Review Article

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Steering signification for sustainability

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Abstract

Non-Technical Summary. Powerful influences on societal knowledge, values, and behavior, artificial intelligence-infused media systems, new and old, currently reinforce the interlinked problems of inequality and unsustainable consumption. This problem is rarely discussed in environmental research and policy, and even less so how it might be overcome. Discussing this consequential blind spot and the power structures that underpin it, this article argues that sustainability researchers should centrally explore the need and possibilities for democratic reconfiguration of the political economies and charters of media systems to achieve sustainability and other broad, inclusive public goals.

Technical Summary. Powerful influences on societal knowledge, values and behavior, artificial intelligence-infused media systems, new and old, currently tend to reinforce the interlinked problems of inequality and unsustainable consumption. This problem is rarely discussed in environmental research and policy, and even less so how it might be overcome. Discussing this consequential blind spot and the power structures that underpin it, this article argues that sustainability researchers should centrally explore the possibilities for democratic governance and reconfiguration of the political economies of media systems to foster human wellbeing and just transformations toward sustainability.

Social Media Summary. Sustainability transformations require 'signification steering' and interventions in media systems' configurations.

1. Introduction

The power to question and transcend existing paradigms and mindsets is one of the most powerful levers for achieving transformations toward sustainability (Meadows, 1999; O'Brien, 2021). Sustainability research is vague about how this lever is best activated, however. Outside of a tiny subfield of critical media policy studies (McChesney, 2007; McChesney & Pickard, 2017) – which in turn rarely center on sustainability transformations (Murphy, 2011, 2017) – there is particularly little discussion about the option of deliberate steering of signification to facilitate transformations toward sustainability and, in particular, whether media systems, new and old, might effectively and responsibly (ethically) be used to this end, and under what governance arrangements. There are deep historical grounds for caution, sustained by justified fears and historical memories of fascist, top-down use of media, not least by Adolf Hitler during the Second World War (Turner, 2013, 2019). On the other hand, recoiling from policy options at this level is inconsistent with the fact that scientists widely call for large-scale changes in norms and beliefs, judging them as urgent and vital for transformations toward sustainability (O'Brien, 2021; Raskin et al., 2002; Sachs et al., 2019). Recoiling is also to concede to the forces driving status quo, since the current situation is an outcome of the logic of current institutions. Authoritative theoretical and empirical work in the social sciences and humanities resoundingly concludes that status quo is an outcome of inextricably interlinked power, politics, and knowledge that ensure – and depend on – dominance through the shaping of cognition through signification – that is, the act of conveying meaning through the repetition of signs and symbols, including images, sounds, and language. In Western culture, cognition (the process of thinking, perceiving, and understanding) tends to be associated closely with thinking and, therefore, also with rationality. However, cognition also subsumes norms and emotions; human thought is deeply shaped by pre-programmed assumptions and emotions (Kahneman, 2011; Mercier & Sperber, 2017). Under the United Nations and other international institutions, nations around the world have already made normative commitments; signing on to treaties and conventions on climate change, biodiversity, sustainable development, and human rights, they assumed normative environmental and political commitments to transformations toward sustainability. Why would and should societies not use the tools available to ensure that these commitments are honored in the best manner possible, especially given the existential nature of the threats involved?

Using a recent synthesis of twenty years of sustainability science (Clark & Harley, 2020) as evidence of dominant tendencies, this article illustrates and challenges sustainability

researchers' silence on the perils, necessity, and possibilities of deliberate signification steering. It argues: since power to question and transcend existing paradigms and reshape mindsets is key for transformations, a central focus of sustainability research should be how to define responsible configurations, governance and use of information and communications systems for that end. By contrast, most of the sustainability scholarship – even a burgeoning body of literature on transformations toward sustainability – hardly addresses this, much less the policy implications. There is generally neither academic nor public discussion about the desirability and possibility of policy interventions to steer signification in favor of sustainability. The implicit underpinning assumption, it appears, is a nebulous mix of perceptions of current media systems as capable of serving transformations towards sustainability, or at least as the best or only system possible (McChesney, 2007), as well as prevalent norms of objectivity and policy neutrality (Lahsen & Turnhout, 2021). In Orwellian double-think fashion, these norms sustain generally implicit and unexamined interlinked assumptions that *non-intervention* in how people think is somehow possible and *neutral,* and that *neutrality is both possible and desirable*, even as few deny that current communications structures tend to reinforce consumerism. These assumptions are untenable and *unscientific*. They reflect and reinforce misrecognition that old and new media systems *inescapably* shape public values, and obstruct attention to the critical question: to what end should these structures be used, subject to whose control and what oversight? Expanding on these points, this article illustrates and discusses the lacuna on signification steering in sustainability research.

The term 'media systems' adopted here is meant to be inclusive of the various types of media – mass (one-to-many) media and social media with large-scale reach, including super apps such as Whatsapp. Micro-targeting by means of artificial intelligence (AI) technologies in the form of algorithms increasingly structure both traditional print- and newer digital media content and their dissemination, blurring distinction between mass and social media in terms of their reach (Kitchin, 2017). Social media can involve person-to-person (non-mass) communication, but they have also become an important means of shaping large-scale societal outcomes, increasingly with the aid of micro-targeting. While difficult to establish, the consequences include widespread right-wing victories in national election outcomes around the world (Cadwalladr, 2020; Ituassu, 2019; Ott & Mack, 2020; Watts, 2018; Zuboff, 2019). These outcomes, in turn, have profound consequences for the environment at local, national, and global levels, as illustrated by the election of Jair Bolsonaro to the federal presidency in Brazil in 2018 (Lahsen, 2024b).

2. Illustrating the silence

2.1 Synthesizing twenty years of sustainability science

In honest self-assessments at the end of the U.S. National Academy of Sciences' *Progress, Challenges, and Opportunities for Sustainability Science* workshop, one of the panel chairs acknowledged that the topic of media, including social media, was not raised. Showing an overhead with an image of the cover of Pink Floyd's album *Dark Side of the Moon*, another panel chair noted that political economic aspects fall outside of her comfort zones but should be 'remembered'. Clark and Harley's review and stock-taking of twenty years of sustainability science (Clark & Harley,

2020), which inspired the workshop, stresses the need for research into relatively neglected and more hidden types of power that operate through exclusion and influence, rather than compulsion, and the potential to overcome incumbency by means of collective reframing. But the 42-page review (not counting the 15 pages of references) does not contain any references to media nor to communications technologies, nor do most of the 357 peer reviewed works that they cite, including some cited as sources for topics bearing on norms and imaginaries.

This omission is a wider tendency in scholarship on sustainability. Reading the titles of all 357 references on Harley and Clark's reference list and examining the few publications whose titles indicated possibly media-relevant content also yielded little obviously pertinent discussion and references to media nor communications systems, and much less as possible tools for positive change. That included entire books with titles such as *Governing Sustainability* (Adger & Jordan, 2009) and *Power, Empowerment and Social Change* (McGee & Pettit, 2019). Harley and Clark cited Schot and Steinmueller (2018) as an example of scholarship that emphasizes 'the importance of crafting more radical shared imaginaries' (p. 357). But it, too, did not have content about media and communications as elements in achieving transformative change, nor did Mitchell and Carpenter's article (2019), despite being about 'norms for the earth' in favor of climate action. One cited publication did attend significantly to media, including how oppressed groups have sought to use them in their favor (Evans, 2018). However, Clark and Harley's review did not pick up on the media aspect of this cited work, which also did not discuss political economic or policy aspects of media ownership and governance.

The contours of the field of sustainability science are blurry, but its core is centrally defined by a few persons, including William Clark, who in the early 2000s started and subsequently led a program by that name in the JF Kennedy School of Government at Harvard University. It also includes social scientists who have run projects affiliated with the Global Environmental Change programs, especially under the International Human Dimensions Programme, which has since merged into the Future Earth research platform (see futureearth.org). Harley and Clark's synthesis showed a broad scope, and inclusion also of some so-called 'critical' studies of science and policy. Indeed, even extending a search to scholarship beyond the more explicitly self-identified mentioned core of sustainability science to relatively more sociological and systems critical researchers, one finds little discussion of the question of deliberate interventions and responsible arrangements by which to steer signification to improve societal responses to contemporary existential environmental threats. For example, a 23-strong team of leading social scientists (Stoddard et al., 2021) joined to assess why the world still has not 'bent' the global emissions curve downwards after three decades of diplomacy and policies aiming at greenhouse gas mitigation. They identified the main drivers of climate and biodiversity devastation in widespread norms and social meanings ('imaginaries') inflected by entrenched corporate interests, chauvinisms, militarism, and geopolitical rifts (Stoddard et al., 2021). They also noted that these intertwined socio-cultural, (geo)political, and cognitive aspects permitting global environmental devastation are under-addressed in both scholarship and policy debates (ibid. pp. 663–664). But they, too, refrained from discussing the role of media communications policies, and whether and how these might help shape and harness imaginaries such that they might help bend the curve.

As this suggests, sustainability researchers are much more comfortable posing abstract questions around the topic – such as, how research might 'be better integrated into systems for adaptive management and societal learning' (Kates et al., 2001, p. 642); 'how might we find the leverage points for transformative change in any particular system?' (*source*: Ruth Defries, U.S. National Academy of Sciences' Progress, Challenges, and Opportunities for Sustainability Science workshop, wrap-up session, 1 December 2020), and 'What are the prospects for creating collectively held sustainability imaginaries … that create visions of good and attainable futures … and scale-up of more sustainable technologies and sociotechnical systems?' (Clark & Harley, 2020, p. 358). With few exceptions – one being Lenton et al. (2022) – do sustainability researchers discuss whether and how information and communications systems could and should be harnessed to overcome incumbency and address existential socioenvironmental threats in ways that maximize the needs and well-being of the majority of the world's population, present and future (Lahsen, 2020). Yet that question is even more urgent considering the socially and environmentally destructive agendas that these systems currently serve around the globe.

Given sustainability science's central aim to create socially just transformations toward sustainability driven by inclusive, collective movements and consent, sustainability scientists' pervasive silence on how to govern emerging and established information and communications systems is puzzling, and arguably its Achilles' heel. The fact that new digital technologies enhance the power of those who control them intensifies the need to understand and overcome this silence.

2.2 Vague models of the how of social change

Arguing that transformation to meet the sustainable development goals within planetary boundaries still is feasible, contemporary sustainability scientists linked to the Club of Rome (Randers et al., 2019) have offered policy recommendations: rapid moves towards renewable energy sources, sustainable food systems, and new development models; inequality reduction; and investment in education for all, free health care, gender equality and family planning. But they leave unanswered the nagging question of how societies might build support for such sweeping changes when these challenge formidable incumbent interests.

When sustainability scientists explicitly discuss how societies might build support for – and actually achieve – the needed, interlinked normative, behavioral, and systemic changes, their attention typically centers on bottom-up social movements as the likely and appropriate propellants (for review showing this, see Lahsen 2020). For example: Raskin et al. (2002, p. 50) posit 'public awareness and values, especially as manifested in youth culture' (p. 50) as an essential force for positive change, but not how, and they only mention media as a problem because it promotes consumerism. Similarly, Jeffrey Sachs and Johan Rockström look to 'social activism' to change norms and behaviors, observing that 'changes in the hearts and minds of the people' often proceed – indeed, drive – changes in legislation and economic policies (Sachs et al., 2019 #10837, p. 812). They discuss how technologies of the Fourth Industrial Revolution might be harnessed to achieve positive change in a myriad of areas. However, beyond noting that preachers can nurture sustainability-conducive norms in their congregations, they do not specify whether and how efforts can and should be made to actively stimulate the needed activism and changes in hearts and minds.

Obstacles to the hoped-for social mobilization, and how to overcome them, merit much closer attention in current scholarship and supposedly transformative policy frameworks. If we recoil, we implicitly accept the unexamined and erroneous assumption that non-intervention in how people think is somehow neutral and possible. This assumption is not only untenable, it is *unscientific*. It reflects the mistaken, common, historically rooted assumption that current, corporate-owned media under capitalism allow us power over our own values and cognition and freedom from mind-bending influence, including propaganda (McChesney & Pickard, 2017; Turner, 2013, 2019).

2.3 Communications media, cognition, and politics

Scholars from a variety of environmental social sciences and humanities fields call for transformations by means of deliberate, self-conscious effort to connect with our deeper selves to strengthen self-awareness, pro-social values, or human-nature-connectedness (Wilber, 2007; Woiwode et al., 2021). Even when the associated conceptual frameworks integrate recognition that individual and collective spheres are inextricably interdependent (O'Brien, 2021; O'Brien & Sygna, 2013), distinguishing between 'inner' and 'outer' spheres risks obscuring more than illuminating the actual dynamics at play, as well as opportunities for action. The dualism invites dominant, liberal conceptualizations of freedom and of individuals as the basis of society. Yet, psychologists and political theorists alike have long illuminated the great extent to which humans' opinions and behaviors are susceptible to social influence, tending to conform with majority views and social norms, even if doing so is against personal preferences, objective self-interest (Wei et al., 2019) and, even, obvious evidence to the contrary (Asch, 1951).

Recent contributions in cognitive science have illuminated the extent to which apparently intimate, private and, even, biological aspects of cognition are deeply social, and imprinted by power, and how susceptible people are to influences exerted through social media messaging (Epstein et al., 2023). The concept of 'neuropolitics' (Lakoff, 2010) drives home that how humans reason and argue is deeply structured by politics and in particular by the political economy of 'the marketplace of ideas' – that is, political economies of information and communications systems. The general undemocratic and increasingly elite ownership and control of these systems, even in supposed democracies, disempowers citizens and organized, non-business civil society groups, limiting their ability to gain uptake of their ideas, values, and policy preferences, and contributing to the problem of 'hypocognition' – the lack of appropriate cognitive basis for understanding and successfully act, for example to address complex environmental problems (Lakoff, 2010).

Humans understand the world through signification – systems of frames, metaphors, and narratives. Dominant, collective meanings are stimulated by reiterative and consistent messages that are built up over time through repetitive exposure. Once in place, these meanings and attitudes become largely unconscious and difficult to dislodge – indeed, the repeated messages and frames build neurological pathways in our brains (Lakoff, 2010). Mercier and Sperber's (2017) argument that human reason is deeply emotion-driven and used chiefly to justify our initial intuitions and to convince others of their validity is supported by empirical studies of receptivity to climate science (Kahan et al., 2012). The power of new information, including science, is limited in the face of such preset beliefs and defenses that are

inextricably simultaneously cognitive, emotional, cultural, and political (Kahan et al., 2012). Large-scale change of understandings and behavior requires building up an ecosystem of frames, and it is difficult, if not impossible, to achieve in a context of countervailing messaging in dominant media (Lakoff, 2010). New words and slogans can bring improvement but not deep impact (Lakoff, 2010); dislodging and replacing existing understandings at the individual and collective levels requires strong stimulus and repetition. In the case of societal problems, frames embed understandings of causes and solutions, but sometimes frames distort actual causes and render invisible solutions that in fact are available, possible, and that might serve the greater good, including just transformations towards sustainability. The frames are in fact composites of subframes, and new information is absorbed in function of its congruity with existent frames (ibid.).

This accumulated knowledge points to the importance of rethinking and redesigning governance of information and communication systems to ensure that dominant frames and messaging are conducive to action towards sustainability. Long identified as a crucial tool of power (Gramsci, 2000; Hall, 2005), media systems are a prime means of thought control, and it is a power wielded overwhelmingly by elites to serve their own interests. Empirical data from around the world show that media ownership tends to be elites' most reliable means of retaining their disproportionate wealth and power (Eleftheriadis, 2014; Markus & Charnysh, 2017), and that allowing them such control perpetuates the interlinked problems of inequality and unsustainable use of planetary resources (dos Santos et al., 2019; Hughes, 2010; Hughes & Prado, 2011; Markus & Charnysh, 2017; Rogers et al., 2012).

Why, then, are sustainability scholars avoiding attention to media systems as both tools of oppression *and* of transformation?

3. Media power

3.1 Political economies of communications media

Fifty years after the release of *Limits to Growth*, adequate responses have been stunted by many factors, and non-democratic control over norms and beliefs through the political economy and media systems is arguably important among them. Unequal and undemocratic control of media messaging reinforces structures of inequality and change-aversive incumbency (Blofield, 2011). It is the essential tool that ensures that the average citizens' opinions and even mass-based organized interest groups have little discernible power over public policy in most countries, rich and poor alike (Eleftheriadis, 2014; Gilens & Page, 2014; Markus & Charnysh, 2017). Mainstream media also help minimize critical public attention to this (McChesney & Pickard, 2017). A recent example is The New York Times' presentation (Kulish, 2021) of elites' purchases of newspapers as acts of philanthropy in the service of society, and its silence about the option of democratic control of U.S. news media.

This is why world leading communications scholars long have urged reform of the communications media, noting that transformative social goals are unlikely to be achieved in its absence (McChesney, 2007). As a whole, writes MacLeod (MacLeod, 2019a, p. 1), media are 'largely owned and paid for by the elite and run in their interests', wherefore they 'do not challenge power, they *are* power':

> Today just five gigantic corporations, Comcast, Disney, News Corporation, AT&T and National Amusements, control the vast majority of American media, and similar monopolies exist worldwide. We all understand that state-dominated media in a dictatorship is propaganda. Yet we are told that corporate-owned media under capitalism constitutes a free press, despite the fact that in both cases the entities that control society also control the media.

The unequal and undemocratic structures of media systems also reinforce unsustainable use of planetary resources. In most Latin American societies, for example, media systems are 'controlled by a small elite that uses the media's definitional power to further, consciously or unconsciously, a set of class- and family-based interests and ideologies that have helped maintain a status quo of social inequality' (Hughes & Prado, 2011, p. 109). Thus, for example, in 2012, citizens and scientists were overwhelmingly against proposed revisions to the country's forest code that legalized and increased deforestation practices (Soares-Filho et al., 2014), but the new forest code was nevertheless adopted. This was facilitated by limited public knowledge about viable alternatives to the socially and environmentally destructive extractivist development model, which dominant discourses, spread by national media, portray as good and necessary (dos Santos et al., 2019; Michelini & Lahsen, 2016). Limited existence and enforcement of laws are allowing cross-ownership, generating a scenario in which those already controlling radio, television, and newspaper production also acquire and control online outlets (Fonsêca, 2017).

Even so, media are rarely conceptualized as political actors in the policy literature in Latin America (Hughes & Prado, 2011), as elsewhere, and dominant beliefs are widely treated as if they were authentically personal, springing from nowhere, and thus sacred and not to be interfered with (Turner, 2013).

3.2 Media messaging and movement control: The case of silent spring

The well-studied historical example of Rachel Carson's 1962 book *Silent Spring* underscores that the large-scale transmission of sustainability ideas and their translation into policy reforms depend not only on a push from grass-roots movements and scientists but also on reiterative and carefully tailored, varied messaging in traditional mass media and social media to reach different audiences.

Silent Spring is credited with helping stimulate a global revolution in environmental awareness, igniting the modern environmental movement by awakening the American people to the critical needs of their environment and propelling national popular and legislative action to regulate pesticides (Parks, 2017). Carson's impact was ensured through reiterative mass media representations, including in mainstream elite media, both more popular outlets, such as CBS, and more intellectual venues such The New Yorker. Myriad decisions by copy editors, agate clerks, and calendar compilers were instrumental, as they tailored the coverage of *Silent Spring* to transmit messages uniquely adapted to particular audiences (Parks, 2017). The accumulation of such decisions has 'assemble[d] like nanoparticles into a solid, recognizable structure' (Parks, p.1233) in the form of collective memory and understanding of the book's meanings, content, and messages, gradually bearing more on collective understanding than the book itself, the content of which is decreasingly read as time goes by. While media built the book up as an icon, they also curtailed its political impact, through attacks on Carson's credibility but also in more subtle ways, such as not bringing

up her work at crucial moments of environmental legislation (Parks, 2017). Media messaging thus sustained an 'ambiguity about the book's real impact on environmental policy and social movements' (Meyer & Rohlinger, 2012; Parks, 2017, p. 1227). Carson's work obviously did not prevent continued increase in the use of chemical pesticides, nor even the use of persistent organic pollutants (Lahsen, 2022; Tickner et al., 2021).

This begs mindfulness that understandings of the past, which also shape beliefs and actions in the present (Meyer & Rohlinger, 2012), are produced not only by singular events or scientific facts, nor, only, on the basis of careful reflection; understandings are also centrally and continually (re)shaped by media outlets' 'instrumental, arbitrary, and habitual content decisions' (Parks, 2017, p. 1,233).

3.3 Increased urgency due to new digital technologies

Artificial intelligence increasingly shapes social realities, including through algorithms that guide what is and is not repeated and featured in the news, and by mediating interactions among journalists, newsrooms, and audiences (Kitchin, 2017). Beyond newsrooms, algorithms are deployed in myriad ways, shaping what knowledges and types of actions are promoted in societies, including which are brought to bear on existential threats such as climate change (Machen & Nost, 2021). New digital technologies and social media platforms are reinforcing elite power, inequality, and environmental destruction (MacLeod, 2019b).

A 2018 headline in *The Guardian* captured the stakes: 'Our planet can't take many more populists like Brazil's Bolsonaro' (Watts, 2018). This pronouncement was quickly proven right (Werneck & Angelo, 2021). The extent to which information and communications systems helped Jair Bolsonaro and many other environmentally destructive political leaders into power has proven clear and astounding. After leaked documents showed that Cambridge Analytica influenced elections in at least 68 countries around the world, it has become public knowledge that 'global manipulation is out of control' (Cadwalladr, 2020). The integrated surveillance, information, and communications technologies that the now dismantled Cambridge Analytica used in service of the highest bidders have become commonplace tools of power today. Shaping signification at the individual and societal levels, these tools serve their owners and the highest bidders, a 'surveillance capitalist' model that predominantly spreads hate and undermines democratic processes, collective action, and progressive goals (Zuboff, 2019). Especially in Europe, governments are taking steps to crack down on some abuses, such as hate propagation (Alkiviadou, 2019) and to enhance privacy protection (Hamilton, 2021). However, they are doing relatively little about these technologies' deeper, pervasive power and destruction of meaningful democratic rule, which requires addressing deeper inequities and questions of ownership and democratic control (Zuboff, 2021).

Algorithms shape media consumption and an increasing number of aspects of our daily lives in ways that we have yet to fully theorize, and with political implications for all aspects of our lives, including environmental governance, that we do not fully grasp, much less know how to control. Evidence suggests that the logic of algorithms tends to produce hegemonic knowledge regimes, with important implications for politics of climate change and most other existential threats we face as a civilization (Machen & Nost, 2021).

These profound effects of new and old Information and Communications Technologies (ICTs) beg research and wise governance, not least efforts to ensure that algorithms serve the overall and long-term public interest in sustainability and well-being for all. Algorithms may currently be more commonly used to maximize cost reduction and efficiency, but what they optimize can – technically, if not politically – easily be made to serve alternative criteria, such as ecological conservation and human wellbeing (Machen & Nost, 2021, p. 8).

4. Inescapability of political choices and influence

4.1 Progressive, democratic transformations require fair and conducive conditions

In light of current socio-political and environmental realities, including the urgency of reconciling human needs with planetary boundaries (IPBES, 2018; Randers et al., 2019), it is arguably more naïve and counter-intuitive than prudent and science-based to merely hope or expect publics to overcome all hurdles in timely manner considering the narrow timeframe available for avoiding socio-ecological collapse. Rather, to gain scale and impact, progressive movements need a level playing field and other supporting conditions.

Successful, progressive, green transformations depend on both bottom-up social mobilization and top-down facilitation (Scoones et al., 2015); citizen mobilization has been vital for all major progressive policy changes (Stirling, 2008, 2014), but average citizens and mass-based interest groups currently have little or no policy influence in countries around the world, rich and poor (Eleftheriadis, 2014; Gilens & Page, 2014; Markus & Charnysh, 2017), as also expressed in globally wide popular disillusionment around climate change (Hickman et al., 2021; Pew, 2015). As noted above, government decision-making overwhelmingly reflects and serves the interests of economic elites and business-oriented organized interest groups (Gilens & Page, 2014), and elites centrally ensure this outcome by means of communications media control: the power that this gives them over politicians and public norms and understandings is their prime tool for protecting wealth and privilege (Eleftheriadis, 2014; Markus & Charnysh, 2017).

At a minimum, societies should seek benign ways of influencing people to adopt practices in favor of sustainability. This could be encouraged by targeting individuals using current media structures. However, studies suggest that achieving significant systemic and progressive change requires media reform, in particular changes in ownership and control arrangements. They suggest that media systems governed with meaningful public participation and oversight are more reliable means of serving broader public interests (McChesney, 2007). Research is needed that explores and defines the best institutional arrangements by which to foster understanding and norms conducive to the needed socio-political pressure and change in favor of the common good. Standard educational systems should also be engaged at all levels. In light of the urgency of change, that cannot replace interventions at these other communications levels, however, given the decades-long time-lag common in implementation of sustainability curriculum in educational programs (Desha et al., 2009), and the fact that media form a deep layer of conditioning that is resistant to new information once formed, including educational content (Lakoff, 2010).

There is, for good reasons, a discomfort with top-down control. Stirling (2014) questions whether control is even compatible with emancipating progressive change, placing his hope on the

uncontrolled and unpredictable stochastic surge of social movements. But would that also include *democratic control* over media systems, even if structured on the basis of the best available knowledge about deep and meaningful participation in decision making (Atlee, 2012; Chilvers, 2008; Macnaghten et al., 2014; Weymouth & Hartz-Karp, 2015)? In such conditions, might there not be a role for social marketing, too (Bogueva et al., 2017; Rodriguez-Sanchez, 2023)? Social marketing has been shown to be very effective in changing imaginaries and behavior to better reconcile sustainable development goals and planetary boundaries (ibid.). By definition, social marketing for sustainability develops and harnesses marketing concepts with other approaches 'to influence behaviors that benefit individual and communities *for the greater social good*' (Bogueva et al., 2017, p. 282, emphasis added). Is such orientation and use of media not preferable to profit-driven commercial media? Involving a different configuration of politics and economic obstacles and possibilities compared to marketing via mass media, social marketing research also explores virtual reality tools as means of promoting changes in awareness, attitudes, and behavior bearing on environmental conservation and sustainability (Scurati et al., 2021; Wang et al., 2019). Why is social marketing for sustainability not more widely discussed?

A look in *The Oxford Handbook of Compassion Science* (Saturn, 2017) can nurture scintillating ideas about how communications media might be used to harness the best rather than the worst of human potential. By contrast to the intensifying political polarization and a global phenomenon of climate anxiety, despair, and perceptions of moral injury (Hickman et al., 2021; Pew, 2015), communications media and new digital technologies are capable of inducing 'moral elevation.' Psychological experiments have established that the fact of witnessing self-interested acts of compassion generates powerful effects that they call 'moral elevation.' Humans are highly sensitive to such stimulation; the fact of witnessing acts of compassion tends to quickly and perceptibly inspire not only feelings of compassion but also a desire to be a better person, love of people, optimism about humanity, and a tendency to also *act* compassionately (Saturn, 2017). Such emotions are conducive to steering societies 'out of the wreckage' (Monbiot, 2017), and new digital tools such as virtual reality technologies can help do so (Scurati et al., 2021). By contrast, common contemporary portrayals of human and animal nature as inherently competitive and selfish misrepresents both (Kohn, 1992), encouraging selfishness and indifference to others' needs, contributing to the global phenomenon of distress and despair induced by environmental existential threats.

Certainly, the dangers of using artificial intelligence and other technologies in environmental governance (Machen & Nost, 2021) must be carefully explored and considered, as must projects to intervene in public meanings and private emotions generally. But so must the negative potential of *not* doing so (which is *not* to do nothing), and the *positive* potential of doing so responsibly. Choosing neutrality and non-intervention in status quo are also political choices.

4.2 The imprint of power in sustainability research

Sustainability scholars recognize that some dimensions of power shape hearts and minds, and that successful resistance requires collective reframing (Clark & Harley, 2020, p. 350; Gaventa, 2019). Clark and Harley recommend that sustainability scientists attend more to the role of Steven Lukes' 'third dimension of power' in incumbency – that is, the imprint of power on what individuals and larger societies think, desire, and do - and to how it can obstruct adaptive responses in the face of risks. They note that Gaventa's (1982) empirical study of miners in Appalachia (summarized by Clark and Harley, p. 350) illustrated that all three dimensions of power are important for successful resistance and change: direct power over others through incentives or coercion; power to set agendas and thus exclude persons or issues; and power over signification. In Gaventa's case study, the third dimension of power was exercised by the miners against their employer when they succeeded in collective issue framing to highlight and transmit their perspective on issues pertinent to the conflict.

It is hard to avoid the conclusion that sustainability scientists' silence about the power and need to reshape communication systems ownership and governance reflects the imprint of power on science. Knowledge serves power most effectively when political aspects (e.g. the fact that elite interests tend to dominate the construction of reality and messages in dominant media outlets) remain undiscussed and hidden (Stirling, 2015), and norms, assumptions and perceptions about what is proper also limit scientists' power as change agents (Lahsen & Turnhout, 2021). This happens through scientific enculturation and, in assessment processes, in pressures to 'filter statements from a political feasibility perspective' (Schipper et al., 2021, p. 18). This engenders 'structures of feeling' (Williams, 2014 [1976]) – power-inflected culturally patterned assumptions about what is in and outside of the scope of 'appropriate' and worthy research, analyses, and policy recommendations. This is why both politics and science need a 'drastic overhaul' (Driessen et al., 2010, p. 168) to foster positive social change (Lahsen & Turnhout, 2021). Sustainability scientists are caught in webs of meaning as simultaneous consumers of mass media, citizens, and members of professional subcultures and interest groups. This may variously lead them to obfuscate and be blind to their own subjugation and participation in reinforcing prevailing powers that obstruct transformations towards sustainability, and this reflects in their avoidance of discussion of the need to reshape communications systems ownership and governance.

Simply mentioning – even repeating – knowledge that goes against power is insufficient; support and scale are needed for impact. For example, social scientists frequently call the European Commission's attention to the 'crucial neglected fact that knowledges are also themselves deeply shaped by power' and urge specific policy mechanisms to directly address power relations that obstruct official, stated goals of becoming more sustainable, just, and equal (Stirling, 2015, pp. 137). But, as documented (Felt et al., 2016; Stirling, 2015), such observations are systematically left out of final reports.

Social studies of science are essential to the 'overhaul' that leading analysts judge that environmental science and policy processes need to foster vital social changes towards sustainability (Driessen et al., 2010, p. 168). Yet – indeed, it seems, for that very reason, albeit supported by cultural criteria of worth and norms of neutrality – they are kept marginal in many academic fields (Lahsen, 2013; Lahsen & Turnhout, 2021).

5. Conclusion

World leading communications scholars have long urged reform of the communications media, noting that social goals are unlikely to be achieved without it. Information and communications systems are a prime tool by which elites consolidate their

power and wealth and, by the same token, inequality, and environmental destruction. The fact that sustainability scientists and policy analysts have done so little to develop research programs and policy frameworks that adequately examine and address the political economy of both traditional mass media and new, digital media begs change and critical reflection about both academic silos and the imprint of power in sustainability research itself. The pervasive silence undermines the power to question and transcend existing paradigms (or mindsets), the deepest lever for transformations toward sustainability.

Structures of social worlds are constituted through interpretations and norms that are 're-instituted time and again, dramatized every moment of every day'; they are not 'naturally there' (Alexander, 2019, p. 44). This is a critically important insight. It can be empowering to realize that the imprint of any single targeted advertisement only has short-lasting effect (Doyuran, 2021). The insight that social worlds and meanings only persist if actively sustained is disempowering for sustainability transformations only if no effort is made to use it as inspiration to make interventions in current signification and communications media policies. Such interventions can and should be done with meaningful, democratic public participation and oversight, to ensure that they serve the public good, including carefully considered implementation of Agenda 2030, the Paris Agreement, and other agendas to which many nations already have committed under the United Nations. The means to steer cognition exist. While dangers and challenges exist in such implementation (Schneider et al., 2019) – indeed, for that reason – it is vital that societies prioritize learning how to responsibly govern and use the relevant technologies and socio-political processes to serve sustainability needs.

The lack of discussion and exploration of possible, alternative positive uses of communications media is a failure of imagination and, it would seem, a glaring reflection of the imprint of power in science. It is striking how little is done, in science and society, to imagine how current socio-technologies systems might be re-imagined and their positive potential harnessed based on the best knowledge available about their wise and ethical governance. Sustainability researchers can only be 'honest brokers' (Pielke Jr, 2007) if they analyze all relevant aspects of the sustainability challenge and lay out all the policy options in light of political sensitivities, without self-censorship.

Besides a general, enhanced emphasis on critical thinking and on understanding of complex systems, giving due attention to media systems and related power aspects, societies should privilege critical studies at the nexus of media, science, technology, and policy. To advance both the field and goals of sustainability research, researchers ought to engage in reflection – and invite critical study and input – to help them understand and overcome their own participation in the systematic (hegemonic) exclusion of attention to communications media as both tools of oppression *and* transformation. By what mechanisms is it that researchers, social movements, and decisionmakers overwhelmingly come to limit imagination and exploration of alternative, social change nurturing communications systems governance? Inviting and institutionalizing critical questioning and input, even when doing so can be uncomfortable, is a means of achieving more robust knowledge and basis for action (Harding, 1992). Aware of this, Dixson-Declève et al. 's (2022) much praised 'guide for humanity' by which to achieve an 'Earth for all' stresses the need for education that fosters critical thinking.

Currently, broad-scale, critical thinking is under-emphasized in global environmental research and policy (Dauvergne & Clapp, 2016; Lahsen, 2016; Lahsen & Turnhout, 2021; Park et al., 2008), despite its particular importance for achieving change. Studies in the interdisciplinary field of global environmental politics have tended towards lower-scale and often narrow technocratic foci, sacrificing broader political forces and contexts (ibid. See especially Dauvergne & Clapp, 2016). In the realm of communications, broader contextual aspects are similarly hard to find. The need for such an expanded lens that encompasses the growing concentration and globalization of news media ownership as well as the role played by public relations companies and sophisticated digital technologies has been stressed before (see, for example, [Anderson, 2009]), without engendering the needed changes. Broader infrastructural aspects must not be missed through an overly narrow focus on media content; disinformation and infodemics are only symptoms of bigger and deeper communications systems (Bechmann, 2020) structured by laws and other infrastructures that rarely are analyzed and addressed across regulatory silos (ibid.). Communications policy reform is a complex and relatively neglected area of study (Lentz, 2014), not least in environmental research.

Critical social studies of science and technology (STS) remain under-tapped for their strength in fostering meta-level understanding and, as such, a meta-science of sorts (Jasanoff, 1996) of great importance for global environmental research and policy (Lahsen, 2024a). The field of STS offers and encourages reflection on, and redesign of, how science and technology, including communications systems and related policies, affect our societies, with emphasis on understanding and countering oppressive power and on implementing participatory arrangements in service of collective interests (Kreimer & Vessuri, 2018; Stirling, 2003). Responsible scholarship and policy efforts to steer cognition must especially harness important lessons learned about participation, democracy, power, and diversity, using these to 'bring the strengths and limits of our always uncertain knowledge of the world's complexities into better alignment with the cognitive and political pluralism that is the foundation for democratic governance – and the life's blood of any democratic society' (Rayner & Sarewitz, 2021, p. 43) (see also [Prins et al., 2010; Rayner, 2014; Stirling, 2008]).

Clark and Harley (2020) draw on Lukes' (2021) 'third dimension of power' in incumbency (that is, the imprint of power in what individuals and larger societies think, desire, and do) to understand the role of power in societal responses to risks. In the case study that they cite (Gaventa, 1982), the third dimension of power was exercised by miners; when Appelachian miners succeeded in collective issue framing to highlight and transmit their perspective on issues pertinent to the conflict, they exercised this power against their employer. For this third type of power to be successfully mobilized in favor of transformations toward sustainability, scholars must similarly guide societies in the formidable task of purposefully reshaping the political economy and governance of communications systems. Increasing the urgency, new digital technologies and social media platforms are now boosting mind control capacity, inequality, and environmental destruction, with limited public controls.

Broadcasting frequencies are publicly owned and can be reclaimed. With proper advice and pressure, decision makers might bend to publics insisting on public oversight and involvement in shaping media systems and algorithmic power such that these serve broader public interests, including commitments to sustainability and human rights. The alternative to democratic control of the media for the public good is not neutrality but acquiescence to the

power of elite private interests that currently control them, and to media systems and supporting policies that, thus far, have not helped overcome existential threats and build healthy societies in service of the majority, present and future.

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