for women only ($p=0.11$), added information made less effect ($p=0.23$), again women only
Salmivaara & Lankoski, 2019	Injunctive norm messages on posters at point of purchase	Neither messages regarding the wellbeing of Baltic Sea or local food created an uptake of the roach fish patties food choice ($p=0.7320$/ $p=0.2638$ respectively)
Slapø & Karevold, 2019	Traffic light labelling and single red and green labelling	Traffic light labelling decreased meat dish choice by 7%-9% in period 1 ($p=0.10$) but not in period 2 ($p=0.38$) and neither the single green nor red label made a significant impact ($p>0.1$)
P/SA combination		
Kaljonen, et al., 2020	Climate labels and food order position in a buffet line	Food positioning increased vegetarian food choice by 10% but climate labels only made people look 'now and then' 42% of the time; mainly women

McBey et al., 2019	Environmental labels and changes to physical environment of supermarket	Environmental labels were shown to be importance for people to connect between food choice and the environment. Changing the layout of a supermarket so that alternative can be placed in aisles that are not rarely visited would help customers feel like these products are for them and not part of 'otherness'
Ohlhausen & Langen, 2020	DNLs and a DE	DNLs increased vegetarian dish uptake by 10% ($p \leq 0.001$), DE did not influence food choice ($p=0.23$), however combined had significance ($p \leq 0.001$)
D/SA combination		
Campbell-Arvai et al., 2014	Rating of unappealing and appealing vegetarian/vegan dishes and implementing four different menu's (default, default & information, information & control)	Using appealing vegetarian/vegan dishes help to predict food choice ($p \leq 0.o01$), default menu (appealing dishes at top) had a significant impact ($p \leq 0.001$), whereas an additional information menu was not significant ($p=0.534$)
I/MN/SA combination		
Becchetti et al., 2020	3 x small posters/labels indicating an environmental responsibility message, two of which have a 5% and 10% price increase	Overall positive impact by 2% ($p \leq 0.01$) and a significant effect with price increases of 5% & 10% labels (5% &4.3% respectively) ($p \leq 0.01$). Suggesting that consumers are price elastic
D		

Zhou et al., 2019	Implementing plant-based 'Dish of the Day' to a menu of three dishes: 1. fish cakes 2. meat balls 3. veggie balls (Dish of the Day)	'Dish of the Day' had an insignificant effect (p=0.109-0.865) The more importance participants gave to sensory factors and universalism the more they chose the veggie balls (p<0.05)
P		
Garnett et al., 2019	Doubling proportion of vegetarian dishes available from 25% to 50%	Vegetarian dish sales increased in the three separate cafeterias by 61.8%, 78.8% &40.8%, the largest effect occurring with participants whom previously had the lowest purchase of vegetarian options (p≤0.001)
D/P combination		
Coucke et al., 2019	Enhancing visibility of poultry products by increasing the display size area and quantity of poultry products	Sales increased by 13% for poultry (p<0.05), decreasing revenue of other meat products by 18% (p=0.001).
Vandenbroele et al., 2018	Differing portion size of sausages: 150g (D) 125g 100g	52% of 125g &100g portions were purchased, reducing meat (kg) purchased by 13%. Customers did not buy extra 125g/100g portion packages to compensate (p=0.001). Compensatory purchases did not differ among buyers of 150g/125g/100g portions (p=0.62)

SA as a nudge

Gravert and Kurz, (2019) suggested that the simple and inexpensive rearrangement of menus in terms of convenience could reduced meat consumption by 38% and increase vegetarian and fish dishes sold by 200% ($p<0.01$). Kurz (2018) further supported this theory by suggesting that increasing visibility and changing menu position could encourage a persistent shift in consumption behaviour ($p\leq0.01$) whereas Löfgren et al. (2012) proposed that experienced participants were harder to nudge than inexperienced participants. The heterogenous effects of the nudge in relation to the type of vegetarian dish served identified that the target dish(es) offered had to be more attractive to meat eaters, hence vegetarian burgers/patties had the most successful impact. With that said, disentanglement of which nudge (visibility/position) caused the vegetarian dish increase was not undertaken.

Conversely, Piester et al. (2020) found the effectiveness of sustainability labels with additional information on a menu was not effective, possibly due to the unknown duration of the intervention and information overload of having messages that combine different types of information (Carfona et al., 2019). Women were more likely to purchase vegetarian dishes with sustainability labels ($p=0.11$), and with additional information this increased ($p=0.23$), this is consistent with past research emphasising gender influence in SFC (Andersen and Hyldif, 2015; Zhou, et al., 2019). Piester et al. (2020) highlighted that only 45% of participants purchased what they intended, hence the intention-behaviour gap of consumers is crucial in understand purchasing habits (ElHaffar et al., 2020; Rausch and Kopplin, 2021).

Slapø and Karevold (2019) provided marginally significant results utilising traffic light labelling, supporting the theory of the 'compromise effect' (choosing the middle option) (Carroll and Vallen, 2014). Initially there was 7-9% reduction in meat consumption ($p=0.10$), this behaviour declined over time and almost reverted back to the control period behaviour after period 1; providing evidence that consumers can develop "label fatigue" ($p=0.38$) (Thorndike et al., 2014). Single red and green labels had no signficant impact ($p>0.1$), possibly due to lack of available environmental information (Ratner et al., 2008), limited previous knowledge regarding the connection between food choices and environmental consequences (Hartmann and Siegrist, 2017; Lea et al., 2006) and perceived needs of consumers in the choice situation (i.e. focused on sensory factors rather than environmental preservation) (Andersen and Hyldif, 2015; Slapø and Karevold, 2019).

Salmivaara and Lankoski (2019) concurred with these results, suggesting that activating injunctive norm messages to promote sustainable food choice is an ineffective measure (p=0.6263), possiblly due to the 1-day intervention duration and exclusion of vegetarian and vegan participants. Nevertheless, this intervention could help identify potential subgroups of consumers who are sensitive to the intervention, i.e. older educated women influenced more by the message of "ecological wellbeing". Multiple norms could have complex casual interactions and joint effects, i.e. messages of ecological wellbeing and local food could be combined to have greater impact than the message used independently; a topic requiring further attention (McDonald et al., 2014).

P/SA combination as a nudge

Ohlhausen and Langen (2020) were able to identify the SA nudge (DNLs) as 10% more effective in increasing vegetarian dish choice ($p \leq 0.001$), especially the use of "sustainability" and "regional" (20% and 15% respectively), proving consistent with past research (Morizet et al., 2012). Whereas, in constrast to previous non-food related literature, the P nudge (DE) lowered choice frequencies of sustainable choices overall (p=0.23) (Simonson, 1989; Doyle et al., 1999; Masicampo and Baumeister, 2008). This study supports Kurz (2018) theory that nudging interventions are not only influenced by the type of nudge or setting but by other variables (i.e. target dish), hence based on systematic assessment of similarities and difference between dishes, careful selection and grouping of target dishes and competitor dishes is required (Ohlhausen and Langen, 2020).

Both Kaljonen et al. (2020) and McBey et al. (2019) undertook qualitative studies that used descriptive labels as the SA nudge. Kaljonen et al. (2020) suggested that climate labels are a restriction to menu and recipe development, whilst McBey et al. (2019) suggested that how descriptive messages are framed is crucial, i.e. comparing meat products with sources of environmental pollution. Kaljonen et al. (2020) further suggested that availability and accessibility, by changing the food order available in a buffet line (P nudge), helps to encourage more vegetarian dish choices (+10%). Coinciding with McBey et al. (2019) who suggested that the physical layout of supermarkets play a pivotal role in highlighting the 'otherness' of alternative food choices (i.e. plant-based), creating a 'not for me' implication. Both studies agreed with past research that more qualitative research is required in understanding SFC (Lehner et al., 2016), the complex and multi-faceted nature

of food choice means that what holds true in controlled conditions may not work in every day life (Kahneman, 2011).

D/SA combination as a nudge

Campbell-Arvai et al.'s (2014) D/SA combination suggested that by placing less environmentally-friendly food choices in slightly less convenient positions on a menu (i.e. bottom) the default menus increased the probablility of consumers choosing a meat-free dish ($p \leq 0.001$). This was consistent with other research (Downs et al., 2009; Just and Wansink, 2009). The attractiveness of menu dishes had a significant influence on food choice enabling prediction of the choice ($p \leq 0.001$), whereas the presence of information on a default menu provided statistically insignificant interactions ($p=0.534$). Additional information is less effective at motivating behaviour change at an individual-scale and with real time choices due to immediate or intuitive factors that dominate decisions, especially when time pressure and distractions conspire to prevent personal deliberation (Shiv and Fedorikhin, 1999; Ariely and Loewenstein, 2006). The study design did not record 'actual' food choice or consumption, hence exaggeration of environmentally-friendly behaviour could have occurred (de Boer et al., 2009; Bray et al., 2011).

I/MN/SA combination as a nudge

As previously discussed, Becchetti et al. (2020) provided marginally significant results when implementing three posters/labels, highlighting the effectiveness of consumers environmental responsibility (+2%; $p \leq 0.01$). These findings exceeded the results of Hainmueller et al.'s (2015) study. Consumers believe that this form of intervention can affect other consumers choices by up to 80%, coinciding with the theory that social norms have strong effects on consumer purchasing habits (Collins et al., 2019; Liu et al., 2019).

D as a nudge

Zhou et al.'s (2019) 'Dish of the Day' (veggie balls) intervention provided statistically insignificant results across four countries ($p=0.109$-0.865). This is in contrast to many studies that have shown that D nudges can promote healthier purchase behaviour (McDaniel et al., 2001; Feldman et al., 2011). The unappealing nature of the veggie balls could have resulted from a lack of detailed information accompanying the dish and the equality it was given amongst the other two

dishes, lowering participants' attention to the default dish. Females from the UK and Denmark were more likely to choose the D target dish, especially when more importance was given to sensory factors and universalism ($p=0.042$ and $p=0.033$), supporting the view that peoples' concern about nature could be effective for SFC (Worsley et al., 2016). Zhou et al. (2019) highlighted that default-based interventions can be important tools in motivating pro-environmental behaviour and serve to complement information and educational efforts over the long-term. However, this could be seen as underhanded and choice constraining, limiting freedom and autonomy of decison makers.

P as a nudge

P as a nudge has the potential to encourage SFC, it is a relatively cheap and easily implemented strategy that generally goes unnoticed by consumers. Garnett et al. (2019) highlighted that meal selection is neither fixed nor random but rather partially determined by availability. By increasing the proportion of vegetarian choice uptake significantly increased, reflecting past research (Holloway et al., 2012; Lombardini and Lankoski, 2013; Bianchi et al., 2018). The greatest impact was measured amongst participants who were least likely to chose vegetarian dishes before the intervention ($p\leq0.001$), corresponding with Scarborough's findings (2014).

D/P combination as a nudge

Both Coucke et al. (2019) and Vandenbroele et al. (2018) provided statistically significant results for encouraging sustainable food choice ($p<0.05$ and $p=0.001$ respectively), however the studies lacked information on either sample size or duration. Vandenbroele et al. (2018) suggested that nudging consumers at point of purchase, rather than at moment of consumption, led to a 13% reduction in meat (kg) purchased and helped to change consumers purchase behaviour, concurring with previous research (Arno and Thomas, 2016; Vermeer et al., 2010). Coucke et al. (2019) supported this theory by suggesting that increasing the display size and quantity of more sustainable meat products (poultry), increased sustainable choices (+13%). When the intervention was removed sales of the sustainable meat product decreased, highlighting that visual cues can have an impact on consumers behaviour (Van Kleef et al., 2012; Wilson et al., 2016; Helmefalk and Berndt, 2018). Overall, D/P combination is an effective nudge for promoting and encouraging consumers to change their behaviour to more SFC practices.

Conclusion

Overall, this review has established the potential of certain nudging interventions for encouraging sustainable food choices and SFC. Strategies that required little involvement (system 1) from consumers, produced higher statistically significant outcomes compared to nudging interventions which required more deliberation (system 2). Gender, sensory factors, attractiveness, and type of target dish played a pivotal role in encouraging sustainable food choices. Females were influenced by interventions significantly more than males. Proximity, placement, and information encouraged consumers to adopt more sustainable food choices and the overall presentation, portion size and choice of sustainable alternatives played a key role in encouraging consumers into SFC. Successful nudges included P, D/P combination, SA, D/SA combination and I/MN/SA combination. These five nudges utilised intervention strategies that enhancing availability and accessibility, promoted consumers environmental responsibility, altered portions sizes, offered food alternatives upon request, and targeted appealing dishes in combination with a default menu. Five studies that utilised D, SA combination and P/SA combination all provided insignificant results. Interventions such as 'Dish of the Day', activating injuctive norms and sustainability labels, with additional information, proved ineffective tools for promoting sustainable food choices. The effectiveness of nudging is optimal when utilsied together with information campaigns, economic incentives and education, and hindered by factors including bias, intention-behaviour gap and external influences such as social norms, environmental determinants and financial status (Broers et al., 2017; Taufika et al., 2019).

This SR had several limitations. The search terms "nudges, nudging or nudge theory" may have lead to many undetected studies being left out, as well as "behavioural interventions" not being included in the search strategy may have limited the outcome. The studies were mainly heterogeneous with different interventions measured. Participants were mainly students or staff and the intervention settings were primarily universities, restricting greater external validity. All of the studies were undertaken in developed and highly westernised countries, hence further research should be undertaken in developing countries to allow for better understanding of the effectiveness of nudging interventions. Only English papers were eligible, hence a possibility of missing important relevant studies in other languages. Furthermore, this SR has been conducted by a single reviewer which could potentially cause bias on screening, rating and synthesis of the studies.

All of the studies, bar one, focused on short-term effectiveness of nudging and thus more research should be undertaken to understand if nudging is effective in the long-term. Further research regarding gender, sensory influences, dish attractiveness, multiple norms, intention-behaviour gap and tinkering could be addressed in conjuction with nudging interventions to better understand how more sustainable eating can be achieved in real-life situations, strengthening evidence and knowledege of how nudging might encourage SFC.

Further qualitative research should also be undertaken to enable greater understanding of what occurs in non-controlled environments. Ethical consideration of nudging and transparency is required in any future use of the technique in order to address the issue of freedom or autonomy in decision-making.

The number of people that can be supported within planetary boundaries in part depends on their choices (Cohen, 2017). The massive environmental impact of agriculture and the food industry mean that food choices will become of increasing importance. People are at the centre of sustainable development and with global population projected to increase to 9.7 billion by 2050 (United Nations, 2019), individual and collective human choices coupled with environmentally sustainable practices will be key drivers to enable a sustainable expansion in food production (Cohen, 2017). Nudging may play a role in changing behaviour toward habits of sustainable food consumption.

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COMMENT

It's time to revisit the Cairo Consensus

Christopher Tucker[1]

Chairman, American Geographical Society

Abstract

Just over a quarter century ago, the so-called 'Cairo Consensus' was forged, fundamentally improving how governments worldwide, international organisations, and the NGO community approached women's reproductive health and reproductive rights on the world stage. Yet, the deafening silence this consensus offered on issues of runaway population growth has had massive repercussions on the world we live in today, with the ever-increasing human footprint fuelling climate change and ecological destruction on a scale that was entirely predicted. Given what we know now about how empowering, just and ethical strategies focused on women and girls can effectively bend the global population curve, it is time that we revisit the Cairo Consensus.

Keywords: Cairo Consensus; population growth; ecological destruction; women's empowerment; fertility reduction; sustainable population.

Putting the Cairo Consensus in context

In the Fall of 1994, in Cairo, the United Nations' International Conference on Population and Development convened voices from around the world to reformulate the UN's thinking around issues of population and development. At this formative event, much progress was made in how the world grappled with these issues, particularly related to women's reproductive health and reproductive

1 tucker@americangeo.org

rights. The so-called 'Cairo Consensus' was forged, placing women's health, empowerment, and rights at the center of discussions around population and development. This was a huge step forward in our global thinking about the centrality of women and girls to the fate of our global community, and to the notion that women's rights are human rights.

One important issue was lost in the shuffle – runaway population growth. From 1994 forward, there was a formalization of the American diplomatic silence on issues of runaway population growth that had begun under President Reagan, permeating deep into the United Nations community. This was an enormous change in direction. This topic of runaway population growth had been a mainstay of UN World Population Conferences in 1954 (Rome), 1965 (Belgrade), 1974 (Bucharest), 1984 (Mexico City), and even as far back as 1927 (Geneva) under the League of Nations. The global community had watched with grave concern as the world population more than doubled between 1900 and the 1965 conference (from 1.6 billion to more than 3.3B), with another doubling projected by the end of the 20th century. Serious attention had been paid to the issue by world leaders, resulting in a 1967 statement by world leaders signed by 30 heads of state including US President Lyndon Johnson that cast a spotlight on runaway population growth, and the criticality of international family planning to human rights, global development, and international security (Dunlop, 2000).

So, what happened between 1967 and 1994 – other than the addition of more than 2 billion more people to our planet in this very short period of time? How did the intense focus on runaway population growth lead to utter silence on the issue in the world of international affairs?

Some participants in the Cairo process attribute it to an oversight, with experts in reproductive health playing more prominently in the process and simply overlooking the historical focus on population growth as they worked hard to bring focus to their important issues. Others attribute it to an effort to turn the page on a dark chapter of history that had brought racist, eugenicist, nativist, and paternalistic impulses to the population discussion. Still others attribute it to an active lobbying effort by the Vatican to shape the population discussions they had opposed for decades. No doubt a swirl of dynamics led the Cairo Conference to institutionalize what became known as the Cairo Consensus. In turn, this consensus

shaped strategies within the UN's various institutions, by national governments, by major foundations and NGOs over the following decades – leaving the issue of runaway population growth unaddressed as it spiralled out of control at a critical moment in human history, and the history of our planet (Sinding, 2016).

Shedding the dark past of population debates

The historical turn embodied in the Cairo Consensus was in no small part an attempt to shed the dark past of population debates that had shaped international development for decades. One does not have to look hard to find plenty of unsavoury undertones and overtones in the population debates of the 20th century. To this day, one can still find those whose animating concerns around population dynamics are racist, eugenicist, nativist, and paternalistic.

The history of this dark past is, of course, complicated, fraught with misinterpretation and wilful misrepresentation, and grounded in some inescapable truths. It is useful to examine two historical moments that collided to produce such a complex set of controversies that they are frequently re-adjudicated to this day.

As far back as 1912, Margaret Sanger, who popularised the term "birth control," advocated contraception as a means of avoiding "back alley abortions" (Cox, 2005). Seeing the connection between contraception and working-class women's empowerment, Sanger came to believe that a transformation toward women's equality would only be possible if they were liberated from the risk of unwanted pregnancy. Her initiative on this issue, of course, was in the midst of the suffrage movement and early American feminism. Additionally, early on during her time in England, Sanger came to share the concerns of English Neo-Malthusians around overpopulation. Sanger's insights and advocacy forever transformed the future for women and families around the world. Moreover, she will always be labeled a firebrand for being early and outspoken in her own unique mix of feminism, anti-religion, sexual frankness, and social activism on issues of race, class, and fertility.

Still, her public association with eugenicist organizations forever tainted her legacy, and equipped opponents of family planning with an effective rhetorical weapon with which they could attack the entire enterprise – to this day. Sanger's relationship with the eugenics movement was complex – part strategy and part ideology. Yet, many historians now believe that Sanger opposed eugenics along

racial lines, and opposed eugenicists' notions that poverty, criminal behaviour and other social problems were hereditary. Indeed, she saw intentional family planning as a tool that empowered the downtrodden, rather than a tool for weeding out 'bad genes' (Chesler, 2011; Latson, 2016).

It was Francis Galton, Charles Darwin's half-cousin, who in 1883 captured the minds of elites in America, England, Germany and beyond with his twisted reading of Gregor Mendel's pea plant breeding experiments and Darwin's survival of the fittest. Galton provided a scientific veneer to the notion that many social ills were caused by the genetic proliferation of the wrong sort of people. Galton postulated that this problem could be addressed with the introduction of eugenics – a term he coined in 1883. It is no surprise that he also introduced the phrase "nature versus nurture." In America, the Carnegies, Rockefellers and Harrimans became acolytes of this worldview, and funded the practice and teaching of eugenics. Theodore Roosevelt, Alexander Graham Bell, John D. Rockefeller, Jr. and many other prominent citizens were outspoken supporters. Scientific American published articles in support of the concept. The American Museum of Natural History hosted conferences on the subject. The Cold Spring Harbor Laboratory had a Eugenics Record Office, which was an epicenter of research in the field, and home to Harry Laughlin, perhaps the most influential eugenics advocate in America. Eugenics became taught in schools, celebrated in exhibits at the World's Fair, preached in pulpits, advocated by respected scientists at Stanford, Yale, Harvard, and Princeton, and implemented in state and Federal policy. Thirty-two states passed eugenic-sterilization laws during the twentieth century. The Immigration Act of 1924 excluded eugenically undesirable races from entry to the United States. And Supreme Court Justice Oliver Wendell Holmes wrote in the seminal case Buck v Bell "It is better for the world, if instead of waiting to execute degenerate offspring for crime, or to let them starve for their imbecility, society can prevent those who are manifestly unfit from continuing their kind" (quoted in DenHoed, 2016).

Race theory and race science, based on faked and untested data, served eugenicists' racist goals. Mixed with a pre-existing Neo-Malthusian strain of thought, this led to a dark interpretation of who was responsible for perceived overpopulation, and how it should be dealt with.

This moment in Western thought informed decades of gruesome theory and action, culminating in Nazi Germany's abominable atrocities, but by no means solely restricted to the Third Reich. Credible and exhaustively cited historical analysis has even rooted Nazi eugenics in British and American thought leadership. Perhaps this is why eugenicist thought, and its racist, nativist and paternalistic impulses, continued on past WWII, before the label was widely abandoned by the mid 20th century. It is the deeply held suspicions of those who rightfully oppose these impulses that often motivate them to avoid or actively oppose discussions of runaway population growth – even long after humanity has exceeded Earth's carrying capacity.

More recently, of course – and with different cultural origins – thoughtful and righteous objections have been raised over China's One Child Policy and policies by other authoritarian regimes that have sought to harness coercive measures to oppress women or eradicate minorities through the use of forced sterilization or forced abortion. In the wake of the Cairo Consensus, proper attention was paid to the inhumane practices being embraced under the guise of "population control," which disproportionately affected women and girls around the world. In some cases, a connection could be drawn to old eugenicist thinking in Western cultures, repackaged by the dominant racial or ethnic group in power in non-Western nations. In other cases, similar oppression by authoritarian regimes has been undertaken with no need for philosophical foundations, though delivering the same effect.

This dark history has led many who are firmly ensconced in the Cairo Consensus to be deeply averse to re-opening discussions about runaway population growth. Others avoid population discussions in the hope that the global population curve will bend as global health and wealth improve – as the great Swedish physician and health statistician Hans Rosling insisted it would. To be comfortable with a Rosling-esque worldview, one must avoid the fact that humanity long ago overshot our planet's carrying capacity. Others, particularly from the climate action community, demand that we avoid population discussions, and focus entirely on consumption and carbon emissions. They correctly point out that the developed world, which indeed is guilty of creating the vast majority of the historic carbon burden on our climate, should not be allowed to shift the blame on to poor, Black and Brown communities around the world, who consume far less per capita, just because of

their fertility rate. Yet, they fail to grasp the rate at which the developing world is projected to join the global middle class over the next decade, taking on a decidedly bigger per capita human footprint. As such, we should all be concerned about population growth even if it is consumption in the developed world that has led to our environmental crisis (Hickel, 2018; O'Neill, 2018).

Lessons learned and embracing our future

Because of the dark past of population debates, it is far too easy to ignore runaway population growth despite the ample scientific evidence that humanity's size and our rate of growth is crushing our planet and undermining its ability to support us as a species. This dark past makes an already awkward discussion about runaway population growth downright unpalatable. It enables a sort of intellectual cowardice – letting some advocates for the reduction of humanity's carbon footprint ignore the inexorable realities of runaway population growth. It allows valid claims of racism, colonialism, and paternalism to be wielded as a means of silencing those who raise issues of runaway population growth. This is a particularly potent argument in a world that continues to be filled with racism, and a future where most Western populations are already below replacement value fertility, while large parts of Africa, Asia, and South America are projected to grow their populations substantially over the coming decades (Vollset, et al, 2020).

In any discussion of population dynamics, we must learn from this deeply troubling past and its echos into our present. Despite this reality, we must also embrace the lessons that have been learned about the just, ethical and empowering strategies available to us which could bend the global population curve. We have learned that the empowerment of women and girls leads to the reduction in fertility rates. In many geographies where women and girls are empowered, educated, integrated into the workforce and given access to family planning technologies, that they are allowed to harness for their own bodily autonomy, we see below replacement value fertility (Sachs, 2005). This is because such factors lead to smaller, educated, and prosperous families – a virtuous circle in development that naturally bends the fertility curve in the geographies where these factors take hold.

This means that there is a real nexus between the truths elevated in the Cairo Consensus and the building blocks required to bend the global fertility curve. This makes it all the more mysterious that the Cairo Consensus was devoid of any

real notion how many people the Earth can support, and the need to shift fertility norms in a way that can bring our species into balance with our planet. If it were not, the Cairo Conference deliberations would have begun with a discussion of whether the 5.6 billion souls inhabiting the planet in 1994 exceeded our planet's carrying capacity. And reasonable discussions would have been had around feasibility of near-term reductions in consumption, given the projected population growth already baked into our demographics. This would have immediately led to a discussion not only of the empowerment of women and girls, and a focus on reproductive health and women's rights as human rights. It would also have led to a real discussion about the need to shift reproductive norms away from the norm of children having children, to a more modern fertility norm of relatively small families. The Cairo Consensus would have rallied around the need for small, educated and prosperous families with healthy and empowered women and girls. But, this is not the form that the Cairo Consensus took, and now humanity has hurtled from 5.6 billion to 7.8 billion with no end in sight and with nothing less that the fate of our planet and our species at stake.

If Cairo had truly been a conference on population and international development – rather than a much needed effort to recenter the empowerment, reproductive rights, and welfare of women and girls on the world scene – a frank discussion would have occurred about the actual fertility rate (e.g., the current slope of the curve) and the path toward not only bending the global fertility rate to below replacement value, but the time horizon by which this change must occur if we were to avert climate catastrophe and ecological destruction. In 1994, both climate catastrophe and ecological destruction loomed large.

I have proposed a goal of achieving a total fertility rate (TFR) 1.5 by 2030, to not only help us avert 1.5C in temperature rise, but also to begin lightening the overall human footprint (not just our carbon footprint) at a rate that could bring our species into balance with of our planet's carrying capacity soon after 2100 (Tucker, 2020). Whether my assumptions and calculations are correct should be something debated and decided in any adjustment to the Cairo Consensus. Whatever the actual resulting population decrease, aspiring to an average global fertility rate of 1.5 by 2030 would massively increase the prospect of averting ecological catastrophe and widespread misery – especially for the poorest in the world. Perhaps another such goal is more appropriate. I welcome the debate.

Updating how the United Nations thinks about population

In a way, it is unfair to saddle the Cairo Consensus with sole responsibility for the UN's failure to properly consider runaway population growth in our collective global strategies for achieving long term sustainability. The UN did, after all, spearhead the development of the Sustainable Development Goals (SDGs), which also were silent on issues of population. Nevertheless, one can, perhaps, blame the Cairo Consensus' silence on population growth for shaping the fundamental assumptions underlying the UN's SDGs. The SDGs weirdly take the UN's population projections as immutable, with 17 goals that the global community must collectively meet even as humanity continues to grow in numbers and in its massive ecological footprint. Goal 5 does call for Gender Equality, which is a useful hook for a larger discussion around fertility and population dynamics. But, other than that, the SDGs are silent on this issue. Of course, so many of the SDGs are actively being undermined by runaway population growth.

An 18th SDG, focused on ending runaway population growth, stabilizing population, and decreasing it to a lower more sustainable population plateau would go a long way to helping in the achievement of the other 17 SDGs. Alas, it seems that the SDG process is considered unchangeable, even as we observe global society overshooting its SDGs, year after year. The day that the SDG community begins openly discussing runaway population growth and its deleterious effects on our planet and our global society will be a watershed moment.

The UN could also contemplate the creation of a United Nations Framework Convention on Population Growth, as was proposed by planetary health activist Rob Harding. Modelled on the United Nations Framework Convention on Climate Change, this approach would allow us to recognize that we (e.g., humanity) have exceeded our planet's carrying capacity, and that we are accruing long term ecological debt that is threatening our planet and its ability to support us as a species (Harding, 2018). Such a Framework Convention on Population Growth would allow us to collectively set goals for bending the global population curve in a particular time frame. Goals, after all, are nothing without a target date for their accomplishment.

Again, my goal of 1.5TFR by 2030 would only be a proposal that would have to be negotiated in this context. The United Nations Framework Convention on

Climate Change has negotiated targets for carbon emissions. Yet, it completely failed to appreciate the role of runaway population growth in fuelling climate change. History will look back on this failure with contempt. As a UN Secretary General who is so passionate about climate action, António Guterres could help empower the global community by advancing this proposal for a United Nations Framework Convention on Population Growth.

It is easy to anticipate that climate activists and global leaders might simply call for amending the UN Framework Convention on Climate Change to include population references. However, this is much bigger than climate. Remember, the UN is also the home for the UN Decade of Ecosystem Restoration, led by the UN Environment Program (UNEP) and the Food and Agriculture Organization of the United Nations (UN FAO), with the aim of restoring degraded and destroyed ecosystems, contributing to efforts to combat climate change and safeguard biodiversity, food security, and water supply. Runaway population growth is not just fuelling climate change, it is annihilating natural habitats at an alarming rate. Our collective carbon footprint is only one small part of our much larger human footprint. And, to properly grapple with runaway population growth, a substantial agreement with many moving pieces would be required. It is not as simple as setting targets. Population issues touch every single Sustainable Development Goal, and every aspect of human rights discussions across the UN and its member nations.

We have it at our fingertips to embrace just, ethical, and empowering strategies – particularly focused on women and girls – that can help us bend the global population curve, but all nations would need to agree to them. It is abundantly clear that the international community should build on the Cairo Consensus by establishing a UN Framework Convention on Population Growth.

Establishing new fertility norms for a sustainable future

Any agreement would, in effect, call on the self-conscious establishment of a new species-wide fertility norm. To some geographies, where below replacement value fertility has already become the norm, this will be no real imposition. To others, the establishment of a norm that is substantially lower than the TFR in their region will be quite a heavy lift. However, when in this discussion people are led to realize that fertility is not some exogenous factor or inexorable process, the dialog will

get interesting. This global dialog will lead them to realize that if only women and girls are empowered, educated, integrated into the workforce (at the appropriate age), and given access to family planning technologies that allow them bodily autonomy, then not only will fertility drop, but the multiplicity of benefits tied to education will be unleashed, and economic prosperity will abound. Furthermore, ecological calamity will no longer loom large. Small, educated and prosperous families capable of making deliberate choices about their impact on our planet will become the species wide norm. What a change that will be.

Norms are not policy mandates. They are not "population control". If we have learned anything over the past century, such mandates and policies do not work. Only empowering strategies deployed at global scale can work. And these can only work when implemented within a global discussion about the kinds of fertility norms that could help humanity live within the ecological constraints of our planet, in the here and now. The 2020s are a fundamentally different moment in time than 1994, when the Cairo Conference was held. The global community has come to appreciate acutely the burden humanity's growing numbers have come to place on our fragile and finite planet – including the global community of scientists (Ripple, 2019). By situating the welfare and rights of women and girls at the center of our approaches to international development, the Cairo Conference did us all a favour. By sidelining discussions around runaway population growth, the Cairo Conference did us all, and our planet, a huge disservice. We now have the opportunity to collectively make a course adjustment that could mean the difference between prosperous sustainability and oblivion.

The time for action is now.

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EDITOR REVIEWED ARTICLE

Outside *The City of Grace*: appraising dystopia and global sustainability

David Wadley[1]

The University of Queensland

Abstract

The City of Grace: An Urban Manifesto *(Wadley, 2020) models an eco-tech settlement, aiming to achieve economic and social sustainability over a substantial period. The City is intended to be anti-dystopian and non-exclusive, with the possibility of replication in receptive settings. In this rejoinder to the book, the potential for dystopia attending population and sustainability issues in the outside world is appraised. Foundations are established in general systems, complexity and chaos theories, and an interpretation of procedural and substantive rationality. Two possible global failure modes are examined, one contained within the human sphere involving the future of capital and labour, and an external one founded in the familiar problematics of the human-environment nexus. Dilatory responses in advanced societies to these dilemmas are outlined. The subsequent prognosis regarding population and sustainability co-opts a meta-theory from environmental management to assess the viability of possible counterstrategies to dystopia although, in conclusion, its existence is instantiated.*

Keywords: dystopia; systems theory; labour dynamics; economic and demographic growth; planetary constraints; IPAT.

1 d.wadley@uq.edu.au

Introduction

My 2020 book, *The City of Grace*, models the function and form which a settlement would require to achieve economic and social sustainability over a substantial period. The resulting eco-tech configuration, aiming to be gracious in function and graceful in form, distinguishes itself from paradigms in prior urban-utopian literature by assuming a surrounding environment of neoliberal globalisation. The characteristics of grace arguably surpass those of either goodness or greatness. They are identified through a situation audit of contemporary urbanism combined with a comprehensive literature review covering religious, ascetic, aesthetic and material expressions of grace. On this basis, graciousness is modelled in economic, political and social terms. Gracefulness of form is portrayed in architectural practice and, at a higher level, city planning and development. The book undertakes an empirical enquiry to see whether such a City already exists anywhere on Earth, but a definitive answer is lacking. Interested parties are invited to continue the search or appraise the thesis and attempt to create a real-life settlement for themselves.

While no future is anywhere assured, the City is designed as an island of relative stability in a turbulent milieu. It is not exclusive, being spatially replicable. Nor, in following a survival strategy, is it utopian but, instead, claims to be 'anti-dystopian' relative to its external milieu. The focal question therefore arises: 'how dystopian is the future beyond the urban boundary?' As a sequel to the book this paper aims to address and resolve the query with as much foresight as possible: it appraises the potential for dystopia attending population and sustainability issues in the outside world.

A properly constructed approach requires a normative foundation for the assembly of evidence apropos dystopia. It relies upon general systems, complexity and chaos theories to expose the context, while unconventional philosophical baselines are established around the precepts of human (ir)rationality. With these underpinnings outlined, I gather evidence to adjudge the supposed dystopia outside The City. As they bear on global population and sustainability, the drivers and constraints behind two possible failure modes in the external domain are examined. One involves the future of capital and labour contained within the human sphere, and a wider one is recognised in the familiar problematics of the human-environment nexus.

A résumé follows outlining dilatory responses to these dilemmas in advanced societies. It is argued that, as distinct from positive action to address these modes, western industrialised society appears in denial, preoccupied with communications media and the advocacy of sectional, systemically-constrained causes. The subsequent prognosis co-opts a meta-theory from environmental management to assess the viability of possible counterstrategies to dystopia. Suggested remedies are found wanting and thus, from the information assembled, the case for the existence of dystopia outside the City is endorsed. A set of conclusions rounds off the investigation and provides an answer to the focal question.

Foundations

Herman Daly (1977) has helpfully differentiated scholarly disciplines within a spectrum spanning the ultimate means (matter, physics) to the ultimate ends (ethics, religion) of human society. High level discussion of future utopian and dystopian outcomes lies on the boundary of empirical experience and belief (Rorty, 1991). It requires a solid foundation of deductive reasoning and applied philosophy which draws on relevant theories and a pragmatic interpretation of procedural and substantive rationality.

A systems view of human society

At any scale of enquiry, general systems theory examines 'a set of objects and the relationships between the objects and between their characteristics' (Hall and Fagan, 1956 p.18). Human society can be interpreted in this framework, as a system processing environmental inputs such as matter, energy or information into physical and conceptual outputs. In transforming the throughput, linkages among system components can provide stability, with negative feedback acting to restore settings (as is common in mechanical servo-systems). Positive impulses can be energising and, on occasion, dis-equilibrating. Thresholds represent a critical mass of perturbation which exceeds system capacities to contain change, one example being the emergence of the 2008 global financial crisis. Passing through a trigger point could cause a phase shift to a new state of the system. As internal configurations change, the disruption can be experienced acutely as a shock or, over a longer period, as stress (Leach et al., 2010).

'Complexity' means that there can be numerous independent variables involved in the operation of a system (Sardar and Abrams, 2013). Their interactions create

entropy, the 'degree of dissipation…of the energy or force that enables the system to undertake its work, whether this be internal differentiation or export to the environment' (Walmsley, 1972 p.28). Entropy encompasses energy and matter but, absent negative feedback and subject to the second law of thermodynamics, it can only increase over time. The inherent depreciation reduces orderliness (e.g. as observed in the failure to work of a 'worn-out' appliance).

Complex systems employ negentropy to counter the chaos which can infuse and amplify states of high entropy. Before it eventuates, there is a tipping point known as the 'edge of chaos' which leaves the system in a state of suspension and indeterminacy (as arguably occurred during the pre-war month of August 1939). As opposed to regular laws in the physical environment, disorder and unpredictability can introduce dystopian elements into the affairs of people and societies.

Philosophical baselines

Pursuing a contrarian thesis, *The City of Grace* questions the precepts of neoliberal globalisation and devises a model to avoid its most unsustainable expressions. This positioning has the analytical advantage of mandating the highest level of systemic resolution (viz. a binary choice, whether or not to 'believe' in the contemporary social trajectory). Questioning conventional assumptions encourages the doubt necessary in any comprehensive appraisal of dystopia.

In this connection, a state of 'rationality' is thought to underpin agency, interpretation and theorising in the physical and social sciences. It is influenced by the rational choice model in economics and sociology which, broadly, defines 'rational' as applying to actions of which the benefits (gains) exceed the costs (losses). Though this model is foundational, it suffers from the lack of a unitary definition of 'utility' (and hence value), and incommensurability among non-economic ends (d'Agostino, 2011). Paradoxically, its difficulty lies in specifying a substantive definition of rationality.

In *The City of Grace*, rationality is approached both procedurally and substantively. First, following Paul O'Grady (2002), it requires procedural coherence, consistency, and the full and honest use of all available evidence (as in legal work). Substantively, to avoid the 'evaluative pluralism' besetting utility, it is afforded only one objective, taken to be of universal (non-relativist) application. This aim, individual and

collective survival based on free-will, is empirically and theoretically defensible. The intermediation of rationality and survival occurs through strategies of sustainability which could, in conditions of exigency, recursively engage the rational choice model.

With the purview of rationality established, the next step is to acknowledge irrationality, as it relates to system dynamics and entropic dystopia. With no fixed timescale or reference points, irrationality might spread from individuals to groups bottom up, as in a moral panic, stock market flight, or popular rampage created by a shock; or, more gradually and stressfully, top down from the wayward actions of political and economic élites. The condition is recognised in two forms: motivated and unmotivated.

Motivated irrationality can produce definitive social outcomes but they are, on balance, detrimental. Economic and political end-uses could involve any of the following cognitive biases:

- Refuting contrary observations for ulterior motives or ideological adherence
- Changing definitions, so obfuscating a case and replacing logical precepts with an allegedly 'better' definition
- Unrequited obligations applied through the use of moral suasion to impel people to act against their better judgment
- Framing errors including value attribution to persons or situations
- Diagnosis blindness, ignoring important evidence
- Belittling by experience, as in calling people or cases 'childish' or claiming to 'have seen all these problems before'.

Unmotivated irrationality could apply if an agent were ignorant of the 'logic' of the rational choice model. Such a person could regularly lose monetary or psychic wealth, status or social reputation but fail to realise as much. According to the philosopher, David Pears (1984), unmotivated irrationality has two modes, each constructed around the question, 'how can these things happen, which are so obvious to the rest of us?' Unless incompetence (mental illness) is established, attention gravitates to self-deception and acting flagrantly against one's own better judgment or best interests.

Self-deception is said to involve a perversion of reason, in so far as mentally sound people are assumed to have an unchangeable desire for truth in their own beliefs. It should therefore be impossible to deceive oneself simply for the sake of it. An ulterior motive or goal is always required. Acting against one's better judgment indicates that an individual is no longer controlling speech or behaviour to his or her utmost advantage, hinting at the Greek concept of akrasia or weakness of the will. It might arise from incorrect processing of information towards some end. It does not apply if information is just forgotten or misperceived. It has more to do with the dilution of reason by emotions such as desire and appetite.

At this point, the issue of divergent world views must also be raised. Can a single definition of 'rationality' serve everyone (Rorty, 1991: 26-27)? Heinrich (2020) contrasts the thinking behind long-standing, holistic approaches of societies (such as the 60,000 years of continuous adaptation by Australia's indigenous inhabitants) with that of WEIRD people. The acronym refers to the post-Enlightenment analytical reasoning of **W**estern, **E**ducated, **I**ndustrialised, **R**ich and **D**emocratic societies. WEIRD populations have embraced technological innovation and, in the last 100 years, have locked their welfare into an encompassing *belief* in 'growth' and 'change' (Samways, 2021). Conversely, in linking rationality, sustainability and species survival, the call in this rejoinder has been to *suspend* belief. WEIRDness affords every reason to do so, since systemically it involves contradictions which could activate two critical failure modes leading to dystopia outside *The City of Grace*. The first could occur in the production régime of advanced and developing nations. The second, the unbridled pursuit of economic and demographic expansion against a finite resource base, could, as an external threat, prompt an environmental crisis.

Dystopian failure modes

First mode: changing labour dynamics

The first ('internal') potential failure mode is contained within human social systems. It concerns workforce dynamics in WEIRD and other developed nations. While the sustainability of work is a fundamental issue in *The City of Grace*, it has been afforded little emphasis in many world views and geopolitical expositions.

At issue is the substitution of capital and management for labour in the factor mix. Advanced agriculture, mining and construction are trimming their labour

inputs, and manufacturing has been 'hollowed out' since the mid-1970s. In raising productivity and particularly in the virtual sphere, many business-to-business (B2B) and selected consumer services are becoming more capital-intensive (e.g., telecommunications, data handling, libraries, transport systems). Rapid economic and technological transformation influences company investment and could reduce labour demand by way of:

- increasing access to scale economies in production and corporate organisation
- the 'zero marginal cost' society (affecting industries in which the marginal costs of (electronic) production are approaching zero)
- ongoing product and service development (new offerings, inevitably involving smarter applications, diminished resource use, and greater efficiency in delivery)
- casualisation and contracting (freelancing and the 'gig' economy in which regular employment cedes to project-based engagements)
- shadow work (consumers overtly undertaking work for producers as in online booking, and in uploading personal data for analysis, and in providing private workspace and facilities when working from home)
- automation, robotisation and augmented/artificial intelligence (viz. information technologies, the onset of quantum computing)

These trends are underwritten by élites and social classes who own, or support the interests of, capital. Within the literature, technological optimists, business and population boosters argue that, as in the past, technology will create rather than destroy jobs. A whole new range of occupations will emerge, many yet unimagined. At worst, employment could level out. The alternative view is that the above six movements could suppress the demand for labour in developed countries. The resultant falling wage rates could meet rising ones in developing countries which continue to prosper from offshoring and endogenous growth. The global equilibrium price for labour would be well below that in the advanced world today.

This scenario might be welcomed by those who argue that much of the developing world remains locked into subsistence activity which will not benefit from population growing continuously against a constant resource base. Vast

numbers of people cannot access full employment in the formal sector. Nor, for two reasons, are their work prospects likely to be sustainable. As the burgeoning young of underdeveloped countries come of working age, the first cause will lie in the net annual addition (averaging 35 million people between 2010 and 2019) to the global labour supply (3.387 billion) (World Bank, 2021). Second is the matter of emerging economies capturing contract, production and marketing opportunities. The People's Republic of China has had estimable success in this regard. Yet as a middle-income nation, it is now, in its push for higher technology lines, engaging in exactly the factor substitutions outlined above (Powley, 2014; Aeppel and Magnier, 2015). Without pressing the point, the limited logic of this strategy is also pursued in *The City of Grace* as one of the few ways possibly to realise financial stability and prosperity.

The substitution/displacement thesis outlined here is unacknowledged in advanced nations which, to support their business interests, eschew effective labour market policies. This stance could represent motivated irrationality as the view from the edge of chaos heralds declining real wages and spatial equilibration over the next 30 or more years. Business is no longer constrained by the demand/supply relativities of a national market, since there exists in the worldwide workplace ('www') a mobile, ready and price-competitive workforce. Domestic wage pressure can be relegated when skilled and unskilled employees can be simply imported. The capital/labour failure mode is one subset of an unstable future world system. It links with a second one now to be examined.

Second mode: unlimited growth and planetary constraints

In the 1920s and 1930s, interest in fledgling neoclassical economics turned to measuring market activity in an attempt to define 'progress' in standards of living and, *in extenso*, quality of life. Today, 'economic growth', though the bane of ecological economists (Jackson and Victor, 2016), is an article of faith in neoliberal nations. In that setting, it has fostered among believers what Clive Hamilton (2003) calls a 'growth fetish' and Douglas Booth (2004) an 'addiction.' Hay (1978 p.8) has correspondingly written that 'growth, as a central dynamic of capitalism… serves an integrative and unifying purpose in rationalising or making sense of our social system.' Guided by Peterson (2017), we move now to have a closer look at this concept.

The poster child is the statistical quantity of gross domestic product (GDP), scrutinised and compared in international league tables. It is calculated over an accounting period in three ways, each respectively the sum of:

- the creation of goods and services produced at each stage of production less the costs of production (i.e. value added) (GDP – P)
- incomes generated by production (GDP – I)
- final expenditure on goods and services produced, including a statistical entity's exports but minus imports (GDP – E).

GDP (A) is the average of these three measures and, when read at constant prices, is regarded as the most satisfactory trend indicator of the size of an economy (McLellan, 1996). The word, 'gross' indicates that no deduction has been made for the consumption (or depreciation) of fixed capital, thereby producing a flow, not a stock, estimate. Nor does GDP record non-market (untraded) activity, so that much in the interpersonal realm and that of civil society goes uncharted, irrespective of its contribution to welfare or the quality of life.

Being dollar-denominated, the nominal level of GDP over successive accounting periods is influenced by inflation or deflation (temporal price movements in a standard basket of goods). Hence, national statistical bureaux advocate the use of 'real' (i.e. 'constant') GDP indexed to a base year. GDP *per capita* relates more directly to ordinary people's income level but is seldom referred to in the media. It can be modified as real GDP per capita which, *omnibus paribus*, reflects economic advance or decline over time. Though rarely cited, it is a strong, practical measure of pecuniary wealth, that being a rational and worthy aim of society. Yet, this per capita averaging can mask great inequalities between the rich and the poor in the flow of income and, hence, the accumulated stock of wealth and standard of living (Piketty, 2014). Such disparities can persist even as absolute GDP ('the pie') grows (cf. Jackson and Victor, 2016). The effect is that society in aggregate could be getting wealthier but that initially-poor people are becoming poorer. This is one of several possibilities which might erode the legitimacy of a growth fetish around the single metric of GDP.

More expansively, the ultimate constraint on unbridled economic performance is the physical resource base (Das, 2015 pp.120-47). The ecological economist, Herman Daly (1977) pointed out that advanced (WEIRD) societies, with their

culturally specific outlook producing certain kinds of material effects, have long tried to turn the ecosphere into a technosphere. To use vernacular terminology, so much could be achieved by 'growing' economies and populations. Ehrlich and Holdren (1971) nailed the dilemma in their IPAT equation. Against the finite bounds of Earth, it asserts that environmental impact (I) is a multiplicative function of population (P), times affluence (A), times a level of technology (T). In system terms, (P), (A) and (T) are inputs to the human-environment system and the economy is the processing mechanism which produces the output (I), impact. Each of Ehrlich and Holdren's interlinked, independent variables relates to the size of an economy measured in GDP.

Back in the production arena, the pitch of the political class to increase GDP relies on the 3Ps of population, participation, and productivity. In a brief commentary, less nuanced than Peterson's (2017) analysis, it can be said that gains in population (P) always imply increased consumption (GDP-E) which will impact physical sustainability through resource usage, whether of renewables or non-renewables. Labour force participation (commonly, the proportion of working-age people who are actually employed or able to look for work) will do likewise through the production function (GDP-P and GDP-I). Productivity (a ratio of outputs to inputs in the creation of goods and services) relates to the (T) in the IPAT equation. Technology attracts hope among the more intellectual growth leaders as a way of attenuating the irrationality of endless economic expansion given the fixity of resources and sinks. Evolution of the IPAT relationship is relatively slow-moving (i.e. over decades), presently more a stress than a shock. Its trajectory can thus be predicted by systems theory. Without mitigation (negative feedback), complex human-environment interaction should advance towards one or more tipping points followed by a phase shift towards a higher state of entropy and possible chaos (decline of societies). The underlying disjunction concerns both decentralised and command régimes since each is characteristically focussed on GDP (Dale 2012, pp.17-20). The impasse defies any reasonable reckoning of human sustainability: that is, it beggars belief.

Distraction, diversion, inaction…

The élite convergence around, and support for, economic and demographic growth contrasts with increasing fractiousness in the Western polis, perhaps reflective of self-deceptive denial toward emerging problems. Neoliberalism has

urged the primacy of the individual, encouraging self-determination and free will within a cosmopolitan world view. In certain societies, divergence breeds incapacity to acknowledge even the fundamentals of a case as per the claims of procedural rationality. Recent years have seen an upsurge of fake or disputed facts, spin and 'post-truths', all of which erode social consensus. At a more elevated level of epistemology, 'truth' is challenged by relativism and the rise of 'polyvocality' within postmodern social science (cf. Rorty, 1991 p.23). These schools have disputed comprehensive macro-theory as, for example, in Freud's psychoanalysis or various 'laws' in microeconomics: such thinking is allegedly 'totalising' and too nomothetic to be relevant to a many-sided society. Relativism drifts toward solipsism as people appropriate 'rights' to assert strongly-held values. Whether secular or religious, they are usually more ideological than original. They concern gender, sexuality, class, race, skin colour, educational level, politics, energy sources, attitudes to the environment, culture, outlooks on social justice and many other intersecting categories. Critical thought about human futures is less common.

In atomised, neoliberal democracies, individuals are encouraged by enablers of identity politics to disseminate their thoughts, claims and censures. The rise of social media has allowed for extemporary comment upon, and disparaging of, views challenging progressive expression of headline categories. An efficient way to deal with contrary standpoints is to eliminate them from the outset, via a 'cancel culture' or 'de-platforming.' These initiatives act to banish not only an idea but also, *ad hominem*, the person putting it forward. Such is the mood that a *Journal of Controversial Ideas* has recently been launched in which at-risk authors can publish under pseudonyms or anonymously. Paradoxically, the censure continues despite calls for participative diversity to ensure a range of thought and opinion. This free-ranging and reproachful movement might engage any of the irrational cognitive biases rehearsed previously.

Unless acting as an outstanding 'influencer', the neoliberal individual can rarely match the clout of a collective. Nonetheless, corporations are being forced by coalitions of stockholders, customers and employees to acknowledge the spreading politicisation and respond to social media challenges by 'taking sides' on contentious issues, some sectarian in nature and others, regarding energy uptake and climate change, of wider impact. Against this mixed backdrop of

developments, Furedi (2021) argues that engaged ('woke') business is usurping social space and advocacy roles normally associated with politics, religion, and civil society, with the ability to turn workplaces 'into a university seminar room.' McGuiness (2021) then asks, 'why not give large companies the power to take policy decisions on behalf of the country?' As neoliberal enterprise free-rides on progressive thought, plutocracy and oligarchy would supplant democracy.

Overall, these trends appear removed from the early conviviality and promise afforded by social media. In a marketplace for ideas which can admit irrationality, it is a moot point how the forces of distraction and inaction might handle higher entropy, as economic and population growth pressures the natural environment in line with the IPAT equation. On that note, some prognostication regarding the world outside *The City of Grace* is indicated.

Population and sustainability: prognostications

Precepts

My 2020 urban manifesto critiques its own modelling, but there remain broader issues. From medieval times a literature has existed, often radical and sometimes apocalyptic, about the passage and future of humanity (cf. modern 'collapse' contributions by Ahmad et al., 1997; Diamond, 2007 and Goodrich, 2014). Rather than starting with this broad assemblage, *The Journal of Population and Sustainability* affords an enlightened platform from which to mount a prognosis about dystopia. Readers would remember the incisive ideas of Garrett Hardin (1968, 1974) about the tragedy of the commons and living on a lifeboat, along with the eminent works of Herman Daly (1977, 2005) on steady state and ecological economics. They might also recall the multilateral Brundtland Report (which defined sustainable development as a call to one generation to do nothing which could impact the welfare of future ones) (World Commission on Environment and Development, 1987). It was made at a time when the global population was 5.02 compared with today's 7.79 billion (Worldometers). These various references have been routinely ignored as humanity burdens its surrounding environment.

The first pivot to any viable prognosis has already been advised: suspend belief in the rational choice model and in 'progress'. Similarly, much received ideology could be set aside as dysfunctional and too static in a turbulent environment. Since the internal (labour) and external (environmental) constraints upon

humanity apply worldwide, also suspect are sources which fail to take a high-level systemic view (i.e. involving global geo-economics or geopolitics) or which (like city planning) offer micro-level solutions to macro-level problems. Social media posting facilitative ideas might be able to advance welfare but, so far, it has suffered generous servings of self-infatuation, punctuated by trolling, grievance, and unauthorised data gathering by sponsoring platforms or hackers.

The second prop is to acknowledge the conceptual power of systems thinking, especially at high levels of resolution. As it clarifies the status and roles of entities relevant to sustainability, this technically-oriented analysis has little time for relativism, obscurantism or flaccidity. Once the foundations of rationality in individual human behaviour are established, its collective application should be recognised to enquire whether whole groups and populations are acting accordingly (Ball, 2005: 372-73). Writ large, and as a keynote of this rejoinder, the dimensions of rationality and irrationality introduce a new level of systemic enquiry into social agency and potential failure modes.

Any forward view must acknowledge humanity's constantly turning treadmills. The most important is global population growth of around 81 million, or 1.05 per cent per annum. Another is technological advance (total factor productivity) which Shackleton (2013), over the first decade of the new millennium, estimated at circa 1.5 per cent each year. Some might hope, from the IPAT equation, that the rate of technological change should compensate for the pace of population growth, but the former is subject to much risk, including loss of intellectual property and difficulties in engineering further breakthroughs. Human reproduction, multiplied over, is much easier and capable of delivering proximate results. Further, some applications of technology can have little effect in offsetting demographic impacts.

Mitigation according to IPAT

The IPAT equation should be strongly defended against relativist, idiographic and irrational challenges. It offers the best base upon which to interpret the human trajectory. Let us consider it, P-A-T, element by element. Although these independent variables are strongly interrelated, population (P) is a key to long-term sustainability (Bradshaw and Brooks, 2014). Complacency could ensue, in that the rate of global demographic increase is falling. Even so, it is unlikely to stop absolute human numbers reaching 10.9 billion by 2100, nearly 40 per cent greater

than the present count (Worldometers). Only writers as ebullient as the (late) expansionary economic demographer, Julian Simon, might hold that, even if jobs were abundant, such a gain would lower human stress and ease environmental loads. The thesis is apparently that more minds produce more solutions – but, in real life, the stock of brainpower might be less than fully utilised.

The immediate appeal of affluence (A) is most probably even greater than that of technology. Most people are risk and loss averse, few opt for an ascetic poverty, and even fewer for a return to hunter gathering or feudal serfdom. The wage freezes after the global financial crisis have seen numerous populations despair and search for reasons. Putative causes in the realm of capital have been assembled in this article. Popular silence ('keep calm and carry on') does not preclude a call for scapegoats and doubtless engenders some of the divisiveness observed in WEIRD societies.

Typified in the writings of Herman Kahn and co-authors (1972) is the view that the future will be infused with greater technological (T) advance, an apotheosis of progress to date. Though comforting, the idea has some problems. One is technology's ongoing substitution of capital for labour since, as remarked by Finn Bowring (2002), the aim of the most efficient enterprises is the elimination of work. Technology could also run into physical asymptotes, as in there being no further process or product improvements possible (for instance, in household cutlery?). Nor might there be room to imagine new goods or services (which would at least check the affluence (A) element of the IPAT equation by limiting consumption). Another daunting thought is that, if technology *were* to solve current impact (I) challenges of greenhouse gas emission, there would be little to stop growth-obsessed nations arguing that the threat of climate change had passed and thereafter they could continue to increase and densify their populations. This prospect would disconcert the Australian environmentalist, Ian Lowe (2005, p.84), who writes that, 'there is no prospect, even in principle, of a sustainable society if population continues to grow.'

Close-up on population

As distinct from a prevailing growth fetish, precautionary views on demography and economics might be held contrarian but, in future, their inherent realism could emerge. In one failure mode, chaos could involve millions – why not billions – of

people unemployed. In another, it could consist of global warming of more than two – well, say four – degrees Celsius. Hardin (1974) paints a sad picture of those unable to sustain their most basic Maslovian needs of shelter and nourishment. Such prospects are squarely at odds with the intergenerational proclamations of the World Commission on Environment and Development (1987). Very likely, given the shortfalls of technology and affluence, a slowdown or reversal in human numbers is the most efficacious, perhaps the only, way to ensure future welfare. In any country, that move would be hindered by labour immigration, irrationally engaged as if capital substitution were no longer in operation.

Confronting the obstinacy of various religious and political organisations, the case for population control has been raised over some 50 years by ecologically aware authors (e.g. Ehrlich and Harriman, 1971; Lowe, 2005). It would desirably involve 'carrot' incentives until a high-entropic phase necessitated 'stick' solutions. The latter might be hard to imagine in WEIRD societies but famines before the reforms of the later 20th century influenced demographic controls in the People's Republic of China and they proved effective.

In this journal and her foregoing book, Sarah Conly (2016) has thoughtfully debated some of the relevant instruments. Various leads also appear in *The City of Grace*. A least-worst and still partly 'carrot' approach would raise the opportunity (and probably the actual) costs of successive births to privatise rather than socialise procreation (cf. Landsburg, 2007 pp.153-55). Daly and Cobb (1989 pp.243-44) propose a quota ('far less harsh than the Chinese plan') with transferable reproduction rights. Jeremy Rifkin (n.d.) has sensibly suggested that extension of electricity supply would improve vocational opportunities for women and so constrain reproduction. The same goals have been pursued per media of education and employment by Cohen (2008), Barakat and Durham (2014), Lutz et al. (2019) and Vollset et al. (2020). Alexander and Gleeson (2019 p.192) call for a global fund to minimise unplanned pregnancies and, simultaneously, the abolition of all incentives toward population growth.

Following these authors, more ideas could be added, though a whole book of proposals would be more apposite. Given that world GDP presently approximates $US80 trillion per annum – actual *turnover* much greater – it could be worth imagining how far a budget of around one per cent (e.g. $US 1 trillion) might

extend as a yearly insurance premium to check global demographic increase and thus have an impact on human-environmental sustainability. If a rationale for large family size in traditional societies is surety for parents in old age, could other safety nets be devised? How many elderly people in underdeveloped countries with high population growth rates could be supported by subventions of say, $US 2,000 per annum? This amount approximates annual per capita GDP in some of the poorest nations where life expectancy is anyway constrained. Fifty million people would claim $US100 billion: 500 million (around half the world's population aged over 60) would require $US 1 trillion. Moral hazard might emerge, and the financial sum is estimable, but the subvention could be a small price to pay to avoid systemic phase shifts and possible demographic chaos. It pales into insignificance compared with the $US16 trillion outlay on the COVID virus to October 2020 in the United States alone (Cutler and Summers, 2020).

At the other end of life, the aim is to restrain some of the world's 80 million net population gain per year – logically, the 'target market'. Indirectly, it could be made widely known that women disproportionately bear the costs of childrearing, much in the lost compounding of foregone wages (and pension contributions should they exist) (Gittens, 2007). More directly, $US 1 trillion would energise effective family planning, often significantly hampered by a lack of contraceptive aids. Sadness can engulf couples unable to have children but can likewise accompany unplanned or excess pregnancies. Checking them would be a primary objective, despite the aspirations of pro-natalist administrations. Such practical measures are put in the 'too hard' or 'complicated' basket by conservative or obfuscating politicians in countries which could be either donors or recipients of financial assistance. Today, rapidly growing nations appear as unable to manage population problems within their borders as they are to stop emigration (cf. Peterson, 2017). Pareto inferior, large-scale movements offer no real solutions and might only scupper the rationale of other countries to manage their own fertility. Better to tackle the issue at source.

Conclusion

This rejoinder to *The City of Grace* has enabled speculation on potentially dystopian outcomes in the neoliberal world. Just as the treatise on the City set prior precepts aside, this article has urged suspension of belief in comfortable social axioms. The most widespread and seductive is the assumption of a

prevailing rationality (and improvement) in human affairs. The current foray into irrationality uncovers some of the shortcomings of such orthodoxy.

Outside *The City of Grace*, two failure modes in contemporary human development were identified. The one inherent in the socioeconomic system, which concerns labour dynamics, is scarcely touched upon in the literature. It imbricates into the external threat involving human-environmental relations, which is well understood but incompletely addressed. The focus on carbon emissions attempts to reduce the (I) of the IPAT equation through (T) technology, but leaves the key variable, (P) population unconstrained. Greater understanding is available through a systems approach which exposes essential elements, sidesteps relativism and eschews overbearing ideologies such Margaret Thatcher's imperative regarding neoliberal globalisation – TINA, '**t**here **i**s **n**o **a**lternative'.

The foundations of dystopia are not impenetrable once conventional shibboleths are set aside. To this end, the building blocks of the growth fetish were investigated. It was observed that pronatalist and pro-immigration calls overlook major changes in the means of production in advanced societies, via which technological substitution of other factor inputs for labour is likely only to expand. Abetting popular polarisation in WEIRD nations and a lack of strategic focus in social media, contemporary economic and demographic advocacy appears substantively irrational as the respective trajectories push further into resource constraints.

Invoking the IPAT equation, the analysis found that technology (T), though applauded by sections of society, can be an ambiguous influence, since its ultimate end in production is the diminution of work. Leaders who support reduction in affluence (A) are misreading human aspiration and will be disregarded. The societal objective is neither to retreat into poverty nor create unimaginable riches, but instead equitable and sustainable real per capita wealth. The environmental failure mode could be avoided by reducing population (P) pressure on the planet, though falling numbers are not going to address emerging imbalances from capital substitution in production. In this way, the two failure modes studied here are linked.

The article has tested certain means to deal with entropic tendencies in neoliberal human development. Unless technological advance and dynamics in the factor

mix falter, it is hard in a globalised and highly-integrated market to see how the labour disjunction outlined here can be readily avoided. The specific remedy relying upon cutting-edge technology proposed in *The City of Grace* would be hard to scale up in what could be a zero-sum game. Individual countries which, in a protectionist vein, withdrew from unrestricted engagement with the world would probably experience politically unpalatable declines in affluence. This is a research frontier inadequately contemplated, except in management reports which often exhibit unsubstantiated foresight into, or optimism about, the future of the workforce. The issue requires critical consideration and a new generation of pragmatic scholars, just as contrarians switched on to the natural resource dilemma in the late 20th century.

With herculean effort, the environmental crisis might be solvable if societies were less focused on internal division and state and non-state conflict, and more on fundamental labour and population (P) issues. There will always be free-riders sponsoring expansive and ill-advised policies and arguing that the maxim, 'demography is destiny', still applies positively rather than negatively. No country can overcome the environmental impasse alone, the more so when situated at the edge of chaos. At that point, world governance might be the only panacea, maybe under more authoritarian auspices to enforce necessary 'stick' measures.

In conclusion, foibles and folly seem hard-wired into human endeavour. On the drive through life, reason is assigned the back seat. Many uncertainties attend the high-level systemic quandaries reviewed in this article. Hence, the imputation of dystopia outside *The City* should stand.

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PEER REVIEWED ARTICLE

Post-materialism as a basis for achieving environmental sustainability

Douglas E. Booth[1]

Associate Professor Retired, Marquette University

Abstract

A recent article in this journal, "Achieving a Post-Growth Green Economy", argued that a turn to post-material values by younger generations may be setting the stage for a more environmentally friendly, post-growth green global economy. To expand the foundations for the possible emergence of such an economy, the current article offers empirical evidence from the World Values Survey for the propositions that individual post-material values and experiences leads to (1) a reduction in consumption-oriented activities, (2) a shift to more environmentally friendly forms of life that include living at higher, more energy efficient urban densities, (3) having families with fewer children, and (4) greater political support for environmental improvement. Such behavioral shifts provide a foundation for a no-growth, or even a negative-growth, economy among the affluent nations of the world leading to declining rates of energy and materials throughput to the benefit of a healthier global biosphere.

Keywords: post-materialism; sustainability; population growth; post-growth economy.

1 cominggoodboom@gmail.com

Introduction

A sea-change in values among middle-class youth has occurred around the world away from giving high social priority to materialist economic social goals and towards non-economic social purposes such as advancing freedom of expression and increasing social tolerance (Inglehart, 2008; Norris and Inglehart, 2019). This change appears to be accompanied by less emphasis on the pursuit of wealth and material possessions and more emphasis on seeking cultural and social experiences that take place outside the sphere of economic transactions or within the economic arena but for non-economic purposes. This article hypothesizes that such a shift in outlook and activities brings a less entropic and more environmentally friendly way of living and greater political support for sustaining a healthy natural environment. Not only have values shifted in a post-material direction away from more traditional concerns among global populations, but interest in the pursuit of post-material experiences beyond the strictly economic has expanded as well. In the following, data from the World Values Survey, Wave 6 (2010-2014) will be used to offer evidence for these claims and to show that post-materialists are (1) less oriented to expanding material consumption, (2) choose to reside in denser, more energy efficient urban settings, (3) have smaller families than others, and (4) support the environment through political actions, all to the benefit of a healthier global biosphere (World Values Survey Association, 2015).

Various authors have suggested limiting material economic activity in those countries most responsible for the violation of ecological sustainability measures such as the ecological, carbon, or materials consumption footprints. Some argue simply for a cessation of economic growth and others for actual reductions in economic activity in order to meet global sustainability goals (Booth, 2020a; Jackson, 2017, 2019; Victor, 2008). To accomplish either of these would be a profound political act and require a substantial constituency. Such a constituency is potentially found amongst individuals who express post-material values or participate in post-material experiences. These individuals are more likely than others to themselves limit their material consumption and to be strongly supportive of doing something about global environmental problems. Whatever position taken on the question of limiting growth to address harms to the environment, the historical evidence is clear that economic growth, and the technological changes and population expansion behind it, have brought about substantial harms to the environment, and this is especially the case for the U.S. and the U.K. (Booth, 1998).

The post-material silent revolution

Ronald Inglehart and his colleagues have extensively documented a 'silent revolution' in social values among younger generations occurring over the last half of the 20th Century and continuing into the early 21st Century (Inglehart, 1971, 2008; Inglehart and Abramson, 1994). In these years, the 'silent revolution' in the formation of post-material values made significant advances in the world's most affluent countries, which have gained the capability of providing economic and physical security to younger generations as they come of age (Inglehart, 1971; Inglehart and Welzel, 2005; Norris and Inglehart, 2019). Statistical evidence shows a substantial advance in the ratio of post-materialist to materialist values in a diverse collection of European countries and the U.S. (Inglehart, 2008; Inglehart and Norris, 2016). Growing up in economically secure conditions enables the formation of 'liberal' post-material values among younger generations such as freedom of expression, social tolerance of all irrespective of race or sexual predilections, a humane society based on ideas rather than money, and democracy in all of life's arenas. These values are given disproportionate support by younger individuals over such materialist goals as increased economic growth and expanded personal security (Inglehart, 2008; Inglehart and Abramson, 1999). Inglehart also provides evidence showing that younger generations continue to be more post-materialist than older generations over time despite fluctuations in post-materialism measures related to economic cycles (Inglehart, 2008). In brief, as particular generations age they retain their basic commitment to values formed in their younger years.

The realization of post-material values more commonly occurs among those from more affluent middle-class backgrounds than among those from less economically secure working-class backgrounds (Inglehart and Abramson, 1994, 1999; Inglehart and Welzel, 2005). For this reason, a class divide between middle-class post-materialists and working-class materialists who occupy the lower end of the social class spectrum is likely (Booth, 2020b).

The World Values Survey data and measuring post-materialism

The data source used in the following analysis comes from the World Values Survey, Wave 6, a global sample survey of a full array of human values under the auspices of the World Values Survey Association composed of 100-member countries (World Values Survey Association, 2015). For a full explanation of the

methodology behind the survey, go to the World Values Survey web site, http://www.worldvaluessurvey.org. The survey is funded by member countries and a variety of foundations and administered in person to a randomly selected set of respondents by professional staff and is confined to adults 18 and older. Wave 6 data were collected over the period from 2010 to 2014 and include 60 countries (Table A1) and a total sample of 86,274 respondents.

A post-materialism index based on respondent expressions of attitudes towards materialist and post-materialist social goals can be constructed using data from the World Values Survey-Wave 6 (WVS), administered over the period 2010-2014 (World Values Survey Association, 2015), and is referred to here as the Inglehart post-materialism index. The construction of the index is set out in Table 1 where all WVS variables used in the following are described. Data from the WVS survey shows that 69 % of respondents are materialists who each claim less than a majority of post-material social goals among the options used in the construction of the Inglehart Post-Materialism Index, and 31 % are post-materialists who each claim a majority of their social goals as post-material (World Values Survey Association, 2015). Between the WVS wave 6 (2010-2014) and wave 7 (2017-2020), for 32 countries common to each sample, the share of post-materialists increased more than 10 % from 30.5 to 33.7 % of the global sample population (World Values Survey Association, 2015, 2020). Unsurprisingly, in an outwardly materialist world, post-materialists still constitute a minority of the population, but one that has expanded in recent decades in European countries and the U.S. as already described (Norris and Inglehart, 2019).

Table 1. World Values Survey Wave 6 * Questions Wording and Coding

Variables	Questions	Coding
Inglehart Post-Materialism Index	People sometimes talk about what the aims of this country should be for the next ten years. On this card are listed some of the goals which different people would give top priority. Would you please say which one of these (on each Card) you, yourself, consider the most important? And which would be the next most important? (PM refers to a post-materialist social goal and M to materialist). Card 1 (1) A high level of economic growth (M) (2) Making sure this country has strong defense forces (M) (3) Seeing that people have more say about how things are done at their jobs and in their communities (PM) (4) Trying to make our cities and countryside more beautiful (PM)** Card 2 (5) Maintaining order in the nation (M) (6) Giving people more say in important government decisions (PM) (7) Fighting rising prices (M) (8) Protecting freedom of speech (PM) Card 3 (9) A stable economy (M) (10) Progress toward a less impersonal and more humane society (PM) (11) Progress toward a society in which Ideas count more than money (PM) (12) The fight against crime (M)	Index=sum of the number of first and second post-material (PM) priorities for each set Range: 0-5

Variables	Questions	Coding
Organization Membership Index	Now I am going to read off a list of voluntary organizations. For each organization, could you tell me whether you are an active member, an inactive member or not a member of that type of organization? Sport or recreational; art, music or educational; environmental; humanitarian or charitable.	Not-0 Inactive-1 Active-2 Index= summation of scores. Range 0-8
Creative Tasks/ Independence at Work Index	Are the tasks you perform at work mostly routine tasks or mostly creative tasks? Use a 1 to 10 scale with 1 mostly routine tasks and 10 mostly creative tasks. How much independence do you have in performing your tasks at work? Use a 1 to 10 scale with 1 no independence at all and 10 complete independence.	1-10 1-10 Index= sum of above Range 1-20
Participation in Political Action Index	I am going to read out some forms of political action that people can take. Tell me for each action how often you have done it in the last year. Signing a petition; joining a boycott; attending peaceful demonstrations; joining strikes; other acts of protest.	Not at all-0 Once-1 Twice-2 Three-3 More-4 Index=sum of for all actions. Range 0-20
Age	Can you tell me your year of birth, please? 19____ (write in last two digits) This means you are ____ years old (write in age in two digits).	Years

Variables	Questions	Coding
Education	What is the highest educational level that you have attained? [NOTE: if respondent indicates to be a student, code highest level s/he expects to complete]: 1 No formal education 2 Incomplete primary school 3 Complete primary school 4 Incomplete secondary school: technical/ vocational type 5 Complete secondary school: technical/ vocational type 6 Incomplete secondary: university-preparatory type 7 Complete secondary: university-preparatory type 8 Some university-level education, without degree 9 University-level education, with degree	1-9
Social Class	People sometimes describe themselves as belonging to the working class, the middle class, or the upper or lower class. Would you describe yourself as belonging to the 1 Upper class 2 Upper middle class 3 Lower middle class 4 Working class 5 Lower class	1-5
Importance of Being Rich	Now I will briefly describe some people. Using this card, would you please indicate for each description whether that person is very much like you, like you, somewhat like you, not like you, or not at all like you? It is important to this person to be rich; to have a lot of money and expensive things.	1-6

Variables	Questions	Coding
Importance of Work	For each of the following, indicate how important it is in your life. Work.	1-4
Importance of Leisure	For each of the following, indicate how important it is in your life. Leisure.	1-4
City Size	(Code size of town): 1 Under 2,000 2 2,000 – 5,000 3 5 – 10,000 4 10 – 20,000 5 20 – 50,000 6 50 – 100,000 7 100 – 500,000 8 500,000 and more	1-8
Family Size (No. of Children)	Have you had any children? (Code 0 if no, and respective number if yes): 0 No children 1 One child 2 Two children 3 Three children 4 Four children 5 Five children 6 Six children 7 Seven children 8 Eight or more children	0-8
Environment Importance	Now I will briefly describe some people. Using this card, would you please indicate for each description whether that person is very much like you, like you, somewhat like you, a little like you, not like you, or not at all like you? (1-6 scale). Looking after the environment is important to this person; to care for nature and save life resources.	1-6
Give to an Ecological Organization	During the past two years have you given money to an ecological organization?	

Variables	Questions	Coding
Attend an Environmental Demonstration	During the past two years have you participated in a demonstration for some environmental cause?	0-1
Life satisfaction	All things considered, how satisfied are you with your life as a whole these days?	1-10
Job Loss Fear	To what degree are you worried about the following situations? Losing my job or not finding a job.	1-4

**Source: (World Values Survey Association, 2015). Wave 6 Countries Surveyed: Algeria, Argentina, Armenia, Australia, Azerbaijan, Bahrain, Belarus, Brazil, Columbia, Cyprus, Chile, China, Ecuador, Egypt, Estonia, Georgia, Germany, Ghana, Hong Kong, India, Iraq, Japan, Jordan, Kazakhstan, Kuwait, Kyrgyzstan, Lebanon, Libya, Malaysia, Mexico, Morocco, Netherlands, New Zealand, Nigeria, Pakistan, Palestine, Peru, Philippines, Poland, Qatar, Romania, Russia, Rwanda, Singapore, Slovenia, South Korea, South Africa, Spain, Sweden, Taiwan, Thailand, Trinidad, Tunisia, Turkey, Ukraine, United States, Uruguay, Uzbekistan, Yemen, Zimbabwe.*

***This social option is excluded from the final 12-item index as a social priority because it fails in practice to adequately separate materialists from post-materialists (Chang and Chen, 2013; Inglehart and Abramson, 1999)*

The formation of post-material values has also resulted in the advance of post-material experiences such as joining voluntary groups, pursuing creativity and independence in the world of work, and engaging in political actions, experiences that go beyond a strict focus on accumulating financial wealth and material possessions (Booth, 2018a, 2020b). Henceforth in this article, the terms 'post-materialism' and 'post-materialist' will encompass both Inglehart post-material values and post-material experiences. If we are materialists, our life's focus is on gaining control over both tangible and material-like intangible objects and transforming them to mirror our deepest wishes (Booth, 2018a). Our experience of such control and its resulting manipulations of the material stuff of life is sensual and virtual, a product of our perception-driven, conscious thought process. Our desire to physically manipulate and alter objects as we find them in nature can ultimately result in huge transformations of the material world. Witness the remaking of the global environment following, first, the agricultural revolution and, second, the industrial revolution (Harari, 2015).

Some object ownership is inevitably a part of all our lives – we each need our own private supply of food, clothing, living space, and such – but post-materialists

look increasingly for experiences and actions not necessarily contingent on ownership of objects in their field of perception. For post-materialists, the essential quest in life is for experiences of the world apart from any requirements for ownership and private control. A post-materialist is not just someone with a certain value orientation, but a person who lives in a certain way and participates in certain kinds of activities. A post-materialist can afford to pursue extensive activities beyond the purely economic. Three activities of this kind postulated here are these: (1) voluntary group membership, (2) creative and independent work such as that undertaken by artists, and (3) political action beyond voting in support of some cause. Each measures a dimension of post-material, action-oriented experience where private possessions or wealth are secondary and, in some cases, inessential to the activity (Booth, 2018a). The World Values Survey (WVS) can be utilized to construct measures of these activities and estimate the extent of participation in them (World Values Survey Association, 2015). An index of voluntary group membership can be formulated from WVS inquiries about respondent participation in (a) sport or recreational, (b) art, music, or educational, (c) environmental, or (d) humanitarian or charitable organizations with inactive membership assigned a value of 1 and active membership a value of 2 for each of the four organizational categories which are then added up for each survey respondent (Table 1). These organizations were chosen on the assumption that participation in each type generally requires only a modest amount of material possessions or financial wealth. The particular kind of groups selected here are those that normally provide a public benefit of some kind and would consequently be of interest to individuals with post-material values seeking self-expressive activities. People choose to belong to other kinds of organizations including labor unions, political organizations, and professional groups, but these generally have a 'utilitarian' focus and provide private benefits of some kind to members. Membership in utilitarian groups was virtually flat globally between 1980 and 2000 in post-industrial societies, but by contrast public benefit groups experienced substantial growth (Welzel, Inglehart, and Deutsch, 2005).

The extent of creative and independent tasks at work can be measured by summing up two WVS survey responses, each measured on a 1-10 scale, first, that asks whether work tasks are mostly routine or mostly creative and, second, whether independence is exercised in performing work tasks (Table 1). Seeking work that possesses such characteristics doesn't necessary require one to be

materially wealthy, as in the case of so-called 'starving artists' (Alper and Wassall, 2006; Lloyd, 2002). Work does necessitate participation in a product market for the self-employed or a labor market and is inevitably subject to market transactions unlike membership in voluntary organizations or participation in political action, but product or labor market income can often be traded off for creative and independent tasks (Alper and Wassall, 2006).

Participation in political action can be measured with the sum of the number of times (up to a maximum of four each) that a respondent signed a petition, joined a boycott, attended a peaceful demonstration, joined a strike, or participated in some other act of protest (Table 1). Participation in such activities normally doesn't require much in the way of material possessions and financial wealth. Actions of this kind are the product of either formal or informal mass organization by activists and can frequently be described as 'elite-challenging'. Such actions experienced an upswing in the last two decades of the 20th Century in post-industrial societies (Inglehart and Welzel, 2005; Welzel et al., 2005).

The three experience activities should measure phenomenon significant in daily life if these phenomena are to be of any importance. The World Values Survey – Wave 6 (WVS) data reveal that voluntary organizations indeed matter for respondents, 33.5 % of whom belonged to at least one athletic, arts, environmental, or humanitarian organization. For membership scoring purposes, inactive membership in each type of organization is given a value of 1, and active membership a value of two. Of those who participate in on or more of the four types of voluntary organizations, the mean participation score is 2.81 out of a maximum possible of 8, the latter number being achieved only with active membership in all four types of organizations. The mean sample score for creative and independent tasks is 10.5 out of a possible 20 with approximately 23 % of the sample realizing a score of 15 or more, suggesting that creativity and independence in work occurs for a substantial portion of the respondent working population. Finally, the rate of respondent participation in political action is 20.4 % of the total sample population and the mean participation rate is 3.0 actions for those who are politically active. The three experience activities are thus a significant part of individual lives on a global scale, and importance of post-material experiences around the world is established for a substantial minority of the sample population (Booth, 2018a).

The statistical approach

To repeat, the purpose of the statistical analysis to follow will be to provide evidence that (1) post-materialists are less oriented than materialists to expanding material consumption; (2) choose more so than others to reside in denser, more energy efficient urban settings; (3) have smaller families than others; and (4) support the environment through political actions, all to the benefit of a healthier global biosphere. The basic statistical approach is to use regression analysis to show that post-materialism measures are statistical predictors of (1) – (4) in a global setting. Using such a large survey with such a diverse geographic coverage for this task has its benefits and dangers. The benefit is that the statistical results apply globally. The drawback is that any useful regression analysis for such a large sample will necessarily leave out a huge number of possible explanatory variables and will end up explaining a relatively small portion of variation in the data. Nonetheless, with such an analysis significant statistical relations can be discovered that are highly useful in explaining human behavior. To account for country-level differences, a hierarchical mixed-effects regression technique is used that creates a random effects constant for each country that controls for country differences unaccounted for by included variables in regressions equations (Stata Corporation, 2015). Note that actual sample sizes will be reduced in equations limited to the actively employed portion of the sample and generally because of missing data where respondents fail to answer questions.

Statistical analysis of post-materialism

The following WVS regressions (Table 2) confirm that (1) Inglehart Post-Materialism is predicted negatively by age and positively by education, (2) the three post-material experiences – Voluntary Organization Membership, Creative and Independent Work, and Political Action – are in turn positively predicted by Inglehart Post-Materialism, and (3) Social Class (higher to lower) negatively predicts both Post-Materialism and post-material experiences:

Table 2: Mixed-Effects Post-Materialism and Post-Material Experience Regressions (Coefficients and Standard Errors)

Independent Variables	Inglehart Post-Materialist Index	Voluntary Organization Membership	Creative/ Independent Work	Political Action
Inglehart Post-Materialism Index		.1130988*** .0049122	.2113903*** .0149283	.1552952*** .0054388
Age	-.0041246*** .0002624			
Education	.0409622*** .0019717			
Social Class (Higher to lower)	-.0223641*** .0043434	-.1960595*** .0056974	-1.023931*** .0176207	-.0861862*** .0063107
Regression Wald Chi-square Statistic	1114.64***	1794.66***	3661.46***	1041.82***

*Statistical Significance: *<=5%; **<=1%; ***<=.1%. Sample N=77,294; 77,336; 63,584; 77,972.*

Younger individuals tend to be more post-materialist than their older peers and education positively predicts the post-materialism index as Inglehart's theory postulates. Education is both a liberalizing force and an indicator of an economically secure upbringing (Inglehart and Welzel, 2005 p. 37). Post-material values matter in choosing to engage in post-material experiences as inferred by the post-materialism index positively predicting each of the post-material experiences. This analysis makes clear that social class (measured higher to lower) also matters for both post-material values and experiences and has a negative impact on respondent post-materialism, meaning that members of the working class are more heavily materialist in their outlook than the middle and upper classes and are also less likely to participate in post-material experiences.

The emergence of post-materialism is especially interesting because it is intrinsically 'anti-capitalist' in its value-orientation and its conversion to a focus on actions and activities beyond the realm of marketed material possessions. The post-materialist movement according to Inglehart and Welzel is 'elite-

challenging', and it supports an expansion of democracy in all of life's arenas including the workplace, something that would be antithetical to the bureaucratic form of control exercised within the modern capitalist corporation (Welzel et al., 2005). Carried to its logical conclusion, a switch to post-material values and experiences means a dampening of demand growth for consumer goods without which modern capitalism loses an essential driver for its expanding global influence. Were post-materialism to become globally prevalent and a threshold income reached universally beyond which demand for further material possessions takes a back seat to post-material experiences, then global growth in consumer demand could well shrink towards zero. Historically, the central opposing force to unfettered capitalism has been the materialist-oriented labor movement driven by the tendency of large corporations in the pursuit of profits to place downward pressure on wages and upward pressure on labor effort. Materialist members of the working class and middle-class post-materialists both have interests counter to the unhindered operation of capitalist enterprises, but these interests differ. Workers primarily desire increased incomes and economic security through higher wages and benefits that as a cost of production eat into business profits, and post-materialists are more oriented to obtaining increases in freedom of expression, expanded say over the organization of the work process, and the enlargement of life prospects beyond market transactions. This division is important and will be revisited later in this article. For now, it is worth noting that while their interests differ, both post-materialists and the working-class individuals in the pursuit of their particular interests oppose key outcomes delivered by capitalist businesses.

Post-materialism as a low-entropy form of life

The future spreading of a 'post-material silent revolution' around the world, I will now argue, provides an economic and political foundation for an environmentally friendly 'green economy' with less energy and materials throughput and associated waste emissions, an outcome that may well be essential to prevent the existential threat of climate change and other environmental stresses to the global biosphere. To repeat, the 'silent revolution' will assist in bringing about such an economy for the following reasons: (1) first and foremost, post-materialists likely consume relatively less over their life-time than materialists with similar economic opportunities, reducing the negative effects of such consumption on the environment; (2) post-material forms of living and experiences tend to be

less entropic and harmful to the environment than materialist ways of life; (3) post-materialists have smaller families dampening global fertility and eventually population growth and associated environmental harms; (4) and post-materialists are more supportive of environmental protection than others in both their attitudes and political actions, increasing the likelihood of government action favorable to the environment.

Those who adopt a post-material way of life are more prone than others to lack an interest in accumulating material possessions beyond a basic threshold level. As already described, post-material experiences tend to be pursued for their own sake, and material possessions are wanted for their supporting role in meeting the basic threshold material requirements of modern life. This infers that beyond some point post-materialists will be uninterested in voluntarily expanding either their consumer purchases or their purchasing power. In such circumstances, added economic growth is no longer desired, especially if it means more working hours and less time for post-material experiences. Simply put, the spread of post-materialism carries with it an attendant dampening of growth in consumer demand that in turn will diminish the growth of aggregate economic demand and output measured by Gross Domestic Product (GDP). In brief, more post-materialism, less economic growth, lower energy and materials throughput and reduced waste emissions, and the closer a country comes to the reality of an environment-conserving 'green economy'.

The evidence for reduced consumption by post-materialist is circumstantial given the unavailability of actual data on consumption for those who profess post-material values, and such evidence is available from the World Values Survey (WVS). That survey asks three different questions that shed light on an individual's commitment to earning and spending on consumer goods (see Table 1): (1) How important is it to the respondent 'to be rich' and have a lot of money and expensive things (1-6 scale), (2) How important is 'work' in the respondent's life (1-4 scale), and (3) How important is 'leisure' in the respondent's life (1-4) scale. Statistical analysis of the WVS data in Table 3 on these questions finds that the Inglehart Post-Materialism Index is a significant negative predictor of the Importance of Being Rich and the Importance of Work and a positive predictor of the Importance of Leisure controlling for Age and Education:

Table 3: Mixed Effects Regressions: Consumption Orientation Indicators (Coefficients and Standard Errors)

Independent Variables	Importance of Being Rich	Importance of Work[+]	Importance of Leisure[++]
Inglehart Post-Materialism Index	-.0422719*** .0044899	-.0563488*** .0063815	.0986588*** .0057835
Age	-.0110707*** .0003288	-.0179869*** .0004678	-.009527*** .0004105
Education	.0133356*** .0023682	-.0046225 .0032364	.0728458*** .0028822
Regression Wald Chi-square Statistic	1416.76***	1565.39***	1393.20***

*Statistical Significance: *<=5%; **<=1%; ***<=.1%. Sample N=77,776; 76,627; 78,258. [+]Multi-Level Ordered Logit Regression. [++]Ordered Logit Regression; the Mixed-Effects model random constant is not statistically significant.*

In other words, post-materialists express a positive desire for leisure but a negative desire for being rich and engaging in work, the latter two being positive indicators of a materialist consumption orientation, and leisure being important to the pursuit of post-material experiences as a substitute for seeking more income to fund expanded material consumption.

Having attained a basic threshold of economic security and material possessions, post-materialists not only limit their overall demand for material possessions, but as a matter of taste seek a comparatively low-entropy form of life, placing less demand on energy and materials flows to the benefit of the environment. Post-materialists are more prone than others to reside in larger, denser cities that are more energy efficient and thus less entropic than the spread-out suburban areas so attractive to their older peers after World War II (Booth, 2018b). Energy efficiency increases with urban density for such reasons as reduced human travel distances, less use of energy inefficient private motor vehicles and more use of energy efficient public transit, and lower per person consumption of private dwelling space and associated heating and cooling energy requirements (New York City, 2007; Newman and Kenworthy, 1999, 2015). In the U.S., a return to downtown living has been driven in part by Millennials choosing to live in high-density urban

neighborhoods as opposed to spread out low-density suburbs (Birch, 2005, 2009). Even in already densely populated countries such as Germany, center-city, dense neighborhoods recently experienced a relative surge in population growth driven by younger generations (Brombach, Jessen, Siedentop, and Zakrzewski, 2017). Complementary to higher-density living by younger generations in the USA, the rate of car ownership and the miles of driving undertaken by Millennials is less than their older peers (Polzin, Chu, and Godrey, 2014). Higher urban densities support more of the publicly shared experience opportunities afforded by parks, libraries, public squares, museums, art galleries, entertainment and sports venues, spaces for group meetings and public demonstrations, street cafes, and more that provide opportunities for a post-material mode of living (Markusen, 2006; Markusen and Gadwa, 2010; Markusen and Schrock, 2006).

Data in the latest World Values Survey (WVS) confirms that Inglehart post-materialists and those who engage in two of three post-material experiences – creative and independent work and political action – tend to reside in larger cities around the world controlling for individual respondent Age, Education, and Social Class (Table 4):

Table 4: Mixed Effects Post-Materialism and Post-Material Experience Regressions and City Size (Coefficients and Standard Errors)

Independent Variables	Materialism/ Post-Materialist Index	Voluntary Organization Membership	Creative/ Independent Work	Political Action
City Size	.0069311** .0022541	-.0044558 .0031385	.0849591*** .0093077	.0161175*** .0034227
Inglehart Materialism/Post-Materialism Index		.1172729*** .0057623	.1843335*** .0173879	.1485208*** .006293
Age	-.0039707*** .0002966			
Education	.0373454*** .0022587			
Social Class (Higher to lower)	-.0263753*** .0048888	-.2044908*** .0065603	-1.011185*** .0200966	-.0762095*** .0071657

Regression Wald Chi-square Statistic	794.30***	1459.35***	2938.87***	739.95***

*Statistical Significance: *<=5%; **<=1%; ***<=.1%. Sample N=58,691; 58,899; 48,417; 59,230.*

This is an especially important inclination because, larger cities feature greater residential density, and, as already described, denser cities are more energy efficient, less entropic places to live (Newman and Kenworthy, 1999, 2015; Tsai, 2005). City Size is a statistically significant predictor in the Post-materialism, Creative/Independent Work, and the Political Action equations. The only exception occurs in the Voluntary Organization Membership equation where City Size lacks statistical significance. Organization Membership is apparently invariant with respect to city size.

Simply put, the choices made by post-materialists about where and how to live lead them to a less entropic and environmentally destructive form of life, and this is on top of their inclination to lower aggregate rates of material consumption.

A third choice that post-materialist make favorable to a slow-growth green economy is to have fewer children, placing downward pressure on human fertility and ultimately population growth. Global economic growth as measured by GDP contains two components: (1) growth in GDP per capita, and (2) growth in global population (Booth, 2020a; Jackson, 2019). The turn to post-materialism and its focus on purposes and activities outside the economic arena serves to dampen growth in GDP per capita as already suggested. Choosing to live in higher density settings, in and of itself, limits the accumulation of material possessions – less space, less stuff. Less population growth will mean less growth in GDP as well. The rate of human fertility that drives global population growth is, thankfully, declining at a fairly rapid rate, although it still has some distance to go to reach the magic 2.1 (children born per women) that will lead to long run population stability. Globally, world fertility peaked at 5.06 in 1964 and declined to 2.43 in 2017. The fertility rates for lower-middle, upper-middle, and high-income countries are respectively 2.3, 1.9, and 1.6, suggesting that population stability, and in some countries even population decline, is on the horizon (World Bank, 2019a). The global population annual growth rate peaked in 1969 at 2.11 % and declined to 1.11 % in 2018 (World Bank, 2019b).

There is an abundant literature on human fertility explaining the reasons for its decline, and increased individual family affluence, education, and access to health care are among the most important causes, each of which was in turn rendered possible in the past by economic growth per capita (Rogers and Stephenson, 2018). While historically the turn to post-materialism is certainly a modest contributor to the aggregate decline in fertility, the simple point to be made here is that post-materialists indeed contribute to fertility decline and will likely continue to do so in the future by possessing lower fertility rates than their materialist peers according to data in the WVS data analysis in Table 5:

Table 5: Mixed Effects Family Size Regression (Coefficients and Standard Errors)

Independent Variables	Family Size
Inglehart Post-Materialism Index	-.018067** .0053613
Voluntary Organization Membership	-.0254281*** .0039189
Creative/Independent Work	-.0054564*** .0014113
Political Action	-.0033483 .0034205
Human Development Index (HDI)	-3.497555*** .5977993
Age	.0537231*** .000383
Social Class (Higher to lower)	.0767966*** .0064439
Regression Chi-square Statistic	20639.95***

*Statistical Significance: *<=5%; **<=1%; ***<=.1%. Sample N= 61,069*

Post-Materialism and two measures of post-material experience – Voluntary Organization Membership and Creative and Independent Work – are statistically significant 'negative' predictors of Family Size controlling for respondent Age. Inglehart post-materialists and those who participate in two out of three post-material experiences thus have smaller families with fewer children than others. A comprehensive and widely used measure of economic and social development

across countries is the Human Development Index (HDI) compiled by the United Nations Development Program (United Nations Human Development Program, 2018). The index measures human capabilities across countries, and includes in its construction indices of life expectancy, education, and gross national income per capita (measured on a purchasing power basis). The index in each sample country for 2013 is reported in appendix, Table A1. The human development index is a country-level negative predictor of family size as one would expect given that human fertility typically declines with each of the three measures of human development. Finally, Social Class is a negative predictor of family size suggesting a positive connection between fertility and economic insecurity at the individual level.

The expansion of post-materialism on a global basis thus contributes to lower global fertility rates and ultimately to the dampening of global population growth. A slowing of population growth worldwide by itself will lead to slower economic growth, lower throughput rates than otherwise for energy and materials, and less harm to the global biosphere. Again, post-materialism is a good deal for the environment. Note also that development is especially important in reducing family size. Countries with a larger human development index have smaller families and consequently lower fertility. Both post-materialism and human development matter for reductions in human fertility that lead to lower population growth and perhaps eventual population reductions. Given that the life-time environmental impact of another person in the developed world is many multiples of someone in a comparatively poor country, reduction of family size among post-materialists in affluent societies is especially important. Note also that post-materialists tend to have smaller families while working-class materialists farther down the social class pecking order tend to have larger families implying that a reduction in social inequality could in turn decrease human fertility.

The essential takeaway message of the 'post-material silent revolution' is this: younger generations in economically and physically secure countries around the world express values and pursue activities outside the arena of material possessions more so than their older peers. The best experiences of their life don't require continuous additions to material affluence, and for them a low- or even no-growth economy would be just fine as long as opportunities to earn a minimum threshold income are available. Post-materialists also seem fine with

smaller families, less population growth, and a subsequent diminished need for continuing economic expansion. Through generational replacement, post-material values more prevalent among younger individuals will become more extensive in the global population as a whole over time. In short, the growth orientation of capitalism possesses little appeal to post-materialists, especially if it is destructive of the global biosphere and harmful to cultural and natural assets that support access to post-material experiences.

In addition to being oriented to a less entropic form of living, post-materialists exhibit support for the environment in terms of both their attitudes and actions in the world. A long line of research demonstrates that the possession of Inglehart post-material values around the world predicts individual support for the environment, and, more specifically, for addressing the problem of climate change (Booth, 2017). Such support extends as well to those individuals who engage in post-material experience activities as suggested by the WVS statistical analysis to follow in Table 6:

Table 6: Mixed Effects Environmental Support Regressions

Dependent Variable	Environmental Importance (Coefficients, Standard Errors)	Give to an Ecological Organization (Logit Odds Ratios, Standard Errors)	Attend Environmental Protests (Logit Odds Ratios, Standard Errors)
Inglehart Materialism/Post-Materialism Index	.0204977*** .0043438	1.128183*** .012342	1.191855*** .0175816
Voluntary Organization Membership	.0331226*** .003129	1.255632*** .0081557	1.300911*** .0107939
Creative/Independent Work	.0118229*** .0011487	1.035225*** .0031052	1.014692*** .0039225
Political Action	.0268521*** .0027929	1.137106*** .0064427	1.211818*** .0076544
Social Class (Higher to lower)	-.0207358*** .005247	.7795145*** .010265	.8503685*** .0145291

Regression Wald Chi-square Statistic	500.26***	3066.21***	2681.81***

*Statistical Significance: *<=5%; **<=1%; ***<=.1%. Sample N= 62,430, 62,468, 61,898.*

Note: the marginal effect of the independent on the dependent variable is equal to 1-coefficient in the case of odds ratios.

The essential conclusions that follow from Table 6 are these: (1) Four separate measures of post-materialism (Inglehart post-material values, voluntary organization membership, creative and independent work, and political action) positively and significantly predict each of three different measures of individual support for the environment (the importance of doing something for the environment, contributing to ecological organizations, and attending an environmental demonstration); (2) Social Class (higher to lower) negatively predicts support for the environment at significant levels. The dependent variables, Give to An Ecological Organization and Attend Environmental Protests, are both binary variables and require a logistical regression for estimation. For the independent variables in the regression equations, if the odds ratio is greater than one and statistically significant then the variable has a positive effect on the dependent variable and if it is less than one and significant it possesses a negative effect. To illustrate the meaning of the odds-ratio consider the coefficients in the Attend Environmental Protests. The odds ratio for Inglehart Post-Materialism equals 1.19 meaning that a 1 unit increase in the Index will increase the probability of a typical individual attending protests by 19 %. If we compare a materialist with an index equal to 0 and a post-materialist with an index equal to 5, then the odds are that such a post-materialist will attend environmental protests will be (5 x 19=) 94 % greater than the materialist. Clearly, post-materialism matters for engaging in environmental actions. Similar calculations can be undertaken with the other independent variable with similar results.

These findings interestingly, and perhaps unsurprisingly, reveal a social class gap in support for the environment between middle-class post-materialists and working-class materialists. Moving down the social class ladder by a single class results in a (100-85.0=) 15 % reduction in the odds of attending environmental protests, for example. Working class individuals at the lower end of the social class pecking order struggle to sustain a decent standard of living, a struggle that

is aggravated by increasing economic inequality in the most affluent countries around the world and by economic disruptions such as the 2008 global economic meltdown (Alvaredo, Chancel, Piketty, Saez, and Zucman, 2017; Saez, 2009; Stiglitz, 2010; Wisman, 2013). For this reason, members of the global working class, many of whom suffer from economic insecurity, are more strongly oriented than others to materialist goals and consequently place a lower priority on support for the environment.

Conclusion

The long-term trend towards post-materialism around the world fueled by generational replacement is a good thing for the environment worldwide as it takes the pressure off the growing demand for material possessions, fosters more energy efficient and less entropic forms of living, reduces fertility and population growth, and increases political support for protecting the global biosphere. This trend supports the emergence of a green economy with reduced rates of energy and materials throughput as a foundation for increasing the health of the global biosphere.

Reducing energy and materials throughput rates alone will not be enough to bring about the climatic stability necessary to a healthy world environment (Jackson, 2017). This will require a decarbonization of the global energy system and a worldwide 'Green New Deal' (Booth, 2020a; Sachs, 2019). Such decarbonization has the special virtue of creating well-paid working-class jobs by replacing capital-intensive fossil fuel energy with labor-intensive clean energy (Wei, Patadia, and Kammen, 2010). Doing so will not only satisfy the political demands for environmental improvement from politically active post-materialists but will help bring working-class materialists on board the environmental protection bandwagon by improving their immediate economic prospects and in the longer term moving them upwards in the social class structure to the point where post-materialism will become an attractive option for youths coming of age in working-class families that have attained a middle-class material status (Booth, 2020a). The social class divide between middle-class post-materialism and working-class materialism may well be surmountable by way of a Green New Deal that brings in its wake a healthier global biosphere.

Appendix

Table A1. Human Development Index (HDI Distribution Across 59 WVS Sample Countries, 2013)*

Country	Human Development Index	Cumulative %
Rwanda	.503	1.80
Yemen	.507	2.97
Zimbabwe	.516	4.74
Nigeria	.519	6.80
Pakistan	.538	8.22
Ghana	.577	10.04
India	.607	11.90
Morocco	.645	13.31
Kyrgyzstan	.658	15.08
Iraq	.666	16.49
South Africa	.675	20.64
Palestine	.679	21.81
Egypt	.680	23.61
Philippines	.685	25.02
Uzbekistan	.690	26.78
Libya	.707	29.29
Tunisia	.723	30.70
Jordon	.727	32.12
Thailand	.728	33.53
China	.729	36.23
Ecuador	.734	37.64
Columbia	.735	39.42
Peru	.736	40.85
Armenia	.742	42.14
Algeria and Ukraine	.745	45.31
Brazil	.748	47.06
Lebanon	.751	48.47
Azerbaijan	.752	49.65

Mexico	.756	52.00
Georgia	.757	53.42
Turkey	.771	55.30
Trinidad	.779	56.48
Malaysia	.785	58.01
Kazakhstan	.788	59.77
Kuwait	.795	61.30
Uruguay	.797	62.48
Romania	.800	64.25
Belarus and Russia	.804	68.99
Bahrain	.807	70.40
Argentina	.820	71.62
Chile	.828	72.79
Poland	.850	73.93
Cyprus	.853	75.10
Qatar	.854	76.35
Estonia	.862	78.15
Spain	.875	79.55
Slovenia	.885	80.81
South Korea	.893	82.22
Japan	.899	85.09
New Zealand	.907	86.08
Sweden	.912	87.50
Hong Kong	.915	88.68
United States	.916	91.30
Netherlands and Singapore	.923	95.86
Germany	.928	98.26
Australia	.931	100.00

**Taiwan data is unavailable.*

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