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AGAINST BROOME'S "AGAINST DENIALISM"

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IMAGINE that on a Sunday afternoon, I take a ride in my SUV just to enjoy myself. I could have easily not taken the ride and done nothing. (I will refer to this case as *Joyride*.) Call those who defend *individual denialism* (ID)—the claim that current humans (in some sense) do no wrong by not refraining from performing acts that emit insignificant or small amounts of greenhouse gases (call such acts *GHG acts*)—individual deniers.[1] An individual denier holds, for example, that I did no wrong in Joyride. Positions in the neighborhood of ID have recently been defended by Walter Sinnott-Armstrong, Elizabeth Cripps, Aaron Maltais, and Ewan Kingston.[2] ID has recently been argued against by John Broome.[3]

In this paper, I critically evaluate Broome's argument against ID. He argues that the claim that individual emissions "do no harm is not true in general."[4] I proceed as follows. In section 1, I clarify, isolate, and present Broome's argument. Sections 2–4 contain three problems for Broome's argument. I argue that Broome's argument overgeneralizes (section 2), is in tension with his defense of carbon offsetting (section 3), and uses problematic assumptions (section 4). Section 5 closes.

Before I start, a preliminary. In the literature, ID is expounded in various ways. Some use the language of obligations. For example, Aaron Maltais notes that "obligations to reduce one's greenhouse gas emissions appear to be difficult to justify."[5] Others use the language of (partial or group) causation. For example, Casey Rentmeester writes that "an individual drive does not itself cause climate change, but it is certainly a … factor."[6] Still others use the language

1 "Small" is important in the formulation because even individual deniers will say that I do wrong if I commit acts that produce enormous amounts of emissions.

2 Sinnott-Armstrong, "It's Not My Fault"; Cripps, *Climate Change and the Moral Agent*; Maltais, "Radically Non-Ideal Climate Politics and the Obligation to at Least Vote Green"; Kingston and Sinnott-Armstrong, "What's Wrong with Joyguzzling?"

3 Broome, *Climate Matters* and "Against Denialism."

4 Broome, "Against Denialism," 110.

5 Maltais, "Radically Non-Ideal Climate Politics and the Obligation to at Least Vote Green," 589.

6 Rentmeester, "Do No Harm," 16.

of contribution. For example, Melissa Lane notes that "every single emission contributes to the composite problem, which is made of trillions of tiny emissions."[7] Since my aim in this paper is to critically evaluate Broome's argument against ID, I grant him his formulation. According to Broome, ID is the thesis that "individual human beings do [no] harm by their emissions."[8] I think that Broome's argument against ID can be objected to on the ground that Broome's construal of ID is inaccurate, but this is a critique I will not develop further.

1. BROOME'S ARGUMENT

1.1. Two Mistakes

Broome, in his "Against Denialism," argues against ID by noting that the individual denier goes wrong in two respects. First, she fails to consider that what matters in issues of uncertainty is not the actual goodness (or value) of the outcomes of an action, but the expected goodness of the outcomes:

> In the face of uncertainty . . . what you ought to do depends, not on the goodness of actual results, which you cannot know, but instead on the goodness of the "prospect" that each of your alternative acts leads to. A prospect is a portfolio of all the various outcomes that might result from an act, each associated with its probability of happening.[9]

Broome cashes out the goodness of an act's prospect in terms of expected utility theory (EUT).[10] In EUT, the *ex ante* value of (the prospect of) an act is its expected value, where the expected value of an act is the sum of the product of the probability of each possible outcome of the act and the value associated with that outcome.[11] That is:

$$Exp(A) = \sum_j P(A\Box \rightarrow O_j)V(O_j).$$

7 Lane, *Eco-Republic*, 59.

8 Broome, "Against Denialism," 110.

9 Broome, "Against Denialism," 114.

10 There are many versions of EUT, including ones that give plausible results in infinitary scenarios (Easwaran, "Strong and Weak Expectations"; Thalos and Richardson, "Capitalization in the St. Petersburg Game") and those that permit different risk attitudes (Buchak, *Risk and Rationality*). For surveys, see Buchak, "Decision Theory"; Briggs, "Normative Theories of Rational Choice"; and Thoma, "Decision Theory."

11 What follows is the causal decision theory version. One can also provide an evidential decision theory version (see Ahmed, *Evidential Decision Theory*, for a thorough treatment). The differences are inessential to my argument.

A consequentialist (like Broome) takes the further step and holds that an agent ought not to do an act iff there is an alternative that has a higher *ex ante* value.

Second, according to Broome, the individual denier errs in being ignorant of the chaotic nature of weather systems. Broome contends that "most writing on the ethics of climate change ignores the instability of the atmosphere."[12] "Chaotic" is a technical term and is usually used to describe nonlinear deterministic systems that are highly sensitive to initial conditions. Although a chaotic system is deterministic—that is, it follows a unique evolution fixed by the dynamics and the initial conditions—its final state is taken to be unpredictable. Importantly, a chaotic system (or any deterministic system for that matter) cannot evolve to become a nondeterministic system. The unpredictability of a chaotic system is not ontic: given initial conditions and dynamics, a chaotic system—*qua* a deterministic system—will after time *t* end up in a unique final state. The unpredictability is epistemic: given initial conditions and dynamics, it is not always possible to tell in which state a chaotic system will end up after *t*.[13]

I turn to presenting Broome's argument next.

1.2. Broome's Challenge

Broome founds his challenge to ID on the two mistakes mentioned above. Although in "Against Denialism," Broome is concerned with arguing against specific defenses of ID (particularly Kingston and Sinnott-Armstrong and Cripps), a general argument against ID can be isolated.[14] According to Broome, given the unstable nature of the atmosphere, the outcomes of a GHG act may result in a different weather condition than the condition that would have occurred had the GHG act not been committed. He writes, "Given the atmosphere's instability, we should expect global weather in a few decades' time to be entirely different if you go joyguzzling on Sunday from what it would have been had you stayed at home."[15] These different conditions, given the chaotic nature of the atmosphere, may result in states that are completely different in their goodness than other states:

12 Broome, "Against Denialism," 113.

13 This is an informal and rough gloss. For a more detailed and careful introduction of chaos, see Strogatz, *Nonlinear Dynamics and Chaos*. Batterman, "Defining Chaos"; Bishop, "Metaphysical and Epistemological Issues in Complex Systems"; and Bishop, "Chaos," provide good introductions to issues of chaos in philosophy of science.

14 Kingston and Sinnott-Armstrong, "What's Wrong with Joyguzzling?"; Cripps, *Climate Change and the Moral Agent*.

15 Broome, "Against Denialism," 113.

> Increasing emissions … will cause typhoons to form at quite different times and places, and it will lead to a completely different distribution of cholera outbreaks. Your Sunday drive will cause a completely different group of people to be exposed to cholera and other risks of death. Some who would have died will survive because of your drive, and others who would have survived will die.[16]

We do not know whether the state resulting from the outcomes of a GHG act will be good or bad: "When you consider whether or not to joyguzzle … you cannot know what good or harm will actually result from what you do. The result may be a typhoon or a child's death, or it may be good."[17] What we do know is that our GHG act will have some effect: "There is literally zero probability that [it] will do no harm and no good.… Also, there is about equal probability that it will do good as that it will do harm."[18] And the expected value of a GHG act will be lower than the expected value of not committing a GHG act because GHG acts cause harms in expectation. Broome bases the expected harm of a GHG act on the social cost of carbon: "Your joyguzzling on Sunday afternoon creates a prospect that has a positive expectation of harm to other people. Its expectation of harm is *given by the [social cost of carbon], which measures the average*, or expected, harm done by emissions of carbon dioxide" (emphasis mine). Since GHG acts result in expected harms, ID is incorrect: "Your act may or may not do harm, but it certainly creates an expectation of harm. Individual denialists [do] not claim merely that your emissions may not do harm, which is true. They claim they actually do no harm, which is not true in general."[19]

In premise-conclusion form and a bit more filled in, Broome's argument is:

P1. If the atmosphere is a chaotic system, then small changes in the state of the atmosphere at one time may lead to drastically different states of the atmosphere at a future time.
P2. *Unpredictability*: If the atmosphere is a chaotic system, we cannot know what the state of the atmosphere will be at a future time given a small change in the state of the atmosphere at a previous time.
P3. *Appropriate*: In decisions under uncertainty, we should appeal to expected utility theory.

16 Broome, "Against Denialism," 113.

17 Broome, "Against Denialism," 114.

18 Broome, "Against Denialism," 113.

19 Broome, "Against Denialism," 115. As I noted in the introduction, it is not obvious that individual deniers will accept Broome's characterization of ID.

P4. *Diff*: The drastically different states of the atmosphere resultant from small changes in the atmosphere correspond to states of affairs that may differ drastically in their goodness.[20]
P5. The atmospheric system is chaotic.
P6. GHG acts lead to small changes in the state of the atmosphere.
C1. GHG acts lead to drastically different states of the atmosphere that correspond to states of affairs that may differ drastically in their goodness. (from P1, P5, P6, and Diff)
C2. We cannot know what the state of the atmosphere will be at a future time given a GHG act at a previous time. (from Unpredictability and P5)
C3. In the decision of whether to commit a GHG act, we should appeal to expected utility theory. (from C2 and Appropriate)
P7. *Risk*: Under expected utility theory and given C1, GHG acts lead to a net expectation of harm.[21]
P8. ID denies that GHG acts lead to any harm.
C4. ID is incorrect. (from C3, Risk, P8)

I think that problems can be raised against many steps in this argument. For example, one may deny Appropriate by claiming that EUT (or at least standard EUT), which does not allow for differences in risk attitudes or discount for negligible probabilities, produces paradoxical results. One may maintain that in cases of uncertainty—especially when the probabilities associated are minuscule—we should eschew standard EUT. Monton considers infinite St. Petersburg paradox like cases and argues that it is irrational to take into account

20 See the passage from Broome ("Increasing emissions … will die"), quoted earlier in this section, where he seems committed to Diff. Indeed, it seems that something like Diff is indispensable to anyone who is sympathetic to Broome's argument. In other places in "Against Denialism" and in *Climate Matters* (see esp. ch. 7), Broome seems to assent to principles in the neighborhood of Diff.

21 See the quote from Broome ("Your joyguzzling … carbon dioxide") earlier in this section where Broome seems committed to Risk. As with Diff, Broome assents to Risk in *Climate Matters*. He writes:

> Expected value theory tells us that, in assessing the badness of climate change, we have to think in terms of expectations. The expectation of harm caused by a catastrophe is the badness of the catastrophe multiplied by the very small probability that it will happen. … The most likely result of climate change is warming of a few degrees. But the view is that the possible catastrophe of a greater increase would be so bad that, even multiplied by its very small probability, its expected badness is more important than the harm that would be caused by this most likely result. (Broome, *Climate Matters*, 131)

small probabilities in our calculations.[22] Russell argues against Appropriate in the context of longtermism.[23] Decision-theoretic worries aside, one may deny Broome's argument on physical grounds. For example, recent works in the philosophy of physics problematize Unpredictability. In a series of papers, Werndl argues that the issue of unpredictability in climate science is much more nuanced than previously appreciated.[24] I think these points are—or at least can be converted into—powerful objections against Broome's argument. However, in this paper I will focus on Diff and Risk.

In the rest of the paper, I discuss reservations with Risk, arguing in section 2 that it leads to a problem of overgeneralization and that it is unstable, and arguing in section 3 that it is incompatible with Broome's appraisal of carbon offsetting. I discuss a reservation with Diff in section 4.

2. OVERGENERALIZATION AND INSTABILITY

Here is a compelling principle:

> *Restrict*: Any account that denies ID must not be so restrictive that, on the account, an agent is required not to ϕ, when ϕ–ing is uncontroversially taken to be morally permissive.

An example of an uncontroversial act that is morally permissive is breathing continuously. I hope that this is uncontroversial: it would be incredibly strange to say that I ought not to breathe continuously if I can skip some breaths. But I submit that on Broome's argument, I do wrong when I do not skip a breath whenever I can; I do wrong when I exercise (other things being equal) because a human engaged in exercising produces (on average) up to eight times the CO_2 emissions of a sedentary human; I do wrong when I play the clarinet or perform any activity that increases my greenhouse gas emissions (other things being equal).[25]

22 Monton, "How to Avoid Maximizing Expected Utility."

23 Russell, "On Two Arguments for Fanaticism." See Wilkinson, "In Defence of Fanaticism," for a defense of fanaticism in the context of longtermism.

24 Werndl, "What Are the New Implications of Chaos for Unpredictability," "On Defining Climate and Climate Change," and "Initial-Condition Dependence and Initial-Condition Uncertainty in Climate Science."

25 Palmer, "Do We Exhale Carbon?" See also Sinnott-Armstrong, "It's Not My Fault," 301–2, where Sinnott-Armstrong makes a similar remark about exercise counting as a moral wrong if one denies ID. However, he does not take into account the chaotic and unpredictable nature of the atmosphere—one of Broome's major points in "Against Denialism."

Broome's argument is insensitive to the difference between the wrongness of a GHG act and the wrongness of a morally unproblematic act. What goes for a GHG act also goes for an act like breathing continuously. Consider:

BID-*n*: In taking every *n*th breath, an individual does no expected harm.

Steps after P6 in Broome's argument can be suitably modified to give an argument requiring an individual to skip, say, every *n*th breath:

P6*. Every *n*th breath I take leads to small changes in the state of the atmosphere.
C1*. Every *n*th breath I take leads to drastically different states of the atmosphere that correspond to states of affairs that may differ drastically in their goodness.
C2*. We cannot know what the state of the atmosphere will be at a future time given that I breathe at a previous time.
C3*. In the decision of whether I should take every *n*th breath, we should appeal to expected utility theory.
P7*. *Risk**: Under expected utility theory and given C1*, every *n*th breath I take leads to a net expectation of harm.
P8*. BID-*n* denies that breathing acts lead to any expected harm.
C4*. BID-*n* is incorrect.

This, I think, is a highly undesirable consequence of Broome's argument. In focusing only on the expected harm and arguing that an individual ought not to perform an act only because of its expected harm, Broome's account fails to satisfy Restrict.

Climate scientists and policymakers usually explain why breathing does not contribute to climate change by appealing to the fact that respiration is part of a closed-loop cycle—that is, respiration is part of a cycle that, on net, is (approximately) carbon neutral. The closed loop includes CO_2 absorption by plants. Humans—like other animals—are a carbon sequestration machine, albeit a very slight one.[26] But this reply is not available to Broome. The material facts of an act of emission are of no consequence in Broome's view. All that matters, as I noted above, is whether the act of emission has expected harm.

For Broome, an act of emission has expected harm even if the emissions are insignificant. In arguing against the insignificance of a particular GHG act, Broome argues both that an act that produces insignificant harms cannot have zero expected harms because "only zeros add up to zero" and that a proponent of

26 Schwarcz, "Why Isn't the Carbon Dioxide from Breathing a Concern for Global Warming?"; Withers, "How Much Does Human Breathing Contribute to Climate Change?"

ID "must say that . . . emissions do no harm at all."[27] But if the only thing that matters is that an act has expected harm of zero, then we should refrain from committing any number of activities—including breathing—because even though the expected harm of the CO_2 emitted when I breathe is extremely small, it is not zero.

It is estimated that every day an average human emits about one kilogram of CO_2.[28] Numbers are inessential to Broome's argument. Suppose that I breathe m times in a day and that I can—without any effect on me—skip taking a breath once every two days. I will not contribute $1/2m$ kilograms of CO_2 into the atmosphere per day. Since Broome maintains that I cannot know whether this particular emission will "trigger a jump" to an extremely bad state of affairs that includes floods, famines, and so on, I must base my decision of whether I should exhale this particular breath on the expected harm related to this act. As I noted above, there is some (maybe extremely tiny) expected harm associated with my exhaling this particular breath. I should, Broome must say, refrain from breathing once every two days. This is an extreme consequence, and I submit that any account that supports such a consequence must be dismissed.

But this is not all. Broome's account has another distasteful consequence: it is *unstable*. A Broome-style argument can be used to show that the action Broome's account recommends is itself an action that leads to expected harms. That is, a Broome-style argument can be given to show that in refraining from committing a GHG act, an agent does harm in expectation. Consider

NID: In not committing a GHG act, an agent does no expected harm.

Call the omission of a GHG act a *non-GHG act*.[29] To be sure, by a "non-GHG act" and by "not committing a GHG act," I mean the non-doing of a GHG act. For example, if instead of taking the ride in my SUV in Joyride, I do not take the ride, I commit a non-GHG act. A Broome-style argument can then be run to show that NID is incorrect.[30] Steps P6 onward in Broome's argument against ID can be suitably modified as:

27 Broome, "Against Denialism," 122.

28 Palmer, "Do We Exhale Carbon?"

29 This should not be read as any endorsement of whether an omission is an act or whether an omission can cause something else to be the case. For positions arguing against causation by omission, see Beebee, "Causing and Nothingness"; and Moore, *Causation and Responsibility*. For positions arguing for causation by omission, see Lewis, "Causation as Influence"; Lewis, "Void and Object"; Schaffer, "Causation by Disconnection"; and Schaffer, "Causes Need Not Be Physically Connected to Their Effects." And for positions arguing that omissions can cause something to be the case but that omissions have an inferior causal status, see Dowe, *Physical Causation*; and Hall, "Two Concepts of Causation."

30 Thanks to an anonymous reviewer for advising me to expand this point. The reviewer also raised a worry that if "non-GHG acts" is read this way, P6** may be contentious, especially

P6**. Every non-GHG act leads to small changes in the state of the atmosphere.
C1**. Non-GHG acts lead to drastically different states of the atmosphere that correspond to states of affairs that may differ drastically in their goodness.
C2**. We cannot know what the state of the atmosphere will be at a future time given a non-GHG act at a previous time.
C3**. In the decision of whether to commit a non-GHG act, we should appeal to expected utility theory.
P7**. Under expected utility theory and given C1**, non-GHG acts lead to a net expectation of harm.
P8**. NID denies that non-GHG acts lead to any harm.
C4**. NID is incorrect.

This makes Broome's account critically unstable. If we are to agree with Broome, we (do harm in expectation and hence) do wrong by both committing and not committing a GHG act. I submit that this consequence is sufficient to dismiss Broome's argument.

3. TENSION WITH OFFSETTING

I now turn to another problem with Risk. Risk is in tension with Broome's defense of offsetting our carbon emissions. In *Climate Matters*, Broome notes that the "most effective way of reducing your emissions to zero is to cancel or offset the emissions" and that "offsetting is the way you can fulfil your duty of justice."[31] He takes offsetting to be any action that removes greenhouse gases

if "lead to" is read in causal terms. The point I want to make in P6** is not that the absence of a GHG act will lead to (or cause, partially or otherwise) changes in the atmosphere. That will commit me to some form of causation by omission. What I want to say in P6** is a bit more modest: whatever action an agent does instead of performing the GHG act will inevitably have some impact on the distribution of greenhouse gases and hence will lead to (or cause, partially or otherwise) changes in the atmosphere. It is in this sense that every non-GHG act leads to changes in the state of the atmosphere. Consider Joyride. As I set it up in the introduction, I commit a GHG act in Joyride because I take a ride in my SUV. Now consider the modified version of Joyride I mentioned in my discussion of non-GHG acts. If I refrain from taking the ride in my SUV, I commit a non-GHG act. But not taking a ride (i.e., a non-GHG act) will lead to (or cause, partial or otherwise) changes in the state of the atmosphere. For example, instead of taking the SUV ride, I might take the bus or walk or decide to stay in my room. Whatever I do (e.g., when I breathe), I change the state of the atmosphere in some way. It is in this way I want to read P6**. And it seems to me that read this way, P6** is not very contentious.

31 Broome, *Climate Matters*, 80.

from the atmosphere. According to Broome, an individual does "no harm by emissions" if they "successfully offset all" of their emissions, although he considers some concerns about the idea of offsetting. He writes: "I am not recommending offsetting to governments; I am recommending it only to individuals as a way of acting justly. . . . Private offsetting is a means by which each person can avoid causing harm to others."[32] He notes in "Against Denialism" that "once carbon dioxide is in the atmosphere, some fraction of it remains there in effect forever," and he says in *Climate Matters* that "once you have put a tonne of carbon dioxide molecules into the atmosphere, those molecules will wreak their damage."[33] But in justifying offsetting, he further claims:

> If at the same time you remove the same number of other carbon dioxide molecules, you prevent those ones from wreaking damage. Your overall effect is zero. As far as the climate is concerned, emitting a tonne of carbon dioxide and offsetting it is exactly as good as not emitting it in the first place, providing the offset is genuine.[34]

But this seems at odds with his argument against ID, especially Risk.[35] Broome's argument is insensitive to any kind of offsetting. Once a GHG act has been committed and some amount of greenhouse gases have been added to the atmosphere, the expected harm of the act cannot be changed. Even if offsetting removes the same (or indeed even if it removes a greater) amount of greenhouse gases, Broome must say that the GHG act ought not to be committed. Broome's argument against ID makes offsetting or any kind of carbon-canceling principle otiose. The only way for offsetting (of a GHG act *G*) not to be in tension with Broome's account is for offsetting to guarantee that it instantly takes out from the atmosphere the particular greenhouse gas molecules emitted because of *G*. This is impossible. Broome's argument may block ID, but it makes his own views untenable.

The force of my objection against Broome can be appreciated in another way. In justifying and defending offsetting, Broome is appealing to a principle along the following lines:

> *Aggregate*: The overall effect due to a GHG act *G* is fully grounded on facts about the change in the total amount of greenhouse gases in the atmosphere due to *G*.

32 Broome, *Climate Matters*, 94–95.

33 Broome, "Against Denialism," 118.

34 Broome, *Climate Matters*, 118.

35 See Campbell, "Offsetting, Denialism, and Risk," for a similar observation but a different line of argument to show the tension between offsetting and Broome's argument against ID.

When Broome writes that "if . . . you remove the same number of other carbon dioxide molecules, you prevent those ones [i.e., the ones from a GHG act] from wreaking damage," Broome appeals to Aggregate. However, it seems that Aggregate stands in stark tension to his argument that due to the chaotic and unstable nature of the atmosphere (and Diff), a GHG act will produce expected harm, however one compensates for it. Consider Joyride. When you drive your gas-guzzler for fun, your emissions of greenhouse gases will create atmospheric disturbances that may cause significant changes in large-scale meteorological events, some of which may result in harm that would not otherwise have occurred. Offsetting your emissions probably would not undo these effects. Insofar as offsetting would also cause (sufficiently large) atmospheric disturbances, offsetting would probably also inflict harm that would not otherwise have occurred.[36] Here again, instability looms.[37]

Contra Broome, it is difficult to claim, given his own argument against ID, that adding greenhouse gases and then removing the same amount of greenhouse gases (and not the same greenhouse gases) from the atmosphere does not result in any harm.

4. AGAINST DIFF

Recall Diff. In the case of GHG acts and given P6, Diff gives us:

> *Diff-G*: The drastically different states of the atmosphere resultant from GHG acts correspond to states of affairs that may differ drastically in their goodness.

Given the atmosphere's chaotic nature, Diff-*G* seems like a reasonable premise. After all, since a chaotic system is sensitive to initial conditions, the minutest change in the composition of the environment may lead to completely divergent final states. However, I think that this is a bit quick. I present two reasons for my trepidation.[38]

36 As an anonymous reviewer helpfully points out, offsetting itself requires acts such as planting trees and rainwater harvesting that will need one to commit GHG acts.

37 Elliott Thornley raises the point that offsetting might lower the expected harm of my life overall and that it might also cause benefits that would not otherwise have occurred. Agreed. But these points can also be made in favor of GHG acts. A GHG act may also cause benefits that would not have occurred, and due to the chaotic nature of the atmosphere, it might also lower the expected harm of my life overall. Broome designs his argument to deny individual deniers this strategy. But in doing so, he also denies helping himself to this strategy to defend offsetting.

38 Diff—at least as it stands—can also be challenged on the grounds of the existence of carbon reservoirs. One can argue that not all the emissions from a GHG act are absorbed

First, observe that Broome's argument has nothing to do with climate change *per se*. Broome's argument is independent of the issues of climate change or global warming. Broome's argument only turns on decision-making under uncertainty. In our case, it is decision-making about committing a GHG act under the instability of the weather. This feature makes the scope of Broome's argument quite wide. It seems that his argument against ID is insensitive to particular issues of climate change. I leave it to the reader to judge how bad such a consequence is for Broome's account.

My second reason against Diff is more direct. I think Diff-*G* is question begging. According to Broome, the expected goodness of different states due to a GHG act is measured by the social cost of carbon (SCC), which represents "the present discounted value of the additional social costs (or the marginal social damage) that an extra tonne of carbon released now would impose on the current and future society."[39] Putting SCC and Diff-*G* together gives:

> GHG acts at time *t* lead to drastically different states of the atmosphere that correspond to states of affairs that may differ in their goodness, where the goodness of a state of affairs can be measured (or represented) by a function of the amount of CO_2 in the atmosphere at the state and the SCC at *t*.

According to Broome, whether an agent should commit a GHG act then boils down to whether the SCC associated with the act is positive. If it is positive, then the act is associated with expected harm and thus the agent should refrain from performing it:

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by the atmosphere; rather, the (extremely) vast majority of these emissions are absorbed by deep oceans. Indeed, environmental economists working on calculating the social cost of carbon make this assumption. For example, the influential integrated assessment model Dynamic Integrated Climate-Economy (DICE) developed by William Nordhaus explicitly models the deep oceans as a carbon reservoir (see Nordhaus, *A Question of Balance*; and Nordhaus and Boyer, *Warming the World*). More recently, Golosov et al. write:

> The stock of carbon in the deep oceans is very large compared to the amount in the atmosphere and also relative to the total amount of fossil fuel yet to be extracted. This means that, of every unit of carbon emitted now, only a very small fraction will eventually end up in the atmosphere. Thus, the linear model [such as DICE] predicts that even heavy use of fossil fuel will not lead to high rates of atmospheric CO_2 concentration in the long run. ("Optimal Taxes on Fossil Fuel in General Equilibrium," 64)

I will, however, not engage further with this strand of opposition, in part because Broome maintains that any tiny amount of emissions absorbed by the atmosphere, given the atmosphere's chaotic nature, creates expected harm.

39 Hope and Newbery, "Calculating the Social Cost of Carbon," 10.

> The total benefit of cancelling the emission [i.e., not performing a GHG act] is the integral over all future times of the reduction in harm at each time. This integral is what is measured by the social cost of carbon.... Its total benefit is therefore the integral over an infinite time of a positive amount.... [But] economists who estimate the SCC estimate this integral as finite, because they discount future benefits exponentially. Exponential discounting leads to a convergent integral.... My point in this paper is only that the integral is not zero.[40]

Broome's explication of the SCC as an "integral over all future times of the reduction in harm at each time" is, I think, unclear at best. Rather the SCC (at a time t) is a function of the difference between the harms associated with large-scale emissions activity committed at t and the harms associated with no such large-scale activity. For example, in explaining their Policy Analysis of the Greenhouse Effect 2002 (PAGE) integrated assessment model (IAM), Hope and Newbery write:

> The PAGE model calculates the social cost of carbon (SCC) by finding the difference in the discounted economic cost of climate change impacts between two emission scenarios that are identical except for the emission of an extra one billion tonnes of carbon as CO_2 in 2001 for one of the scenarios. The difference in impacts is divided by one billion to obtain the SCC.[41]

Similarly, Nordhaus's influential DICE IAM defines the SCC at time t as:

$$\mathrm{SCC}(t) := \frac{\frac{\partial W}{\partial E(t)}}{\frac{\partial W}{\partial C(t)}} = \frac{\partial C(t)}{\partial E(t)},$$

where W is a welfare function (which depends on, among other things, population, per capita consumption, and time discount factor), $C(t)$ is a consumption

40 Broome, "Against Denialism," 118.

41 Hope and Newbery, "Calculating the Social Cost of Carbon," 14. Influential IAMs include DICE (Nordhaus, *A Question of Balance*), CETA (Peck and Teisberg, "CETA"), PAGE (Hope, "The Marginal Impact of CO_2 from PAGE2002," "Optimal Carbon Emissions and the Social Cost of Carbon over Time under Uncertainty," and "Discount Rates, Equity Weights and the Social Cost of Carbon"), MERGE (Manne and Richels, "Merge"), FUND (Tol, "On the Optimal Control of Carbon Dioxide Emissions"), and MIT ISGM (Webster et al., "Uncertainty Analysis of Climate Change and Policy Response").

function at t, and $E(t)$ is the total carbon emission function.[42] $E(t)$ is in turn defined as:

$$E(t) := \sigma(t)[1 - \mu(t)]Y(t) + EL(t),$$

where $\sigma(t)$ is the "carbon intensity" due to uncontrolled industrial CO_2 emissions, $\mu(t)$ is the emissions reduction rate, and $EL(t)$ is the exogenous land emissions. Again, as in the case of PAGE, we see that the SCC is calculated, not by considering GHG acts, but by using a unit of emissions due to industrial or large-scale disturbances.

A proponent of ID might already get off the bus because to appeal to the SCC to determine the expected harm of a GHG act seems to beg the question. The individual denier is not necessarily a collective denier, so she will be happy to accept that the SCC provides a measure of the harms caused by humans as a collective. But the individual denier, rightly in my opinion, will deny that it follows from the SCC that a GHG act causes any expected harm.

Moreover, even if one is not antecedently committed to ID, Broome's use of the SCC to argue against ID is problematic. First, his argument commits what Zimmerman and Kaiserman label the pie fallacy, "according to which there is some fixed 'quantity' of responsibility available for every outcome, to be distributed among all those, if any, who are responsible for it."[43] It is not obvious—and Broome must provide additional arguments to support the claim—that there is a fixed amount of responsibility associated with the harms of climate change that should be distributed among individuals. Second, in taking the SCC as the basis for proportioning expected harms among individuals committing GHG acts, Broome is implicitly assuming that moral facts about groups and collectives reduce to or supervene on moral facts about individuals. This is a highly controversial position.[44] Indeed, I think that a central issue in the debate about ID is whether such a reduction is even possible. The proponents of ID may deny it.[45] Broome in using the SCC is begging the question.

42 Nordhaus, "Revisiting the Social Cost of Carbon," 1521.

43 Zimmerman, "Sharing Responsibility"; and Kaiserman, "Responsibility and the 'Pie Fallacy,'" 3598.

44 Recent work in deontic logic proves that given plausible assumptions about group membership, moral facts about groups are not logically reducible to moral facts about individuals. See Tamminga and Duijf, "Collective Obligations, Group Plans and Individual Actions"; Tamminga and Hindriks, "The Irreducibility of Collective Obligations"; and Duijf, Tamminga, and Van De Putte, "An Impossibility Result on Methodological Individualism."

45 Relatedly, a proponent of ID may deny that there is any connection between the phenomenon of climate change due to the aggregate greenhouse gases in the atmosphere and the greenhouse gas molecules that make up the aggregate. For example, Kingston and

Objection: In raising problems against Broome's use of the SCC to evaluate the expected harms of GHG acts, I have concentrated only on the calculation of the SCC by IAMs. Models by their design only provide an approximate measure of harm. Maybe an analytic expression rather than numeric calculation of the SCC will not face the same problems.

Reply: Analytic expressions for the SCC are—like analytic expressions for any complex problem—nonexistent or extremely difficult. In recent years, there has been a growing literature on providing analytic expressions for the SCC, under suitable assumptions.[46] The most prominent expressions are by Golosov et al. and van den Bijgaart, Gerlagha, and Liski.[47] Given certain plausible assumptions, Golosov et al. derive the SCC as:

$$SCC(t) = Y(t)[Exp(\Sigma_{j=0}^{\infty} B^j \gamma_{t+j}(1 - d_j))].$$

The details of the expressions are not important to my point. What is important is the fact that analytic derivations proceed in the same way as the IAMs. They take harm done at a large scale and then calculate the harm done per capita. In the Golosov et al. expression, $(1 - d_j)$ represents "the amount of carbon that is left in the atmosphere" j time steps in the future.[48] Similarly, van den Bihgaart, Gerlagha, and Liski use the global CO_2 stock, defined "over and above the pre-industrial level of CO_2."[49] The problem I raised for IAMs still stands for (at least the current) analytic expressions of the SCC.

Moreover, every model or analytic procedure to calculate the SCC makes use of global temperature patterns. The damage function that "describes the economic impacts or damages of climate change" used in DICE is defined as:

$$\Omega(t) := \frac{D(t)}{1 + D(t)},$$

where

$$D(t) := \psi_1 TAT(t) + \psi_2[TAT(t)]^2.$$

Sinnott-Armstrong argue that it is plausible to think that climate change is an emergent property ("What's Wrong with Joyguzzling?" 175–76).

46 Namely that (i) utility is a logarithmic function of consumption, (ii) current climate damages are proportional to output and are a function of the current atmospheric carbon concentration with a constant elasticity (a relationship that is allowed to vary over time/be random), (iii) the stock of carbon in the atmosphere is linear in past and current emissions, and (iv) the saving rate is constant.

47 Golosov et al., "Optimal Taxes on Fossil Fuel in General Equilibrium"; and van den Bijgaart, Gerlagha, and Liski, "A Simple Formula for the Social Cost of Carbon."

48 Golosov et al., "Optimal Taxes on Fossil Fuel in General Equilibrium," 51.

49 Van den Bijgaart, Gerlagha, and Liski, "A Simple Formula for the Social Cost of Carbon," 77.

and where *TAT* is the global average temperature.[50] Nordhaus writes that "the DICE-2016R model takes globally averaged temperature change (TAT) as a sufficient statistic for damages."[51] Parallelly, Golosov et al. follow Nordhaus in taking the damage function to be (in the first step) "the mapping from carbon concentration to climate (usually represented by global mean temperature)."[52] The individual denier is well within her rights to deny Broome's argument just by pointing out that in using the SCC to argue against ID, Broome is begging the question.

5. CONCLUSION

My aim in this paper has been to critically evaluate Broome's recent argument against individual denialism. By clearly presenting Broome's argument in section 1, I made the target of my criticism clear. In sections 2–4, I raised three problems for Broome's argument. In particular, I showed that Broome's use of Risk overgeneralizes and categorizes even innocuous activities in the same basket as GHG acts. Furthermore, Risk makes Broome's account unstable, making an agent powerless since Broome's reasoning applies equally well to the omission of GHG acts. Risk is also problematic—or so I argued—because it is in stark tension with Broome's defense of offsetting. I also argued against Diff and Broome's use of the SCC by showing that Broome's use of the SCC employs some problematic assumptions.

I close by noting the upshot of my argument on wider issues. The problem of individual denialism is a collective action problem involving tipping points.[53] There are many more problems with a similar structure: voting for a responsible electoral candidate, consuming factory-farmed meat, and checking one's microaggressions, to name a few. Broome's mistake—I suggest—is in neglecting the collective dimension of the problem of individual denialism. By focusing only on individual acts and their (expected) harms, Broome misses what makes the problem of individual denialism puzzling: the complicated interaction between an agent *qua* an individual and the agent *qua* a member

50 Nordhaus, "Revisiting the Social Cost of Carbon," 1519.

51 Nordhaus, "Revisiting the Social Cost of Carbon," 1519.

52 Golosov et al., "Optimal Taxes on Fossil Fuel in General Equilibrium," 50.

53 See Lenton et al., "Tipping Elements in the Earth's Climate System," for a thorough discussion on the tipping points associated with climate change. They list fifteen policy-relevant tipping elements in the climate, where tipping elements are "subsystems of the Earth system that are at least subcontinental in scale and can be switched—under certain circumstances—into a qualitatively different state by small perturbations" (1786). The switch or transition point is defined as the "tipping point."

of a collective. I think that any solution to the problems of voting, individual denialism, consumption of factory-farmed meat, and microaggressions that only appeals to the individual will face analogous problems to the ones I have raised in this paper. It is only in taking the collective dimension of these problems seriously that we can make progress in solving these difficult issues.[54]

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54 See Hormio, "Can Corporations Have (Moral) Responsibility Regarding Climate Change Mitigation?"; and Bowman, "The Relevance of Motivations to Wrongdoing for Contributing to Climate Change," for recent attempts to solve the general problem of ID by taking seriously the collective dimension of ID.

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