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Environmental learning, metaphors and natural capital[1]

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The pervasiveness of metaphor in environmental discourse suggests important questions about the role of metaphor in environmental learning. A conception of environmental thinking and action is proposed, which identifies five analytically distinct 'moments' of 'environmental sense-making': conceptualising, knowing about, knowing how to respond, responding and acting. The (much-criticised) 'information deficit' model of environmental learning requires that the second moment—knowing about the environment—is the only locus of environmental learning. On the information deficit model the only role of metaphor is didactic. On the proposed conception, all five moments of environmental sense-making may be independent moments of environmental learning. Metaphor can have a rhetorical role (encouraging responsiveness) and, more importantly, conceptual metaphors can frame our understanding of the environment. The development of new metaphors plays a key role in environmental learning. The 'natural capital' and 'real options' metaphors are considered as 'case studies' of conceptual (or first-moment) learning. It is argued that while they may be important innovations in environmental sense-making, our general discussion of the role of metaphor in environmental learning suggests that we need to look beyond economic metaphors to improve our understanding of the environment–human relationship.

In less than two decades the idea of 'natural capital' has become a regular part of environmental and sustainable development discourses. Indeed, it is used so readily that we might forget both that it is such a young concept and that it is a metaphorical concept. The metaphorical character of natural capital raises interesting questions about the role of metaphors in environmental thinking. How much of our environmental thinking is metaphorical? How are new environmental metaphors invented? How do we know when a new environmental metaphor is worth pursuing or developing? What roles do the introduction and development of new environmental metaphors play in environmental learning? In this paper, I want to begin to tackle some of these questions by looking, generally, at the role of metaphors in

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environmental learning and, particularly, at the natural capital metaphor as a possible example of environmental learning.

The paper has five sections. In the first section, I set out a schematic conception of 'environmental sense-making' or environmental understanding, which identifies five analytically distinct 'moments' in the process of making sense of the environment. I suggest that each of these five moments might be an independent locus of environmental learning. In the next section, I consider how this conception of environmental sense-making and environmental learning is related to the well-known and much-criticised 'information deficit' model of environmental learning. I suggest that the proposed schema provides a framework in which we can locate both the deficit model and criticisms of the deficit model. In the following section, I consider the roles of metaphor in environmental sense-making and environmental learning. I argue that metaphors used for didactic and rhetorical purposes can play significant roles in environmental learning. However, it is conceptual metaphors that are most important because they play a key role in framing how we think about and respond to the environment. In the next section, I consider the natural capital metaphor as a (possible) case study of environmental learning through conceptual innovation. I suggest that it might well be an example of conceptual learning but I also consider the possibility that there might be scope for further conceptual learning. In particular, I consider a new conceptual metaphor, 'real options', that has been developed by Steven Gough and John Foster from a critique of the idea of natural capital. I then draw on the general account of the role of conceptual metaphors to consider how we might assess the merits of the real options metaphor. Finally, I conclude by highlighting the limits of environmental metaphors and the dangers of looking for the *right* metaphor.

Five 'moments' of environmental sense-making and action

John Foster has characterised learning as 'improving, through processes of more or less directed sense-making, our capacities to negotiate the experienced world' (Foster, 2003a, p. 1). Starting from Foster's conception of learning and some of the questions it raises, I suggest we think of environmental learning as *improving our capacity for environmental sense-making and action*. Environmental learning occurs when we develop this capacity—when we learn to respond to environmental issues in a way that 'makes more sense'.[2] This 'definition' shares Foster's emphasis on improving our capacity to act in the world while also recognising that the consequences of our environmental actions may extend beyond the 'experienced world'. The idea of environmental sense-making (or 'making sense' of the environment and our relationship with it and response to it) is intended to be a broader notion than 'environmental rationality', which allows us to avoid prejudging the role of rationality in environmental action. In this section, I want to propose a schematic conception of the capacity for environmental sense-making and action. The proposed schema (at this level of abstraction) is intended to be applicable to individual environmental sense-making, societal environmental sense-making and institutional environmental sense-making.

How do we make sense of environmental issues? What are the moments of environmental sense-making? For analytical purposes, we might distinguish five moments of environmental sense-making and action. I do not intend to suggest that they are temporally ordered stages nor, more generally, that they can be held separate in the sense-making process as it actually occurs. Instead, I claim only that they are analytically distinct and that they provide a useful way of thinking about different aspects of environmental learning.

The five moments that I want to identify are conceptualising, knowing about, knowing how to respond, responding and acting. The first moment of environmental sense-making is conceptualising the environment—both generally and in relation to particular issues or problems. The 'choice' of individual concepts and the 'choice' of conceptual schemes are both important as is the relation of environmental concepts to other concepts, for example, economic and aesthetic concepts. If environmental learning is to occur at this first moment, it must be possible to move from a concept or conceptual scheme that makes less sense to one that makes more sense. In other words, there must be scope for conceptual progress.

The second moment of environmental sense-making is knowing about the environment and knowing about anything else that is relevant for environmental decision-making. This includes scientific and lay knowledge about environmental issues as well as knowledge of technological and social systems and how they affect and are affected by the environment. Environmental learning in this second moment might be understood as the acquisition of new knowledge.[3]

The third moment of environmental sense-making is knowing how to respond to the environment or to particular environmental issues. This kind of practical knowledge includes ethical or moral knowledge of how we should respond to environmental issues as well as the ability to assess the relative merits of different means-ends strategies. If environmental learning is to occur in this third moment, there must be better and worse ways of responding to the environment and environmental issues. In other words, there must be scope for ethical progress and progress in judging among alternative means given specified ends.

The fourth moment of environmental sense-making is responding appropriately to the environment or environmental issues. In this context, I understand 'responding' to include having the appropriate values and motives but not to include acting in an appropriate way. The fourth moment marks an affective or motivational stage that takes us beyond judgement but may not take us all the way to action. The distinction between the third and fourth moments assumes that we can judge something to be right but not be motivated to act accordingly. We might call this the 'judgement-motive gap' or the 'affect gap'. The distinction between the fourth and fifth moment assumes that we can be motivated to do something but not do it. We might call this the 'motive-action gap'.[4] If environmental learning is to occur in this fourth moment, it must be possible to become motivationally more responsive to our environmental judgements. Perhaps, this might mean that we are more affected by environmental issues or more sympathetic toward the environment.

Finally, the fifth moment of environmental sense-making is action. Environmental learning is practical, action-oriented learning. If it doesn't result in action, it is ineffective or incomplete learning. Environmental learning in this fifth moment might be thought of as changing behaviours—learning new behaviours and abandoning old behaviours.[5] It might involve acquiring new habits or breaking old habits. Environmental learning in this sense means becoming behaviourally more responsive to our environmental motives.

Locating the deficit model in the 'sense-making schema'

The information deficit model of environmental learning assumes that the key moment of environmental sense-making is the second moment.[6] If people are provided with new knowledge about the environment (second moment), they will automatically become more environmentally concerned (fourth moment) and their behaviour will change (fifth moment). On this account, the fourth and fifth moments are not independent loci of environmental learning. The first moment (conceptual progress) is completely ignored. The position of the third moment (ethical and strategic progress) is less clear. Prima facie, it appears to be ignored but things are slightly more complicated. Strategic judgements—judgements about the most effective means to achieve given ends—may be integrated into the deficit model's conception of new knowledge. On this interpretation, 'knowledge' includes (theoretical) knowledge about the environment and (practical) knowledge of how to achieve particular ends. The position of ethical judgements is rather different. Effectively, the deficit model denies the judgement-motive gap. It conceives of ethical commitments as essentially motivational. On this interpretation, ethical judgements are essentially ethical motives and the ethical part of the third moment of environmental learning cannot be distinguished from the fourth moment.

In short, the deficit model makes the second moment of environmental sense-making 'dominant': judgements, motives and actions are completely dependent on knowledge. New knowledge (e.g. that carbon dioxide emissions cause climate change, which can disturb ecosystems) provides a motivationally and behaviourally efficacious reason for action (e.g. reducing emissions). On this account, it is literal knowledge (typically, scientific knowledge) about the environment that provides reasons for action. If we have the knowledge, we have the reasons. If we have the reasons, we have the motives. If we have the motives, we act accordingly.

The deficit model has been very thoroughly discussed by a wide range of critics. For my purposes, it is useful to distinguish two kinds of criticism. First, there are those critics who reject the idea that new knowledge leads automatically to behavioural change (Kolmuss & Agyeman, 2002). For these critics, the second moment of environmental sense-making is not dominant: at least one of the third, fourth or fifth moments is not completely dependent on the second moment. For example, we might know about climate change but judge that we have no reason to do anything about it (perhaps) because the costs for us (whoever 'we' are) of mitigation will outweigh the benefits for us and we have no responsibility to pay such high costs to

protect the interests of people in other places or future times. Equally, we might know about climate change and judge that we should pay the costs of mitigation but remain wholly or largely unmoved by that judgement (perhaps) because we lack or suppress our feelings of sympathy for those people who will suffer. Finally, we might know about climate change, judge that we should pay the costs of mitigation and feel motivated to do so but do nothing (perhaps) because action would involve giving up things that we don't want to give up or breaking habits that we 'can't' break. If we accept this kind of criticism, we recognise that there is more than one independent moment of environmental sense-making. I would suggest that each of the third, fourth and fifth moments may be an independent locus of environmental sense-making (and learning).

The second type of criticism of the deficit model is, in some respects, more fundamental. The deficit model assumes that knowledge about the environment is (basically) uncontroversial. Environmental learning is learning the truth about the environment. The role of environmental educators is either to teach the truth about the environment or to teach the skills necessary to learn the truth about the environment (i.e. to develop the capacity to learn the truth about the environment). Critics question the idea that environmental knowledge is uncontroversial. I want to consider two versions of this criticism. A moderate version points out the complexity and uncertainty of environmental issues and emphasises the wide-ranging disputes about environmental issues in both natural and social sciences (Scott & Gough, 2003). If scientists can't agree on the truth about the environment, environmental educators can hardly teach the truth about the environment. On this version, the 'action' is still in the second moment of environmental sense-making: the problem is that we haven't accumulated (and, probably, can't accumulate) enough knowledge about the environment to settle the disputes between scientists. A less moderate version claims that the truth will always be controversial because there are multiple methods of discovering different (partial) 'truths'. On this account, if we speak of 'environmental knowledge', we must speak in the plural of 'environmental knowledges' (Irwin, 1995). Environmental learning cannot simply be a matter of acquiring new knowledge about the environment. We must also learn how to assess different ways of conceptualising the environment and environmental issues. If any conceptual scheme provides only a partial way of thinking about the environment, we need to be able to negotiate our way through competing conceptual schemes. This is the first moment of environmental sense-making—ignored by the deficit model but absolutely essential to environmental sense-making and an independent locus of environmental learning.

The roles of metaphor in environmental learning

The deficit model seems most naturally connected with the 'literal-truth paradigm', according to which 'literal language…is the *only* adequate vehicle for (a) expressing one's meaning precisely, and (b) making truth claims, which together make possible correct reasoning' (Johnson, 1981, p. 12). On the deficit model, the

only positive use of metaphor is for 'didactic purposes' (Johnson, 1981, p. 4). A metaphor might be a useful aid to learning or memory. For example, the phrase 'greenhouse effect' might provide a useful metaphorical image that helps non-scientists (and scientists) to understand a process that can be described literally using scientific theories that have both linguistic and mathematical content.[7] The metaphorical image conveys some essential features of the theories, notably, that '[some] of the absorbed energy is reradiated back toward Earth, thus keeping the lower atmosphere and Earth's surface warmer than it would be otherwise' *just as* '[the] glass walls of the greenhouse reradiate…infrared energy back, so the greenhouse retains some its heat energy' (Brown, 2003, pp. 168–169).[8] The metaphorical image may be a way of introducing the literal ideas in a vivid way, which encourages people to learn more and helps them to remember the key ideas. However, it is the literal ideas (whether in detailed scientific theories or simplified versions for non-scientists) that provide us with reasons for action. On the deficit model, all environmental learning takes place in the second moment and the role of metaphor and imagery is simply to facilitate the acquisition and retention of new (literal) knowledge.

The first criticism of the deficit model, which highlights the independence of the third, fourth and fifth moments of environmental sense-making, might also suggest uses for metaphor that are consistent with the literal-truth paradigm. In particular, metaphors might be used rhetorically to motivate environmental concern. For example, we might read of the 'battle with the rising sea' being fought (or lost) by the residents of island communities threatened by rising sea levels (Brown, n.d.). More famously, the metaphorical images of the 'silent spring' and the 'population bomb' have played a key role in the development of environmental concern in the second half of the twentieth century (Carson, 1965; Ehrlich, 1972). Metaphors, like visual images of polluted environments, can make remote environmental issues much more vivid. The rhetorical use of metaphor aims to engage the emotions of the audience, inviting them to sympathise with the plight of the islanders or experience the uneasiness and loss of the 'silent spring'. In this sense, metaphor can play an important role in the fourth moment of environmental sense-making by helping to shape our affective and motivational response to environmental issues.

So far, I have suggested uses of metaphor in environmental sense-making that are consistent with the literal-truth paradigm. However, it is now widely accepted that the uses of metaphor extend far beyond the 'stylistic, rhetorical, and didactic purposes' allowed by that paradigm (Johnson, 1981, p. 4). Metaphor is not just a 'characteristic of language':

> [Metaphor] is pervasive in everyday life, not just in language but in thought and action. Our ordinary conceptual system, in terms of which we both think and act, is fundamentally metaphorical in nature. (Lakoff & Johnson, 1980, p. 3)

Even if we were reluctant to accept some of Lakoff and Johnson's more mundane examples of 'metaphor' as metaphorical, the critical role of metaphors in our conceptual schemes seems beyond question.[9] In the environmental context, the role of

conceptual metaphors at all levels of thought—from basic environmental science to our broadest conceptions of the environment and our place in it—has been documented in several studies.[10] At the 'macro-level' of conceptions of 'the environment' or 'nature' we can easily draw up a list of nature metaphors, which would include (among many others):[11]

NATURE IS AN ORGANISM
NATURE IS A MECHANISM
NATURE IS A COMMUNITY
NATURE IS 'RED IN TOOTH AND CLAW'
NATURE IS A WORK OF ART
NATURE IS A WORK IN PROGRESS
NATURE IS A GARDEN
THE GARDEN OF EDEN or NATURE IS AN ABUNDANT GARDEN
MOTHER NATURE or NATURE IS OUR MOTHER
NATURE IS AN ADVERSARY
NATURE IS A RESOURCE
NATURE IS CAPITAL

Each of these metaphors provides a framework of concepts through which we might understand nature. For example, NATURE IS AN ORGANISM—as suggested, for example, by Lovelock (1979)—gives us a holistic conception of nature and directs us to look for connections and dependencies among 'parts' of the natural world. In other words, the metaphor outlines a scientific 'paradigm' or 'research programme' within which 'normal science' can proceed (Kuhn, 1962). In contrast to the NATURE IS A MECHANISM metaphor, it gives us a new way of thinking about or interpreting what we 'know' about the environment. In this respect, learning in the first moment of environmental sense-making can transform what we already 'know' about the environment (second moment). The second moment of environmental sense-making, far from being dominant (as the deficit model suggests), is dependent on the first moment of environmental sense-making. Of course, the second moment remains an independent locus of environmental learning—we can within a particular conceptual scheme acquire new environmental 'knowledge'—but it is not wholly independent.

Interestingly, conceptual metaphors shape not only our understanding of the environment but also our environmental values (third moment). Daniel Philippon has recently identified five key 'nature' metaphors that have shaped the US environmental movement during the last 130 years. For him, major US environmental organisations have been influenced by key 'nature writers' whose understandings of the environment have been framed by particular metaphors:

> [Each] of these writers understood 'nature' through a particular metaphor—frontier, garden, park, wilderness, utopia…These metaphors enabled certain narratives that explained how human beings should interact with nature and, in so doing, conveyed certain environmental values. (Philippon, 2004, p. 6)[12]

The impact of Philippon's conceptual metaphors is primarily normative. They frame our understanding of the right way of responding to nature or valuing nature. For example, NATURE IS A GARDEN suggests that nature should be managed by

humans in a particular way (which depends on our conception of gardens and gardening), while NATURE IS A WILDERNESS suggests that we should leave nature alone. Many other environmental metaphors are also primarily normative, including NATURE IS MOTHER and NATURE IS A COMMUNITY. Of course, the normative implications (and the scientific or theoretical implications) of any environmental metaphors depend on how we conceive of the metaphorical 'vehicle'. For example, Roger King has commented on the multiple meanings of NATURE IS MOTHER:

> At times, nature is the mother, honored for her nurturing support. At times, she is the admired lady on a pedestal, to be gazed upon from a distance. At other times, however, she is the passive and grossly physical other, whose irrationality and contingency demand to be controlled, or she is one who should be feared for her chaotic and uncontrollable vengefulness. (King, 1999, pp. 32–33)

A metaphor opens up a field of possibilities (sometimes normative and sometimes cognitive or scientific) while simultaneously excluding other possibilities.

A significant part of learning in the first and third moments of environmental sensemaking may involve acquiring new conceptual metaphors through which we can see the environment and our right relationship to it. The exploration of these metaphors will involve the development of new 'environmental knowledges' as suggested by the second criticism of the deficit model. It will also involve the development of new 'environmental ethics'. The multiplicity of conceptual metaphors will provide us with 'multiple stories' and we should not expect to find a 'view from nowhere' that enables us to stand back from any and every metaphorically loaded conceptual framework to see 'the truth' (Nagel, 1986; Philippon, 2004, p. 27). Instead, learning to assess the alternatives will involve developing the capacity to use both existing and new metaphorical frameworks as standpoints from which to critique the theoretical and normative 'knowledge' that we accumulate within other metaphorical frameworks. We may not be able to view the world from nowhere but we can view the world from a multiplicity of standpoints (or through a multiplicity of conceptual lenses) to build a complex (and sometimes 'inconsistent') set of 'pictures' of the environment and our place in it. Environmental learning might occur when we improve the quality or resolution of some of our pictures, add new pictures or remove old distorted pictures. In the next section, I turn from the general discussion of the role of metaphor in environmental learning to consider a particular metaphor as a potential focus of environmental learning. What, if anything, does it (to push the TRUTH IS A SET OF PICTURES metaphor) add to our 'gallery' of pictures of the environment and our place in it?

The NATURAL CAPITAL metaphor

The idea of 'natural capital'—the NATURE IS CAPITAL metaphor—has become very influential in the (slightly less than) two decades that have elapsed since David Pearce first introduced it as a way of interpreting 'sustainable development' in 1988

(Pearce, 1988). Unlike the ORGANISM or MECHANISM metaphors, the CAPITAL metaphor focuses on the socio-economic rather than the natural science aspects of environmental issues. The research agenda it suggests is a social science agenda focusing on the relationship between humans and the environment. The CAPITAL metaphor enables us to restructure our existing knowledge about human–environment relationships in terms of the value that the environment has for us as a form of capital. Moreover, it provides a conceptual framework in which we can develop new techniques for valuing nature.[13] In turn, the new techniques will enable us to acquire new knowledge about the value of nature as a form of capital. The new knowledge is knowledge about the human–environment relationship as viewed through the lens of the NATURE IS CAPITAL conceptual framework.

The influence of the CAPITAL metaphor is not confined to our understanding of the environment and our place in it. It is also significant in the third moment of environmental sense-making—how we should respond to the environment—because we know (or, at least, have some conception of) how we should respond to capital. More specifically, we know that the right response (at least) for a stable or growing business is usually to maintain or increase its capital value. So, the CAPITAL metaphor might suggest that we should similarly be concerned to maintain or increase the value of nature.[14] In this respect the CAPITAL metaphor presents an interesting contrast with another common (economics-derived) metaphor, NATURE IS A RESOURCE. Maria Åkerman in her review of the origins of the 'natural capital' concept points out that before the 1980s the environment or nature figured in economics only as 'natural resources' (Åkerman, 2003, p. 1). The RESOURCES metaphor suggests that nature is there to be used; it does not suggest that we should seek to maintain nature/natural resources. The CAPITAL metaphor suggests that we should maintain nature's capital value—i.e. its ability to produce 'income'—into the future. The two metaphors frame two radically different ways of thinking about nature and may have significant implications for environmental policy. The introduction of the CAPITAL metaphor is an example of first-moment environmental learning that opens up opportunities for new second-moment learning (the development of a new environmental valuation research programme and the accumulation of new knowledge about the value of the environment) as well as suggesting a new account of how we should respond to nature (third-moment learning).

It might be argued that the CAPITAL metaphor is not an example of environmental learning (at either the first or third moment of environmental sense-making) but rather a turn in the wrong direction. It adds nothing of positive value to our gallery of pictures of the environment and our place in it. Perhaps, the idea of valuing nature in terms of the 'income' stream (or the 'human welfare') it can produce gives us only a distorted picture of the environment and our place in it (Holland, 1997). Perhaps, the idea of maintaining the capital value of nature gives us a distorted picture of our duties to future generations (Dobson, 2003). However, we have recently seen that we cannot adopt a view from nowhere to evaluate alternative metaphorical frameworks. We can never stand outside all of the pictures in our gallery. Instead, we must look at competing or alternative pictures (conceptual frameworks) from within other pictures

(conceptual frameworks). If we try this with the CAPITAL and RESOURCES metaphors, we might think that the attraction of the CAPITAL metaphor lies in its greater resonance with conceptions of nature as an 'island' and humanity as a 'transgenerational community' dependent on nature for its survival (de-Shalit, 1995; Philippon, 2004). From the standpoint of the ISLAND and TRANSGENERATIONAL COMMUNITY metaphorical frameworks, the CAPITAL metaphor may have significant advantages over the RESOURCES metaphor. If we have to choose between them, we may well choose the CAPITAL metaphor. We may feel confident that the introduction and development of the CAPITAL metaphor is an example of environmental learning.

At the same time, we may wonder whether the CAPITAL metaphor provides the *best* framework for policy-makers, businesses and individuals to use when they are making environmental decisions. Is there more conceptual (or first-moment) learning still to be done or should we be concentrating on developing the research programme suggested by the CAPITAL metaphor (second-moment learning) and, ensuring that people know how to respond to it (third-moment learning), are motivated by its results (fourth-moment learning), and behave accordingly (fifth-moment learning)? Stephen Gough and John Foster have recently argued in a series of papers that there is a need for a new conceptual framework (Gough, 2002b, 2003; Foster, 2003b, c; Scott & Gough, 2003, pp. 128–131). On their account, the problem with the CAPITAL metaphor is that it doesn't take sufficient account of the uncertainty and complexity of environmental issues (Foster, 2003c, p. 4; Gough, 2003, p. 4). We are asked to make decisions now based on current estimates of the future 'income' or benefits that can be obtained from 'bits' of nature (or natural capital).[15] But those estimates are dependent on current knowledge and values, which are a very poor guide to the future. We do not know what possibilities for deriving benefits from 'bits' of nature might be imagined in the future—new 'inventions' create new uses for natural capital and new reasons to liquidate it.[16] Equally, we do not know how the environment will respond to our actions. As John Foster puts it:

> [Living] systems are inherently unpredictable under novel anthropogenic stresses, and our attempts to manage them introduce further levels of unpredictability and open-endedness. (Foster, 2003c, p. 4)

Nature is not passive and manageable but active, responsive and too complex to be predicted. In short, the 'ingenuity' of both humans and nature completely undermines the possibility of either valuing the future benefits of natural capital or working out what actions are implied by those values in a useful and non-arbitrary way.

Gough and Foster suggest an alternative economics metaphor, the real options metaphor or NATURE IS REAL OPTIONS. The idea of options comes from the financial markets:

> [Where] 'options' is a technical term conferring the right but not the obligation to do something at some future time under predefined conditions—for example, to convert currency at any point up to some specified date at a certain fixed exchange rate. (Foster, 2003c, p. 9)

The buyer of an option pays a one-off fee for the possibility of a significant gain (if he chooses to exercise the option at the right time). He knows that the only loss he has to incur if the market doesn't move as he hopes is the one-off fee he has paid for the option. The idea of real options is itself a metaphor, A PHYSICAL ASSET IS (or embodies) AN OPTION. Foster offers this account:

> A real option is that feature or configuration of a physical (non-financial) asset which embodies an opportunity—the scope but not the necessity—to develop or apply the asset in some particular direction in the future, depending on how, and whether, relevant current uncertainties are resolved. (Foster, 2003c, pp. 9–10)

A real option is 'built into the material structure of the asset':

> For example, a power plant with dual-fuel burners that can run on either gas or oil, or a domestic power-system that can incorporate different levels of contribution from solar or wind energy, both build in real options. (Foster, 2003c, p. 10)

The cost of the option—the one-off fee—is paid at the design and construction stages of the power plant because the operator wants to have 'scope' to use gas (oil) but not to 'need' to use gas (oil). The real option enables him to deal with his uncertainty at time t about future oil and gas markets by deferring the decision about which fuel to use at time $t + n$ until $t + n$ (or at least much nearer to $t + n$). At $t + n$ he will know the market price for oil and gas so he no longer makes his decision under uncertainty.

The next step in the Gough–Foster argument is to combine the REAL OPTIONS metaphor with the NATURAL CAPITAL metaphor to give NATURE IS REAL OPTIONS. If physical assets *are* (or can be) options and nature *is* a physical asset (or a form of physical capital), nature *is* (or can be) options. If nature or 'bits' of nature, from the rainforest to the local pond, embodies options, we might choose to 'buy' those options now by paying the (opportunity) cost of protecting them from development or liquidation. In 'buying' a 'natural option' at time t we do not attempt to estimate the 'benefits' that this 'bit' of nature will provide at $t + n$. Instead, we buy the option precisely because we are uncertain about the benefits that it will provide at $t + n$. We want to have the opportunity to realise whatever benefits might become available. While humans create real options in man-made physical assets at the design and construction stages, we discover and maintain real options in nature.[17] We 'buy' an option in nature in the anticipation that new knowledge of nature will reveal new benefits that might be obtained from nature in the future. In other words, we decide at t to defer the decision about what benefits a 'bit' of nature should or can provide at $t + n$ until $t + n$, by which time we will have learned more about the benefits of that 'bit' of nature.

The NATURE IS REAL OPTIONS metaphor is a particularly interesting conceptual innovation (first-moment learning). It suggests a programme of research (second-moment learning) that Foster has begun into how 'real options valuation' might differ from standard environmental valuation under the natural capital model (Foster, 2003c). Moreover, it suggests a novel way of responding to the environment (third-moment learning). We should 'buy' the real options that *exist* in nature so that we can defer our environmental decisions until we have *learned* more about the

benefits it can provide. Gough has emphasised that one of the key things we learn from the REAL OPTIONS metaphor is the importance of environmental learning. More specifically, we learn the importance of a particular kind of second-moment learning—learning *about* the benefits that the environment can provide.[18] This second programme of research is rather different from Foster's programme of research. Foster's aim is to work out how we should make decisions under conditions of uncertainty. The aim of Gough's programme of research/learning is to equip us to make good environmental decisions in the future by removing uncertainty and improving our knowledge of the benefits that the environment can provide. However, the inescapable character of environmental uncertainty means that Foster-type learning and Gough-type learning must be integrated because when we arrive at time $t + n$ we will not have removed the uncertainty about the future benefits of nature. Therefore, we need to learn how to make decisions under uncertainty as well as reducing uncertainty by learning more about the environment and the benefits it can provide.

Conclusion: natural capital, real options and going beyond economics

The development of the NATURAL CAPITAL metaphor and the REAL OPTIONS metaphor represents an interesting case study of the role of metaphor—specifically, conceptual metaphor—in environmental sense-making and environmental learning. However, they are also more than an interesting case study insofar as the metaphors themselves provide an important conceptual lens through which to see what kind of environmental learning is important. In this section, I want to conclude by suggesting that while the REAL OPTIONS metaphor may have significant advantages over the NATURAL CAPITAL metaphor, we may need to look beyond economics for a conception of nature that resonates with our discussion of environmental learning.

We saw in our general discussion of environmental learning that the relative merits of competing conceptual frameworks can only be assessed from within other conceptual frameworks. We are always 'inside' one of the pictures in the gallery. I suggested that the CAPITAL metaphor might look more attractive than the RESOURCES metaphor from within the NATURE IS AN ISLAND and HUMANS ARE A TRANSGENERATIONAL COMMUNITY metaphorical frameworks. Similarly, the REAL OPTIONS metaphor might look more attractive than the CAPITAL metaphor if we go beyond the idea of an island to conceive of nature as a complex living system that is co-evolving with and in response to humans and other subsystems (Norgaard, 1994). Scott and Gough explicitly draw on this version of the NATURE IS AN ORGANISM metaphor to support their preferred conception of environmental learning, which is the same conception of environmental learning that they believe emerges from the REAL OPTIONS metaphor (Scott & Gough, 2003). In drawing together mutually supportive and interlocking metaphorical frameworks they demonstrate how important conceptual metaphors are in environmental sense-making, environmental learning and environmental argument. Of course, anything more than a preliminary judgement that the REAL OPTIONS metaphor is an example of conceptual (first-moment) learning as opposed to mere innovation must wait

for more thorough discussion of the idea and the further development of the research programmes that it suggests.

Even if we accept that the REAL OPTIONS metaphor does represent conceptual learning, we may still wonder whether it provides the *best* framework for policy-makers and individuals to use when they are making environmental decisions. Is there more first-moment learning to be done? I want to suggest that our general discussion of environmental learning might prompt us to look for another metaphor. In my opinion, the most important lesson that we have learned about environmental learning is that conceptual learning (first-moment learning) is vital because it shapes our research programmes (second-moment learning) and may show us how we should respond to the environment (third-moment learning). Yet the REAL OPTIONS metaphor does not emphasise conceptual learning. Instead, it emphasises the development of new research programmes that will deliver knowledge about decision-making under uncertainty and the benefits that nature can provide. In other words, it emphasises second-moment learning—learning about the environment. If we think back to our discussion of the deficit model, I suggested that critics worried about the controversial nature of knowledge about the environment have taken two positions, a moderate and a less moderate position. The moderate position emphasises the complexity and uncertainty of environmental issues. The REAL OPTIONS metaphor is tied to this claim and proposes a programme of environmental learning to deal with the problems of uncertainty and complexity. The less moderate position claims that there are multiple methods of discovering different (partial) 'truths' about the environment. It is this claim that has led us into a discussion of different conceptual and metaphorical frameworks. Perhaps what we need is a metaphorical framework through which to see the interplay and contests among different conceptual frameworks for understanding the environment.

In some respects we might think of this as a second-order metaphor for the environment. It won't tell us that we should think of nature as capital or as real options but it might tell us how to think about thinking about nature. It won't prompt a research programme that could tell us what environmental decisions we should make. Instead, it could only suggest a research programme that might tell us what procedures (e.g. democratic deliberation, free market) we should use to make environmental decisions. In a very limited way, I have tried to offer this kind of metaphor with my talk of conceptual frameworks as pictures in a gallery. The right way to make environmental decisions is to look at as many pictures as possible from 'inside' as many other different pictures as possible. If we are all limited creatures with limited imaginations and experiences, we might best put our gallery together in an inclusive deliberative democracy where all conceptions of the environment can be discussed and debated.[19] The REAL OPTIONS metaphor, like many other first-order metaphors, might have an important role to play in understanding the environment, our place in it and how we should respond to it. The problem with first-order environmental metaphors is not that they don't help us to understand the environment but rather that we are too often ready to treat just one of them as a definitive conceptual framework from which to make environmental decisions. This may be particularly true of economic

metaphors that appear to offer us 'public' (and quantitative) criteria for environmental decision-making. The lesson we need to learn is that developing our capacity for environmental sense-making and action is not a matter of finding *the* right conceptual framework. Instead, we make most progress—we learn most—when we work cooperatively to deliberate and discuss new and existing conceptual and metaphorical frameworks and the relationships among them. The arena in which the most important environmental learning occurs is not the economist's study but the deliberative forum.

Notes

1. A first draft of this paper was produced for the second seminar of the Economic and Social Research Council Environment and Human Behaviour New Opportunities Programme project, 'Natural Capital: Metaphor, Learning and Human Behaviour', which was held in Bath in June 2003. I would like to thank the participants—especially Alan Reid who was discussant for the paper—for their constructive comments. I would also like to thank Bill Scott, Stephen Gough, John Foster and Robin Grove-White for inviting me to participate in the seminar, and especially Stephen Gough and John Foster, for providing the stimulus of the 'real options' metaphor.
2. I use this expression rather than the more common idea of 'pro-environmental behaviour' because it is often assumed (wrongly) that we know what the latter means (Gough, 2002a, p. 274).
3. This moment of environmental sense-making is emphasised by the 'quantitative tradition' of educational thinking, which 'sees learning as a process of accumulation of knowledge' (Scott & Gough, 2003, p. 91).
4. The much better known 'attitude-behaviour gap' might plausibly be understood as a combination of these two gaps (Kolmuss & Agyeman, 2002; Bell, 2003). The expression of an 'attitude'—as typically measured by response to a survey question—might be a judgement about how the interviewee believes he/we should respond to a particular environmental issue more often than it is an indication of what he is motivated to do.
5. Carlsson and Jensen (2004, p. 2) make an important distinction between 'action' and 'behaviour'—and between 'behaviour modification' and 'action competence'—which my use here may seem to ignore. On their account, '[before] an action, there will always be a conscious making up of one's mind, while this is not necessarily the case with a behavioural change' (p. 2). For them, an 'action' is autonomous whereas 'behaviour' may be heteronomous. I have three problems with this distinction. First, at each moment of sense-making and action there may be a separate question about the individual's (or the institution's) autonomy—any change at each moment might be either autonomous or heteronomous. Second, our understanding of autonomy and heteronomy may well be different at each of the five moments. Third, autonomy and heteronomy—and action and behaviour—might be better understood as existing on a continuum rather than as a simple opposition.
6. On the deficit model see, for example, Kolmuss and Agyeman (2002, p. 241) and Irwin (1995, pp. 13–14).
7. For an account of the origins of the 'greenhouse' metaphor (going back to 1824) see Brown (2003, pp. 167–168). Brown (2003, p. 169) argues that the 'greenhouse' metaphor has provided a conceptual framework for most subsequent thinking in this area. In other words, the metaphor is not purely didactic but also a 'conceptual metaphor' (Brown, 2003, p. 32). I discuss the role of metaphors in our conceptual schemes in the text below. For an account of some of the peculiarities and complexities of the 'greenhouse' metaphor, see Myerson and Rydin (1996, pp. 150–151).

8. Of course, it isn't really 'just as'. The 'greenhouse' is a metaphor not a literal description.
9. For critical discussion see Denham (2000, pp. 232–242). See also Beardsley (1981, p. 117) on 'dead metaphors'.
10. On the general role of metaphor in science, see especially Brown (2003) and Kuhn (1979). On metaphor in environmental discourse, see especially Philippon (2004) and Myerson and Rydin (1996).
11. The notation used follows Lakoff and Johnson (1980).
12. The writers are Theodore Roosevelt, Mabel Osgood Wright, John Muir, Aldo Leopold and Edward Abbey.
13. On the debate between Pearce and the ecological economists, notably Daly and Costanza, over what is involved in valuing the environment, see Åkerman (2003).
14. Of course, when natural capital is integrated with man-made capital in 'weak sustainability' theories the implications for nature of the 'constant capital' requirement become much less clear (Pearce, 1994, pp. 1–3; Åkerman, 2003).
15. 'The value of this [capital] stock at any time t is taken to be the net present value of the total flow of benefits as at t—that is, the value of the benefits actually flowing from the stock at t, plus the value (appropriately discounted) ascribed at t to the benefits which it is expected to provide in the future, less the corresponding values of any present or future costs associated with maintaining the stock in being [i.e. the costs of not liquidating the capital]' (Gough, 2003, p. 4).
16. New inventions create new opportunities for valuing and, therefore, new values (Foster, 1997, 2003c, p. 5).
17. Compare Gough's claim that natural capital is 'a state attributed to aspects of nature by humans. It is not intrinsic to such aspects of nature' (2003, p. 11).
18. Gough's overall account of environmental learning integrates the programme here and Foster's programme of learning (see text below).
19. On the role of deliberative democracy given a conception of the environment as 'a subject about which there is disagreement', see Bell (2004). On the nature of deliberative democracy more generally see Thompson and Bell (2004).

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