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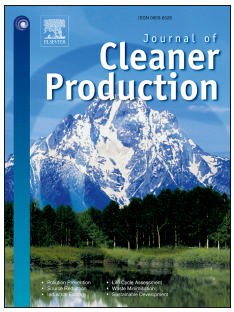

Working with human nature to achieve sustainability: Exploring constraints and opportunities

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Highlights 'The question of sustainable production and human nature'

- This article links structural constraints to sustainability to human nature.
- Human nature is understood as cross-cultural and historically consistent psychological traits.
- These traits, when combined with specific cultural conditions, result in unsustainable behaviors.
- The relationship between human nature and culture, and between human nature and sustainability are explored.
- Policies that take advantage of some of our natural tendencies, and mitigate others are highlighted.

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Working with human nature to achieve sustainability: Exploring constraints and opportunities.

Abstract

Sustainable production is often limited by structural factors such as industrial development, neoliberal democracy, growing population and globalization of consumer culture. Drawing on the work of some theorists linking unsustainability to universal psychological propensities, this article discusses sustainable production in relation to human nature. Human nature is understood here as complex cross-cultural and historically consistent psychological traits or universal physiological predispositions that result in the largely shared repertoire of human behavior. It is posited here that these traits, when combined with specific conditions of industrial development result in unsustainable behaviors. This article explores the relationship between human population and sustainability, human nature and culture as well as human nature and environment, and between human nature and sustainability. Recommendations focus on how sustainability efforts can take advantage of some of our natural tendencies, and mitigate others in order to provide strategic solutions to unsustainable practices.

Keywords: cradle to cradle; human nature; sustainable production; sustainability; universals

Introduction

Human nature has had a status of the grand old theory for the duration of our intellectual history, falling in and out of favor as an explanatory concept of human bahavior within various disciplines. Human nature has been defined as a set of psychological and physiological predispositions or universal propensities arising from a number of cross-culturally shared characteristics (e.g. Wilson 1993; Fukuyama 1999; Kaplan 2000; Rees 2010; Pinker 2011). American anthropologist Donald Brown (1991) refers to human nature as a collection of 'universals', exemplifying them by the types of realms in which these occur. To name just a few, "those in the cultural realm include myths, legends, body adornment, daily routines, rules, concepts of luck and precedent, and the use and production of tools; in language there are grammar, phonemes, polysemy, metonymy, antonyms, and an inverse ratio between the frequency of use and the length of words; in the social realm there are a division of labor, social

groups, age grading, the family, kinship systems, ethnocentrism, play, exchange, cooperation, and reciprocity; in the behavioral realm there are aggression, gestures, gossip, and facial expressions; mentally there are emotions, dichotomous thinking, empathy, and psychological defense mechanisms" (Ibid p. 118).

The originator of the 'ecological footprint' concept William Rees (2010) relates consistent features of human nature to the issues of (un)sustainability. In the article titled *What's blocking sustainability*, Rees (2010) puts forth a theory that modern humans are unsustainable by nature, connecting human nature to certain evolutionary traits, such as subconscious, genetic predisposition to expand (shared with all other species), both territorially and in numbers. Rees argues that this propensity to expand become maladaptive when strengthened by industrial development, neoliberal democracy, growing population and globalization of consumer culture. The capitalist market system typically demands the "externalization of social and environmental costs, an economic system wedded to continuous growth, a hierarchical social system that scripts for consumption as a means of both inclusion and exclusion; and a political system unable or unwilling to regulate consumption for fear that doing so would threaten the tax base" (Isenhour 2015:146).

Sustainability-related universals include, but are not limited to, the propensity for technological innovation, the desire to elevate one's status through material possession and preoccupation with social justice (Kopnina 2013a). Technological innovation might have unintended side effects, such as efforts to address climate change through geo-engineering, which often entail unacceptable levels of risk as these techniques would have to be continued for the indefinite future, for failure to do so would lead to a potentially catastrophic surge in greenhouse gases (Nemetz 2015). Material markers of status lead to consumption of unsustainable products, such as cars. Social justice leads to the promotion of equitable economic growth (e.g. United Nations 2015), that resulting in globalization of unsustainable practices (Hansen and Wethal 2014).

Sustainability in this article will refer to issues associated with depletion of natural resources, pollution, climate change, and biodiversity loss. This article will distinguish between conventional (or mainstream) and transformative (or radical) approaches to sustainability (Kopnina and Blewitt 2014). Unsustainable production is characterized by the 'cradle to grave'

system in which materials are extracted, used and wasted (McDonough and Braungart 2002). Conventional approaches to sustainability attempt to *reduce damage* through the triple R ('reduce reuse, and recycle'), or eco-efficiency (Blowfield 2013). The more transformative approaches, including Cradle to Cradle (C2C) and circular economy, focus on a radical re-evaluation of production strategies that *eliminate damage* altogether (McDonough and Braungart 2002; Bocken et al 2014; Kopnina 2016; Lieder and Rasheed 2016; Witjes and Lozano 2016).

Transformative approach to sustainability requires the design of policies that specifically take advantage of some of our natural tendencies, and mitigate others (Fehr-Duda and Fehr 2016). While natural characteristics can be harder to counter, human beings are also products of their culture (e.g. Geertz 1973; Ingold 2006). Most human behaviors are both learned and natural (Wilson 1984). Capacity for empathy, for example, can be 'natural', at least in some people, but it can also be nurtured. Thus altruism can be seen as both 'inborn' and learned. Self-interest is essential to all species' survival, but can be also conditioned by 'merchant values' of capitalist industrial societies.

This article will examine whether both self-interest and altruism can be balanced in such a way that sustainable choices become more 'natural'. The relevance of the concept of human nature to understanding (un)sustainability will be explored in sections on the relationship between human population and sustainability, human nature and culture, between human nature and Nature (environment), and finally, between human nature and sustainability. The concluding section will outline possible strategic solutions in addressing unsustainable practices by examining both inherited predispositions and learned attitudes and behaviors. This article will culminate in suggestions as to what altruism/self-interest or competitive/cooperative behavior can be taken advantage of, and how to mitigate others.

Population growth

Population growth is one of the most pressing and yet least dealt with sustainability challenges that can be discussed along the "altruism/self-interest lines". While critical authors have noted that population growth is a single most important source of continuing crises of natural resources

(e.g. Rees 2010; Washington 2015; Daly 2016), others consider it to be positive (Simon 1981; Goklany 2007; Fletcher et al 2014). Simon (1981) or Goklany (2007) have stated that the population growth is an essential prerequisite for the development of more efficient and cleaner economies. From a neoliberal economics point of view, population growth is celebrated since greater population implies greater economic growth and expanding markets (Blowfield 2013). Basically, the more people, the more consumers, the larger the labor force, the more young people to pay old people's pensions. For this reason, in many countries high fertility is actually stimulated (see, for example, population-related issues of The Economist 2012a, 2012b).

It has been argued that having more children in poor countries can ensure greater survival rates and provide the parents with additional sources of income from working children (Blowfield 2013). Some scholars have argued that since most population growth happens in the poorest countries of sub-Saharan Africa, those that want to limit population growth do not take the needs of the poor into account (Fletcher et al 2014). Since most poor people's carbon footprint is negligible, it is argued that population growth serves as a scape-goat for sustainability discourse that distracts from the necessity to address economic growth in industrially developed countries (Ibid). Partly due to these altruistic concerns, and partly due to a number of social and political sensitivities, linking population growth to sustainability has become a taboo (Washington 2015).

While economic growth in industrial countries is certainly a major contributor to unsustainability, critical scholars have noted that the question of population growth cannot be ignored. Western donors might be truly altruistic in promoting worldwide vaccination and hygiene programs. Yet, the self-interest in being able to live decent lives and to provide for future generations also needs to be considered. Wijkman and Rockström (2012) and Washington (2015) have argued that a position that population is 'not a problem' actually ignores the needs of the poor themselve. First, a high birth rate exacerbates poverty (United Nations 2015). Second, higher fertility is often associated with failures to address human rights and women's rights (Wijkman and Rockström 2012). Memory Banda, a Malawian girl who told her story on TED talk clearly indicates the extent of the problem of unwanted pregnancies due to rape and child marriage (Banda 2015). By some estimates, there are about 215 million women who want access to contraception but are denied it (Campbell 2012; Hindin et al 2016). Consequently, in the many parts of the world the

number of women of child-bearing age is disproportionately large, this 'population momentum' being likely to outrun fertility decline (e.g. Singh et al 2010).

Also, the perspective that the poor's carbon footprint is negligible and thus unrelated to sustainability concerns is very short-sited (Wijkman and Rockström 2012). From the perspective of social justice one cannot expect that the poor will never escape poverty, nor ever migrate to the more economically developed countries (Kopnina and Washington 2015). Additionally, while concerned about social fairness, proponents of population growth Simon (1981) or Goklany (2007) do not consider planetary fairness. As Crist (2012) has sarcastically remarked:

> As Julian Simon (1981) rightly pointed out, with much anthropocentric pomposity, resources are highly malleable. Consider the ways. The resource base can be enlarged: for example, more land under the plough, more groundwater discovered, more oil and mineral reserves found, etc. The services of previously depleted or forsaken resources can be accessed through new or alternative ones: for example, biofuels, tar sands, wind energy, electric cars, artificial meat, hydroponics, etc. Resource-use efficiency can be intensified or revolutionized: for example, by eliminating food waste, dematerialization, recycling industries, etc. … As long as such a "resource enhancement portfolio" can be developed and implemented, then an increasing and eventually very large stable population might be supportable; maybe such a large population can even be provided with a high-consumption way of life. Environmentalists' objection to this Simonian reverie, of billions of people enjoying a global consumer culture and expanding the human empire to the universe at large, is that limitlessly enhancing the resource base eventually results in breaching biophysical limits, with consequences like climate change, agricultural and industrial pollution, peak oil, and the severe degradation or loss of ecological services… More serious than modern society's potential ability to technologically fix or muddle through problems of its own making is people's apparent willingness to live in an ecologically devastated world and to tolerate dead zones, endocrine disruptors, domestic animal torture (aka CAFOS), and unnatural weather as unavoidable concomitants of modern living.

While all people want to live decent lives, there is a large debate about whether having many children is a natural tendency or whether it is simply caused by unavailability of birth control (Campbell 2012; Crist 2012; WHO 2016). 'Naturally', it can be argued, humans exhibit expansionist tendencies, and like all other species, maximize their comparative advantage (Rees 2010). Due to antibiotics, vaccines and other medical advances, and the absence of political initiatives such as the recently abandoned one-child policy in China, as well as relative peace, one would suppose that it is 'natural' to produce more children that survive to adulthood. However, some countries show that despite availability of contraception (freely distributed by development

agencies) and education (without specifying the level of educational achievement) female fertility has not subsided (Wijkman and Rockström 2012). The fact that wealthier and more educated societies have chosen to have less children (Campbell 2012), also speaks of differential cultural adaptation.

Unless one assumes that persistent high fertility rates in Sub-Saharan Africa are due to 'natural' factors, greater accent on cultural mechanisms favouring large families need to be sought. Cultural factors such as the prestige associated with having larger families and persistent belief that having more children can help families economically also need to be addressed (Wijkman and Rockström 2012; Engelman 2013; WHO 2016).

Human nature linked to culture

Cognitive psychologists have noted that values are not 'innate' but conditioned by cultural and social conventions (e.g. Stern 2000). While successful commercial marketing has helped to stimulate consumption, there are also other emotional, social, and cultural factors that play a role (Isenhour 2015). In anthropology, the focus is most frequently on the cross-cultural differences in shaping knowledge about and behavior toward nature and specific local conditions that influence value orientations (e.g. Geertz 1973; Ingold 2006). These value orientations include environmentalism, which has been linked to religions that render the environment as sacred (e.g. Sponsel 2016), or predisposing adherents to devalue the environment (e.g. Taylor 2010). Aside from religion, conservation psychologists have provided support to the hypothesis that early childhood exposure, including playing in trees or with animals, hiking, camping, fishing, and mushroom picking, enhance person's identification with nature (Sivek 2002; Chawla and Cushing 2007). These experiences are supposed to form key 'entry-level variables' that predispose people to take environmental action (Chawla and Cushing 2007).

Yet, this research is contested. Studies linking exposure to nature to positive environmental attitudes do not explain why some people who grew up next to forest areas, for example, have not protested against logging, while others from the same villages, or from cities, did (e.g. Kopnina 2015a). Indeed, love of forests might be 'innate' in some people (Wilson 1984; Kellert and

Wilson 1995), while conditioned in others, with other priorities (such as profit from logging) coming into play. By contrast to the particularistic approaches that single out culture, religion, or experience in shaping environmental values, interdisciplinary work spanning the fields of evolutionary science (e.g. Panksepp 1998), environmental sociology (e.g. Dunlap and Van Liere 1978), cognitive and physical anthropology (e.g. Konner 2003), and cognitive psychology (e.g. Schwartz 1994; Stern 2000), has focused on universals that underlie human thought, or common behaviour patterns rather than cultural outliers (Kirner 2017).

Human nature linked to (nonhuman) nature

Humans, like all animals, have adapted to the natural environments for millennia. Environmental determinism theory has postulated that natural surroundings were conducive, but also limiting, of the development of diverse cultures across the globe (Ratzel 1896). While more contemporary theories dispute this determinism, the fact that social elements were associated with the material culture is largely undisputed as the materials people use to build their houses from, and the food they eat, were made from what is available to them (e.g. Benyus 1997). Obviously, the situation of building from local materials and eating locally grown crops is very different in the world of cross-national supply chains and global production networks. Yet, according to E.O. Wilson (1993) "It would...be quite extraordinary to find that all learning rules related to that world have been erased in a few thousand years, even in the tiny minority of peoples who have existed for more than one or two generations in wholly urban environments." Simply put, humans (still) need nature, and the notion of sustainability addresses this basic need (Lewis 1996; Polasky et al 2012; Washington 2015). If human (as well as nonhuman) lives are to be achieved the balance between human nature and Nature as a whole needs to be found. One of the key motivators can be self-interest in realizing that Nature supports us as species.

Yet, this pragmatic realization of self-interest and utilitarian approach to nature preservation alone is not enough. Despite the fact that some individuals care about environment or individual species, there is a growing proportional difference between the number of people and the number of nonhumans, other than those used in food production and medical experimentation industries. While small fragmented habitats can sustain smaller species, accommodating larger animals, and

securing the stability and integrity of the entire ecosystem, requires a larger territory (e.g. Noss 1992). While the apex predators are normally checked by environmental constraints, this is no longer the case for our own species (Shoreman-Ouimet and Kopnina 2016).

As Vucetich and Nelson (2013) have noted, the practical import of acknowledging nature's intrinsic value rises from the recognition that some elements of nature, including endangered species, offer little direct benefit to human welfare. Contrary to the evidence about high interdependency of all species (e.g. Polasky et al 2012), it appears that humans are well-supported by monocultures (Crist 2012). Thus, we need to learn to care for the entire planetary community that includes nonhumans, an aim that is encompassed in the notion of altruism.

Combinations of propensities such as the ability to empathize with others, but also the ability to follow one's own self-interest, are at times mutually exclusive, but at times complementary. For example, expanding the benefits of globally spread distribution of cheap products creates new labor markets and new groups of consumers, which further enrich the established corporate and political elites (Washington 2015). The propensity to acquire wealth (which can be seen as selfish) but also to share the benefits of natural resource exploitation globally (which can be seen as a moral virtue) leads to the perpetuation of unsustainable production. While development aid agencies and humanitarian non-governmental organizations (NGO's) seek public support by appealing to the altruistic side of their donors, the more profit-oriented organizations, such as the World Bank, might be motivated by the lucrative benefits of global economic development (Hansen and Wethal 2014).

On the one hand, as poorer people may not be able to afford the more expensive fair trade, organic, or animal welfare-conscious food, the social altruism would support availability of less 'responsible' cheaper products. However, there is also evidence that poor people actually care more about animal welfare and thus buy animal-friendly products because they experience more vulnerability, which may make it easier to empathize with other downtrodden groups (Deemer 2015).

There are a number of natural tendencies that are conductive to this aim. One such tendency is the universal evidence of biophilia, or love of nature (e.g. Wilson 1984; Kopnina 2015a). Wilson

(1984) hypothesized the "innately emotional affiliation of human beings to other living organisms" explains environmentalist action by individuals as cross-cultural, despite severe repercussions, demonstrating that commitment to environmental causes, however diverse, is a universal phenomenon (e.g. Kellert and Wilson 1995; Kopnina 2015a). Collective biophilia can be helped by education that fosters a sense of responsibility to nonhumans, the way education has helped to foster humanitarian values in the past (Kopnina and Gjerris 2015).

Cultural barriers

Chawla and Cushing (2007) have noted that students with greater knowledge about the environment or more pro-environmental attitudes are more likely to report action for the environment, but only when other structural barriers area addressed. Despite realization of our dependency on environment, there is a large gap between rhetoric of sustainability and sustainable behaviour (Kollmuss and Agyeman 2002), or the so-called knowledge-behavior gap, with prohibitions of environmentally unfriendly behaviors having little effect. Despite availability of correct information, human beings sometimes fail to behave rationally due to a number of evolutionary, psychological, and adaptive predispositions (e.g. Kaplan 2000; Rees 2010; Kopnina 2013a).

Consider this simple example. At my educational institution, there are paper recycling bins placed next to the general garbage bins. Both types of bins are located close to the printing/copying machines. Often times, papers are deposited in general bins, and plastic cups and other objects are stuffed through the narrow slots of the paper recycling bins. Without financial incentives or punitive measures, reliance on individual responsibility or behavior change can be insufficient for sustainable action. It is questionable whether well-informed and well-intentioned behaviour of those that separate garbage is significant in the face of majority patterns of behavior.

While we can hardly say that a mundane habit of garbage disposal is part of human nature, it is clear that relying on individual's sense of responsibility can lead to tons of paper being wasted daily. Without financial rewards or punitive incentives, some individuals (e.g. other than the responsible few who are by choice vegetarian, or do not use cars or smart phones, etc.), will

choose the easy, cheap and essentially unsustainable option. Thus, while incentives can be different – appeal to altruistic values or to self-interest through financial rewards or punishments – it is the necessity to appeal to the majority of product users. Yet, the most effective means of addressing this irresponsible behavior is not offering the choice of acting unsustainably – the so-called consumer-choice editing (Blowfield 2013), or the system in which products produced not have to be wasted – a point discussed in the section below.

A larger example of knowledge-behaviour gap involves that of climate change. For all the torrent of scientific reports and the robust evidence gathered by the Intergovernmental Panel for Climate Change (IPCC), according to the analysis of internet searches, climate change commands a good deal less public attention than Kim Kardashian, a reality-TV star (The Economist 2015a). While structural factors such as climate-averse policies that favour fossil-fuel energy are part of the answer, psychological barriers also impede behavioral choices that would facilitate mitigation, adaptation, and environmental sustainability (Gifford 2011). Gifford (2011) notes that although many individuals are engaged in some ameliorative action to address climate change they are hindered by psychological barriers. These include limited cognition, ideological world views that tend to preclude pro-environmental attitudes and behavior, comparisons with key other people, sunk costs and behavioral momentum, mistrust toward experts and authorities, perceived risks of change, and positive but inadequate behavior change.

Obviously, these adaptive predispositions are not solely determining our behaviors. There are large cultural differences between how people make objects, what the objects mean and how they are consumed (Wilk 2011). There are, for example, many ‘sustainable communities’ known in anthropological record (e.g. Sponsel 2016), including indigenous societies and urban environmentally aware minorities. However, since the aim of sustainability is to move the majority, not just the committed fringe, toward less environmentally destructive practices (Miller 2001), more regulative approaches are needed.

Yet, democratic governments might not be as successful in regulating as they are subject to public pressures as well as influences of (industrial) lobbies (e.g. Washington 2015). The Economist (2015a) observes that people’s beliefs are determined by feelings of cultural and political identification. When asked for their views on climate change, American Republican or

Democratic voters translate this into a question of whose side are you on (The Economist 2015a). This apparently irrational, emotional, and culturally determined response, can be attributed to universal human desire for group belonging (Isenhour 2015) and the perceived need to conform to social status expectations (Kollmuss and Agyeman 2002). Here again we see how cultural and social norms may be reinforced by natural tendency for group belonging, or for developing certain routines – all patterns also observed in other mammalian species (Panksepp 1998).

Another tendency that might explain today's unsustainability is the inherent acquisitiveness of all human beings, as well as universal belief in linking possessions to their social status (in Wilk 2011). However, "conspicuous consumption" (Veblin 1902) may also be reflective of a need generated within a particular historic context and mode of production and not an innate trait. The present-day urge to overconsume is probably a learned or culturally mediated trait, perpetuated by industrocentric ideology of economic growth and open markets (e.g. Ingold 2006; Wilk 2011; Kidner 2014). An anthropologist has Clifford Geertz stated "There is no such thing as a human nature independent of culture" (1973:49). Indeed, what we might be talking about in the case of inability to deal with the threat of climate change is overconfidence in the face of threat of suffering consequences of climate change and a common culture of denial (Rees 2010; Washington 2015). This denial can also be seen as a 'natural' mechanism of escaping the necessity to make difficult adjustments, such as the necessity for a politician to prohibit the use of subsidies for fossil fuel lobbies, or the necessity of a consumer to give up his/her oil-guzzling car or methane-generating meat diet (e.g. Ayres et al. 2013).

The Economist (2015b) recommends that action on climate change should be more concerned about adaptation rather than mitigation to climate change. According to this article, humanity will 'have to adapt, in part by growing crops that can tolerate heat and extreme weather, in part by abandoning the worst-affected places'. As for biodiversity, The Economist (2015b) suggests, 'Animals and plants will need help, including transporting them across national and even continental boundaries. More research is required on deliberately engineering the Earth's atmosphere in order to cool the planet'. Such a recommendation suggests that the dire predicament the planet can be remedied by the same very mechanism that has created this predicament in the first place – the belief in human ingenuity and technical ability to solve the problems of its own making (Rees 2010; Kopnina 2013a). This belief is not necessarily part of

human nature but an outgrowth of the Western Social Paradigm (Dunlap and Van Liere 1978)), or industrocentric ideology (Kidner 2014). This ideology is based on the belief that humans are superior to nature and in control of science and technology. Prosperity results from the exploitation of natural resources (presupposing their continuous abundance), achieved through economic growth. Since this is a dominant paradigm in most modern societies, the 'culture of majority' is created in which the arrogance of humanity is universally accepted (Ehrenfeld 1978). This universal acceptance is manifested by the eagerness of developed countries to emanate the developed countries' 'progress'. On the global scale, the noble aim of equitable redistribution of limited resources stimulating the 'catch-up' with the rich countries does not bode well for the planet (Hansen and Wethal 2014). As illustrated by The Economist's (2015b) opinion that in our 'bold thinking' about relocating entire populations – both human and nonhuman –we need to address that dominant culture that threatens to endanger life on this planet.

A new cultural narrative

Post-humanist education, for example, questions the ontological and epistemological assumptions underlying notions of human nature, and draws attention to the myriad ways in which animals are always already part of ourselves, our learning, and our culture (Spannring 2016). In doing so, education about animals, plants, or entire 'nature' combines knowledge with effective and ethical appeals targeted at enhancing pro-environmental attitudes. Critique of industrocentric ideology (Kidner 2014) needs to be specifically tackled in education (Kopnina 2012).

Rees (2010) notes that the world community must write a new cultural narrative that is explicitly designed for living on a planet of limited resources, a 'narrative that overrides humanity's outdated innate expansionist tendencies' (P. 13). Rees (2010) suggests that cultural conditioning should actually override natural tendencies, addressing structural constraints created by industrocentric modern culture that exacerbates human natural tendency for expansion. Culture and nature here are seen as intertwined, mutually reinforcing, but also, simultaneously, able to check one another. Indeed, human nature always acts in accord with historical, social and cultural conditions (Kopnina 2013a). Unsustainability inevitably emerges out of the systemic

interaction between universal propensities, as well as specific features of contemporary technoindustrial society and the ecosphere (Rees 2010). The natural tendency to expand, for example, is currently reinforced by the socially constructed economic narrative of the desirability of continuous economic growth and the need to control nature (Rees 2010). Yet, this need to control nature is also learned, and not 'inherited' and can thus be easily unlearned through alternative narrative.

Yet, those who try to explain global unsustainability by structural factors alone do not necessarily address the underlying mechanisms that enable these conditions to emerge and dominate in the first place. Complementary to recognizing industrocentric ideology, evolutionary, cognitive, and motivational approaches to human behavior have been revealing in how people create and relate to environmental problems (Kaplan 2000). Thus, both cultural and natural tendencies need to be explored in tendon, and translated into the types of educational programs, and information programs which appeal to both innate needs (e.g. the need of secure and healthy environment) and learned culture. If this learned culture (e.g. the seeing economic growth as progressive and desired) counteracts the natural need for safe environment, this cognitive dissonance needs to be made explicit in policy and education.

Human nature and sustainability: practical implications

While the call for multiple sustainabilities is heard (Moncebo 2013), as it is argued that sustainability discourse is mired in the intricacies of uncertainty, interpretation, and endless contestation, it is easy to see why cultural explanations for both causes and solutions to sustainability challenges abound. Yet, the hard reality of limited natural resources, climate change, and biodiversity loss call for recognition of a less relativistic and more instrumental approach to sustainability, which is more likely to lead to a transformative change than multiple open perspectives (Corner 2014). Transformative change involves learning from nature's designs by developing a model of production that recognizes the integrity of the entire ecosystem as a starting point of human manufacturing (Lieder and Rasheed 2016). As reported in this journal, the approach of sufficiency, which follows the premise that we should limit what is produced or consumed in absolute terms, was proposed to avoid the rebound effect (Figge et al 2014).

Sufficiency refers to products that are not overproduced or wasted but kept in the productive loop.

In *Cradle to Cradle: Remaking the Way We Make Things*, McDonough and Braungart (2002) criticize the current method of production as a linear (take, make, waste) process. The conventional reduction of damage through eco-efficient use of resources serves as examples of misguided (although well-intentioned) methods. As the authors of Cradle to Cradle (C2C) reflected, a bad thing should not be 'efficient' but eliminated altogether. Recycling leads to 'down-cycling' resulting in energy and resource loss. Similarly to C2C, the idea of circular economy that draws on the understanding and appreciation of the natural systems (Ellen MacArthur Foundation) sees sustainability in terms of transition to a circular (waste equals food) model.

The C2C framework rests on a number of theoretical developments in the field of industrial ecology and ecological economics, including those developed by physicist Robert Ayres and economist Allen Kneese (1969); and engineers Robert Frosch and Nicholas Gallopoulous (1976). Based on the laws of thermodynamics, Nicolas Georgescu-Roegen (1971), one of the founding fathers of the sub-discipline of ecological economics, argued that unlimited economic growth is physically impossible. In regard to human nature, Georgescu-Roegen (1971) has noted that the rate of evolutionary change of endosomatic organs (literally, within skin organs such as heart and kidneys) is exceedingly slow; while the rate of change of exosomatic organs (literally, outside skin types of natural and manmade capital, such as farms, and factories) has become very rapid. In fact, as noted by Daly (2016), the collective evolution of the human species is now overwhelmingly centered on exosomatic organs, such as the use of airplanes, rather than wings. This exosomatic evolution is goal-directed towards "economic growth," and that growth has been achieved largely by the depletion of non-renewable resources (Daly 2016). In this context, C2C framework builds on the critique of industrial system as well as techno-social adaptation that has significant side-effects in the form of ecological costs. C2C industrial design tool identifies three key design principles that address long term sustainability: (a) waste equals food; (b) use current solar income, and (c) celebrate diversity. In short, these principles are:

Waste equals food. Unproductive waste does not exist in nature because the living processes of each organism contribute to the whole ecosystem. A fruit tree's blossoms serve as food for other living things or decompose in soil. As nutrients flow indefinitely in cycles of birth, decay and rebirth, all products can be designed as nutrients that flow through natural or designed metabolisms. This designed metabolism mirrors natural cycles in a closed-loop system in which valuable, high-tech synthetics circulate in cycles of production, use, recovery and remanufacture.

Use current solar income. Trees and plants manufacture food from sunlight, an elegant, effective system that uses the earth's continuous source of energy income. Despite recent precedent, human energy systems can be nearly as effective. C2C systems—from buildings to manufacturing processes—tap into current solar income by using direct solar energy collection or passive solar processes, such as day-lighting, which makes effective use of natural light. Wind or tidal wave power can also be tapped.

Celebrate diversity. Diversity in natural and cultural systems need to be respected. Healthy ecosystems and traditional cultures are complex communities, each of which has developed a unique response to its surroundings that works in concert with other organisms to sustain the system. Indeed, "Ecosystem goods (such as food) and services (such as waste assimilation) represent the benefits human populations derive, directly or indirectly, from ecosystem functions" (Costanza 1992:253). As biomimicry (Benyus 1997), C2C takes nature's diversity as a prototype for human designs tailoring designs to maximize their positive effects and enhance the local landscape. This idea is similar to natural adaptations of humanity (and other species) to their environment and thus in this sense largely consistent with human nature.

In regard to human nature we can note that the linear production model is not 'hard-wired' as it is unprecedented in human history, but an obvious example of unintended consequences of industrial revolution (McDonough and Braungart 2002). Also, as the current attempts and failures at mitigating environmental damage are learned and not 'inherited' some misguided efforts at fostering sustainability can be substituted by more informed practices. C2C designs, in a business sense, can offer significant financial benefits as no new costly raw materials will be required (Blowfield 2013; Kopnina and Blewitt 2014). The cultural or learned aspect of operating such an ecologically benign system of production can enhance the natural human propensity for

technological innovation. This requires learning how C2C is different from conventional sustainability models, and how it can be applied on a global scale. An introduction of any of the hopeful frameworks on the global scale requires caution to in order to overcome natural expansionist tendencies. As Georgescu-Roegen (1971) has pointed out, even a circular system would inevitably lose energy and resources given the thrust of modern economies towards constant growth and innovation. The risk of subversion of production to the cult of ever-growing economic systems needs to be seriously addressed (Engelman 2013; Kopnina 2016) in terms of countering natural tendency for expansion (Rees 2010).

There are trade-offs that need to be considered when it comes to implementing circularity ideas. Circular frameworks can be subverted to the cause of continuing business-as-usual. The companies that get on the 'best practice' examples of MacArthur Foundation still focus on minimising damage, recycling and eco-efficiency. For example, Coca Cola touts its *efficiency* (should be *effectiveness*) in *recycling* (should be *infinitely reusing*) of *plastic* (should be another *non-damaging material*) bottles. Often, circular economy is advertised as a 'new engine of growth', rather than promoting fundamental change (Kopnina 2016). Some of the companies improve one small part of their operation, without the needed overhaul of the entire supply chain, mode of operation and the radical change in product materials. Thus, optimistic 'simple and easy' approaches need to be treated with caution (Kopnina 2016; Lieder and Rasheed 2016).

Despite these difficulties, it is important not to 'throw the baby out with the bathwater'. While it still has a long way to go in practice, the C2C and circular economy frameworks have the potential to reach beyond mainstream sustainability strategies (Kopnina 2016). Good historical examples of ecologically benign products can be easily found in the form of pre-industrial production systems, from small-scale horticulture to clay pots. This does not mean that consumers should revert to pre-industrial life-style or that producers should be at a disadvantage selling products from 'retrogressive' design (Kopnina and Blewitt 2014). Considering the challenges of creating economies of scale, innovative designs, such as hyperloop for modern transportation system (Matthews and Brueggemann 2015), might be better adopted to the world of billion consumers than pre-industrial small-scale produced products. Typically, such innovations are supported by competitive behavior – which might well be part of human nature.

Reflecting on positive example

Practically, the application of C2C and circular economy theory bears upon the way engineers and designers construct products, policy makers support radical re-orientation of industrial system, and ecologists instruct designers, engineers and policy makers of the optimal ecologically benign products. An example of Climatex suggests how such products can be made. The aforementioned fields of industrial ecology and ecological economics have inspired development of "green fabric". The partnership between Designtex, McDonough, Braungart and Rohner has incorporated the "waste = food" principle in the brand Climatex, resulting in the fully biodegradable quality fabric which was awarded Gold-level C2C Certification. Remarkably for normally protective profit-oriented business models, Climatex stresses the importance of transparency of its production and in fact encourages others to imitate its innovation to contribute to the economies of scale (IEHN). This potentially can make the fabric not just widely available but also affordable for various individuals involved in interior design, healthcare, automotive, transportation, clothing, shoes and other industries.

This example suggests how the 'positive' (in terms of ecological integrity) natural propensity for innovation and sharing can be applied. One of Brown's (1999) universals is cooperation between individuals - but also within and across industries, can help facilitate transition toward sustainability. As noted by Witjes and Lozano (2016), cooperation includes better access to markets and knowledge, enriched creativity, avoidance of confrontation, a decrease in the time needed to accomplish objectives. Indeed, cooperation between companies can increase trans-disciplinary learning (Fadeeva 2004) and enable economies when different actors of green supply chain cooperate with each other. Simultaneously, a degree of competition (Matthews and Brueggemann 2015), perhaps equally embedded in human nature as cooperation, is likely to lead to successive inventions and innovations.

Thus, returning to the question of whether both self-interest and altruism can be balanced in such a way that sustainable choices become 'natural', C2C framework does offer substantial hope that it can be done. C2C framework does not force people to be unnaturally burdened by constant guilt of having a negative environmental impact, and in a cultural sense is conditional on

educational and policy initiatives, as well as on revision of current methods of manufacturing and services, in which some cultural conventions need to be unlearned.

Rees (2010) outlines his working hypothesis that because of certain evolutionary traits, modern people are biased against sustainability. Yet, the genetic predispositions alone do not lead to unsustainability – it is a combination with other external factors that act together with the predisposition to make addressing sustainability very difficult. Thus, unsustainability is due to both historically specific characteristics of industrial capitalism as well as certain features of human nature (Kaplan 2000; Kopnina 2013a). Rees (2010:15) states,

> "humanity's technological prowess and society's addiction to continuous material growth reinforce the biological drivers, making the problem particularly intractable. More specifically, I hypothesize that unsustainability is an inevitable emergent property of the systemic interaction between contemporary technoindustrial society and the ecosphere. Both genetic and socio-cultural factors contribute to the conundrum".

Thus, a tendency for expansion is reinforced by the socially constructed economic narrative of continuous material growth, perpetuated by industrially developed neoliberal societies, resulting in cognitive dissonance and collective denial (Washington 2015).

An example of what types of cultural practices can be unlearned is the odd aesthetics of urban planning. As McDonough and Braungart (2002) note, in present urban designs 'diversity – an integral part of natural world - is treated as a hostile force (p.32). They reflect: 'The average lawn is an interesting beast: people plant it, then douse it with artificial fertilizers and dangerous pesticides to make it grow and keep it uniform – all so that they can hack and mow what they encouraged to grow. And woe to the small yellow flower that raises its head!' (Ibid, p. 33). Indeed, the use of energy, water, pesticides and insecticides that are involved in keeping 'neat' lawns, even in natural desert environments, basically serves to destroy any biodiversity and pollutes the environment (Kopnina 2013b, 2015b). The easy solution for saving labor and electricity costs involved in mowing and watering the lawns can be easily accomplished by simply *not* exercising this odd cultural practice which eliminates biodiversity in urban spaces. There is nothing unnatural about that.

Conclusion

It was argued that understanding of both altruistic and profit-maximizing tendencies (which often coincide with self-regarding/self-interested motivation) allows us to see why certain measures targeted at enhancing sustainable action are ineffective, while others are easier to implement as they are congruent with natural tendencies. This article focused on the differences between 'natural' (hard-wired and hardly changeable) features of human behavioural repertoire and those cultural, social, and generally 'conditioned' or 'learned' features that can be easily influenced and changed. Future interdisciplinary research that includes both psychological experiments (by, for example, social psychologists and consumer behaviour specialists), cross-cultural observations (by, for example, anthropologists) and behavioural theories (by, for example, biologists) could add insight to the types of situations and actions that 'naturally' foster sustainability. This article has laid an accent on behaviors that can support transformative sustainability frameworks, such as C2C and circular economy. Some education specialists already place great accent on learned behaviors that support these transformative frameworks, by, firstly, teaching about the difference between conventional (eco-efficiency, recycling) models and more radical (complete elimination of unproductive waste) models, and providing theoretical and practical examples, as to how sustainability can be achieved (e.g. Kollmuss and Agyeman 2002; Chawla and Cushing 2007; Kopnina 2012; Kirner 2017).

Population growth, in combination with human natural propensity to expand (Rees 2010), can be best addressed through both self-interest and altruism. Caring about future generations implies the necessity of non-coercive measures addressing population growth. Human nature does not dictate how many children one should have. Also, human nature does not dictate what type of production system should be employed, but the capacity for innovation can serve the cause of switching from the damaging industrial cradle-to-grave production to a more ecologically intelligent designs.

While self-interest may be one of the more powerful forces in human behaviour, in the context of sustainability it can be used for collective good, as in the case of competition that stimulates innovative designs. As Fehr-Duda and Fehr (2016) have noted, care for others and cooperation is

also part of our nature, which in the case of sharing of ideas can help ecologically benevolent designs to take precedence.

Generally, many examples in human history, including social justice and equality movements, demonstrate that it is possible to mobilize the better angels of our nature (Pinker 2011) to improve the human condition (Fehr-Duda and Fehr 2016). Ideally, care for the environment and our own self-interest as species dependent on this environment, will lead to radical re-orientation of the system of production towards more ecologically benign C2C and circular economy models. If the wonderful capacity for empathy can be expanded to nonhuman species – and there is plenty of evidence that cross-culturally and historically, it already is (Wilson 1984; Kopnina 2015; Sponsel 2016) - we may yet live in a truly sustainable world. Less idealistically, pragmatic considerations call for the assessment of financial feasibility of re-orienting the entire chain of production towards ecologically benign models, as well as removing a number of structural factors.

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