

In Defense of the Precautionary Principle

The precautionary principle (PP) is thought by many to be a useful strategy for action but by many others as useless at best and incoherent at worst [1]–[5]. It is particularly popular in Europe where it is enshrined in regulations and advocated in policy documents, especially in environmental and health areas. In the United States it is less popular (although it has been argued that U.S. reaction to the terrorist threat is a clear instance of an application of the PP [6]).

Here are three versions of the principle:

Where an activity raises threats of harm to the environment or human health, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically [7].

In order to protect the environment, the precautionary approach shall be widely applied by [sovereign] States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation [8].

Where there are significant risks of damage to the public health, we should be prepared to take action even when the scientific knowledge is not conclusive, *if the balance of likely costs and benefits justifies it* [9].

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Various calls have been made to apply the PP to aspects of new technologies, the most famous of these being made by Bill Joy, who, talking of the dangers of genetics, nanotechnology, and robotics said

“The only realistic alternative I see is relinquishment: to limit development of the technologies that are too dangerous, by limiting our pursuit of certain kinds of knowledge” [10]. A number of reports also advocate the PP in new technologies, including the influential report of The Royal Society and The Royal Academy of Engineering [11] and a Greenpeace report [12] that calls for an extension of the scope of the principle to include nanotechnology, artificial intelligence, and robotics.

The PP is often said to be an alternative to cost-benefit analysis (CBA) in certain situations. Cass Sunstein [4] argues for the use of CBA rather than the PP and Steve Clarke [5] also maintains that it is a more defensible alternative.

It is not altogether clear however, that CBA and the PP are the real alternatives in practice. The alternative to the PP seems to be rather something like the Bravado Principle (BP):

Where an activity appears to have benefits, do it and worry about any harmful consequences if and when they arise.

The BP is rarely stated explicitly in the literature but underlying it is the view that unless this kind of approach is taken, there will be little progress. All actions, after all, are potentially harmful.

The Precautionary Principle

In this article the precautionary principle is taken to be both a normative ideal and a pragmatic guide. Despite the cognitive limitations of humans (there will always

be some doubt about whether we have acted in the best way to reduce or eliminate some future harm), in certain cases it is a principle that ought, morally, to be applied. More importantly however, it is also a pragmatic guide, and despite commonly raised difficulties, it is a reasonable and coherent principle and a useful guide to action if formulated and applied carefully.

A generic formulation of the PP is:

If *action A* has some *possibility P* of causing harmful *effect E* then apply *remedy R* (based on Manson, [13])

where

Action A is some scientific research or technological or other development, or some action, e.g. research into and development of RFID chips, or the use of nanoparticles in sunscreens; *Possibility P* is more than a logical possibility; it must be an empirical probability. There must be *some* scientific evidence that A does or can cause E, even if this evidence is weak. Examples are that the RFID chips implanted in humans cause privacy problems and that nanoparticles in sunscreens are dangerous to humans.

Effect E is some serious or perhaps catastrophic or irreversible harm.

Remedy R is some measure or measures that should be taken to avoid or minimise E occurring, e.g. halting or never starting the research, the development or the use of some technologies or products.

Problems with the Precautionary Principle

Weckert and Moor [14] have defended the PP against four criticisms: 1) the difficulty of predicting, 2) the relationship between the action and the possible harm, 3) the supposed harm itself and, 4) the PP's paradoxical nature. In this article the first three will be only briefly mentioned but the fourth will be considered in some detail. If it is indeed true that the PP inherently contains a paradox, it is an incoherent principle and of no use.

The first three problems are less worrying.

Prediction

The PP does involve predicting consequences of scientific and technological research and development and of other actions. This is undoubtedly an activity fraught with dangers. This could be attested to by a Royal Society president, William Thomson (Lord Kelvin) who predicted that “Neither the balloon,



Eruption of Eyjafjallajökull Volcano, Iceland, April 17, 2010.

nor the aeroplane, nor the gliding machine will be a practical success” [15]. But with care, reasonable predictions can be made. For example, given current technology for the monitoring and surveillance of people and the manner in which these technologies have developed and have been used, it is reasonable to predict that with further developments in nanoelectronics and more sensitive sensing devices, that further threats to personal privacy will arise in the future.

Relationship between Action and Harm

This concerns the causal link between the action and the effect. All versions of the PP state that the principle should be applied even if “some cause and effect relationships are not fully established scientifically.” While scientific certainty is not necessary, the threat of danger must be credible, that is, a hypothesis that that threat is caused by a particular action is a reasonable hypothesis, even if there is little actual evidence to support the causal link (based on Resnik, [16]).

There must of course be evidence that that sort of hypothesis is a reasonable one in the circumstances. The hypothesis that certain nanoparticles cause harm to humans is reasonable given what is known about asbestos and deserves further testing (it must be noted of course that we regularly breathe in nanoparticles without any apparent harm). It is plausible to believe that they might be harmful even though there may not yet be enough evidence to even say that this is probable.

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Nature of the Harm

Yet another criticism concerns the nature of the harm. In the first formulation of the PP, in the list above, any threat of harm is enough. This is too strong.

The second formulation of the PP on our list modifies this statement, and raises the prospect of “serious or irreversible damage.” While both *serious* and *irreversible* require closer examination, this formulation is more plausible, particularly when it involves the suffering and death of humans or widespread destruction of the environment.

The Paradox

The most serious criticism of the PP, coming from, among others, Sunstein [4] and Clarke [5], is that the Principle is internally incoherent. If it is to be applied to some action in order to avoid a harm, it should also be applied to the action of applying it because that too, at least in many cases, will lead to harm. So it should be both applied and not applied. The paradox arises in the case of the strong version of the precautionary principle (sPP), to be explained shortly.

The problem can be set out as follows:

Action A1 might cause bad effect Eb1 (harm eventuates because of A1);
Remedy R1 (don't do A1) stops Eb1 (PP applied);
But suppose that A1 causes good effect Eg1 (Eg1 eliminates some harm);
Then R1 stops Eg1 (harm eventuates because of R1).
So, if PP should be applied to A1 (because A1 causes harm) it should also be applied to R1 (because R1 prevents an action that would eliminate some harm)

Possible Solutions

In the article by Weckert and Moor [14], a way of avoiding the paradox was presented, based on moral duties. The proposal was based on a ranking of duties widely accepted by ethicists. Negative duties, duties not to cause harm are generally held to be more stringent than positive duties, duties to do good. Intermediate duties, duties to do good to someone in situations where we have played a role in harming that person, are somewhere in between.

A straightforward case to illustrate these points is this. The negative duty not to kill a child is normally held to be stronger than the positive duty to save a drowning child. However, if my carelessness caused the child's perilous position, I have an intermediate duty to save the child that is much stronger than a positive duty.

In his recent article Clarke [5] has argued that this solution to the supposed paradox inherent in the PP is

inadequate. First, in many cases it does not work and second, in cases where it does, it gives the wrong solutions. This criticism will be examined here. It must be noted that Clarke distinguishes between a strong

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version of the PP (sPP) which only takes harms into account, and a weak version (wPP) that will also consider benefits. The sPP, Clarke argues, is incompatible with CBA, but wPP is compatible. The paradox arises in the case of sPP. Our argument is that the paradox is not a problem even for sPP.

First, Clarke claims, the duties solution does not work in situations where the conflicting duties are of the same type. His example is this (based on Manson [14]):

the U.S. Government, faced with the dilemma of whether or not to comply to the Kyoto protocol, appears to be one such case. It seems that the U.S. Government has an intermediate duty to comply with the Kyoto protocol, as Americans significantly contribute to the fossil fuel emissions that are driving climate change. However, if they do comply with the protocol, then they may risk causing massive civil unrest, as a response to the resulting economic hardships that civilians will be required to endure. As the U.S. Government is significantly responsible for the social circumstances that dispose its citizens towards civil unrest in such circumstances, it seems that they have an intermediate duty not to adhere to the Kyoto protocol [5], [14]–[15].

Formulated in this way, two intermediate duties are in conflict.

Consider now a different formulation of the problem. According to most scientists, continuing to burn fossil fuels at the current rate is unsustainable. Serious environmental harm is inevitable. Even if there is not complete scientific certainty, we should stop it (apply the PP). But stopping it will very likely lead to lowering of living standards and civil unrest so we should not stop it (apply the PP to not stopping it).

The situation looks stark in this simplified version:

- a) Burning fossil fuels causes harm (global warming)
- b) Not burning fossil fuels causes harm given that our way of life currently depends on it

So there is a negative duty in both cases and our strategy does not help. We are damned if we do and damned if we don't, it seems. The PP does appear to be impotent here and CBA to have a definite advantage. It has

the potential to assess the relative harms and come to a decision. Is it worse to have an environment not conducive to life as we know it or to have extreme civil unrest? What is the probability of each? The problem here for CBA is that many subjective judgements need to be made in order to carry out any analysis of the relative costs and benefits. But at least the situation is not paradoxical. Clarke appears to have identified a genuine difficulty here for our proposal, but more can be said.

Certainly in the case above, harm results from both burning and not burning fossil fuels but not burning fossil fuels is a negative duty and burning them a positive one. Burning fossil fuels causes harm in the same way that drowning a child does. And not burning allows harm just as not rescuing a drowning child does. So the paradox is avoided.

Clarke's second objection is that even in cases where the ranking of duties does avoid the paradox, it is not a satisfactory solution. But it is not obvious that it is not a satisfactory solution. Consider the example of sunscreens containing nanoparticles.

It has been argued (eg., by Faunce *et al.* [17]) that the PP should be applied to the use of sunscreens containing nanoparticles (of titanium dioxide (TiO₂) or zinc oxide (ZnO) because of unknown dangers with nanoparticles.

Case 1:

- 1) Applying PP would avoid possible harms relating to the absorption of nanoparticles through the skin.
- 2) Allowing the sunscreen will have the benefit of the wearer not looking like a painted clown.
- 3) Therefore the PP should also be applied to not allowing the sunscreen.
- 4) Therefore the PP could be applied both to allowing and not allowing the sun screen.

But here the negative duty not to harm overrides the positive duty to do good so the paradox does not arise.

Case 2:

- 1) Applying PP would avoid possible harms relating to the absorption of nanoparticles.
- 2) Allowing the sunscreen will reduce cases of skin cancer.
- 3) Therefore the PP should also be applied to not allowing the sunscreen (precautions should be taken to avoid skin cancer).
- 4) Therefore the PP could be applied both to allowing and not allowing the sunscreen.

It might be argued that there are two negative duties in case 2, that is, in both stopping the use and allowing the use of the sunscreen. In both cases there is harm. But allowing the use of the sunscreen causes harm, or has the potential to, while disallowing its use only harms by preventing a benefit; the status quo remains.

The case again seems analogous to that of drowning a child as opposed to not saving a drowning child. Neither is good but the former is worse than the latter. Again the negative duty overrides the positive duty so there is no paradox.

Assuming the priority of negative over positive duties, why does our solution not work here? According to Clarke, in cases where it does work it does not provide satisfactory solutions. It does not provide satisfactory solutions because judgements must be made with respect to the relative strengths of the various conflicting duties, but in the two cases above it is not clear why this is so. These appear to be obvious examples of negative

duties taking precedent over positive duties.

Clarke also argues that cases exist where a positive duty could plausibly be thought to override a negative one and so, even where the duties are of different kinds, a judgement must be made:

Suppose, for example, that an innocent but curious civilian has wandered into a situation where a bomb is being defused, and in a well meaning but misguided attempt to help, is about to set off the bomb inadvertently. The only way I can prevent this from happening is by throwing a nearby rock at the curious civilian, knocking him unconscious. It seems very plausible to think that, in this case, my positive duty to save the lives of many outweighs my negative duty to prevent harm to the curious civilian (Clarke [5]).

The core of his second objection seems to be that "In general, the weighing of negative, intermediate and positive duties is a matter of judgment and a matter about which there are no simple rules." It must be remembered that Clarke is talking here of sPP which does not take into account benefits, only harms, so there is no comparison of benefits against harms, only comparisons of harms against harms. The most that this shows, however, is that the ranked duties approach does not work in all cases.

If we can easily compare harms, that is, where one harm is clearly worse than the other, the paradox would not arise for the sPP. If there is little doubt that the civilian will set off the bomb, this is a case

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where the PP, strong or weak, is most likely unnecessary. If reasonable doubt does exist, it may be applied but because the one harm is so much greater than the other, the positive duty could override the negative. This however does nothing to undermine the ranked duties approach in cases where the harms cannot be easily compared.

Clarke is right in arguing that the ranked duties solution does not work in all cases but it does not follow that in all of those cases in which it does not, PP falls to the paradox (as we have just seen).

Consider a different case: that of the volcanic eruption in Iceland that caused the decision to ground flights in Europe. Airports affected by the cloud of volcanic ash were closed very quickly, not because there was strong evidence that the cloud was dangerous to aircraft but because there was a credible risk that it was. In the past the engines of a plane flying through such a cloud had stopped and the manufacturers of the engines believed that the ash did pose a risk to the engines.

This appears to be a clear case of an application of the strong PP (sPP). If it is an application of sPP then, according to Clarke, a paradox is involved if both closing and not closing the airports causes harm. This is the case so the ranking of duties will not help. Both closing and not closing the airports are negative duties because both actions cause harm or have the potential to cause harm. Closing the airports caused inconvenience to thousands of travellers but more importantly, led to substantial financial losses to airline companies and to many other businesses that relied on airline passengers and freight.

The harms caused by closing or not closing airports however, are quite different. Apart from passenger inconvenience which, while immediate, was relatively trivial, the harm caused by closing the airports was longer term. The potential harm of not closing them was immediate and serious; planes crashing and many people being killed. Where the only options are causing immediate serious harm and longer term serious harm, the sensible action is surely, other things being equal, to do that which results in longer term harm and minimizes the immediate threat. More time is available to take actions to mitigate the longer term problems. So in at least in some cases where the ranking of duties will not solve the paradox, the immediacy of the potential harms can. Of course in situations where there is nothing to choose between harms, the PP is of no help but then neither is any other principle.

Some Underlying Issues

The previous discussion has done little more than provide a sketch of an argument and raise a number of issues requiring detailed examination. One of these concerns the distinction between sPP and wPP and the role of comparison, and another concerns duties. What is a duty and what gives it its force? Are the different types of duties really of different strengths? We will briefly consider the sPP/wPP distinction and just the question of the relative strengths of different duties. A third is the relationship between the PP and CBA on the one hand and moral theories on the other.

First, one of Clarke's worries about the PP is that the strong version, sPP, does not take benefits into account and just focuses on harms. The other side of that worry is that if it does take benefits into account and compares those with the harms, wPP adds nothing useful to CBA. Per Sandin [18] argues that common-sense reasoning is in line with the PP and attempts to demonstrate this with the example of not drinking water from a stream given the chance that it could be contaminated by a dead animal upstream. Clarke counters this by arguing that there may well be an unconscious weighing up of costs and benefits so it might not be a case of just considering harms and therefore not the same as the PP, at least not the same as sPP.

Consider the sunscreen case again. The immediate problem is whether or not the nanoparticles will cause harm. Without its use the rate of skin cancer will not change from its current level. So the PP is applied. Applying it does not mean that the sunscreen will never be used. It is just taken off the market until the risks have been adequately tested and until, perhaps, a CBA has been conducted to see if indeed the ben-

efits outweigh the harms. Rough assessments or comparisons can be made without full-blown CBAs. This is just acting carefully and not with bravado. Suppose that while driving on a two lane road I want to overtake a car traveling slowly. To do so I must move over into the lane of oncoming traffic and that entails some risk. Acting with precaution does not imply that I make no assessment of the risks and benefits but neither does it imply that I undertake more than a very rough and ready assessment. I wait until I can see a long stretch of road in front of me that is free of oncoming cars and I overtake safely. The PP, strong or weak, must allow this kind of assessment if there is to be any force in acting carefully or with precaution in any situation. And it is not clear that it is just a version

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of CBA. Alternatively, if CBA captures all decision-making that involves any comparisons at all, no matter how rough and ready, the precautionary principle is ruled out by fiat.

Second, is it feasible to maintain that duties can be ranked with negative the strongest and positive the weakest? Many utilitarians would resist this. The negative duty not to cause harm would not override the positive duty to provide benefit. The only important issue would be the overall balance of benefit over harm. A related issue is that perhaps refraining from doing a good where the good avoids a harm is also a negative duty. This seems to be Clarke's position but it is not clear now what the difference between a positive and a negative duty is. Any supposedly positive duty will lead to harm in the sense that a benefit will be withheld. No relevant moral distinction can be made between intentionally drowning a child and intentionally not rescuing a drowning child. This would also be a consequence of the utilitarian view that no distinctions can be drawn anyway. But then, do I have the same duty to be a good swimmer in order to save a drowning child if the need arises as I do not to drown a child? This position places enormous burdens on all of us that we would be unable to fulfil. This invites examination too of the moral significance of the acts and omissions distinction, which in many ways mirrors the positive-negative duties distinction.

A third issue underlying the debate concerns the relationships with moral theories. CBA is a strong form of act utilitarianism. All that matters is finding the greatest balance of benefits over costs. While it inherits the strengths of that theory it also has the weaknesses. The PP seems much more closely related to a form of deontology. Certain things are wrong and should be avoided even if benefits are attached. A problem here of course is that an action should be avoided even if great benefits would ensue. A deep understanding of the debate between the PP and CBA would involve exploration of the debate between fundamental moral theories.

PP Paradox is More Apparent than Real

The primary concern of this article has been to defend the precautionary principle against the charge of incoherence; the charge that it contains a paradox. That defense has focused on Clarke's argument that the ranked duties approach does not avoid the paradox. It has been conceded that it does not solve the problem in all cases but in some cases the harms can be compared so the paradox is avoided, and in others it does not arise because of the importance of immediacy. The more immediate problem should be addressed in

the first instance because more time is available for the less urgent. The paradox therefore is more apparent than real and one obstacle thought to render the PP impotent has been removed. The PP is a plausible principle and surely more plausible than its real rival, the bravado principle.

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References

- [1] F. Ackerman and L. Heinzerling, *Priceless: On Knowing the Price of Everything and the Value of Nothing*. New York, NY: New Press, 2004.
- [2] UNESCO, *The Precautionary Principle*. United Nations Educational, Scientific and Cultural Organization, World Commission on the Ethics of Scientific Knowledge and Technology, 2005; <http://unesdoc.unesco.org/images/0013/001395139578e.pdf>.
- [3] *Communication From The Commission on the precautionary principle*. Commission of the European Communities, Brussels, Feb. 2, 2000; http://ec.europa.eu/dgs/health_consumer/library/pub/pub07_en.pdf.
- [4] C.R. Sunstein, "Cost-benefit analysis and the environment," *Ethics*, vol.115, pp. 351–385, 2005.
- [5] S. Clarke, "New technologies, common sense and the paradoxical precautionary principle," in *Evaluating New Technologies: Methodological Problems for the Ethical Assessment of Technological Developments*, P. Sollie and M. Duwell, Eds. Dordrecht: Springer, 2009, pp. 159–173.
- [6] J. Stern and J.B. Weiner, "Precautionary against terrorism," *J. Risk Research*, vol. 9, pp. 393–447, 2006.
- [7] Wingspread Statement on the Precautionary Principle, www.gdrc.org/u-gov/precaution-3.html, 1998.
- [8] Rio Declaration, (2002), Principle 15 of the 1992 Rio Declaration of the UN Conference on Environment and Development, quoted in Neil A. Manson "Formulating the precautionary principle," *Environmental Ethics*, vol. 24, pp. 263–274, 2002.
- [9] *Lancet*. Quoted from the *Lancet* in Douglass L. Weed, "Is the precautionary principle a principle?," *IEEE Technology and Society Mag.*, pp. 45–48, Winter 2002–2003.
- [10] B. Joy, "Why the future doesn't need us," *Wired*, pp. 238–262, 2000; http://www.wired.com/wired/archive/8.04/joy_pr.html.
- [11] "Nanoscience and nanotechnologies: Opportunities and uncertainties," The Royal Society & The Royal Academy of Engineering, 2004; <http://www.cst.gov.uk/business/files/nano-report-2004-fin.pdf>.
- [12] A. Huw Arnall, *Future Technologies, Today's Choices*. A report for the Greenpeace Environmental Trust, Imperial College, University of London, July, 2003.
- [13] Manson, N., "Formulating the precautionary principle," *Environmental Ethics*, 24, 2002, pp. 263–274.
- [14] J.J. Weckert, and J.H. Moor, "The precautionary principle in nanotechnology," *Int. J. Applied Philosophy* vol. 20, pp. 191–204, 2006.
- [15] Kelvin On Science. Interview: Utter Impracticability of Aeronautics & Favorable Opinion on Wireless, Reprinted in *The Newark Advocate*, p. 4, Apr. 26, 1902.
- [16] D.B. Resnik, "Is the precautionary principle unscientific?," *Studies in the History and Philosophy of Biological and Biomedical Sciences*, vol. 34, pp. 329–344, 2003.
- [17] T. Faunce, K. Murray, H. Nasu, and D. Bowman, "Sunscreen safety: The precautionary principle, The Australian Therapeutic Goods Administration and nanoparticles in sunscreens," *Nanoethics: Ethics for Technologies that Converge at the Nanoscale*, vol. 2, pp. 231–240, 2008.
- [18] P. Sandin, "Common sense precaution and varieties of the Precautionary Principle," in *Risk: Philosophical Perspectives*, T. Lewens, Ed. London, U.K.: Routledge, 2007, pp. 99–112.