The self-indication assumption almost stops the Doomsday argument. Almost.

Note: A revised version of this article is now available at http://www.paul-almond.com/SIA2.pdf or http://www.paul-almond.com/SIA2.doc.

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The Doomsday argument proposes that we can have a reasonable statistical expectation about the remaining lifespan of our civilization from our own position in history. According to the Doomsday argument, we should regard ourselves as typical observers, and it should be unlikely that are we extraordinarily early observers in history and more likely that our civilization will not survive for a long period of time. Many people consider the most promising objection to the Doomsday argument to be the self-indication assumption, which suggests that the probability that you are in a possible world – that it is the real world – is proportional to the number of observers in it. The idea is that each observer in a civilization is like a "slot" that you could have occupied. A successful rebuttal of the Doomsday argument by the self-indication assumption would show that it is more likely that we live in a world which contains more observers due to our civilization lasting for longer. The relationship between observers in impersonal possible worlds and the statistics of your situation is analyzed. Your statistical situation is completely described by the set of observer-centred possible worlds centred on you, and the self-indication assumption would need to imply that the existence of observers in an impersonal world has an influence on the distribution of this set. This is shown to be the case for a general version of the self-indication assumption in which the observers' situations are not specified in detail. Each such observer has a corresponding observer-centred world which is a possible candidate for a you-centred possible world, and therefore may affect the reference class of you-centred possible worlds. This deals with the intuition that something like the self-indication should apply, but it only applies for observers that could actually be you, and observers in the future of your civilization do not meet this requirement. The self-indication assumption therefore fails to refute the Doomsday argument.

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List of Abbreviations

bit	binary digit
SIA	self-indication assumption

1 Introduction

The Doomsday argument is a controversial argument suggesting that, if human civilization will survive for a long time into the future, we are now part of an extraordinarily small proportion of people living very early in history and that, as this is unlikely, it is more plausible that our civilization will not survive long (Carter, 1983; Gott, 1993).

One objection to the Doomsday argument was developed by Dennis Dieks (1992) and is known as the self-indication assumption (SIA) – a name given to it by Nick Bostrom. The self-indication assumption argues that you should consider a civilization in which your own existence was likely more plausible than one in which it was not (Grace, 2010). This is supposed to offset the Doomsday argument and cancel it out.

Many people consider the SIA to be the leading candidate for a rebuttal of the Doomsday argument. This article will be arguing that hoping for the SIA to refute the Doomsday argument is somewhat optimistic. It will be shown that there are some grounds for accepting a limited version of the SIA, but this will not help the SIA to refute the Doomsday argument: in fact, the reverse applies. The version of the SIA which will be shown to be valid will be too weak to refute the Doomsday argument, but by showing that it has some limited validity we will have a situation in which we will have dealt with any intuitive expectation that something like the SIA should apply – and shown that it is inadequate for dealing with the Doomsday argument. This actually makes it *less* likely that there is a stronger version of the SIA out there, waiting to refute the Doomsday argument, as the intuitive support we might have for such an idea has already been examined and found to support something inadequate. Further, the analysis of the relationship between observers in possible worlds and the statistics of your possible situation that we will perform in all this will give enough understanding of the role that observers in possible worlds play in the statistics of your situation to show that it is clearly implausible to fit a version of the SIA which refutes the Doomsday argument into this anywhere. The SIA, as a rebuttal of the Doomsday argument, will be shown to fail.

Note:

A revised version of this article is now available at

http://www.paul-almond.com/SIA2.pdf

or http://www.paul-almond.com/SIA2.doc.

The revised version of the article provides an improved argument that does not need to make reference to “impersonal possible worlds”.

2 The Ultimate Reference Class

2.1 The Need for Something More Basic

The SIA attempts to refute the Doomsday argument by suggesting that you should think in terms of "all the people who could have been you". The problem with any such consideration is that it needs some justification. When we start to consider issues of "what could have been", and the role that "what could have been" should play in any assessment of our current situation, if there is such a role, we need something more basic to which we can relate all this. We need some more basic method of assessing probabilities, at least in principle, which is free of built-in assumptions about "what could have been". We can then see if considerations about "what could have been" are justified by such a method – which will ultimately come down to the question of whether they help us to apply it. The method we need is based on observer-centred possible worlds.

2.2 The Ultimate Reference Class

You know that you exist in reality as an observer. You know things about your local reality – for example, you will know whether, right now, you are looking at a red car or not – but there are things you cannot be sure of – for example, what is happening on distant planets that we have never observed directly or, more specific to this article, whether you are living in a civilization that will last for a long time. There may even be some big questions about the nature of local reality – about which you are not sure. The reason that you cannot be sure is that, at any time, you can only ever have a finite amount of information about your situation, and the type of information that you can have will be restricted according to your situation, while there is an infinity of possible situations: you can never have enough information to select one situation while ruling out an infinity of alternatives.

Suppose you make a list of every possible situation in which you could exist. Each entry in the list is a formal description of some possible situation in which you could be. The situations may vary a lot, but they all have one feature in common: each is consistent, in every detail, with what you know. Each of these descriptions is a possible world, but it specifically describes the world in relation to you, so it is a very specific kind of observer-centred possible world: it is a *you*-centred possible world.

An important feature of this list is that every you-centred possible world in it is a candidate for your situation. The list consists purely of observer-centred possible worlds that *might* be yours, and it contains the descriptions of all such possible worlds. It does not contain any observer-centred possible worlds that "could have been" yours but are not: if you could look at one of these observer-centred possible worlds and realize that it cannot possibly be a candidate for your situation, it is not a you-centred possible world and has no place on the list.

This list of you-centred possible worlds, then, gives you a set, or reference class, of all the possible situations in which you could be. We will call this the *ultimate reference class* and define it as follows.

The Ultimate Reference Class

The ultimate reference class is the set of all formally expressed descriptions of you-centred possible worlds. A you-centred possible world is an observer-centred possible world that is a candidate for your situation, and it is consistent with everything that you know about your situation.

2.3 The Superiority of the Ultimate Reference Class

You will never be able to see all of the ultimate reference class: it contains an infinity of you-centred possible world descriptions and if you programmed some computer to construct all these descriptions, it could never finish in any finite time. Nevertheless, there is a way in which we can meaningfully discuss "access" to the ultimate reference class.

Your situation will correspond to one of the you-centred possible worlds in the ultimate reference class, and there is no justification for preferring one such possible world over another. We might say that each you-centred possible world is equally likely to be yours, but it does not make sense to talk about the probability of selecting a single item from an infinite set. To make the set manageable, in the sense of being something on which you can perform statistical operations, suppose that we limit the set to containing only those you-centred possible worlds with descriptions containing n bits or less of information, and suppose that you can make n as large as you want. As n tends to infinity, this set will start to resemble the infinite set of the ultimate reference class. You can now meaningfully discuss the probabilities of being in various situations. For example, to obtain the probability that it will rain tomorrow, for the set of all you-centred possible worlds with some maximum description length, n, you can count the number of you-centred possible worlds in which it rains tomorrow, and the total number of you-centred possible worlds. The probability that it will rain tomorrow is the proportion of you-centred possible worlds in which it rains tomorrow – and you can make this result as accurate as we want just by increasing n. This can be applied to issues of civilization longevity too: to determine the probability that your civilization will still exist one thousand years in the future, you need to determine the proportion of you-centred possible worlds in which your civilization still exists one thousand years in the future.

The important point here is that, given some previous observations of reality, the ultimate reference class, fully defines the statistics of your possible situations. You can have access to it in the sense that, in principle, you can get a computer to generate the

ultimate reference class with some maximum description length, n, with n as large as available computer power and time permit, so in principle you can make the accuracy with which the output of your computer run represents the ultimate reference class as great as you want: we will call this having *full access* to the ultimate reference class. Having full access to the ultimate reference class, given some previous observations of reality, gives you as much information as you can possibly have about your situation, because the entire distribution of possible situations is being laid out before you, ready for counting, with as much precision as you want. If you have full access to the ultimate reference class, any philosophical argument about issues such as Occam's razor, the Doomsday argument or the SIA are irrelevant, because you already have the full description of the statistics of your possible situation and they cannot change this. The ultimate reference class is *superior* to any other reference class or argument that might be made.

This could have clear implications for the SIA. The SIA asks you to think about situations that *could* have existed, but if you have full access to the ultimate reference class this is irrelevant: you already have access to all the situations in which you could exist.

3 A Practical Consideration: You cannot see all of the ultimate reference class.

What has just been said in 2.3 may seem to be implying that ideas such as Occam's razor, the Doomsday argument and the SIA are irrelevant, as the ultimate reference class is going to determine things anyway, but this is not the case. Although the ultimate reference class *is* superior to any philosophical method or idea, we can never have full access to it. We can only ever have some information about the ultimate reference class. This is where various philosophical methods might become useful: they might tell us what the ultimate reference class might be like. If ideas such as Occam's razor, the Doomsday argument and the SIA are valid, you might use them to give you some information about the distribution of you-centred possible worlds in the ultimate reference class, in addition to anything you already know about it.

As an analogy, the ultimate reference class might be considered to be a line of closed boxes, each with various items in. You have a bag with some items in it, and you know that these match the contents of one of the boxes, but you do not know which one. You may have somehow been able to get some idea of what is in the boxes, but you know very little. You may use some philosophical idea to tell you what kinds of things are likely to be found in a lot of the boxes, and this would tell you what you might expect to find in your bag, but the boxes themselves always take precedence. A philosophical method can never change what is already in the boxes: it is only of any use in so much as it can give you an idea of what is in the boxes. Likewise, a philosophical idea which is supposed to give you an idea of expectation, such as Occam's razor, the Doomsday argument or the SIA cannot change the ultimate reference class. It can only ever be of any use in so much that it can tell you something about the ultimate reference class: about the distribution of you-centred possible worlds in it.

This has important implications for anyone proposing some idea that tells you about your expectations of reality. If an idea such as Occam's razor, the Doomsday argument or the SIA really tells us anything – then it should tell us about the ultimate reference class – about the distribution of you-centred worlds that are actually in it.

A correct formulation of any such argument would be saying something about mathematics as much it would be about the physical world. Although an argument about our expectation would involve some initial information about the physical world, the argument would not be using this to make claims about the physical world directly. Rather, it would be using that information to make a claim about a distribution which could actually be computed from that information, if you had sufficient computing power. In principle, you could program a computer with everything that you know about your situation and instruct it to generate every possible you-centred world description consistent with that information, subject to some maximum description length, n. A correct version of the Doomsday argument, or some argument about theory selection,

would actually be predicting the results of such a computation with a large value of n, and telling you that, if you did perform such a computation, you should expect a high proportion of the you-centred possible world descriptions generated by the computer to be ones which have some characteristic. In the case of the Doomsday argument, for example, it would be saying that they will be tend to be ones in which your civilization does not last very long. Thinking of reference class in terms of predicting the results of computations, based on partial knowledge of the results, like this, may suggest some path to a formal method for dealing with the issue of what the members of a reference class should be.

Anyone proposing an idea that tells you about your expectations – such as the Doomsday argument, the self-indication assumption or Occam's razor, should be able to produce a justification of it that shows how it tells us something about the ultimate reference class, and if he cannot do this then there is no reason for thinking that the idea can tell you anything. We might imagine how such justifications could be made for various ideas. Occam's razor, for example, might be justified in terms of "simpler" theories having higher measure across you-centred possible worlds. The Doomsday argument might also be justified by an argument about the distribution of you-centred possible worlds, and this will be briefly discussed later in this article. This article, however, is about the SIA specifically, and if we are going to demand that ideas such as this are justified like this, it has clear implications for the SIA.

4 Relating the Self-Indication Assumption (SIA) to the Ultimate Reference Class

4.1 The Self-Indication Assumption (SIA) must tell us about the distribution of you-centred possible worlds.

The SIA tries to get you to think that it is more likely that you inhabit a possible world if there are more observers throughout history in that possible world, and therefore there are "more chances" for you to exist. All of these other people in a possible world, however are not you. The SIA nevertheless suggests that you should think that a lot of observers in a possible world, even though they are not identical to you, "could have been you", and that this makes such a possible world more likely to be the one you inhabit. This contrasts with the idea of using the ultimate reference class: if you have full access to the distribution of you-centred possible worlds, then this fully describes the statistics of your situation and no considerations of the "could have been" kind are going to change it. The fact that we do not have full access to the ultimate reference class is the only reason that the SIA can have any chance to work. For the SIA to be a plausible objection to the Doomsday argument, its "could have been" is going to have to map onto the distribution of you-centred possible worlds in the ultimate reference class and tell us something about it. Can it do this?

4.2 Going from Impersonal Possible Worlds to You-Centred Possible Worlds

4.2.1 Impersonal Possible Worlds

We have been thinking in terms of the ultimate reference class – the set of you-centred possible worlds – but descriptions of possible worlds that are presented to us are not normally this specific. For example, a possible world may be described in terms of some cosmological theory or some laws of physics, or in terms of the timeline of a civilization. A description of a world can be constructed that does not make direct reference to you. It may contain many observers, and if one of these observers is in a situation that matches yours, then you may be in this possible world. In fact, a possible world could, in principle, contain many observers with situations that match what you know about your situation.

This means that two kinds of descriptions are possible for the world you inhabit. There is a you-centred possible world description, but there is also an impersonal version of this.

4.2.2 Secondary Reference Classes

The ultimate reference class has been defined as the set of all formally describable you-centred possible worlds and your situation must be a member of this set. However, you may need to consider a larger set of observer-centred possible worlds which includes the ultimate reference class, but which includes other observer-centred possible worlds too. We will call such a set of observer-centred possible worlds a *secondary reference class*. A secondary reference class may need to be considered because you may have a set of observer-centred worlds about which you lack complete knowledge, and while you may know that some of these possible worlds are the you-centred ones, corresponding to your situation, you may not know which ones these are, so that you have to consider a larger set of possible worlds.

A secondary reference class, when it does need to considered, should be defined as specifically as possible while ensuring that it contains all of the ultimate reference class. Ideally, we would only need to consider the you-centred possible worlds of the ultimate reference class, but if we cannot meet this ideal we should approach it as closely as possible, using a secondary reference class which involves adding as few observer-centred possible worlds as possible to the ultimate reference class.

If you live in the 21st Century, then an example of a secondary reference class would be the set of all observer-centred possible worlds corresponding to observers living in the 21st Century. This set is more general than the ultimate reference class for you, but any possible world centred on you must be one for a 21st Century observer, so this reference class must include every you-centred possible world, and must therefore include the ultimate reference class: it is just defined more generally than the ultimate reference class. Another example of secondary reference class, and a more general one, would be the set of all observer-centred possible worlds. This set includes every observer-centred world that can be conceived, and again must include every you-centred possible world, and therefore the ultimate reference class.

4.3 Relating Impersonal Possible Worlds to You-Centred Possible Worlds

4.3.1 Relating Impersonal Possible Worlds to a Secondary Reference Class

When we are considering impersonal possible worlds, we have the same issues that occurred with you-centred possible worlds of having an infinite set of possible worlds. We will deal with this as before, by limiting the length of the description of each impersonal possible world to w bits and then considering what happens as w tends to infinity.

Suppose we are considering some type of possible world. The possible world's description contains some information, G, describing that general type of possible

world, followed by some information, S, describing a specific version of that world. G could be the laws of physics of an impersonal possible world; however, different worlds can be made with the same laws of physics and different initial states, so S could describe the initial state. It should be noted, here, that the distinction between G and S is artificial, really, and is just for convenience: all that we have, really, is some information describing each impersonal possible world, and we may wish to take account explicitly of features that some worlds have in common, such as laws of physics.

An impersonal possible world does not have a description that centres it on a particular observer, but it may, of course, contain observers. In fact, you can be sure that the correct description of the impersonal world you inhabit must be one that contains at least one observer, or you would not exist. This means that any impersonal possible world that is a possible candidate for your world must contain at least one observer, and probably many more to deal with all the people you may see from time to time. This should suggest to our intuition that the SIA may, at the least, have some limited validity: the number of observers in an impersonal possible world does matter – at least to the extent of needing at least one of them for it to be a candidate for your world, and that should suggest that the SIA may have some kind of more general validity. Is this validity, whatever it is, enough to stop the Doomsday argument, though?

There are two sets of possible worlds: the set of impersonal possible worlds and the set of you-centred possible worlds, and the important issue is the one of what the existence of an observer in an impersonal possible world implies about the set of you-centred possible worlds.

Thinking about relating the two sets will be easier if we use an intermediate set: the set of all formally describable observer-centred possible worlds. This set includes every you-centred possible world that can be described, but it includes any possible world that is centred on anyone else as well. It is the most general kind of secondary reference class.

For each observer in an impersonal world, it will be possible to express that observer's situation as a description of an observer-centred possible world, centred on that particular observer. Therefore, each observer in an impersonal world implies the existence of an observer-centred world in the secondary reference class. In general, when we limit the description lengths in the secondary reference class to n bits, all else being equal, more observers in a possible world with some particular G and S will imply the existence of more observer-centred worlds corresponding to them in the secondary reference class.

This also applies to a given type of world. For some set of impersonal possible worlds, all sharing some G and each having some different S (for example, a set of possible worlds sharing the same laws of physics, but having different initial states), all else being equal, the more observers that there tend to be in these impersonal possible worlds, the more

observer-centred possible worlds corresponding to them will be in the secondary reference class.

We might conceive of many different impersonal possible worlds, and each will contribute a different number of possible worlds to the secondary reference class of observer-centred possible worlds, depending on how many observers it contains. There are some complications here that should be acknowledged. The description lengths in the secondary reference class are limited to n bits, though in principle you can increase n as much as you want to access as much of the secondary reference class as you want. For some value of n, one impersonal possible world may contribute more observer-centred possible worlds to the secondary reference class than another, and this means that different impersonal possible worlds will be represented in the secondary reference class to different degrees, and by increasing n and w we can see which impersonal possible worlds dominate the secondary reference class as n and w tend to infinity.

4.3.2 The Complications of Large Worlds and Infinite Worlds

One objection could be made to what was just said in 4.3.1: how can this be coherent when possible worlds can be imagined that contain infinities of observers? How could we say that one such world or another would make a greater contribution to the secondary reference class.

In considering this, we should remember that we are not simply counting the number of observers in an impersonal possible world and saying that that number of observer-centred possible worlds exists in the secondary reference class. Rather, the existence of an observer in an impersonal possible world is an indication that a description of a corresponding observer-centred possible world exists in the secondary reference class. Description lengths of observer-centred possible worlds in the secondary reference class are limited to n bits (although you can increase n without limit), however, so for any value of n, an observer in some impersonal possible world can only correspond to an observer-centred possible world in the secondary reference class if the observer-centred possible world description can be expressed in n bits or less. With an impersonal world containing an infinity of observers, there is clearly an infinity of different observer situations, and an infinite amount of information would be needed to distinguish one from another, meaning that each observer-centred possible world, if it described the observer's situation fully, would need an infinitely long description. An observer's situation need not be described fully, however: if a coherent description of an observer-centred possible world can be made with n bits or less, it will still be part of the secondary reference class, even if it does not have all the information from the relevant impersonal possible world. It is also worth noting that the impersonal world description itself may be shortened in a similar way, because impersonal world description lengths are limited to w bits. The limit of n bits on the description lengths of the observer-centred possible worlds in the secondary reference class means that an infinity of observers from an impersonal world can never find its way into the secondary

reference class. For any impersonal possible world, and some maximum description length, n, for the secondary reference class, there can only ever be a finite number of observer-centred possible worlds. Each impersonal possible world must always contribute a finite number of observer-centred possible worlds to the secondary reference class when description lengths in the secondary reference class are limited to n. Other impersonal worlds will also contribute varying numbers of observer-centred possible worlds, and the number of observer-centred possible worlds contributed can be different, for some value of n, for two worlds which each contain an infinity of observers. When infinite impersonal worlds are compared, the issue of density of observers will become relevant.

It may not seem obvious how all this works for an infinite impersonal world with an infinity of observers. If only a finite number of these observers correspond to observer-centred possible worlds in the secondary reference class with maximum description length of n, how are these selected? The answer is that when the length of the observer-centred world description is limited, observers in the impersonal world will correspond to duplicate observer-centred world descriptions: two observers may exist in the impersonal world in situations that have some similarity, but are not completely identical, but when the descriptions of the observer-centre worlds are shortened to n bits, the descriptions become identical, so that only one observer-centred world description is contributed to the secondary reference class for both observers.

As an example, an observer may exist at some place in a very large world who wears a green hat, has a pet cat, drives a red car and sees various patterns of stars in the night sky. Another observer may exist somewhere else in the same large world, who also wears a green hat, has a pet cat, drives a red car and sees the same patterns of stars at night, despite being in a different place in the world: it is just coincidence that the situations of the two observers seem similar. If enough information were used to describe the situation of each observer, there would ultimately be some differences, but if a smaller amount of information is used, the situations will appear identical. Both observers would therefore have the same observer-centred world description – if the description were short enough.

We might ask how the description of an observer-centred world could be shortened. One way would be to describe only local features of the world. For example, the observer-centred world description might consist of the laws of physics and information about the initial state of the world local to the observer – what has happened, or is happening, further away in the world being something about which there is uncertainty.

It has been said earlier that the number of observers in an impersonal possible world will give us an idea of how many observer-centred possible worlds will be contributed by that world to the secondary reference class of observer-centred worlds. It will now be apparent that this is a bit of a simplification: consideration of infinite worlds with infinities of observers makes that clear, and it should also remove any concern about

things becoming incoherent with infinite possible worlds. Using the number of observers in an impersonal possible world still works to a degree. If all the observers in an impersonal possible world correspond to observer-centred world descriptions in the secondary reference class which can be expressed with whatever limit, n bits, on the length of observer-centred world descriptions is in effect, then you can simply count the number of observers to know the degree to which the impersonal world is represented in the secondary reference class of observer-centred possible worlds. If, however, the impersonal world is somewhat "larger", and observers in it correspond to observer-centred possible worlds that cannot be described, within the constraint of the maximum description length of n bits, with enough information to resolve them all apart, then observers in the impersonal world will be sharing observer-centred worlds in the secondary reference class. This is an issue that is not just associated with infinite worlds: it becomes an issue merely when the number of observers, and the description lengths needed to resolve observer-centred worlds apart become too large for some limit, n, on the maximum description length in the observer-centred worlds in the secondary reference class. There is no fixed value of n, that is imposed on you, however: in principle, you can increase n without limit, and as n is increased, observers that were sharing observer-centred worlds start to get separate observer-centred worlds. Any two observers that have the same observer-centred world description will have different descriptions with a large enough description length. The only thing that might seem special about an infinite world is that, no matter how large the observer-centred world description length is allowed to be, it can never be large enough to resolve all observers apart: there will always be observers in the same impersonal world that share an observer-centred world description in the secondary reference class.

Earlier, it was stated that the impersonal worlds would be allowed a maximum description length of w bits. There may seem to be an issue of how large the value of w should be, but this is not really a problem: for some value of the maximum observer-centred world description length, n, there is a limit on the number of observer-centred worlds that can exist in the secondary reference class, and once the value of w is large enough to ensure that every possible observer-centred world features in the secondary reference class, increasing w further makes no difference. We should, however, imagine w tending to infinity, as n does.

Ideally, the maximum description length, n, of an observer-centred world should be as large as possible, and you can consider the statistics of the secondary reference class of observer-centred worlds – in particular, the proportion of it that comes from each impersonal possible world or type of possible world – as n tends to infinity. If w is large enough, for some value of n, the issue of multiple observers in impersonal worlds being allocated the same observer-centred world actually will actually arise for any observer-centred world, even if all the observers in some given impersonal possible world can be allocated unique observer-centred worlds within the constraints imposed by the maximum description length, for any such observer-centred world, there will always be other impersonal worlds which have observers that need to be allocated shortened

observer-centred world descriptions that coincide with it: every observer-centred world description must actually correspond to an *infinity* of impersonal possible worlds. This is not really a problem, though: all of the impersonal worlds corresponding to a single observer-centred world will have something in common, at least in proximity to the observer.

4.3.3 An Analogy: Chessboard Worlds

All this talk of sets and description lengths tending to infinity is a bit involved, so we should have a simple example, to illustrate what is going on. Suppose we use chessboards to represent impersonal possible worlds. We will assume that we are dealing with infinite impersonal possible worlds, so the chessboards are infinite – with the pattern of black and white squares extending endlessly in all directions. Each square may or may not have a piece on it. Each major piece (king, queen, bishop, knight, rook) corresponds to an observer, while pawns do not correspond to observers or anything of real interest to us: a pawn, if it is on a square, is just there.[1]

If we look at such a chessboard we will see some squares with major pieces on them. Each such piece corresponds to an observer, and that observer will be in a particular situation that is defined by the type of piece that he is, the colour of square this piece is on and the arrangement of other pieces (major pieces corresponding to other observers and pawns) around him. If an observer-centred world were to be described for such an observer, therefore, the description would need to include all this information. The chessboard goes on without limit in all directions, however, so from the point of view of an observer, the chessboard extends infinitely in all directions from his own position, and the observer-centred world description would need to describe all this: this could never be done with a description of finite length. (It should be noted that we are not considering time in this analogy, so the idea of anything like an initial state does not concern us.) Even if the description length is limited to n bits, however, enough information could be provided to describe the arrangement of pieces on the chessboard in some finite area around an observer's square: an observer's situation could be described local to that observer. The amount of the chessboard covered by such a local observer-centred world description would depend on n, the maximum description length in bits.

Requiring descriptions to be shortened like this means that, for any value of n, there is only a finite number of possible observer-centred world descriptions. For example, suppose n is made large enough to allow an observer-centred world description to cover a grid of 9x9 squares, with the observer being at the centre. The observer must be on a black square or a white square, so this gives two possibilities. The observer must be a major piece (king, queen, bishop, knight, rook), so this gives 5 possibilities. The grid of

[1] Pieces that are not observers (pawns) have just been introduced to add some realism: not everything in reality is an observer.

9x9 squares contains 81 squares, so without the observer's own square (as it was just dealt with) 80 squares need to be described. On each of these squares there can be another observer (a king, queen, bishop, knight, rook), a pawn or no piece at all, so this gives 7 possibilities for each square. There are therefore 7^{80} possibilities for all 80 squares. Putting all this together, the number of different observer-centred possible worlds that can be described is $2x5x7^{80}=4.1x10^{68}$. This is, of course, an extremely large number of observer-centred possible worlds; however an infinity of such worlds is actually available: limiting the description length means that an infinity of observer-centred possible worlds has to be represented by just $4.1x10^{68}$ worlds. This does not mean that the set of $4.1x10^{68}$ worlds is useless: by examining the statistics of this set we can get an idea of the statistical properties of the set as the maximum description length, n, is increased, and by increasing n we can find out what happens as n tends to infinity. An important point, here, is that the infinite nature of the impersonal possible world – the chessboard – is not causing any contradictions or incoherence: it can be dealt with. Further, these is no guarantee that all $4.1x10^{68}$ observer-centred possible worlds correspond to observers that actually exist in a particular impersonal world: an infinite chessboard does not have to contain every possibility: we might imagine a chessboard that had no pieces at all, for example, or one that did not feature any knights, or one that featured knights but had no knights on white squares.

Suppose now that we have two different, specific impersonal "chessboard" worlds.

- **World 1** is an infinite chessboard, as described above, but with a restriction. Any piece (king, queen, bishop, knight, rook, pawn) or none can be placed on a black square, but no pieces of any kind are allowed on white squares: they must be unoccupied. Apart from this restriction, the pieces appear to be arranged randomly, with no obvious pattern, so any local arrangement of pieces that does not break these rules will occur somewhere on the chessboard.
- **World 2** is an infinite chessboard, as described above, but also with restrictions. Any piece (king, queen, bishop, knight, rook, pawn) or none can be placed on a white square, but major pieces (king, queen, bishop, knight, rook, pawn) are not allowed on black squares: a black square must be occupied by a pawn or must be unoccupied.

The number of observer-centred possible worlds implied by each impersonal world can now be computed. We will still assume that the maximum length of any observer-centred world description is being limited so that it can cover just a grid of 9x9 squares with the observer at the centre.

- For **World 1**, there are 5 possible pieces for the observer (king, queen, bishop, knight, rook) on the central black square, and 7 possibilities (king, queen, bishop, knight, rook, pawn or none) for each of the 40 surrounding black squares in the 9x9 grid. The number of observer-centred possible worlds that can be described is therefore $5x7^{40}=3.2x10^{34}$.

- For **World 2**, there are 5 possible pieces for the observer (king, queen, bishop, knight, rook) on the central white square, and 7 possibilities (king, queen, bishop, knight, rook, pawn or none) for each of the 40 surrounding white squares in the 9x9 grid. In addition, there are 2 possibilities (pawn or none) for each of the 40 surrounding black squares in the 9x9 grid. The number of observer-centred possible worlds that can be described is therefore $5x7^{40}x2^{40}=3.5x10^{46}$.

World 1 contributes $3.2x10^{34}$ observer-centred possible worlds to the secondary reference class and World 2 contributes $3.5x10^{46}$ of them. When the description length of an observer-centred possible world is limited in this way, World 2 is therefore contributing more observer-centred possible worlds to the secondary reference class than World 2.

This situation will continue to apply as the maximum description length of observer-centred possible worlds, n, is increased, and World 2 will contribute many more possible worlds than World 1 as n tends to infinity.

World 2 seems to contain more observers, or rather it has a greater *density* of observers, and this means that observer-centred possible worlds corresponding to World 2 make up a greater proportion of the secondary reference class than those corresponding to World 1. All else being equal, *density of observers* is obviously relevant in determining the degree of representation of an impersonal world within the observer-centred worlds of the secondary reference class.

4.3.4 What determines the degree of representation of an impersonal possible world in the secondary reference class?

Each observer in an impersonal possible world corresponds to an observer-centred possible world, so if we are taking a simplistic view of things, we could say that the number of observer-centred worlds in the secondary reference class corresponding to a particular impersonal world is proportional to the number of observers in that impersonal personal world.

The consideration of infinite impersonal worlds and the need to limit the description length for observer-centred possible worlds, means that it is more realistic to consider the density of observers in an impersonal world as indicating the proportion of the secondary reference class of observer-centred worlds that is derived from it.

It should be recognized, however, that even this is a simplification. What really determines the proportion of observer-centred worlds corresponding to an impersonal world is the number of observer-centred world descriptions that can be made corresponding to observers in that world, with some maximum description length, n, in comparison with the numbers of observer-centred world descriptions that can be made corresponding to observers in other worlds. The density of observers will be important, but the amount of information needed to describe a single observer's situation will also

matter. For example, if a lot of information is needed to describe the basic physical laws of an impersonal world, less information is available to resolve observer-centred worlds apart in a very large impersonal world. What is really important about a high density of observers is that it causes observers to exist that can resolved apart with relatively little information, allowing a lot of observer-centred world descriptions to be made for some maximum description length. We might therefore consider the idea of spatial density of observers as being relevant because of its connection with a more general kind of "information-theoretic" density of observers – how many unique observer-centred worlds can be "pulled out of" an impersonal world when there is some upper limit on description length. An impersonal world might actually be conceived in which the concept of spatial density cannot be practically used, but the more general, information-theoretical version of it would still be usable in such a situation.

The consideration given here does not just apply to individual possible worlds: we can use a similar approach when considering the proportion of observer-centred possible worlds corresponding to some *type* of possible world: a group of worlds with some feature(s) in common. Earlier, impersonal possible world descriptions were described as containing two kinds of information: G, general information about the type of world, and S, specific information about a particular possible world. An approach like that discussed here could be applied to the issue of determining the proportion of observer-centred worlds in the secondary reference class which all have some G in common. With such an approach, the amount of information needed for G, the general information about the world, will be important.

When considering the proportion of observer-centred possible worlds corresponding to a particular impersonal possible world, or to a particular type of impersonal possible world, an information-theoretical consideration is the most appropriate one; however, concepts such as the number of observers or density or observers still give a useful indication of the contribution that an impersonal possible world is making to the secondary reference class. If we use an idea such as the "number of observers" we should be aware that this is a simplification and density is a better concept. In using such concepts, we should just be careful not to assume that they are all that matters: a more general, information-theoretical consideration shows us that the amount of information needed to describe an observer's situation will also matter. In considering things like the density of observers, there must be an understanding that they apply in an "all else being equal" way – although it would be possible to deal with situations in which all else is *not* equal by making a more detailed consideration which accounts for observer density and other aspects of impersonal possible worlds. The whole issue of number of observers vs. density of observers is not one that should concern us unduly: although it is technically more correct to think in terms of density, any consideration of how things appear, or should appear, locally, will not really distinguish between them, and we can just think about how many observers should be local to us.

An important point about what has been discussed here is that it seems to indicate that a greater tendency for observers to exist in a possible world, or a possible world of a given type, means that that possible world, or type of world, will have more observer-centred possible worlds in the secondary class. It may seem, so far, that this discussion is actually going to show the SIA to be true!

4.3.5 Relating the Secondary Reference Class to the Ultimate Reference Class

It has been shown how the secondary reference class of observer-centred possible worlds is made up of worlds corresponding to impersonal possible worlds, and the degree to which a given possible world, or a given type of possible world, is represented in this reference class is dependent on the density of observers, subject to the qualifications just given in 4.3.4 and all else being equal. The secondary reference class now needs to be related to the ultimate reference class: the set of you-centred possible worlds. When that is done, the impersonal possible worlds will have been related to the you-centred possible worlds and a full view of the statistics of your situation will be available.

The ultimate reference class contains every observer-centred possible world centred on *you* as the observer, subject to a maximum description length of n bits. The secondary reference class that we have been discussing contains every observer-centred possible world centred on *anyone* as the observer, subject to a maximum description length of n bits. A you-centred possible is just a special case of a possible world centred on *anyone*, and this means that every you-centred possible world in the ultimate reference class also appears in the secondary reference class: the secondary reference class contains the ultimate reference class. The ultimate reference class consists of some of the possible worlds from the secondary reference class.

Suppose that you do not know anything about whether any particular possible world in the secondary reference class of observer-centred possible worlds corresponds to you or some other observer. You know that every you-centred possible world in the ultimate reference class corresponds to a possible world in the secondary reference class and, for any maximum description length, n, you should view any given possible world in the secondary reference class as being as likely to be a you-centred possible world as any other.

This means that, all else being equal, for any maximum description length of observer-centred possible worlds, n, the number of possible worlds that a given impersonal possible world, or type of impersonal possible world, makes to the ultimate reference class of you-centred possible worlds should be expected to be proportional to the number of *anyone*-centred possible worlds that it contributes to the secondary reference class. The reasoning behind this is quite simple: suppose that there are two impersonal possible worlds, World 1 and World 2. World 1 contributes few anyone-centred possible worlds to the secondary reference class, while World 2 contributes

many anyone-centred possible worlds to the secondary reference class. The you-centred possible worlds all correspond to ones in this reference class, so any you-centred possible world should be considered to have a chance of corresponding to any particular observer-centred world in the secondary reference class, with no such observer-centred possible world being more likely than any other. As more of the observer-centred worlds in the secondary reference class correspond to World 2, it is more likely that any you-centred possible world in the ultimate reference class corresponds to an observer-centred possible world in the secondary reference class that corresponds to World 2 than it is that it corresponds to an observer-centred possible world in the secondary reference class that corresponds to World 1.

All else being equal, we should expect the degree to which an impersonal possible world, or type of impersonal possible world, is represented in the ultimate reference class of you-centred possible worlds to be proportional to the density of observers in that possible world or type of possible world.

5 Where does this leave the self-indication assumption (SIA)?

5.1 Does the number of observers in an impersonal possible world matter?

As has been discussed, it is more accurate to think in terms of density, rather than number, of observers, but this should not concern us too much: from a local perspective, density and numbers will be fairly indistinguishable.

The discussion given so far has actually shown that, *in a general sense*, the SIA is valid! The statistics of your possible situation are fully defined by the ultimate reference class of you-centred possible worlds – and impersonal possible worlds are represented in the ultimate reference class according to density of observers. Some qualifications should be given, here, however. What has been said previously about number of observers, density of observers and information-theoretical considerations applies: considering things in terms of density of observers is a simplification, and there is an "all else being equal" aspect to this. Nevertheless, there seems to be good reason to think that you are more likely to be in a densely populated impersonal possible world than a less-densely populated one. It may seem that the discussion so far, by validating the SIA, amounts to a refutation of the Doomsday argument. However, we should now consider a further, important qualification of what has been said: the justification that has been given for the SIA is based on the assumption that we do not know which observer-centred possible worlds in the secondary reference class are you-centred possible worlds, but the SIA suggests that you "count" observers in the future of your civilization and the implications of this should be considered.

5.2 Does the number of observers in the *future* in some impersonal possible world matter?

5.2.1 The Requirement for Observer-Centred Worlds

It has been shown that the SIA is valid in a general sense and that, *all else being equal*, you should consider yourself more likely to be in a you-centred world corresponding to a densely populated impersonal world than to a sparsely populated one. (As stated previously, this is a simplification, and an information-theoretical consideration should really be made.) The basic idea, here, is that, unless you know otherwise, any observer-centred world in the secondary reference class should be regarded as a possible candidate for one of the you-centred possible worlds in the ultimate reference class – and one of these corresponds to your situation. An observer in a possible world is important because that observer might be you.

When we are considering types of impersonal world for which we do not know much about the specific situations of observers, this makes sense. For example, one cosmological theory may lead to a different density of observers than another theory, based on things such as the expected density of planets suitable for life. A general version of the SIA would favour the theory with the greater observer density, though as has been stated this only applies in an "all else being equal" sense, and a proper, information-theoretical consideration would be more accurate. This would be because any of the observers in an impersonal world corresponding to such a cosmological model *might actually be you*.

The requirement for an observer-centred possible world to be a *you*-centred possible world is a strict one: it must be consistent with every detail of what you know about your situation: otherwise, on finding out about an inconsistency, you could rule it out. For example, if you remember wearing a necktie with a particular pattern last week, any observer-centred world, to be a candidate for a you-centred possible world, must be owned by an observer who also remembers wearing a necktie with that pattern last week. Clearly, the probability of any single observer-centred world matching your experiences enough to be a you-centred possible world is very remote. However, for a large enough maximum description length, n, there will be a large number of observer-centred worlds – and n is considered as tending to infinity. The number of observer-centred worlds contributed to the secondary reference class by a single impersonal possible world may not be so large that many of those are expected to be you-centred possible worlds. However, it is more relevant to consider general types of impersonal possible world – groups of worlds that meet some criteria. A general type of possible world may be expected to contribute a very large number of observer-centred possible worlds to the secondary reference class – enough to ensure that many of these are you-centred possible worlds – even though any *individual* impersonal world of this type may, on average, only contribute enough observer-centred possible worlds for a fractional number of them to be you-centred worlds. Further, the issue of very large or even infinite worlds needs to be considered – and even a single, specific impersonal world of this kind could contribute so many observer-centred worlds to the secondary reference class that many of these will be you-centred possible worlds: in the case of an infinite world, the number of you-centred possible worlds that it provides could increase without limit as the maximum description length, n, is increased. Even though the requirements for a you-centred possible world are very specific, impersonal possible worlds will imply the existence of many observer-centred possible worlds, and just by knowing that some of these will be you-centred possible worlds, you can infer that many of these will be you-centred possible worlds. However, this is only statistics: the fact that a large collection of observer-centred possible worlds will be expected to contain a number of you-centred possible worlds does not mean that it has to do so. This only applies if we have no reason to think otherwise. If we know that all the observer-centred possible worlds in some collection of observer-possible worlds are inconsistent with your experience in any way then, no matter how large this collection

is, you will know that none of them can be you-centred possible worlds – even though a naïve statistical consideration might say otherwise.

This is what determines how the SIA interacts with the Doomsday argument. The SIA suggests that, because there will more observers in the future of your civilization if it is going to last longer, the types of possible world in which your civilization lasts longer contain more observers and, therefore, that this weights things statistically in favour of thinking that you live in a possible world corresponding to a civilization that is going to last a long time. This is supposed to cancel out the Doomsday argument.

In the language used so far in this article, the SIA is suggesting that the probability of any impersonal world being yours should be adjusted according to the number of observers, but the argument in this article has shown that, while there is some justification for such a view, it can only be justified on the basis that observers in an impersonal world correspond to observer-centred possible worlds, that each observer-centred possible world in the secondary reference class has a chance of being a you-centred possible world, and the greater the number of observer-centred possible worlds, the greater the number of you-centred possible worlds that are expected – and it is the set of you-centred possible worlds that determines the statistics of your situation. An observer in an impersonal possible world affects the probability that you are in that world, but only because that observer might correspond to a you-centred possible world – because the observer might be you. What might have been is irrelevant. Your situation is fully described by the ultimate reference class of you-centred worlds, and an observer can only affect your statistics if that observer might correspond to a member of this reference class – if the observer could be you. If you actually know that an observer cannot be you – for example, wrong food preferences, wrong career history, *wrong period in history* – then the observer-centred world corresponding to that observer should be removed from the secondary reference class.

5.2.2 The Problem with Future Observers - Why the Self-indication Assumption (SIA) Fails to Refute the Doomsday Argument

Just taking the secondary reference class as it is may be fine when cosmological theories are being considered – when you do not know much about the observers in it – but the problem with trying to apply it to observers in the future of your civilization is that *you actually know that these observers are not you*, and the fact that you know this means that these observers should be removed from the secondary reference class and should not be considered as having any affect on the ultimate reference class and the statistics of your possible situation. The only reason for "counting" an observer in an impersonal possible world is that the observer might actually be *you* – which means there must at least be the possibility that the observer's experiences are consistent with yours in every detail – but if the observer is living at a different time in history, this cannot be the case. If you live in the 21st Century in London, wear a black suit and drive a BMW, it should be obvious that someone who lives in the 27th Century in New London on Mars,

wears a spacesuit, drives a flying car and sees a different date when he looks at the calendar is not a candidate for you. The observer-centred world corresponding to such a person can never be a you-centred possible world in the ultimate reference class, and the observer-centred worlds corresponding to such observers should be removed from the secondary reference class. Such observers have no relevance to the general version of the SIA which has been justified in the previous discussion. Further, the previous discussion has shown how observers in impersonal possible worlds, or types of impersonal possible worlds, relate to the ultimate reference class of you-centred worlds, and therefore to the statistics of your possible situation. Not only do observers living in your future play no part in this: the relationship between observers in impersonal worlds and you-centred possible worlds has been discussed in enough detail to exclude any plausible way in which an observer living in your future could affect your statistics: an observer in your future is specifically invalid as a member of the reference class that does determine your statistics. At the same time, intuitive ideas about more observers making a possible world more likely have been dealt with, but this will not help the SIA to oppose the Doomsday argument at all, because the general version of the SIA that results specifically excludes the future observers needed to refute the Doomsday argument.

On the basis of this, the idea that the SIA can refute the Doomsday argument should be regarded as implausible. The SIA has been shown to be valid in a general sense, but in the specific sense of answering the Doomsday argument, the SIA should be regarded as dead.

6 Further Considerations

6.1 A Short Justification of the Doomsday Argument

The purpose of this article is not to prove the Doomsday argument correct, but merely to show that using the SIA against it is invalid. Nevertheless, a brief justification of the Doomsday argument will now be given, based on the ideas of impersonal possible worlds, the secondary reference class and the ultimate reference class that have been used in the discussion of the SIA.

We will consider a secondary reference class of observer-centred worlds, but we are not yet relating this to the ultimate reference class, so we will therefore allow it to contain all possible observer-centred worlds – even ones that could not possibly be you-centred worlds.

You have a particular position in history as an observer, and according to the Copernican principle, you should regard your situation as an observer as typical of that of other observers. There is statistical justification for thinking that your situation is typical of that of other observers in the secondary reference class of observer-centred worlds. This does not mean that all the other observers have to be in situations exactly like yours, or even in human civilizations, but it does mean that your own situation should not be exceptional. The common experience of an observer should be that of being in a civilization at about the same level of development as yours. The experience of being in, for example, a galactic civilization which developed interstellar travel twenty million years ago should not be expected to be typical; otherwise the question would arise of why *you* do not find yourself in such a situation if it is so common. This suggests that your observer-centred world should be typical of other observer-centred worlds in the secondary reference class: they should tend to be for observers in civilizations not too far ahead of yours in terms of age or level of development.

Each of the observer-centred worlds in the secondary reference class corresponds to an observer in an impersonal world, but this also works the other way round: each impersonal world contributes observer-centred worlds to the secondary reference class of observer-centred worlds. Suppose that an impersonal world contains a civilization that lasts for an extremely long time; for example, suppose that it contains a civilization similar to ours that lasts for hundreds of millions of years after spaceflight first occurs. Almost all the observer-centred worlds contributed to the secondary reference class by this impersonal world, and corresponding to this civilization, will correspond to observers living in a much older civilization than yours: almost all of these observer-centred-worlds will correspond to observers living in a civilization in which spaceflight has been going on for millions of years. If a significant proportion of the civilizations in the impersonal worlds which are contributing observer-centred worlds to the secondary reference class are like this, then the secondary reference class should contain a large proportion of observer-centred worlds corresponding to observers living in a much older

civilization than yours. This contradicts what was previously stated about the secondary reference class: that our own experience tells us that the typical observer-centred world in the secondary reference class is one corresponding to an observer in a civilization not much older than yours. For this to be the case, there must be a tendency for civilizations in the impersonal possible worlds that are contributing observer-centred worlds to the secondary reference class to be relatively *short-lived* ones.

If there is a tendency for civilizations in the impersonal possible worlds that are contributing observer-centred worlds to the secondary reference class to be relatively *short-lived* ones, this implies that the observer-centred worlds in the secondary reference class will tend to correspond to observers in short-lived civilizations.

As there is a tendency for the observer-centred worlds in the secondary reference class to correspond to observers in relatively short-lived civilizations, it is likely that any given observer-centred possible world selected from this reference class will correspond to an observer in a relatively short-lived civilization. All of the observer-centred possible world corresponding to your experiences – all the you-centred possible worlds – are members of the secondary reference class of observer possible worlds, so there will be a tendency for the you-centred possible worlds to correspond to some version of you in a relatively short-lived civilization.

As your actual situation corresponds to one of the you-centred possible worlds, it is likely that your situation is one of being an observer in a relatively short-lived civilization – and that your civilization will not last very long.

This establishes the main conclusion of the Doomsday argument. The above discussion was not complicated with mention of limits on description length, and maximum description length tending to infinity: things have been discussed in those terms throughout enough of the article that the general idea should be clear, nor have the detailed, probabilistic aspects of the Doomsday argument been discussed.

This kind of justification for the Doomsday argument is not about your civilization specifically, but about the distribution of possible civilizations that could exist. It suggests that your civilization will end soon, but it also suggests that the typical experience of an observer is one of living in a civilization not significantly older or more advanced than yours, and that if other civilizations exist, these also tend to be short-lived.

As discussed previously, this kind of justification of the Doomsday argument is as much about mathematics as it is about the physical world. It is using some information about your situation to make an inference about the expected output of a hypothetical computer run to generate the set of possible descriptions of your situation. It is telling you that, if you did perform such a computation, you should expect a high proportion of the you-centred possible world descriptions generated by the computer to be ones in which your civilization does not last very long. This idea can be used to justify the

application of the Copernican principle – the idea that your situation should be typical of that of other observers – that was just made. You might ask why your situation should be typical of others in the secondary reference class of observer-centred worlds, but the justification is merely that it is the only member of the reference class of observer-centred worlds about which you have any direct knowledge. If a computer is programmed to produce a list of observer-centred world descriptions, then your knowledge of your own situation corresponds to one item in this list. You have partial knowledge of the computer program's output that can tell you something about the rest of the computer program's output. What you know about the program that generates the list will be of relevance here: its length may be important. The kind of characteristics found in your own situation that you expect to find in other situations should also be relevant. This should give more of an idea of what we meant when we said, earlier, that the computational view of reference classes being applied here might suggest a path towards a formal method for dealing with reference class membership.

The Doomsday argument can tell you nothing about the expected outcome of any single random event. For example, suppose that you were about to toss a coin and if the result were "heads" a bomb would be armed, set to destroy your civilization within some time period, while there would be no such consequences if the result were "tails". A naïve understanding of the Doomsday argument might suggest that you should think it more likely that the result would be "tails", to comply with some statistical expectation of the end of your civilization, but the understanding of the Doomsday argument given here could justify no such belief as it can only deal in distributions. (There is one qualification to this: if that if the coin is biased in some way, it might be the case that such a bias is common in possible worlds in general.) This should call into question the idea that William Eckhardt's "shooting room" analogy of the Doomsday argument, used in his criticism of it, is actually a reasonable analogy of the Doomsday argument (Eckhardt, 1997).

6.2 Infinite Worlds and Level IV Multiverses

The issue of whether to consider things in terms of number of observers or density of observers was discussed previously. It was mentioned that the correct kind of consideration is an information-theoretical one, in which the number of observer-centred possible worlds contributed to the secondary reference class for some maximum description length, n, depends on the number of different observer situations which can actually be constructed subject to that limit on description length. Concepts such as "number of observers" or "density of observers" are valid, however, as simplifications when all "all else being equal" kind of consideration is being made.

It was suggested that "density of observers" is a better concept than "number of observers" because of the issue of infinite worlds. This raises the issue of whether your ultimate reference class should be dominated by finite worlds with finite numbers of observers or infinite worlds with infinities of observers: in other words, should you

expect to live in a finite world or an infinite world? An argument can be made that you should expect to be living in an infinite world with infinite observers.

For any set of impersonal worlds with maximum description length of w bits, there is an upper limit on the description length needed to represent any of the corresponding observer-centred possible worlds. However, you can always find many more observer-centred possible worlds by making the maximum description length much larger. These extra observer-centred possible worlds cannot correspond to impersonal worlds with the maximum description length, w, because they have descriptions that are longer than those needed for observer-centred worlds corresponding to such impersonal possible worlds. They must therefore correspond to impersonal possible worlds with description lengths that are larger than w bits. This can be said about any maximum description length for impersonal possible worlds: a maximum description length for observer-centred possible worlds can always be imagined such that almost all possible observers are associated with worlds with a longer description.

Further, it can be argued that as the maximum description length, n, for observer-centred possible worlds tends to infinity, there will be opportunities for increasingly complex observer-centred world descriptions to exist in the secondary reference class. An impersonal world with many different kinds of situations for observers will have many corresponding observer-centred possible worlds. This suggests that the secondary reference class will be dominated by observer-centred worlds corresponding to impersonal possible worlds with increasingly large numbers of different ways for observers to exist as the maximum description length of an observer-centred possible world, n, increases. Using the earlier analogy of chessboard worlds, an impersonal possible world in which observers can only exist on white squares will dominate less of the secondary reference class than one in which observers can exist on black squares or white squares. However, an impersonal possible world in which observers can exist on black squares, on white squares and in some extra, completely different way as well, would dominate more of the secondary reference class than either. As the maximum description length for observer-centred possible worlds is increased, the secondary reference class should therefore become dominated by observer-centred worlds corresponding to impersonal possible worlds which provide increasingly general opportunities for observers to exist. There is no limit on this, and this suggests that as the maximum description length tends to infinity, the secondary reference class, and therefore the ultimate reference class of you-centred possible worlds, becomes dominated by observer-centred possible worlds corresponding to impersonal possible worlds which provide increasingly general opportunities for observers to exist, suggesting that the kind of world in which you expect to be should become increasingly like the very general kind of multiverse which has been justified in other ways (Lewis, 1986; Tegmark, 1998, 2003, 2007; Mitra, 2010; Almond, 2010).Tegmark describes such a general multiverse as a Level IV multiverse. The chessboard analogy given in 4.3.3 is relevant here: a view like Tegmark's ultimate ensemble could be considered to be doing

the equivalent of providing more squares, but in a much more ontologically general way.

7 Conclusion

The self-indication assumption (SIA) is often regarded as the leading candidate for a refutation of the Doomsday argument, but an analysis of the intersection of the SIA and the Doomsday argument has shown that this idea is flawed.

The basis of any consideration of the statistics of your situation should start with the ultimate reference class: the set of all you-centred possible worlds. Each you-centred possible world corresponds to an observer-centred possible world in a secondary reference class of observer-centred possible worlds. Each of these possible worlds corresponds to some observer in an impersonal possible world. It has been shown that the density of observers in an impersonal possible world will be of relevance to the probability that you are in it. An impersonal possible world with a high density of observers will tend to correspond to a high proportion of observer-centred worlds in the secondary reference class, and as each you-centred possible world corresponds to one of these, this implies a high probability that the you-centred world actually corresponding to your situation is in such an impersonal world: that you actually live in it. It should be noted that this is a simplification, as it would be if we merely considered numbers of observers. The correct type of consideration is an information-theoretical one, in which the number of observer-centred worlds with some maximum description length, n, that correspond to some impersonal world is considered, and the proportion of such worlds in the secondary reference class is considered as the maximum description length, n, tends to infinity. The density of observers will determine the proportion of the secondary reference class corresponding to an impersonal world *all else being equal* – and issues such as the amount of information needed to describe the situations of observers will be relevant.

This actually means that a general version of the SIA is valid. The “number” of observers in a possible world does matter. It also resolves one objection to the SIA: that it becomes incoherent when infinite worlds with infinities of observers are involved. As the number or density of observers is merely a simplifying idea, and the correct methodology – applying an information-theoretical consideration – only ever needs to deal with finite numbers of observers and finite possible world description lengths. Even though these numbers are allowed to tend to infinity, the situation remains mathematically coherent, even for infinite possible worlds. An intuitive understanding of what happens with infinite impersonal possible worlds should be easy to get. An observer’s situation in an infinite impersonal possible world would actually need infinite information to describe it, but observer-centred worlds are always considered with some finite maximum description length, n. The description lengths for observer-centred worlds corresponding to observers in an infinite world would therefore always need shortening. Only a finite number of different observers could be represented with some maximum description length, n, and this means that observers in a finite world will have to share observer-centred world descriptions, although as the maximum

description length, n, is increased more observers can be resolved apart. The problem of infinities of observers, however, never arises.

All this may actually seem to be *supporting* the SIA as a rebuttal of the Doomsday argument, but there is a serious problem. What has been shown to apply is a very general version of the SIA, and the existence of observers in an impersonal possible world only makes it more likely that you are in that world because each of those observers gives rise to an observer-centred world that could be yours: *each of those observers might actually be you*. This is relevant if you have only minimal knowledge about these observers, so that you know nothing that could tell you that an observer in some impersonal world is not you; for example, a cosmological theory may give you some idea of the density of planets which could produce life, giving you some idea of the density of observers in a very general way. The SIA, however, when used as a rebuttal of the Doomsday argument is suggesting that you should count observers in the future of your civilization in some impersonal world, and these are observers who specifically *are not you*. If you know that an observer could not possible be you, there are no grounds for "counting" that observer in the general version of the SIA that has been shown to apply.

The general version of the SIA that has been shown to apply, then, does not refute the Doomsday argument. Worse still, obtaining this general version of the SIA has involved enough analysis of the relationship between observers in impersonal possible worlds and the reference class of you-centred possible worlds that we should know enough about the role played by observers in impersonal worlds with regard to the statistics of your situation to see that it is implausible for observers in the future of your civilization to fit into all this and have some effect, somehow. Further, while we may have some intuitive idea that more observers in an impersonal world corresponds to a greater probability of being in that world, this intuition is easily reconciled with the general version of the SIA, so the more specific version of the SIA needed to refute the Doomsday argument can be dispensed with without having to question this basic intuition.

The title of this article has implied that the SIA *almost* refutes the Doomsday argument, and in a sense, this is true: a general version of the SIA *does* work, that does tell us to count observers, but any application of it against the Doomsday argument fails because it involves the wrong observers.

The purpose of this article has not been to justify the Doomsday argument, but rather to rule out the SIA as a serious candidate for a rebuttal of it. Nevertheless, the Doomsday argument can be expressed in terms of the kind of reasoning used here. The Copernican principle would suggest that your situation should be typical of the situations of other observers, suggesting that the set of observer-centred worlds for all observers tends to contain observers in situations like yours. This in turn would suggest that the set of

impersonal worlds in which these observers exist tends to contain relatively short-lived civilizations, suggesting that you probably live in one.

The ideas in this article can also be used to argue for an infinite reality of the kind termed a “Level IV multiverse” in Tegmark’s classification. For any finite world, there will be a finite number of observers with a finite maximum description length for the corresponding observer-centred worlds, and the maximum description length could always be made much larger, to include many more observer-centred worlds. Further, as the description length tends to infinity, worlds which provide more ways for observers to exist would tend to occupy more of the reference class of observer-centred worlds, suggesting that it is likely that the observer-centred world corresponding to your experience corresponds to such an impersonal world and is infinite, with the most general ontology possible – providing an infinity of different ways for observers to be produced.

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