An Enlightened Common Sense Approach to Environmental Education, with Special Reference to Climate Change

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Abstract

This article argues that, in order for humanity to act timeously to ameliorate threats such as climate change, we would do well to heed the central tenets of Roy Bhaskar's transcendental realism, which he also calls enlightened common sense. This is because transcendental realism is critical of the unnecessarily burdensome assumption allied with systems/complexity theory that statistical analyses and complex computer models are necessary and sufficient to deal with complex systems such as climate. To the contrary, from the perspective of transcendental realism, it is knowing 'how things work' – being enlightened – that is necessary, and often sufficient, to deal with complex systems. For example, in terms of climate change, knowing how the Greenhouse Effect works – that is, knowing how extra carbon dioxide in the atmosphere heats the Earth – makes it as simple to decide to act to reduce carbon dioxide as knowing how gravity works makes it simple to decide not to step off a high-rise building. This does not detract from the further need to (preferably democratically) consider different action options, for which computer models can be a helpful tool. Transcendental realism also has implications for how environmental educators define climate and climate change and it provides an antidote to certain challenges posed by climate change deniers. Much of the critique applied in this article to systems/complexity theory can also be applied to posthumanism.

Keywords: *climate change education, Roy Bhaskar, climate scepticism, complex systems, posthumanism*

Introduction

The Greenhouse Effect was first identified over a hundred years ago by Eunice Foote (1856). Since then, the problem has been extensively discussed, such as in Wallace Broecker's (1975) article *Climatic change: Are we on the brink of a pronounced global warming?* and Al Gore's (2006) book *An Inconvenient Truth*. The first Intergovernmental Panel on Climate Change (IPCC) report was published by Houghton, Jenkins and Ephraums in 1990 (Pain, 2009). Nevertheless, despite these warnings, we have been slow to act to protect ourselves from the Greenhouse Effect's heating of the Earth. It is often assumed that a large part of the reason for our lack of action is the powerful lobbying of individuals and

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organisations with interests in the fossil fuel industries (Grasso, 2019). Yet the question remains as to why these lobbyists were able to achieve their goal, which stands contrary to common sense? Kovaka (2021, p. 2356) perhaps begins to answer this question by drawing attention to "an important group of climate change deniers: those who say they are on the side of science while also rejecting what they know most climate scientists accept". These climate change deniers argue from the perspective of Karl Popper [1902-1994] that climate science cannot be considered to be a proper science because it misses out the initial scientific phase of inductive analysis of data and the final stage of carrying out falsifying experiments (Bratby, 2010). They also accuse Climate Change activists and organisations, such as the Intergovernmental Panel on Climate Change, of using models that have not been able to predict global warming (Bratby in Homewood, 2015; Koonin, 2014; Moore, 2021; Readfearn, 2022).

In this article, I argue that at least part of what gives these anti-climate change actors their competitive edge – allows them in theory to stay on the side of science – is that they take advantage of a philosophical error present in the positivist way that most scientists theorise science. I also explain that the way to remove the power of their argument is to take a non-positivist, enlightened common-sense[1] approach to science. Humans use this version of common sense all the time to avoid accidents and disasters, such as when we leave a house by the ground-floor door, not the second-floor window, because we understand – are enlightened about – the effect of gravity.[2] We do not need decades of measurements and statistically significant correlations to decide what to do in these contexts. This position is contrary to that of complexity theorists such as Ilya Prigogine (Prigogine & Stengers, 1997) who argued that the only way to understand complex systems is through statistical probabilities. This is not to say that correlations in the form of, for example, statistical analysis and complex computer models are not useful, but merely that they are neither necessary nor sufficient (Bhaskar, 2016). Correlations are not sufficient because we always need to add an explanation to them, that is, we always need to understand why the correlations exist to avoid errors such as the error of assuming that all correlations indicate causation (they do not). Correlations are not always necessary because we can sometimes obtain important knowledge which is not in the form of a correlation or based on big data, such as our knowledge of the Greenhouse Effect. This latter point is especially important in contexts, such as we have in climate science, where we cannot place our object of interest into a laboratory.

I therefore take the position advocated by ecologists Gunderson and Holling (2002, pp. 32-33) who argued that ecosystem managers can, for instance, "decide whether the caribou herd is increasing or decreasing in size, and gaining or losing health and fitness, without requiring an actual count of the population". That is, we can obtain such knowledge by using our understanding of 'how things work' along with information such as the condition of the individual caribou in the herd, their general behaviour and the general environmental conditions. Similarly, we can use certain rules of thumb to guide our decisions to protect people and planet, based on common sense understandings of how things work.

An example of such a rule of thumb would be that we should avoid adding excess carbon dioxide into the atmosphere based on our understanding of how the Greenhouse Effect works. One of the key concepts of this position, taken from the philosophy of Roy Bhaskar [1944-2014], is that reality is stratified, with lower and higher orders of being (see Table 1). Thus, it makes the ontological assumption that higher order structures and mechanisms – in this case the mechanism of the Greenhouse Effect as originally described by Foote (1856) – are real (Bhaskar, 2016). This approach is also called *transcendental realism* because these higher order structures and mechanisms 'transcend', that is, they are 'more than' the sum of the parts of the lower order things that we can measure and see in relation to each other. Whilst the assumption that the 'something more' is real – that is, while the assumption that the Greenhouse Effect is real – seems like common sense to most, it is, as I explain shortly, not an assumption present in mainstream science based on Popperian 'post-positivism'. I also explain shortly how it is also an assumption that, if it is not present, gives strategic advantages to climate change deniers and significantly slows down our ability to act timeously in the event of impending dangers such as climate change.

Table 1: *Levels of reality of climate change and Mediterranean climate, where structures and mechanisms are the transcendentally real parts of reality*

	Climate change	**Mediterranean climate**
Structure (real level)	Overall disposition of the planets in the universe, in which their atmospheric characteristics influence their climatic conditions.	Overall tendency for areas of the Earth's surface to have particular climates due to their geographical locations and local geomorphological characteristics.
Mechanism (real level)	Carbon dioxide tends to absorb heat from a light source. We have named this mechanism the 'Greenhouse Effect' when it occurs on planets such as Earth.	Certain areas of the Earth, close to the coast, in latitudes 30 to 44 degrees north and south of the equator, tend to have an anticyclone over the ocean in summer, bringing subsiding air and attendant clear skies and high temperatures (no rain). In winter, the replacement of this anticyclone by frontal cyclones brings rain.
Event (actual level)	There is an actual pattern of events on Earth in which increased carbon dioxide is correlated with increased temperatures.	There is an actual pattern over decades in which areas described as having a Mediterranean climate have hot dry summers and cold wet winters.
Measurable entity (empirical level)	We can simulate the Greenhouse Effect in the laboratory and thus witness it on a small scale. We can measure the increased temperature of the Earth.	We can take temperature and precipitation measurements and thus witness the dry summers and wet winters.

In this article, I therefore start by describing how mainstream positivist science is problematic because it lacks an ontology for transcendent things. I then briefly show how the post-structural and post-humanist challenge to positivism – including its inflection as

complexity theory – is flawed and, ultimately, remains with the same problems as positivism. This is because all these positions lack an ontology for transcendent reality. I then illustrate my argument by reference to the empiricist way that environmental educators currently define climate, arguing that transcendental structural definitions would be preferable. As such, I suggest that it would be better for environmental educators to refer to the *Greenhouse Effect*, thus focusing on the structural nature of the problem, rather than *climate change*, which focuses on the less reliable empirical nature of the problem. Such a focus would immunise environmental activists from certain climate change denial arguments, such as that climate change science is not proper science; and it would give them permission to act even in the event of a temporary hiatus in global warming, which empiricists can argue proves that climate change is not happening. That is, activists are justified to act in open-system contexts if the structures and mechanisms that will lead to a future problem exist, even if the effects of the structures and mechanisms have not yet shifted into the realm of the empirical.

Some problems with mainstream positivist science

Bhaskar (2013) [1975] has summarised the problem with mainstream, positivist science as follows:

> … the world, which ought to be viewed as a multi-dimensional structure independent of man, came to be squashed into a flat surface whose characteristics, such as being constituted by atomistic facts, were determined by the needs of a particular concept of knowledge. This led to a barrage of problems and an impossible account of science. For from now on any structure, if it was allowed at all, had to be located in the human mind or the scientific community. (p. 35)

One could argue it is this 'impossible account' of science that most environmental educators use to explain climate change. Such an account follows Popper (1945, pp. 12-14), for whom science is not in the business of transcendent abstractions or definitions. Popper explained this scepticism in terms of puppies. He argued that we can only ever describe individual puppies, and hence science is not in the business of asking the transcendental question, 'What is a puppy?'. He wrote: "Thus the scientific view of the definition 'A puppy is a young dog' would be that it is an answer to the question 'What shall we call a young dog?' rather than an answer to the question 'What is a puppy?'. … In modern science, only nominalist definitions occur, that is to say, shorthand symbols or labels are introduced in order to cut a long story short. And we can at once see from this that definitions do not play any very important part in science". Similarly, for Popper (1972, p. 24), as for Immanuel Kant, the 'laws of nature' (or nature's regularities, constant conjunctions, correlations) are simply something that we humans impose on the world and therefore, "the regularities we try to impose are psychologically a priori … The need to try to impose such regularities upon our environment is, clearly, in-born, and based on drives, or instincts".[3] Both Popper and Kant therefore agreed with the positivist David Hume, who sceptically argues that there is no

such thing as causation, rather, ideas of causation are simply something that we humans impose on the world (Bhaskar, 2016).

From this perspective, all transcendent 'things', whether categories of puppies, or causes (underlying structures and mechanisms) of climate change, do not technically exist and our discourse about them is merely a psychological habit that helps us to order, or make sense of, empirical measurements (Bhaskar, 2016). Furthermore, this Popperian so-called post-positivist science assumes that the only causal laws that can be taken seriously are those that refer to predictable, measurable (that is, non-transcendent) constant conjunctions of atomistic events, which "implies that the world is uniform, flat and repetitive, undifferentiated, unstructured and unchanging, and it is evident that this is not the case" (Bhaskar, 2016, p. 6).

This denial of the transcendent by positivists means that scientist must face incommensurable problems in their theoretical positions, such as the problem of talking about puppies but not really believing that the category 'puppy' exists; or creating climate change models but not believing that the models are literally about something real (climate change). Furthermore, the positivists face a 'problem' that their models cannot be relied upon to predict future states. As Mitchell explained (2009, p. 224), "all models are wrong in some way" and models should not be taken too literally. The idea, fortunately questionable, that we should not take our climate change models 'too literally' plays directly into the hands of climate change deniers. However, rather than seeing the failure of models to predict things in open systems as a problem, from Bhaskar's perspective this is simply an expected outcome of the existence of the layers of reality. That is, the mechanisms identified at the level of the real cannot be expected to play out perfectly on the ground, so to speak, because of mediating circumstances in the open system of the world. An example of a 'mediating circumstance' is the way that dust from volcanic eruptions can reflect the sun's energy from the earth, thus cooling the atmosphere and temporarily counteracting the heating effect of greenhouse gases. The existence of these mediating circumstances means that prediction is not possible in open systems and there cannot be a one-to-one correspondence between the data and the models. "In general a statement can be empirical or universal but not both" (Bhaskar, 2016, p. 29). That is, the structures and mechanisms of climate are transcendent and universal – everywhere has climate which is explainable via structures and mechanisms based on general physical principles – but these structures and mechanisms are not the same thing as the empirical measurements and their actual networked relationships, and therefore they are not reducible to them. Thus, we cannot perfectly predict the weather at any particular time in a particular area despite having a good idea of the area's climate.

Post-structural and post-humanist challenges to positivism are flawed

Roy Bhaskar was not the first to argue the failures of empiricist/positivist[4] science; in fact, one could say that it is usual for environmental educators to be committed to a critique of it, especially in terms of its reductive nature and its inability to deal with subjective,

hermeneutic meaning (see for example, Reed, 2022, p. 318). However, the current alternatives to positivism are themselves problematic and they do not challenge positivism per se; they are more likely to agree that positivism is adequate for the study of natural phenomenon, but that it is not adequate as a way to approach the knowledge in the social sciences, or indeed any of the sciences where human interpretations are important. For instance, when educators influenced by poststructuralism reach for their science interpretation amongst other interpretations – to create a polyphonic, non-absolutist story – they are usually reaching for an empiricist/positivist version of science (an example is provided by Lather and Smithies, 1997).

More recent posthuman 'new empiricisms' or 'new materialist' ontological approaches shift the post-structural emphasis from questions of language and stories "to questions of relational networks or assemblages of animate and inanimate 'affect' "(Hart et al., 2018, p. 80). However, both senses of the word 'affect' point to empiricism/positivism. On the one hand, the sense of 'affect' as 'feeling' reflects empiricism/positivism's focus on what is empirical/measurable since that which can be felt by a human is a subset of everything that can be measured. On the other hand, the sense of affect as 'cause and effect' reflects positivism's focus on constant conjunctions of events. Ironically, despite being, seemingly, polar opposites, *both* empiricist/positivists and post-humanists/post-structuralists are wary of transcendent theorisations, which Hart (2018, p. 80) calls the "bird's eye view of inquiry" (see also Braidotti, 2019a).

Systems/complexity theory alternatives are also flawed

Many environmental educators also have an interest in the work of systems and complexity theorists which aims to move "beyond the traditional paradigm of reductionism" (Mitchell, 2009, p. xi). This interest marries well with the environmental educators' interest in the post-humanists, since the latter's position is commensurate with that of the complexity scientists (Braidotti & Bignall, 2018; Cudworth & Hobden, 2013;). We can see this commensurability in the posthumanist work of the radical empiricist Gilles Deleuze [1925-1995], who focuses on *actual* relations. He calls his position *transcendental empiricism,* although the nature of his position as transcendental is disputed Allen (2020, p. 355). The posthumanist Rosi Braidotti (2019b, p. 34) calls her position *embodied and embedded carnal empiricism* and she also focusses on relations, which she calls 'a web of relations' (Braidotti, 2009b, p. 34). Similarly, systems/complexity thinkers mention 'network thinking' which "means focusing on the relationship between entities rather than the entities themselves" (Mitchell, 2009, p. 233). This kind of relational thinking moves beyond empiricism to what Bhaskar calls actualism (2008, p. 219). This is because it acknowledges that there is more to the world than things that we can measure; there are also actual events, in the form of relationships.

Scientists who take this position see reality as flat in that they assume that reality includes only a) the *empirical* things that we can measure, and b) the *actual* complex interactions or relationships amongst the things that we can measure – relationships which are *events* in

time and space (see for example the early Holling, 1973). Authors who think that only empirical things exist are called *empiricists*. Authors, like the post-humanists and systems/complexity scientists, who go a step further to think not only that empirical things exist, but *also* that relations and events amongst empirical things exist, are called *actualists.* Such scientists therefore may go further than simply talking about the measurable entities and begin to talk about theories or 'models' that explain the entities and their relationships and patterns. Nevertheless, like the positivists already mentioned, they remain sceptical that their theories or 'models' have a real referent, or an ontology, not least because they cannot be used for prediction. For example, Braidotti (2009b, p. 33) describes how her position argues for "... a cartography", which is a "theoretically-based and politically-informed account of the present that aims at tracking the production of knowledge and subjectivity and to expose power both as entrapment ... and as empowerment...". By emphasising the map (the cartography) over the actual territory we see her scepticism about the ontology underlying the theory.

To the contrary, Bhaskar's transcendental realism assumes that theories and models, such as models of climate and climate change, do have an ontology and therefore that they should be taken literally and thus seriously (Bhaskar & Singh, 2020). It therefore goes beyond empiricism and actualism to realism. This is because it assumes that theories and models are about reality and are not simply psychological projections onto the empirical level. From this realist perspective, the search for prediction in open systems is fundamentally misplaced because the theories about universal, transcendent reality do not describe the actual networked empirical data, but rather they describe a transcendent reality, *evidence* for which is provided by the networked empirical data.

I realise that my use of the words *transcendence, universal* and *enlightenment* will strike a discordant note with academics immersed in post structuralism and posthumanism, given the accusations levelled at the concepts, such as represented by Braidotti above. To justify my use of the words, I will on the one hand agree that there is a sense of these words to which I do not subscribe, which I think the posthumanists are correct to critique. Braidotti (2017, p. 22) calls it "the violence and the hierarchical thinking that result from human arrogance and the assumption of transcendental human exceptionalism". I think that Braidotti is here talking about the kind of transcendence/universal thinking/enlightenment that refers to knowledge about things outside of all that is, in other words, transcendent things such as the transcendent, disembodied human mind of Descartes or abstract universals – such as the abstract universal 'ideal woman' – which similarly do not exist. This way of thinking is also related to what Bhaskar (2016, p. 39) calls anthropocentrism, which he convincingly critiques; I would go so far as to say that a main aspect of Bhaskar's philosophy is that it is anti-anthropocentric. Because of the confusion between these kinds of transcendence – the materialist version to which I subscribe and the immaterialist version – it is perhaps better to talk about depth rather than transcendence. However, on the other hand, I continue to use the word *transcendence* because this is standard practice in philosophical discussions since Kant (1724 – 1804). I continue to use the term *enlightenment* to reconnect

our work to that of the enlightenment thinkers who, despite making errors that led to positivism, Kantianism, and poststructuralism amongst others, nevertheless led us away from superstition and slavery. To argue otherwise, to say that we do not need some way of identifying falsity, is not only philosophically problematic – since we rely on our enlightened knowledge, or knowing how things work, for just about everything we do – but threatens our ability to change things for the better on the planet. In the words of Bhaskar (1989, p. 1):

> My use of the phrase 'enlightened common-sense' is deliberate. In a capitalist world and a bourgeois society, socialism will never be simple sense. But what we can hope to aspire to is the dawning of a new enlightenment, a socialist enlightenment which will stand to some future order of things, as the eighteenth-century bourgeois enlightenment stood to the American Declaration of Independence, the French revolution and the overthrow of colonial slavery for which it helped to prepare the cultural ground.

In the section that follows, I illustrate the implications of transcendental realism in terms of the way that we define climate and climate change.

Definitions of climate and climate change considered from the perspective of transcendental realism

Sadly, over time, it seems that we have become more, rather than less, committed to believing in a flat reality. For instance, let us consider some different definitions of climate and climate change. The following typical definition of climate was taken from an environmental education website. Note how this definition is couched in empirical language: readings, averages, and high-tech computer systems designed to deal with 'hundreds of measurements'. Its ontology assumes a flat reality in which what is real is limited to the generalisable pattern of these measurements over long periods of time:

> Climate is 'the general weather in one place over a long period of time'. So it's not what the weather is like today, it is the average weather conditions over a decades. Meteorologists (scientists who measure the weather) collect detailed information about the weather every day, often using high-tech satellite and computer systems. Hundreds of measurements are calculated and the results compared to previous readings. (Young People's Trust for the Environment, 2021)

Based on this definition, we would say that an area has a Mediterranean climate if meteorologists have collected thousands of measurements over several decades from that area, and these measurements have revealed weather conditions that generally follow a pattern of dry summers and wet winters. Consider this to be our first definition of a Mediterranean climate.

Next, consider a second definition of a Mediterranean climate, which assumes a layered ontology:

> Mediterranean climates are located between about 30° and 45° latitude north and south of the Equator and on the western sides of the continents. Poleward extension and expansion of the subtropical anticyclone over the oceans bring subsiding air to the region in summer, with clear skies and high temperatures. When the anticyclone moves Equator-ward in winter, it is replaced by traveling, frontal cyclones with their attendant precipitation. (Editors of Encyclopaedia Britannica, 2022)

The second definition of a Mediterranean climate gives the deeper layers – or structures – of reality that result in Mediterranean climates, while the first definition assumes a flat reality of empirical measurements and actual patterns. In the second definition we therefore have a layered ontology; we can say that climate is 'the structures and mechanisms' that underlie the weather patterns in a region. That is, the weather is real at the empirical and actual levels, while climate is real at structures and mechanisms level (see Table 1). From the perspective of this layered reality, a meteorologist *who has no access to daily weather records over decades* would be able to tell, from topographical features and latitude, whether an area has a Mediterranean climate. Note how the second definition does not need empirical language: it does not need readings, averages, or high-tech computer systems to deal with all the 'hundreds of measurements' to decide whether or not an area has a Mediterranean climate.

Of course, meteorologists have in the past usually described Mediterranean climates this way and some most likely continue to do so. Nevertheless, it is also the case that, because contemporary philosophy of science does not talk about a layered reality, there is an ever-present tendency for scientists, including climate scientists, to prefer flat descriptions of reality to depth descriptions. A depth description of climate, which, unlike the Young People's Trust for the Environment version, does not include 'average weather conditions over a decades' might be along the lines of:

> Climate is the overall tendency of an area to have certain weather conditions at certain times of the year, for reasons related to its geographical position on the globe and its characteristic topographical features.

The typical commitment to a flat ontology has led, unsurprisingly, to NASA's (2021) empiricist definition of climate change which emphasises average measurements over time:

> Climate change describes a change in the average conditions – such as temperature and rainfall – in a region over a long period of time. NASA scientists have observed Earth's surface is warming, and many of the warmest years on record have happened in the past 20 years.

Using NASA's definition, if temperatures do not increase for a few years, it would be hard to argue that climate change is still happening. Therefore, from the perspective of transcendental realism, I argue that environmental educators should talk about the

Greenhouse Effect rather than climate change to shift the focus to the structural problem that we are facing that is resulting in human-induced climate change.

Advantages of transcendental realism to environmental educators

One of the advantages of transcendental realism for environmental educators is that it allows them to counter climate denial arguments, based on positivism, which suggest that theories of climate change are not proper science because climate models are not perfectly predictable and because the science has not involved replicable experiments aimed at falsification (Bratby, 2010; Bratby in Homewood, 2015; Koonin, 2014; Moore, 2021). Transcendental realism counters these arguments by suggesting that, contra positivism, knowledge about climate change *does not* require hypothesis-testing experiments to be known about (nevertheless the mechanism of the Greenhouse Effect has been demonstrated in laboratories, initially by Eunice Foote, and replicated often since then). It also suggests, contra positivism, that models do not have to be perfectly predictable for us to assume that, nevertheless, they are in principle correct. Indeed, we cannot expect such models to be fully predictive due to open system factors which, outside the laboratory, refuse the possibility of perfect correlations (predictability). That is, if there is a global warming hiatus in which the Earth does not warm – as there was between 1998 and 2012 (Medhaug et al., 2017; Meehl, 2014), this does not necessarily mean that climate change is not happening. The Greenhouse Effect is most likely still functioning to heat the Earth, but its structural effects may be countered by open system factors, such as unusually active volcanoes whose dust tends to reflect the sun's rays from the Earth and make it cooler.

In other words, millions of measurements are not always a good indication of what is going on in an open system (non-laboratory) context. We can know about the structural effect of adding extra carbon dioxide to the Earth's atmosphere, which we call the Greenhouse Effect, by the use of *retroduction* (Bhaskar, 2016), in which we think about 'what-must-have-been' to explain the evidence, and then compare the other existing 'what-must-have-been' theories that compete with each other with regard to this evidence. This logical comparison is called judgemental rationality (Bhaskar, 2016). The relevant competing 'what-must-have-been' theory (climate change denial) would be that the temperature changes and other evidence are the result of natural processes in which the Earth simply cycles between warmer and colder periods, and which have nothing to do with increasing carbon dioxide and human activity. However, we can prefer the 'human activity is warming the Earth due to the Greenhouse Effect theory' to the 'natural processes theory' because the latter does not explain certain other evidence, such as the extra carbon dioxide in the air and its heating effects. Thus, the Greenhouse Effect theory gives a more comprehensive explanation for the empirical measurements than the Natural Processes theory.

I would like to add that this advantage of transcendental realism is not solely applicable to questions of climate change; it has implications for social justice in general, and it

strengthens the critique for people who are oppressed. For example, think of a context, such as is still sadly common in parts of South Africa despite nearly 20 years post-Apartheid, which has tendencies towards racism, but the racism is unexpressed due to powerful policing. Thus, the structures of racism continue to exist as a real, ever-present potential (they exist transcendentally) even if they do not become manifest in actual, or empirical ways (there have recently been no racist events, whether empirically measurable or not). Nevertheless, many people, especially those who suffer from racism, will know that the racism is simply latent. This is because we are able to recognise the subtle signs of it, and/or acknowledge that it remains in existence because there is nothing to suggest it has changed; for instance, perhaps we still know of people who are secretly, perhaps even unconsciously, racist but who manage to maintain a façade of antiracism (O'Brien, 2000, p. 49). This is not unlike the problem that we have in terms of climate change activism, when, during the 2000s the Earth failed to warm significantly, and the activists were told that there was no substance to their fears or that they were scare-mongering (O'Keefe, 2000). Positivism's denial of transcendent reality thus works in the favour of the individuals or organisations who need to hide their questionable motives in order to maintain a discourse that suits their interests. One could argue that manipulating the empirical evidence, or at least how things look on the surface, is an important activity of oppressive regimes and it is powerfully enabled by positivism which places an embargo on theorising about what certain evidence may 'mean', or which, at the very least, reduces such theorisation to the lowly status of 'opinion' or 'cartography'. The commitment to surface, empirical things alone, and the lack of ontology for deeper theories, therefore, denies the possibility of social critique that can be taken seriously. Transcendental realism overcomes this problem by underlabouring for the 'masters of suspicion', which is a category that includes all theorising, uppity social activists. A well-known member of this category is Karl Marx (Bhaskar et al., 2017), whom Karl Popper (1962) accused of pseudoscience and soothsaying.

Transcendental realism therefore has practical implications for those people who are oppressed, as well as for environmental educators. The various alternatives to positivism – such as hermeneutics, post-structuralism and the new materialisms – give oppressed people the right to develop opinions (theories) and social critique even if they are not lab-coat-wearing laboratory scientists. However, these people's opinions tend to not be taken seriously as they assumed to have no basis in reality, a state of affairs which is called relativism, in which there is no way to judge better or worse opinions. To the contrary, transcendental realism not only gives oppressed people the right to have an opinion, but also to think that their opinion is more correct than the opinion of the oppressor if, using judgemental rationality, their opinion gives a more comprehensive explanation for the evidence. The emancipatory advantages of this resolution of the problem of relativism, which has paralysed activism for decades, cannot be overstated.

Another important advantage of transcendental realism is that it can help us to avoid delayed responses to existential threats. Currently, positivist-based science concentrates on the empirical level, and therefore it insists on 'big data' and experimental findings of

correlations to make decisions. This can take many years to obtain, and in the meantime, we have not acted to address the problem. Additionally, as I have already pointed out, it seems positivists will never take the kind of (retroductive) science that we *can* obtain about the world's climate seriously. Nevertheless, understandings of structures and mechanisms can be trustworthy – such as the understanding of the Greenhouse Effect which is in fact founded on repeatable laboratory-based knowledge (it is just not able to be tested in the context of the globe). Our action decisions, based on such research, can be sound. This is common sense; that is, it is the same way that the common people, which includes people from traditional contexts, find knowledge.[5] It is equivalent to the way that knowing about gravity can prevent one from stepping off a high-rise building; and it is why Bhaskar called this kind of common sense 'enlightened'. One does not need to read scientific papers correlating death with stepping off high-rise buildings to know that one should not do this if one wants to survive. Thus, despite the global warming hiatus often mentioned by climate change deniers, when millions of measurements over nearly two decades failed to suggest that the Earth was warming, our knowledge of the Greenhouse Effect suggests that we should still have reduced our carbon dioxide output during this period. That is, taking retroductive theories seriously means that we can act on them immediately. If, back in the early 1900s, mainstream science was of the transcendental sort that I advocate here, we would have been justified to act *then*. We would not have had to wait until it was perhaps too late, and the global warming signal had 'manifested itself in the data' (as described by Hoffert in Pattee, 2021, para. 5). Those environmental educators who advocated the need to reduce carbon dioxide output in the 80s and 90s were intuitively acting on the principle that I argue for here; that is, they were arguing that we need to act based on our understanding of how things work rather than waiting for the problem to occur before acting.

However, it should be noted that knowing *that* one should act is not the same as knowing *how* one should act; or knowing what the likely outcomes of our different action outcomes might have. For this, complex models of climate change are powerful tools, and therefore I am not denying a role for such models. Furthermore, just as transcendental realism allows us to take physical structures and mechanisms such as the Greenhouse Effect seriously, so it also allows us to take social structures and mechanisms seriously, such as the structures and mechanisms of neoliberalism. This potentially helps us to find non-instrumentalist, democratic ways to approach the 'how' question, although a full discussion of this is not possible here.

Conclusion

In this article, I have argued that it is important for environmental educators to assume that reality is layered, rather than flat, when talking about climate change. This is because the 'flat-reality' definition of climate and climate change – based on empirical, actual measurements of temperature increases and the assumption that science is predictable – hampers our ability to act timeously and sets us up to lose the argument against climate change deniers.

For instance, during the event of the global warming hiatus between 1998 and 2012, it was difficult to argue that climate change was nevertheless still a problem that needed urgent attention. Thinking in terms of a layered reality, which includes structures and mechanisms, allows us to discuss how the Greenhouse Effect continues to act, in the background so to speak, even if its effects are temporarily mitigated by unpredictable events, such as extra atmospheric dust due to volcanic eruptions. Acknowledging the reality of structures and mechanisms makes the decision-making process that one might go through in terms of climate change mitigation – such as making the decision to resist the global tendencies that are leading to increased greenhouse gas emissions – as simple and as fast as the decision-making process that one might go through to take evasive action whilst driving, should one find oneself facing an impending collision. In putting forward this argument, my objective is to underlabour for our scientific discoveries, such as the discovery of the Greenhouse Effect, to allow us to take these discoveries more seriously. Although it is fair to say that I am critiquing the ontology of mainstream positivist science, my motive behind this critique is simply to strengthen the standing of important, 'most-likely-truthful' scientific theories which are a mainstay of positivist scientists' repertoire. Sadly, because these theories are not seen as having an ontology, they are too easily undermined by commentators with questionable motives.

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Endnotes

1 Note that common sense here refers to the simple process of cognition common to all humans and indeed many non-human species. It is not the hegemonic, ideological 'common sense' critiqued by Antonio Gramsci (2000). I argue that Bhaskar's (2016) version of ***enlightened*** common sense is an antidote to hegemonic, ideological 'common sense'. Common sense in the absence of a genuine attempt to find the real reasons for things could well be a fair definition of superstition, the opposite of Bhaskar's (2016) 'enlightened common sense'.

2 This gravity-ignoring analogy originates in the work of Hume when he said that, since theories such as the theory of gravity are, he argued, meaningless, there is no scientific reason to avoid leaving a building from its upper windows rather than from its ground-floor doors. This analogy is quoted frequently by Bhaskar (see, for example, Bhaskar and Singh, 2020, p. 78; and Bhaskar, 2016, p. 2). Admittedly, in this article, I sometimes up the stakes, shifting the analogy from being about stepping off the second floor to stepping off a high-rise building, but given the current environmental crisis I feel justified in this. Here is a relevant example of the analogy, by Hume, as quoted by Bhaskar (2009, p. 22): "But the most poignant rebuttal of practical scepticism comes from the pen of Hume himself: 'Whether your scepticism be as absolute and sincere as you pretend we shall learn by and by, when the company breaks up; we shall then see whether you go out at the door or the window, and whether you doubt if your body has gravity or can be injured by its fall, according to popular opinion, derived from our senses and more fallacious experience'. When the company breaks up …we are all practicing (transcendental) realists". One way to think of this article is that it is a rebuttal of the practical scepticism present in climate change education.

3 The difference between Popper and Kant was that Popper thought we could be wrong about the inductive ideas that we impose on the world, that is, he argued that we can refute them but not prove them.

4 I talk about empiricist/positivist science because, whilst positivism is the best-known version of empiricism, if I use its name alone, I lose the important reference to the focus on the empirical that we find in empiricism. Bhaskar (2009, p. 155) called positivism "a limit form of empiricism" because it places limits on empiricist knowledge, in terms of the idea that we can only know for sure that something is false and in terms of what counts as science (for example, science should, from this perspective, be based on testable hypotheses). I talk about ***empiricism*** and ***empiricist science***, not empirical science, to indicate that it is fine for scientists to value empirical data, but they should not ***only*** value it (which would make them empiricists, followers of empiricism).

5 One anonymous reviewer was concerned that not all indigenous knowledge falls into this category of common sense, but any theorisation about the explanation behind some seemingly inexplicable event – even if it results in a theory that a deity or deities/ancestors caused the event – falls into the category of transcendental, retroductive theorisation, which is what I mean by common sense. Historically, before humans had developed the knowledge they have now, this kind of 'black box' theorisation was usual; although, as scientific explanations for things have become available, so the need for black box retroductive theories, such as 'the gods did it', has fallen away (Ecklund et al., 2016). That is, by using judgemental rationality, humans have tended to assume that scientific explanations explain more of the evidence than the idea of an intelligent supernatural force. However, it seems fair to say that we still do not fully understand all the processes of life; and many people, whether indigenous or not, and this includes many scientists (Ecklund et al., 2016, p. 5), use judgemental rationality to argue that, in the absence of a scientific

explanation, the best retroductive, transcendent theory to explain life is the existence of an intelligent God. Personally, I do not commit to the theory that an intelligent God exists, as such a theory has too many unknowns for me; I am holding out for further enlightenment. Nevertheless, my point here is simply to show the ubiquity of retroductive, transcendental theorisation; and thus, to justify its description as common sense. I am not suggesting that common sense is always right; to the contrary, I hold it to be unavoidably fallible, but it is nevertheless still good enough for the purpose of providing a method to identify ethical ways of acting based on science.