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HABITS AND BINDS OF MATHEMATICS EDUCATION IN THE ANTHROPOCENE

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Abstract

Human intervention has led some academics to suggest we have now entered a new era of geological time, the Anthropocene. The label ‘Anthropocene’, for some, signals the shift from hopes of ‘saving nature’ and ‘solving’ problems, to living with crises and problems as our new and permanent condition. This article suggests the concept of ‘habit’ allows us to conceptualise ourselves in recursive relationship with the past and future, and with the world around us at all its scales. In other words, habit is a concept in keeping with the partial and paradoxical world we find ourselves in. A distinction is drawn however, between paradoxes that can be generative and paradoxes that lead to a double bind.

Introduction

Humanity faces unprecedented global and societal challenges. The extent and range of potentially imminent crises threatens the sustainability of human and many other forms of life on the planet. The aim of this article is to consider what recognising context means for mathematics education, through the prism of the Anthropocene. The strands and ruptures of thinking implied by the Anthropocene suggest a need to move on from ‘saviour’ narratives for education. I propose that the notion of ‘habit’ is a concept that helps connect individual and global perspectives and captures well the circularity of being in the world. This article proposes, therefore, that ‘habit’ might help us think through the complexities and contradictions of mathematics education in the Anthropocene, alongside the notion of the double bind (Bateson 1972).

The Anthropocene

That the world faces unprecedented global and societal challenges caused by human intervention has led some academics to suggest we have now entered a new epoch of geological time, the Anthropocene (Finney 2014). The label ‘Anthropocene’ was proposed by Crutzen (Crutzen and Stoermer 2000) and has now been formally adopted (Subcommission on Quaternary Stratigraphy 2016). One technical aspect of the designation is the recognition that there will be a visible change in rock strata being laid down at this time and the suggestion that the quantity of plastic that has been produced and discarded over the last

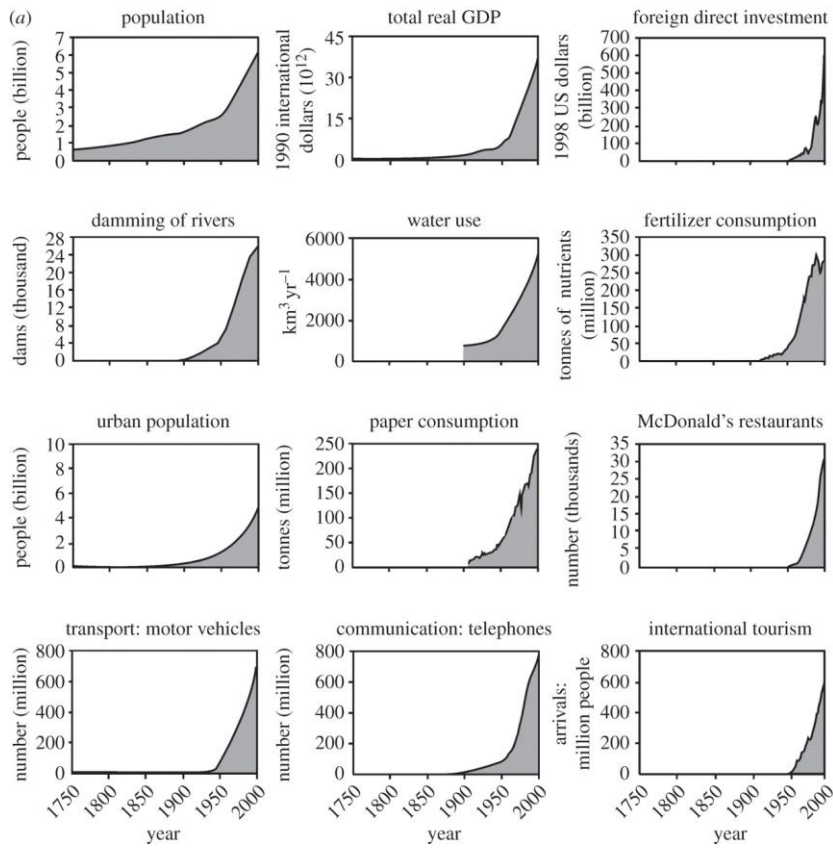


Figure 1: Evidence of accelerating human activity (IGBP, 2004, p.132)

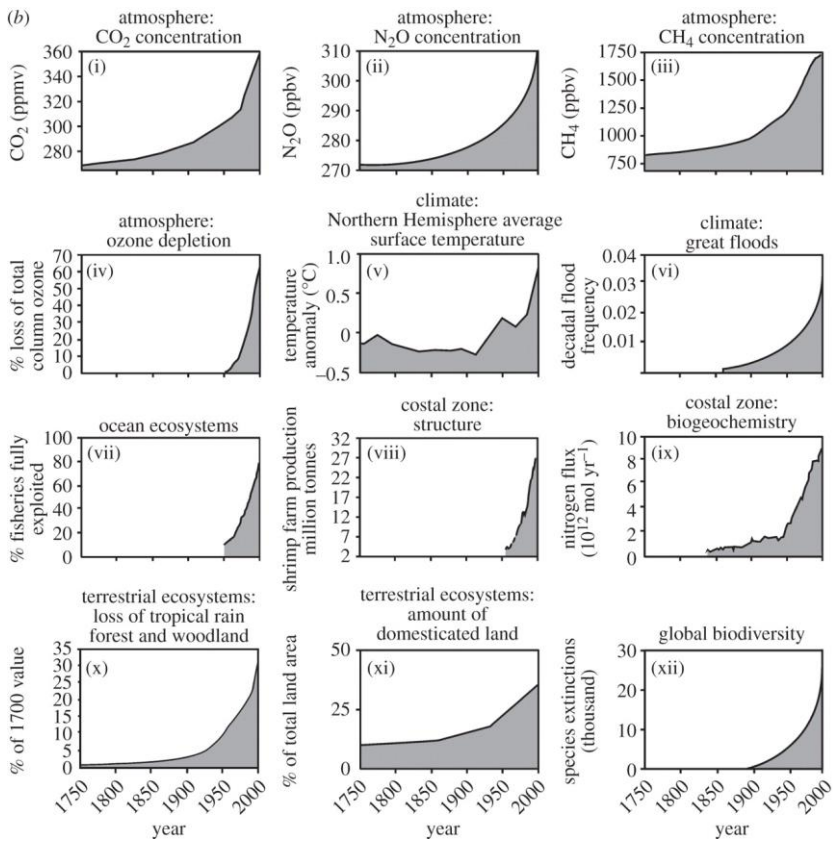


Figure 2: The effect of human change on the planet (IGBP 2004, p.33)

century will constitute such a change. The term is taken up by the International Geosphere-Biosphere Programme (IGBP 2004) and linked to two figures, now quite widely reported, that point to the accelerating impact of human activity on the planet over the last two hundred and fifty years (Figure 1) and secondly, record the impacts of these accelerating human actions over the same timescale (Figure 2). It is the manner in which human activity has provoked change at a planetary level, particularly evident in the last fifty years, that has led to the recognition we have entered a new era of geological time.

The two figures (Figure 1 and 2) do not propose or suggest any direct causality from one graph to another. Rather, together, they offer a graphic illustration of accelerating human activity at a planetary scale and accelerating changes in geology and biology at a planetary scale. They point to the complexity of relations and the sheer number of potential stresses on the planet.

Linking planetary issues to education, Morgan (2016) suggests that, as a species, we have for over a century been operating under the influence of a ‘carboniferous capitalism’, with imagined unending economic development dependent on use of fossil fuels. Education has similarly, Morgan argues, been caught in an assumption of unending progress in the sense of being linked to offering increasing numbers of students access to the ‘good life’, a mind-set in which education is a consumer product with the promise of maximising an individual’s earning power. We could say that we have been caught in a *growth mind-trap* of desiring unending progress within education (and social theory more generally) and, in the process, divorced our thinking from a connection to the limited natural resources of the world.

The recognition of the impact of collective human actions on a geological scale with the label ‘Anthropocene’ is, however, a disputed one (Haraway 2015). There are concerns about the analytical coherence of invoking the category of a single species in thinking about global challenges such as climate change (Malm and Hornborg 2014); there are issues around the potential for implicating all humans equally when it is individuals in the developed world who are uniquely polluting and, there is controversy over what might be meant by ‘human’, spawning a range of alternative naming’s for the Anthropocene: Capitolocene, Corporatocene, to name just two, attempting more precision in what or who is to blame for what has happened to the planet.

For Morton (2016), the Anthropocene involves a shift in our thinking to encompass different times (from the momentary to the epochal) and different scales (from the individual to the planetary) and to accept the paradox or circularity that ensues. The human ‘species’ becomes, in Morton’s words a hyperobject (2013), something massively distributed in time and space relative to humans. A hyperobject for Morton is, among other things, nonlocal (always more than the sum of its local interactions) and interobjective (exhibiting its effects through interrelationships). And it is this expanded conception of the human species, as a massively distributed ‘aura’ extending through space and time, that Morton sees as invoked by the Anthropocene and implicated in the planetary effects in Figures 1 and 2.

Attuning us to the deep time scale and reach of our individual and collective actions (as in Morton’s view of the human species) is taken up in responses to the Anthropocene within

literature (Farrier 2016). The notion of the ‘uncanny’ appears in discussions of how literature might respond to the Anthropocene (e.g., Vander Meer 2016). Embracing the ‘uncanny’ implies recognising differences (between ‘us’ and ‘others’) as potentially productive rather than sources of fear. More generally, thinking in the Anthropocene seems to entail a shift from hopes of ‘saving nature’ and ‘solving’ problems, to living with crises and problems as our new and permanent condition (Purdy 2015). There is no ‘natural’ state of the world to which we can now return (and perhaps there never was); the notions of the unblemished and pristine, for example, are abstractions that do not even act as useful aspirations, to the extent that they generate pessimism and fatalism. Accepting crisis might open us to valuing the corrupted and blemished: ‘Paradox, partiality, and the mixed-up character of everything have come after the grasp at wholeness that began the ecological age.’ (Purdy 2015, p.227).

From wholeness to the double bind

The educational equivalent of ‘the grasp at wholeness that began the ecological age’ within mathematics can perhaps be seen in movements in the 1960s and 1970s across the globe that aimed at ‘humanising mathematics education’ or which held up the ideal of ‘mathematics for all’. There have been suggestions (Pais 2013) that such aims are impossible and even counter-productive. Recognition of the Anthropocene might make us distrust heroic attempts to change mathematics education for the better. In the heroic attempt to reform mathematics teaching there is an echo of the code of the Beautiful Soul who ‘sees the world as evil and itself as pure’ (Morton 2016, p.130). A heroic mathematics educator, in this sense, might be someone who believes they know the answer of how to engage students, or the answer of what curriculum should be offered and is the one who can purge the current context of its errors and reform practice towards a sublime future; if only this hero was teaching all the children in the world (and moves to automatise teaching, or teach via Massive Open Online Courses, might even make this fantasy seem possible). The intervening decades of attempts at ‘saving’ mathematics education in the West, it is probably fair to say, have not yet reached a sublime or humane present.

Without assuming a pessimistic (nor indeed optimistic) outlook, my aim in this article can be summed up as an attempt to consider *how* we might accept ‘partiality, paradox and the mixed-up character of everything’, as provoked by the Anthropocene, in the context of mathematics education. After the grasp at wholeness that began the reform movements in mathematics education, what other stances might be possible, while recognising that the sense of living with crisis rather than solving problems, though perhaps new and challenging in the affluent West is something known for ever, at the scale of whole communities, to under-classes and marginalised groups around the world.

Thinking about the Anthropocene in terms of partiality and paradox finds resonance within mathematics education in strands of work associated with politics and philosophy (particularly those scholars working with the ideas of Deleuze, see Mikulan and Sinclair, this issue) as well as work on environmental sustainability (e.g., Barwell 2013a, 2013b). For example, de Freitas and Sinclair (2014) explore paradox as a ‘pivotal [facet] of mathematical

activity’ (p.43) and in a slightly different, but connected vein, Stinson and Bullock (2012) call for a ‘praxis of uncertainty’ in mathematics education. Boylan (2016) in discussing ethics also draws conclusions about the importance of uncertainty. Linking to sustainability, Skovsmose refers to embracing paradox when asked, in interview, about the future of critical mathematics education (Alro et al. 2010, p.8). Embracing paradox and uncertainty is a move consistent with a recognition of the complexity of the systems human activity now influences. In a very real way we cannot know what to do and yet must still act.

Colebrook (2016) lists some of the contradictory pressures of a recognition of the Anthropocene:

humanity is doomed, and there is no such thing as humanity, and we must insist on the inescapable unity of the human, and we must destroy any illusion of unity, and we must bid a happy farewell to this hapless species, and we must resist all notions of ‘game over’ and refuse the exigency of saving ‘ourselves’ at all costs. (p.444)

As becomes clear in this quotation, the situation is so complex we cannot even express the tensions in terms of simple disjunctions; the succession of ‘and’s pointing to layer upon layer of consideration. Colebrook refers to the impossibilities of the Anthropocene as a ‘double bind’, a concept that originated with Bateson (1972). For Bateson, a *bind* is a contradiction between message and meta-message and he gives the example of the mother who physically withdraws from her son’s attempted embrace (meta-message = I don’t love you), and then says, ‘don’t you love me anymore?’ (verbal message = I love you, conflicting with meta-message) (p.222). What makes a bind into a double bind is if a block is placed on communicating about that bind (the mother then says to the son ‘you mustn’t be embarrassed about your feelings’, effectively making it impossible for the son to communicate about the bind) and Bateson’s view was that a double bind is a formal description of the kind of context that provokes schizophrenia in humans.

I here want to distinguish between different kinds of paradox and partiality, because when Skovsmose and others write about embracing paradox, I do not think they are talking about the kinds of bind Bateson discusses. I have been aware of the following potential paradox in mathematics classrooms in the UK recently. A similarity across a significant majority of the twenty or so UK schools I visited in 2016-17 has been the presence of posters on classroom walls and in corridors, encouraging students to think positively about mistakes they make and with reference to ‘growth’ and ‘fixed’ mindsets (Boaler 2014). At the same time, the context of schooling in the UK is one in which setting by attainment at secondary school (11-18) is widespread and where differentiated work for different ‘attainment’ groups is commonplace at primary and secondary levels.

What these features imply for current UK mathematics teaching is the potential for a double bind, in precisely the manner discussed by Bateson (1972). Firstly, there is the potential for a conflict of messages and meta-message:

1. it’s okay to make mistakes (growth mindset)

2. if you make a lot of mistakes you will be placed in the ‘bottom set’ (with drastic consequences for your life chances)

These contradictory messages would set up a bind. However, there is third element:

3. it is almost impossible to question a teacher’s assessment of a child’s mathematical “ability”

This third element effectively puts a block on communication *about* the bind, which is the only way (for Bateson) to escape conflicting message and meta-message. These three elements, if present, set up a double bind. I suggest this kind of paradox is unhealthy and destructive, raising the question of what might be more productive ways of working with paradox and partiality.

Following Colebrook (2016, p.444), one move in relation to mathematics education, might be to contemplate a succession of conjunctions, mirroring her contradictory pressures of the Anthropocene:

mathematics education is doomed to fail, and there is no such thing as mathematics education, and we must insist on the vital importance of endeavours within mathematics education, and we must destroy any illusion of significance, and we must bid a happy farewell to ‘improving’ mathematics education, and we must resist all notions of the inevitability of student failure and refuse the exigency of saviours of mathematics education.

There can be no ‘answers’ to mathematics education in the Anthropocene and we cannot expect globally applicable solutions. In the spirit in which communities are being encouraged to create their own energy production sources (DfBIS 2013) and the movement of Community Agriculture supports direct relationships between farmers and consumers, it would feel self-defeating to search for global implications from considering mathematics education in the Anthropocene. It would equally feel incongruous to arrive at a list of values or virtues for the Anthropocene, even ones such as paradox, uncertainty and risk, at least if these are interpreted in any normative manner. My intention in this article is, rather, to explore how we might think about our possibilities. We can surely no longer look to others as heroes or saviours. No one else can lead us. If the Anthropocene behoves us anything it is surely that only *we* can do the work that needs to be done, while recognising that we can never know for certain what that work is and that we cannot do it alone.

Morton (2016), in considering the implications of the Anthropocene, puts forward ideas such as becoming more playful and more susceptible (p.129). Part of becoming susceptible, Morton suggests, may involve, and indeed be signalled by, experiences of melancholy, sadness and ennui. These seem like useful forward markers of what lies ahead and what each of us may experience. There is a question, however, about how we might differentiate, for ourselves or others, between an experience of ennui (perhaps signalling an opening outwards) and an experience of being placed in a double bind (closing down possibilities). The distinguishing feature is the silencing of the one placed in the double bind, so that communication about the impossibility of the situation cannot take place. If we notice individuals whose voices are not being heard, whether in the mathematics classroom or

beyond, one possibility is that those individuals have been placed in binds about which they are unable to communicate.

In the next section, I suggest that the concept of ‘habit’ is one that can help us think about relationship, individuality, mathematics education and the future, in this partial and paradoxical world.

On Habit

An old concept that has been receiving attention recently, particularly in thinking around behaviour change in response to the current global context, is that of habit (Dewesbury 2012). One interpretation of ‘habit’ is an unthinking, mechanical reaction and therefore the kind of source of action to be avoided in the Anthropocene. Such a view can be traced to Descartes and Kant who viewed habits as inauthentic, mechanical and routine. If we act out of habit then, in a sense, we debase ourselves (on Descartes’ view) to the mechanical. What, for Descartes, is characteristic of human-ness is having a soul and therefore being able to ascend from base habit. However, drawing on an alternative lineage of thought, starting with Aristotle, Ravaisson (2008/1838), invites us to consider habit as something fused to our very being and therefore essentially human, acquired as a consequence of change.

Within mathematics education, Mason and Davis (2013) write on habit, contrasting acting out of habit (which is done un-thinkingly) with a response arising from in-the-moment awareness of the situation. Like Ravaisson, Mason and Davis conceive of human learning in a recursive manner, if we enter into the journey that is entailed by the effort to become ever more aware of our habits and therefore able to act in a way that is sensitive to the present moment. At the same time, there are echoes of the more mechanical view of habit, in that Mason and Davis conceive of acting out of habit in opposition to actions that spring from in-the-moment awareness.

Ravaisson suggests that the mechanical, automatic view of habit places habit as a ‘state’ or permanent way of being in which the traces of the change that gave rise to it are lost and it is perhaps this sense of habit that is used in Mason and Davis (2013). What Ravaisson attempts (2008/1838) to articulate is a complementary reading of habit as also pointing to a disposition or even virtue that allows us to function effectively in a world of permanent change. The vision is essentially circular in terms of a movement from passivity to activity and back again:

An impression coming ... received with passivity, is gradually transformed into desire. The latter calls for the return of the impression, and thus of the activity. Indeed, for the same impression to be reproduced, the individual must seek it out. By this very fact, and conversely, activity becomes more and more prompt, increasingly easy; the individual ends up accomplishing it mechanically, which introduces an element of passivity into the operation itself. (Malabou 2008, p.x)

On such a view, change creates habits and in so doing creates a habit of changing. An example may help to ground these ideas. When our circumstances alter, for example driving in a country where cars travel on a different side of the road to the one we are used to, we

become highly sensitised to road markings, road signs, other vehicles. We no longer know where to look, for example approaching a roundabout, and become receptive to things we are not receptive to at home (we do not yet know, in this new country, what we can safely ignore). After some time, we get used to a new way of being and, arriving at a roundabout, spontaneously know where to look and how to navigate it safely. Ravaisson sees such experiences as pointing to a general feature of existence that, over time, if I find myself in similar contexts:

[r]eceptivity diminishes and spontaneity increases. Such is the general law of the disposition, of the habit, that the continuity or the repetition of change seems to engender in every living being (2008/1838, p.31).

To unpack this quotation with an example from mathematics: encountering a new mathematical notation for the first time, I may experience a sense of heightened sensitivity and receptivity to the context similar to the example of driving. I may not initially know what is important or significant, or where to look, or quite what the rules are that govern a symbol's legitimate movements; over time, I may shift to being able to manipulate symbols with no conscious deliberation at all – my receptivity diminishes (I no longer notice the symbols themselves, perhaps) and spontaneity increases (in the sense of a capacity for immediate symbol use, for a purpose).

A second common phenomenon, related to habit, highlighted by Ravaisson is exemplified in the experience of getting used to something like a repetitive noise, to the point of noticing, when it stops, that you had stopped noticing it.

Prolonged or repeated sensation diminishes gradually and eventually fades away. Prolonged or repeated movement becomes gradually easier, quicker and more assured. Perception, which is linked to movement, similarly becomes clearer, swifter, and more certain (p.49).

Habit, on this view, infuses every repeated perception and action of an organism. A moment's reflection on any culturally-typical behaviour we engage in (tea with milk in the UK, coffee with sugar in Eritrea) will point to how patterned we are through all that has come before us. This is of course not to say that we are incapable of breaking patterns and acting individually and creatively, but such acts are the exception. We live most of our lives in patterns of action we do not even notice (and we could not survive long if we did not do so). Following Bakhtin's (1981) view of words as emanating from other people's mouths and serving other people's intentions (p.293-4), it might be said that *we enact the patterns of others' actions*.

The insights, about diminished receptivity over time to the same stimulus, have a direct implication for the classroom and more widely. If I notice a behaviour in my classroom that I do not like (for example a student making a negative personal comment to another student), or a context I am in brings to mind a possibility for a risky but desirable action (for example, contradicting a senior colleague who proposes something unethical), then the first time this occurs will be the time with the most heightened sensation. If I choose to act on the sensation then I have begun the work of forming a new habit. If I choose not to act, then the next time I am in a similar context where there might be a possibility for a similar action, it is likely to strike me less forcefully. I am in the process of establishing a habitual behaviour of non-response to this context.

Bateson (1972) invites us to consider the recursiveness of our entanglement with the world – and part of that relationship and entanglement is apparent in our habits; from the way we greet strangers, to the food we eat and what we cook, to the way we organise schools, we are playing out habitual activities developed and established over centuries. Rather than a source of fatalism, this realisation contains the germ of an awareness of our existence through different timescales. In our everyday living we are involved in cycles of activity reaching back a few years (such as mobile phone use); reaching back millennia (such as the continued repercussion of the violence of colonialism or oppression of women); reaching back eons (such as breathing through lungs). And while we enact the patterned actions of others, the habits we live out generate pathways into the future, in turn. The different scales at which we are a member of the human species are made real through our habits. We are, quite literally, *ecologies of habit*. And, as Lemke (2000) notes, there are different kinds of processes and change in operation at each different timescale.

In a book published posthumously and co-authored with his daughter, Bateson wrote ‘what we believe ourselves to be should be compatible with what we believe of the world around us’ (Bateson and Bateson 1987, p.177). I take this statement to be pointing to our connectedness to the world around us and to the primacy of the pattern or relationship that connects us. Bateson believed that most Western societies were organised in ways that embodied fundamental epistemological mistakes. The root of these mistakes was the extension, to the world of the mental, of ways of thinking that are only accurate when applied to the world of inanimate objects. By way of explanation, in one example, Bateson (1972 p.409) asks what the difference is between kicking a stone and kicking a dog. The stone's trajectory will be a function of its size and the energy of the kick; it makes sense to weave a simple lineal causal story (A caused B) to explain what happens in the instants after the kick. The stone's motion will be well predicted by our laws of physics. In the case of the dog, its future trajectory is a function of its own metabolism. The energy for successive movements comes not from the kick but from latent energy in the dog's body. In a world that includes the mental, while it can sometimes seem possible to detect patterns of lineal events, causation is in fact recursive and circular. Our mistake is to pull out, from our experience:

sequences which do not have the loop structure which is characteristic of the whole systemic structure. If you follow the “common-sense” dictates of consciousness you become, effectively, greedy and unwise. (Bateson, 1979, p.440)

While “common-sense” and lineal thinking has been, and can be, highly effective in manipulating our environment, it is erroneous and these errors will ultimately affect us; as Bateson predicted in the 1970s and we are learning now to our cost, in destroying our environment we are in danger of destroying ourselves.

The error, according to Bateson, of applying lineal thinking to a world involving communication and ideas, is one of not recognising the source of our knowledge about the world, in other words, it is an error of epistemology. While we may believe an other person can “make” us feel or do certain things, an other's actions can only trigger a response in me - that if response happens to be an emotion or action, the fact of that response tells me

something about who I am, as much as it says anything about what the other did. I might see 'you' as a problem, or solution, or cause, but that would be an epistemological error. Bateson behoves us to always take a 'double' perspective, to always look for relationships, not phenomena and to seek 'the pattern which connects' (1979, p.10). Bateson's writing (1972, 1979) can be seen as an attempt to articulate an alternative, recursive way of thinking that does not commit the epistemological error of interpreting behaviours in terms of simple cause and effect.

Conceiving of a human as an ecology of habit implies thinking recursively about being in the world and has implications for thinking about teaching and learning mathematics. In particular, it suggests an alternative to a focus on the individual. Instead, in terms of an approach to analysis or an appropriate grain size for analysis, we might look to the existence of habits themselves, across individuals, and the ways in which habits propagate and interact with each other. Throughout this article I am conscious of referring to "I" and "we" while also arguing against an individualistic perspective; my own experience is from a point of view, captured by these human pronouns, but I invite you to read any mention of an individual as referring to an extended ecology of habit. A focus on habits might take place at temporal scales from the momentary to the epochal. I suggest, therefore, that concern about mathematics education in relation to the environment might be framed as follows: what kinds of habit, of mathematics education, are called for in the Anthropocene?

And, taking on the themes from sections 1 and 2, there is an urgency to this question. No one else can develop habits for us. If we are not looking to others to save us, our own habits take on heightened significance. Knowing that our habits are not our own, our actions reach out from our skin in time, both into the past, in the sense that our habits follow the habits of others, and into the future, in the sense that our habits lay down paths for others to follow. If we cannot expect a saviour, we have only our habits, and yet our habits are not our own and link us inextricably to others.

What habits for the Anthropocene?

The notion of habit offers one entry into contemplating and bringing to awareness our recursive relationship to all that is around us, alongside the earlier ideas of paradox and the double bind. In this section, I draw on work taking place at the University of Bristol's School of Education, in order to speculate further how these concepts offer insight into teaching and learning and the Anthropocene. This section is offered in the spirit of an exploration of possibilities, prompted by events.

At the University of Bristol (in the UK), a group of teacher educators, teachers and prospective teachers have been working (since 2015) to develop thinking and practice in relation to the question of what teacher education might look like in the face of a recognition of the current global context (see Coles et al. 2017). This work has been supported by a small grant for the University of Bristol's Green Apple Awards and the group calls itself the 'Green Apple'. In describing just a snap shot of the work, I draw on notes taken and circulated to all members from meetings. The group met three times in 2015-16 and three times in 2016-17.

These meetings started at 5pm, allowing teachers in school and prospective teachers on our teacher education course to attend, as well as teacher educators (pizza is provided, at the start of meetings). All nine secondary school subjects that comprise our teacher education offer at the University of Bristol have been represented at these meetings. I start with one incident from the third meeting of 2017, which stays with me as being particularly generative and linked to the themes discussed in this article. The incident also typifies the kinds of discussions that take place at meetings.

A Science teacher in the Green Apple group reported (in Meeting 3, June 2017) the negative reactions of one of her classes from considering issues around climate change and how poorly students responded to lines of argument such as ‘it is your generation who will need to sort out these problems’ and how debilitating it seemed to be, to offer negative pictures of the state of the world (see Boylan, this issue). When presented with the problems of climate change, the dangers, the damage done and asked what they could do, students offered few ideas and seemed unengaged. In contrast, this teacher reported on how the same students’ imaginations and creativity were released, in a later lesson, by inviting them to imagine a future scenario “Weston is underwater!” (Weston is a town on an estuary near Bristol) with the task of coming up with solutions. For these students, imagining a future, broken world was more relevant and energising than trying to think about protecting or ‘saving’ the current one. There is an intriguing sense that, what these students appear to relate to, echoes precisely the themes and lines of thinking associated with the Anthropocene, in the earlier sections.

The ‘your generation’ line of argument potentially sets up a double bind, as follows: (1) it is your responsibility to solve current crises (message); (2) at school there is no realistic way of engaging in ‘solving’ problems such as climate change; or perhaps more simply, problems such as climate change cannot be ‘solved’ (conflicting meta-message); (3) the moral imperative to be seen to ‘care’ about the living world in school potentially makes it impossible for students to express the bind they are placed in. In contrast, the imagined future scenario allows the possibility of a playful (Morton 2016) engagement with the issues, where both the bind and the block on communication dissipate. The solutions to the imagined problem of the future, of course, arc back in time and become ideas for the present also and have the potential to guide new habits now. Although this scenario is from Science, the idea of working with future scenarios is equally applicable in mathematics (e.g., to take ideas discussed in Green Apple meetings: “All the ice has melted!”, e.g., leading to questions about how much sea level has risen, or, “Tigers are extinct!”, leading to extrapolations from current data).

One thing the mathematics teachers in the Green Apple have done in 2016-17 is to create resources for offering ‘short tasks’ (Worlsey 2017) in the classroom that have both a component that relates to the standard mathematics curriculum and a component that links to wider global issues. The explicit aim has been to generate new habits (for both teachers and students) in relation to expectations of what issues might be considered and discussed in mathematics classrooms. One example of a task invites students to represent the amount of oil consumed by the world per day in standard form (close to a typical mathematics question). The students are then invited to compare this figure with the known reserves of oil in the

world and work out how many years of consumption at that level would be possible, from those reserves (again, a calculation that students could be asked to do in an examination in the UK – the answer is 48 years) before then reflecting on their reactions to this result (extending what might typically be considered a legitimate question in these teachers' classrooms). The point of the tasks being 'short' (meaning they last 10 to 20 minutes) has been an explicit decision by the teachers that, in terms of generating new habits, it is important to shift expectations slowly from the status quo, to avoid responses from students such as 'why are we doing this in maths lessons?'

Discussion

This article aimed to consider issues relevant to mathematics education in the light of a recognition of human influence on planetary processes and a sense we have moved into a new geological era, the Anthropocene. In thinking about this article and Special Issue, over the last few months I have asked many mathematics educators the question, how might what we do take account of current crises? I have sensed a recognition of the importance of the question and an awareness that none of us have answers; it has not been my intention to provide answers in this article but rather to suggest that the notions of 'habit' and the 'double bind' point to a perspective that embraces partiality, paradox and the recursive nature of being in the world. Our habits are *of us* and form the world; our habits are *of the world* and form us. Our habits are from the past and feed the future; our habits can imagine a future that re-configures the present.

The concept of the Anthropocene moves away from a sense of 'growth' (Morgan 2016) and pursuing specific and defined 'ends' for education. It is only on the assumption that there are relatively predictable and linear paths from cause to effect, that it would be desirable to define targets and goals. Instead, a recognition of the role of habit draws attention to the manner in which we are recursively bound to anything from which we might want to distinguish ourselves.

One of the tensions of teaching is that while we are preparing students for a future world that is uncertain and unknowable, our teaching must take place now. The idea of the Anthropocene, in itself, can provide a mechanism for disrupting patterns of interaction and bringing awareness to my on-going habitual relationships with everything around me at scales from the classroom to the planet, but it will not lead to prescriptions of how to act. Indeed, or rather, in our deeds, we might look to paradox, uncertainty, feelings of ennui or melancholy as signals that we are becoming susceptible and are making ourselves vulnerable to the present – open to change and the creation of new habits. At the same time, we might need to become sensitive to the potential for setting up conflicting contexts for students (binds) where they are unable to communicate about those conflicts (making them double binds). We cannot expect anyone to do this work for us and yet cannot hope to act alone. It takes effort to live with an awareness of the interpenetration of world and self.

The 'Green Apple' group at the University of Bristol has been trying to work with implications from a recognition of the Anthropocene and what this might mean for teaching

and learning. We are in a process of consciously exploring new habits and possibilities in the classroom. In the context of mathematics education, we might recognise habits in ourselves and others that do or do not explicitly relate to wider global themes. Rather than judge these habits positively or negatively, the Anthropocene invites us to resist the pull towards a pure and pristine motivation.

There is an Irish saying, or joke, used when asked for advice about what to do in a difficult situation, the joke is to respond: “I wouldn’t start from here”. The Anthropocene invites us to consider how everywhere is in crisis, but the implication reverses the joke about not starting from here, i.e., in a broken, partial and compromised world “you might as well start from anywhere”. There is nothing that need delay action, because it is always already too late and we are always already compromised; our habits have formed us from before our birth. And, given the situation is hopeless already, we have no reason for despair.

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