Chapter 11
New Technologies, Common Sense and the Paradoxical Precautionary Principle

Steve Clarke

Abstract I examine different forms of the Precautionary Principle (PP) to see if these are suitable, *inter alia*, for the regulation of new technologies. Weak versions of the PP may be suitable, but are not importantly different from Cost-Benefit Analysis (CBA). Strong versions of the PP are importantly distinct from CBA but are not a suitable basis for regulation because they lead to paradoxical outcomes if applied consistently. I consider three different lines of response to the change of paradox and argue that all three are unsatisfactory. First, I argue against Sandin's (2007) suggestion that we should be optimistic about finding a solution to the paradox on the grounds that the PP appears to be embodied in common sense reasoning. Second, I consider Weckert and Moor's (2006) attempt to resolve the PP paradox by appealing to the distinction between positive, negative and intermediate duties. I argue that this does nothing to resolve the PP paradox in many crucial cases. Furthermore, even when it can be used to resolve the paradox, it does not provide a satisfactory resolution. Third, I argue that Gardiner's (2006) attempt to recast the PP as a form of maximin is unsatisfactory because, although it resolves the PP paradox, it can only be successfully applied in a range of cases which is much narrower than the range in which advocates of strong versions of the PP typically attempt to apply the PP.

Keywords Common sense · Cost-benefit analysis · Duties · Maximin · Paradox · Precautionary principle · Risk · Uncertainty

11.1 Introduction

Recent developments in a range of areas of science including artificial intelligence, nanotechnology, biochemistry and photonics promise to enable us to develop new technologies that may improve our lives dramatically. However, the use of these new technologies may involve risks to our health and safety as well as risk of damage

S. Clarke (✉)
Faculty of Philosophy, University of Oxford, Oxford, United Kingdom
e-mail: stephen.clarke@philosophy.ox.ac.uk

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to the environment. How should governments and regulatory agencies attempt to formulate policies to manage the risks involved in the use of such new technologies? One influential approach that they may take is to apply cost-benefit analysis (CBA) to different available policy options. Under CBA we attempt to determine the probability of benefits occurring as well as the probability of costs being incurred, given a particular form of regulation of a new technology. We then compare the relative balance of costs and benefits for that policy option with other viable alternatives and select the outcome with the best overall balance of costs and benefits, adjusting for the probabilities of these occurring.

A very different approach is to apply the precautionary principle (PP) to policy options. The PP is a conceptual tool that was applied in environmental law, but which is now applied in a variety of contexts including healthcare and the regulation of new technologies. It made its initial appearance in Sweden and the former West Germany in the late 1960s (Sunstein, 2005: 16) and has become increasingly influential throughout Europe.[1] Indeed, it is sometimes held that there is a fundamental divide between America and Europe in respect to risk management; Americans typically applying CBA and Europeans applying the PP (Sunstein, 2005: 13–14).[2] CBA is not without is problems.[3] However, the focus of this paper is not on these problems, but on a cluster of problems that affect influential versions of the PP. Although it is common to hear references made to *the* PP, there is no one PP. There are many different formulations of the PP. The following three are influential examples of quite different formulations of the PP.

[1] Principle 15 of the 1992 *Rio Declaration on Environment and Development*:

> In order to protect the environment, the precautionary approach shall be widely applied by 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. (United Nations Environment Programme, 1992)

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[1] The PP was referred to in 27 resolutions of the European Union parliament between 1992 and 1999, is referred to in the 1992 Maastricht treaty on the European Union and has appeared in a draft constitution for the European Union (Sunstein, 2005: 17). According to Majone (2002) the European commission actively promotes the PP as a 'key tenet' of European community policy and as a general principle of international law.

[2] Although use of the PP is much more prevalent in Europe that in the US, this is not because Americans do not employ precautionary reasoning. Americans are more risk averse than Europeans when it comes to reasoning about particular issues, such as unemployment and the cost of energy (Sunstein, 2005: 14). Also, the American response to terrorist threats, in the wake of the events of September 11th 2001 amounts to an application of the PP (Stern and Wiener, 2006).

[3] CBA has been subjected to a wide range of criticisms, especially in environmental economics (e.g. Bromley and Paavola, 2002), but also in law and philosophy. In particular it has been extensively criticised for requiring the commensuration of apparently incommensurable costs and benefits (e.g. Adler, 1998) and for involving the monetary valuation of human life (e.g. Anderson, 1988). For a defence of CBA against a variety of criticisms see Schmidtz (2001). Hansson (2007) provides a recent catalogue of philosophical problems that are relevant to the application of CBA.

[2] Final Declaration of the First European 'Seas at Risk' Conference, 1994.

> If the 'worst case scenario' for a certain activity is serious enough then even a small amount of doubt as to the safety of that activity is sufficient to stop it taking place.[4]

[3] The Wingspread Statement:

> 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. In this context the proponent of the activity, rather than the public, should bear the burden of proof. (Wingspread, 1998).

[1] is an example of what is sometimes referred to as a weak version of the PP (wPP). It is not genuinely an alternative to CBA. In fact it is compatible with CBA. The main purpose of [1] appears to be to ensure that CBA is not used in a biased manner in which only those risks that are established with 'full scientific certainty' are considered.

[2] is an example of what is sometimes referred to as a strong version of the PP (sPP). It is incompatible with CBA. It stipulates conditions under which we should regulate on the basis of consideration of the potential costs of a policy, regardless of the potential benefits of that policy or the potential costs of alternatives. So it is antithetical to CBA, which involves a weighing of costs and benefits.

[3] does not focus directly on action but on identifying the 'burden of proof'. It can be understood as being supplementary to CBA rather than an alternative to CBA. Depending on what is required to meet the burden of proof it can resolve into a weak or a strong version of the PP, or something in between. If it does not ask more of the proponents of the activity than that they present the relevant evidence for the conclusion that the potential benefits of the activity in question exceed its potential costs then it resolves into a weak version of the PP. It effectively resolves into a strong version of the PP if it requires the proponent of an activity to establish that that activity carries no risk whatsoever of serious harm to the environment or to human health.

I've characterised CBA and the PP as competing approaches to risk management. In doing so it might be supposed that I have mischaracterised the PP. Defenders of the PP sometimes argue that the PP should be applied in situations of uncertainty,[5] whereas CBA is designed to be applied in situations of risk. The classic distinction between risk and uncertainty goes back to Knight (1921). On Knight's usage, risk refers to circumstances where the probabilities of potential outcomes can be specified, on the basis of reliable evidence, whereas uncertainty refers to circumstances where the probability of potential outcomes cannot be specified, on the basis of reliable evidence.[6] The rolling of an unbiased six-sided die is a clear case of risk without uncertainty as we appear to know what all the possible outcomes are

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[4] Cited in Sunstein (2005: 29).

[5] See, for example, Sandin (1999: 892–894).

[6] This is the standard interpretation of Knight (1921). For a different view see LeRoy and Singell (1987).

and we have good grounds for specifying the probability of all of these occurring. Speculation about the possibility of an afterlife is a case of uncertainty without risk. We can imagine various possible different afterlives, but we have no obvious basis for determining the probability of any of these eventuating.

CBA is grounded on risk assessment, as is wPP, however, sPP involves no consideration of risks, but relies of consideration of the mere possibility of uncertainties. So, it might be thought that sPP is not in direct competition with CBA at all. However, there are very few cases of pure uncertainty and there are very few cases of pure risk, in Knight's senses. When an army goes to war its generals typically have a rational basis for assigning subjective probabilities to the likelihood of different strategies succeeding, even while they will acknowledge that war is beset by many uncertainties. And when an insurer writes a car insurance policy they do so on the basis of an assessment of the risks of a particular driver having an accident, even though they are aware that the act of driving is beset by many uncertainties. Most real world circumstances involve both risks and uncertainties.[7] CBA and sPP are employed by considering different aspects of real world circumstances, but they can also be applied to many of the same real world circumstances. So, despite appearances, they are often in direct competition.

The presence of a variety of different formulations of the PP is responded to very differently by advocates of the PP. Some such as Gardiner (2006) and Weckert and Moor (2006), set themselves the task of identifying a core formulation of the PP which captures the guiding idea behind the PP, while being most able to respond to the various critics of the PP. However, others rejoice in the diversity of formulations of the PP. Jordan, Andrew and O'Riordan (1999) have the following to say about the PP:

> Like sustainability, it is neither a well-defined nor a stable concept. Rather, it has become the repository for a jumble of adventurous beliefs that challenge the status quo of political power, ideology, and environmental rights. Neither concept has much coherence other than is captured by the spirit that is challenging the authority of science, the hegemony of cost-benefit analysis, the powerlessness of victims of environmental abuse, and the unimplemented ethics of intrinsic natural rights and intergenerational equity. It is because the mood of the times needs an organising idea that the Precautionary Principle is getting attention.
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> (Jordan, Andrew and O'Riordan, 1999: 16).

The inclusiveness of a vague, shifting concept may be useful as an organising idea for a diverse protest movement, but once the PP becomes used widely as a tool of policy formation it becomes important that the PP – or at least particular formulations of the PP – are well-defined. If policies are to be guided by the PP, and make reference to the PP, then it is important that the PP can be understood in a consistent manner. If not then we will be unable to secure agreement as to how to implement any particular policy that invokes the PP.[8]

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[7] I've argues that real world circumstances often involve both risks and uncertainty. Many commentators argue, on somewhat similar grounds, that there is no well-founded distinction between risk and uncertainty. See for example, Friedman (1962).

[8] I argued similarly in Clarke (2005: 125). See also Gardiner (2006: 40).

11.2 The PP Paradox

If proponents of the PP are to identify a core formulation of the PP, for the purposes of enabling policy formation, then it looks as if they will have to make a basic choice between wPP and sPP. Because variants of wPP simply offer guidance regarding the proper use of CBA, effectively the core formulation of wPP will be a core formulation of CBA. There may be interesting issues about the proper formulation of CBA, but they are beyond the scope of this discussion. The latter choice requires that the proponents of the PP overcome what has emerged as the most serious objection to sPP, which is that, if properly applied, it produces paradoxical outcomes. In the remainder of this section and also in the next one, I will explain the PP paradox and discuss reasons why people are often unconcerned by the paradoxical nature of sPP. In the final two sections of the paper I will consider two recent attempts to resolve the PP paradox, due to John Weckert and Jim Moor (2006) as well as Stephen Gardiner (2006).[9]

Strong versions of the PP, if applied rigorously, lead to the paradoxical situation where we are neither permitted to perform nor permitted to fail to perform an action under consideration. This well known paradox is expressed somewhat differently by different scholars. One formulation is due to Manson who considers the PP paradox to be analogous to the 'Many Gods' objection to Pascal's Wager (2002: 272).[10] He argues that any precautionary measure that we might take to avoid harm, itself involves risk of harm. Consider, for example, a situation in which the US Government is deciding what to do to respond to the threat of potentially disastrous environmental damage, due to climate change. A possible response would be to reduce carbon emissions significantly, as per the Kyoto Protocol. And it seems plausible to think that an application of sPP would lead to the recommendation that the US Government accepts and applies the Kyoto protocol. However, enforcement of the Kyoto protocol is not without the risk of harms itself. A significant reduction in carbon emission in the US cannot plausibly be achieved, in the near future, without significant changes to the lifestyles of ordinary citizens. There are risks involved in such social and economic change. Perhaps global economic depression will be caused, chaos will ensue, and the current democracy in America may be replaced by a dictatorship. So applications of sPP lead to the contradictory recommendation

[9] In Clarke (2005: 123–124) I examined two earlier attempts to address the PP paradox, due to Sandin et al. (2002) and Saunders and Ho (2000). I argued that neither of these succeed.

[10] Pascal famously argued that one should choose to believe in God, no matter how low one believes the chance of God actually existing is (provided that it is believed to be greater than zero). This is because the potential benefits of belief, if God exists, are enormous (heaven) and these are only available to those who believe. Furthermore the costs of belief are very low. The 'Many Gods' objection is an influential objection to Pascal's reasoning. Suppose that the deity Thor exists and Thor will only allow those who believe in him and in no other deity into heaven. If this is the case then belief in God will lead one to be denied entry into heaven. But it seems possible that Thor exists. So, Pascal's reasoning (applied to many deities) leads both to the conclusion that one should believe in God and the conclusion that one should not believe in God.

that the US Government should act in response to climate change and that it should not act in response to climate change.[11]

Sunstein sets up the PP paradox somewhat differently from Manson. According to him, regulation guided by sPP will itself fall afoul of sPP because '... it might well deprive society of significant benefits and hence produce serious harms that would otherwise not occur' (Sunstein 2005: 29). So, for example, taking a precautionary approach to the regulation of a new drug, by insisting on stringent testing before the drug is made available to the pubic, will deprive society of a benefit, the benefit of having an experimental drug available. This denial of benefit is itself potentially harmful because, if the experimental drug is in fact efficacious in curing or preventing a disease, then lives that could have been saved by use of the drug will be lost.[12]

Given that it is well known that sPP leads to paradoxical outcomes, if applied consistently, why do people continue to attempt to apply sPP? Part of the answer to this question is that the PP lends itself to inconsistent application because, unlike CBA, it is not a comparative concept. When we apply standard formulations of the PP we apply them to particular proposed actions and not to the comparison of alternative courses of action. So, provided that it does not occur to us to apply sPP to the course of action that an application of sPP recommends, we do not find ourselves in paradox. A second part of the answer, supplied by Sunstein (2005: 35–63) is that our thinking is often governed by heuristics that result in a variety of cognitive biases that can cause inconsistent application. Particularly important in understanding lay precautionary reasoning is the availability heuristic, first identified by Tversky and Kahneman (1973).

The availability heuristic is a rule of thumb that people use to provide intuitive assessments of the magnitude of a risk. So when people are asked, for example, how serious is the risk of an accident at a nuclear power plant, a major terrorist attack on their own country, or the outbreak of a new disease, they will tend to make such assessments by equating the magnitude of risk with their ability to bring instances of the particular threat in question to mind. Cognitive availability will be affected, *inter alia*, by familiarity and by salience. If an instance of a class of dangerous events has occurred recently, people will intuitively increase their assessment of the likelihood that it will be repeated, particularly if their awareness of its occurrence has been reinforced by the media. Use of the availability heuristic can lead to serious overestimations of the magnitude of risk, especially in circumstances where risks are associated with excessive public fear. Because there is a limited number of topics that are highly 'available' to us at any given time, when one risk is highly available to us, we are likely to fixate on it and neglect other relevant risks which are less

[11] The Kyoto example is from Manson (2002: 273).

[12] Sunstein (2005) does not appear to differentiate this form of the PP paradox from the Manson formulation. He goes on to describe another example of the PP paradox in which the relocation of 270,000 people in response to the risks of radiation exposure following the Chernobyl incident – an instance of precautionary reasoning – leads to direct harms (psychological harms) rather than to the deprivation of benefits.

available to us. For example, if we are focussed on threats to the environment posed by climate change, when these are highly available, we are liable to neglect other risks, including risks to the economy and social stability that are posed by alterations to our lifestyle that would be required to minimise carbon emissions and thereby reduce the threat to the environment posed by climate change.

11.3 Common Sense and Precaution

It is sometimes thought that even if sPP does lead to contradictory paradoxical policy recommendations, we should be optimistic about finding some way out of the paradox, because the precautionary reasoning that seems to underpin all forms of the PP seems also to be embodied in common sense reasoning (Sandin, 2007). Common sense reasoning generally appears to enable us to make definite decisions and does not often appear to lead us to agonies of indecision brought on by paradox. And it appears that common sense endorses something like the PP. Common sense proverbs assure us that we are 'better safe than sorry' and that 'an ounce of prevention is worth a pound of cure' (Sandin, 2007: 105). I will argue, though, that the PP probably has less in common with common sense reasoning than appearances suggest and that it is plausible to think that CBA has much in common with common sense reasoning.

Sandin provided us with the following example of common sense decision making that appears to him to be based on something like the PP:

> I am hiking in the mountains, and I am thinking of having a drink of water from a small stream. I do not know that the water is safe to drink. There just might be a reindeer carcass a short distance upstream, poisoning the water. Thus, as the saying goes, 'When in doubt, don't'. I abstain from drinking the water, or at least boil it before drinking it. (Sandin 2007: 99).

In this example of common sense decision making, a risk that might result from an action is explicitly considered, while the possible benefits of action are not explicitly considered and the risks of inaction are not explicitly considered. If Sandin was also to consider the risks of inaction as well as the potential benefits of action, then his decision making would seem to be based on something more like CBA than the PP. But these factors do not appear to be considered, so it appears that Sandin's common sense reasoning has much more in common with the PP than CBA. However, the appearance that this example of common sense reasoning, as well as others, has more in common with the PP than CBA may be nothing more than apearance. It is very plausible to think that much of our ordinary decision making occurs 'offline' and that conscious explicit reasoning is only part of the overall process that leads to a decision being made (Bargh and Chartrand, 1999; Schneider and Shiffrin, 1977). Deliberative conscious reasoning and intuitive, non-conscious processing combine to create overall decisions, or so say 'dual processing theorists', an increasingly influential school of thought in social and cognitive psychology (Chaiken and Trope, 1999; Kahneman and Frederick, 2002).

Dual Processing theory is a relatively new trend in psychology and there is no agreed upon model of how deliberative conscious reasoning and offline, intuitive processing are integrated in ordinary decision making. One possible means of integration is that a decision maker consciously focuses on an important aspect of a decision, while non-conscious parts of her brain attend to other aspects of a decision and draw these to the attention of consciousness if and when they become important. Sandin consciously attends to the risk of drinking poisoned water and at the conscious level he ignores the risks involved in failing to take a drink. However, it is plausible to think that at the non-conscious level these considerations are being monitored. There are risks involved in not drinking. Perhaps by failing to take a drink Sandin will become dehydrated and suffer from dizziness, fainting or even death. Sandin ignores these factors at the conscious level but not at the non-conscious level. If he is in significant danger of dehydration a non-conscious part of his brain will send a message to his conscious mind – typically in the form of a strong desire to drink – which can override the decision to avoid the risk of drinking. Also, there may be possible benefits of action. Perhaps Sandin's attractive hiking partner will be impressed by his willingness to risk drinking from the stream and fall in love with him – an outcome which may please him greatly. If social cues indicate that is indeed a significant possibility, then a non-conscious part of his brain may also send a message to his conscious mind, urging him to risk taking a drink so as to show off to his hiking partner.

Once we take account of the non-conscious aspects of ordinary decision making, the common sense reasoning that takes place in this example starts to look a lot less like the PP than it did when we only considered the conscious aspects of decision making. If information about the potential benefits of an action as well as information about the potential risks of a failure to take the action in question are processed non-consciously and if this information contributes to an overall decision, then that overall decision begins to look a lot more like CBA than the PP. I am not arguing that common sense thinking about risk is definitely more like CBA than the PP. The relevant science is not yet advanced enough to establish such a conclusion. However, the case for thinking that common sense thinking about risk is similar to the PP has definitely not been proven and indeed it looks to be difficult to square with recent work in social and cognitive psychology.

11.4 Weckert and Moor

John Weckert and Jim Moor claim that we can resolve the PP paradox by invoking the distinction between positive, negative and intermediate duties (2006: 200). They set up the paradox as follows:

1. Action A1 might cause bad effect Eb1 (harm eventuates because of A1)
2. Remedy R1 (don't do A1) stops Eb1 (PP applied)
3. But suppose that A1 causes good effect Eg1 (Eg1 eliminates some harm)
4. Then R1 stops Eg1 (harm eventuates because of R1)

5. 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) (Weckert and Moor, 2006: 197).

Weckert and Moor go on to argue that there is an in principle way of choosing between applying the PP to A1 and R1 (2006: 199). We have positive duties to do good and negative duties not to harm. As they note, it is widely held in moral philosophy that negative duties are generally more compelling than positive duties. Failing to save the life of a drowning child in our immediate vicinity, when we could easily do so, is a reprehensible omission. But causing a child to drown is worse. As well as positive and negative duties there are intermediate duties. These are duties to 'avert harms that one's past conduct may cause in the future . . .They are positive insofar as they require the agent to do something and negative insofar as this requirement is continuous with the duty to avoid causing harm to others' (Pogge, 2005: 34). If we were instrumental in causing a child to be in a position where she was drowning – for example, by removing a sign that she might have seen, warning of the presence of deep water – then we have a more compelling duty to save her life than we would if we had simply stumbled across her while she was drowning.

A ranked order of positive, negative and intermediate duties can be used as a way of avoiding paradoxical conclusions issued by the PP in circumstances where the application of the PP leads to conflicting policy recommendations, and in which the implementation of those conflicting policy recommendations can be understood as involving different types of duties.[13] So Weckert and Moor are right that their approach can lead to a resolution of at least some paradoxes that are thrown up by the application of the PP. But does their approach provide solutions to all instances of the PP paradox, as they appear to claim? And for the cases that it does provide solutions, are these satisfactory solutions? I will argue that the answer to both of these questions is no.

The Weckert-Moor solution to the PP paradox is of no help in cases where conflicting duties are of a similar type. In cases where we have a negative duty to perform action x and a negative duty to perform action ∼x or an intermediate duty to do x and an intermediate duty to do ∼x then the Weckert-Moor solution does not relieve us from paradox. Are there such cases? Yes there are. Manson's (2002) aforementioned example in which the US Government is faced with the dilemma of whether or not to comply to the Kyoto protocol appears to be one such case. It seems that the US 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

[13] Weckert and Moor (2006: 199) attribute the view that intermediate duties are stronger than positive duties and weaker than negative duties to Pogge (2005). However, in the passage that they quote Pogge (2005: 34) only claims that intermediate duties are more stringent than positive duties. He makes no claim there about their strength relative to negative duties.

that civilians will be required to endure. As the US 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.

Perhaps the reason that Weckert and Moor fail to consider Manson's well known example is that the way that they set up the PP paradox is consistent with Sunstein's (2005) formulation rather than Manson's (2002) formulation. They stipulate that the paradox occurs in cases where taking a precautionary action causes harm in so far as it prevents a 'good effect'. Typically, the avoidance of harm, being a negative duty is more important than the failure to cause benefit, which is usually the failure to perform a positive duty. So in standard cases, under this formulation of the paradox, we have a means of resolution. However, in cases that do not fit Weckert and Moor (2006) and Sunstein's (2005) formulation of the paradox, where the harms in question go beyond the mere failure to provide benefits, we are liable to be faced with a comparison of instances of the same type of duty.

Weckert and Moor (2006) are right about this much; it is commonly accepted in moral philosophy that, all things being equal, negative duties and intermediate duties are more important than positive duties. But not many moral philosophers are willing to allow that negative duties are always more important than intermediate duties and that these are always more important than positive duties.[14] Consider a case in which causing an innocent person to be harmed will save many innocent lives. 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. Negative and intermediate duties may generally be more compelling than positive duties, but they do not always outweigh them. 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. Weckert and Moor's solution to the PP paradox seems attractive in large part because it introduces a simple test to resolve the PP paradox. However, this simple test is not realistic. The weighing of different types of duties requires judgment and invites disagreement. So, on their solution, the PP would not provide clear guidance to decision makers. Instead, decision makers would have to make a delicate and possibly controversial moral judgment, in order to implement the PP.

[14] Indeed Pogge, whom they cite as the source of the distinction between positive, intermediate and negative duties is at pains to insist, against earlier critics, that he does not intend that negative and intermediate duties are always more important than positive duties (2005: 34–35).

11.5 Gardiner and the Rawlsian Core Precautionary Principle

Recently Stephen Gardiner (2006) has proposed a new form of the precautionary principle, which he refers to as the 'Rawlsian Core Precautionary Principle' (RCPP).[15] The RCPP is based on John Rawls (1999) maximin principle. To apply maximin one compares the worst potential outcomes of a range of possible policies and selects the policy which has the least bad worst potential outcome (Gardiner, 2006: 45). RCPP is significantly more precautious than wPP. It is closer in spirit to sPP than wPP because decisions under RCPP turn on a consideration of risks and not on a balancing of risks and benefits.

Applications of maximin appear to proceed quite differently from applications of the PP, conventionally understood, and some critics have complained that a principle based on maximin would be too different from standard instances of the PP to count as a genuine instance of the PP.[16] Whether or not RCPP is best understood as a form of the PP or an alternative to the PP, it has a clear advantage over all other forms of the precautionary principle because it is a comparative principle. Under RCPP we compare a range of policy alternatives and select one of them.[17] So we are able to avoid the paradox that arises when we employ a strong version of the PP.

Maximin is often objected to on the grounds that it seems to produce the wrong result if applied in circumstances in which benefits matter. Consider the following example due to Harsanyi (1975).

> Suppose you live in New York City and are offered two jobs at the same time. One is a tedious and badly paid job in New York City itself, while the other is a very interesting and well-paid job in Chicago. But the catch is that, if you want the Chicago job you would have to take a plane from New York to Chicago (e.g., because this job would have to be taken up the very next day). Therefore there is a very small but positive probability that you might be killed in a plane accident. (Harsanyi 1975: 39)

An application of maximin in this example would lead to the counterintuitive recommendation that you should remain in the tedious and badly paid job in New York. Rawls (1999) and Gardiner (2006) do not dispute that maximin would deliver the wrong result if applied in the above scenario. Instead they argue that maximin should only be applied in a limited range of circumstances that does not include the above example.

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[15] An earlier proposal to base the PP on maximin is due to Hansson (1997).

[16] See Sandin (2007: 102) and Sunstein (2005: 61).

[17] It may not always be possible to make clear comparisons, because the least bad worse potential outcomes of some of the competing policy options may be incommensurable. One policy option in climate management might have extreme global warming as its wost outcome, while another may have extreme famine as its worst outcome. We may be unable to agree as to whether extreme global warming is a worse outcome than extreme famine and there may be no rational way of comparing these two worst potential outcomes. Thanks to the editors for pointing out the importance of this issue.

Gardiner paraphrases Rawls, who identifies three conditions of applicability as follows:

[1] . . . decision makers either lack, or have reason to sharply discount, information about the probabilities of the possible outcomes of their actions.
[2] . . . the decision makers care relatively little for potential gains that might be made above the minimum that can be guaranteed by the maximin approach.
[3] . . . the decision makers face unacceptable alternatives (rejected alternatives have outcomes that one can hardly accept) (Gardiner, 2006: 47).

Gardiner then adds a fourth criterion of acceptability to the RCPP, which is that we should only consider uncertain but realistic outcomes, and not unknown theoretical outcomes (2006: 51–52). This criterion is brought in to head off the objection that like sPP, RCPP can counsel us to act to avoid very unlikely but possibly catastrophic, purely theoretical outcomes. Gardiner does not make much headway in the tricky task of finding a principled way of distinguishing between realistic and unrealistic outcomes, as he himself admits (2006: 52).[18]

The main problem with RCPP is that it appears only to be applicable in a range of circumstances that is much narrower than the range of circumstances in which proponents of the PP usually attempt to apply the PP. The most limiting of the four conditions of applicability is [2], the stipulation that decision makers must happen to 'care relatively little for potential gains'. Often times the PP is invoked when decision makers do care about gains, but nevertheless argue that we should set consideration of these aside and focus on potential losses. Consider, for example, debates about GM foods, a context in which the PP is frequently invoked. Proponents of GM foods sometimes argue that GM crops offer the potential to allow humanity to obtain a state of global food security and that this benefit outweighs any potential risks that the production of GM crops may lead to. Opponents of GM crops do not argue that we should care relatively little for global food security. Instead they argue that the chance of this occurring is low and that the risks of allowing GM crops to be grown are more significant and more likely to be realised than proponents of GM crops allow.

Gardiner is aware that this example does not appear to meet his conditions of applicability, but he suggests that appearances have deceived in this case. According to Gardiner, arguments by opponents of GM crops, for the claim that GM technology is unlikely to lead to global food security, as well as arguments for the claim that global food security could be obtained without the use of GM crops can be understood as arguments about whether condition [2] holds or not (Gardiner, 2006: 56). In other words, opponents of GM crops who appear to be arguing that GM crops are unlikely to bring about the desired aim, and unnecessary for the achievement of that desired aim are actually arguing that the desired aim is one that we should

[18] He is far from alone in this regard. For criticism of other attempts to make this distinction see Clarke (2005: 123–124) and Majone (2002: 104).

'care relatively little for'. This strikes me as a highly implausible way to understand these debates. The fact that opponents of GM crops go to some lengths to try to persuade us that GM crops will not provide global food security and that we could achieve it by other means suggests to me that they think this aim is one that we should care about a great deal, and they wish to rebut arguments due to proponents of GM crops who hold out the possibility of achieving an aim that almost everybody cares a great deal about. Contra Gardiner, RCPP is not applicable in this case, where the PP is often appealed to, and it is probably not applicable in many other such cases.

11.6 Conclusion

We have examined different forms of the PP, with a view to seeing if any of these would be suitable, *inter alia*, for the regulation of new technologies. Weak versions of the PP may be suitable, but they are not importantly different from CBA. Strong versions of the PP lead us to paradoxical outcomes if applied consistently. We examined Weckert and Moor's (2006) attempt to resolve the PP paradox and found it to be unsuccessful in important cases, and difficult to implement. Gardiner's (2006) attempt to rejig the PP on the basis of Rawlsian maximin was somewhat more successful. However, it appears that this solution is only applicable in a range of circumstances that is much narrower than the range of circumstances in which appeals to the PP have typically been made.

Advocates of wPP are often motivated by a concern that CBA is sometimes applied too narrowly. They are probably right to be so concerned. There are those who have wanted to insist that evidence of risk of potential harm must be conclusively established before it can be utilised in CBA and if they were to have their way then CBA would be applied extremely narrowly.[19] Despite their use of the term 'the precautionary principle', advocates of wPP are not establishing a new principle of risk management. Instead they are proposing ways to ensure that current tools of risk management are used properly. Advocates of versions of sPP really are proposing a genuine alternative to CBA, but it is a flawed alternative as it leads to paradox, if applied consistently. I do not want to rule out the bare possibility of this problem being overcome, but current efforts do not appear promising. The most successful attempt is that due to Gardiner (2006). However, Gardiner has had to resort to radical surgery to save sPP – turning it into a variant of maximin – and even this is only applicable in a very narrow range of cases, much narrower than the range of cases in which advocates of sPP have attempted to apply sPP.[20]

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[19] According to Cranor (2004), Frank Cross takes this view.

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