The excellent track record a Presumptuous Philosopher would have had

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1 Introduction

> I might not have existed.

This claim is hard to deny. For instance, my parents might never have met, in which case I would not have been here. And indeed, almost no one does deny it, a few fringe necessitarianists being the only exceptions. Consider, however, this slight strengthening of the claim:

> I might not have existed even if other people did.

In other words, it might have been the case that the world contained (intelligent) subjects, but that I was not among them. This, too, is immensely plausible. Surprisingly, however, there is an important debate in philosophy in which the majority position is based on the denial of this claim. Or, at least, the majority believes that we should reason *as if* that claim were false.

The problem arises when one adopts

> The Self-Sampling Assumption (SSA): I should reason as if I were a random sample from the set of all subjects in the history of the Universe.

This principle, or something like it, seems to be crucial for correct anthropic reasoning. However, it has a very surprising and counter-intuitive consequence, viz. that life in the Universe will die out much sooner than we would otherwise predict. It has this bizarre consequence for the same reason that one is more likely to draw a ball numbered seven from an urn containing only balls numbered one through ten, than from an urn containing balls numbered one through twenty. According to SSA, if life in the Universe comes to an end soon, then the probability of me being who I am—and born when I was—is higher than if life will be prevalent in the Universe for billions of years to come. This is because my birth rank, i.e., my position in the temporal sequence of all subjects who ever have or ever will exist, is analogous to the number of the drawn ball, and the total number of subjects is analogous to the total number of balls. So *who I am* confirms that doom is impending.

This is known as the "doomsday argument". One way to undermine it without giving up on SSA is to further adopt

> The Self-indication Assumption (SIA): The probability of each hypothesis about how many subjects will exist in the history of the Universe should be adjusted by a factor proportional to that number of subjects.

The effect of SIA on the assessment of when "doom" will happen exactly balances out the effect of SSA. So, that problem is solved. A further point in SIA's favor is that accepting SIA is analogous to accepting the majority position concerning the (more widely known) Sleeping Beauty problem, i.e., the thirder position.[1] Nevertheless, the near-universal opinion among experts is that SIA is wrong.[2] This is because SIA *also* has a surprising and counter-intuitive consequence.

Assume that, at some point in the future, the objective evidence available to the scientific community shows with certainty that there will have been either a trillion trillion subjects in the history of the Universe, or a *trillion* trillion trillion subjects. Assume further that scientific experts assign each option a credence of $\frac{1}{2}$ based on standard scientific norms. A *Presumptuous Philosopher* then claims that, if each of us also takes into account the subjective evidence that he or she exists, then we should consider it virtually certain that the larger number of total subjects is correct.

SIA supports the Presumptuous Philosopher's reasoning, and this is what has led most experts to conclude that SIA is wrong. The majority of those who conclude thus belong to one of the following two categories: (1) those who accept SSA and hence the doomsday argument;[3] and (2) those who accept a variant of SSA, whereby the set of all subjects in the history of the Universe is replaced with a more restricted *reference class*.[4] Such a restricted reference class can have the effect of making the doomsday argument invalid. A simple example of this is when the reference class consists of the set of all humans born until the current point in time.

This leads us back to the problem with which this paper opened. SSA without SIA in effect amounts to an assumption that one's own existence is *necessary*, subject only to there being any subjects at all in the history of

[1] Elga (2000).

[2] Leslie (1992), Bostrom (2002), Bostrom and Ćirković (2003), Bradley (2005), Dieks (2007), and Friederich (2016).

[3] Leslie (1990a, 1990b) and Bradley (2005).

[4] Eckhardt (1993), Korb and Oliver (1998), and Sowers (2002). Bostrom (2001) appears to believe the disjunction of (1) and (2) without committing to either.

the Universe. Importantly, this is *not* the sort of easily fixed "accident" that can result from the careless formulation of a principle. Thinking of myself as a random sample from some set that contains both actual *and* some merely possible subjects, such that my existence is not (almost) necessary, leads me in the direction of SIA. So, those experts in category (1), above, either deny that my existence is contingent, or insist that I should reason *as if* it were necessary, even though it is not. I am not sure which is worse. Those in category (2), meanwhile, are just assuming an even stronger necessity claim.

Thus, epistemic agents are instructed to ignore some of their evidence when reasoning about the world. Defenders of SSA without SIA tell me to ignore the evidence that I exist, and defenders of variants of SSA without SIA tell me to ignore even more evidence, e.g., that I was born prior to the present time. They tell me to ignore it in the sense that the evidence is not available as something on which to non-trivially conditionalize in a Bayesian updating process, because I must assign it probability 1 in my priors.

I, on the other hand, believe that the Presumptuous Philosopher's reasoning is correct. Some of my theoretical reasons for doing so have already been indicated above, and additional ones are explained in an excellent paper by Olum (2002). As briefly noted above, opposition to SIA is primarily based on an intuition that the Presumptuous Philosopher *must* be wrong. I surmise that this intuition is caused by an awareness of the historical failures of philosophers who have been presumptuous, in some way or another, when disagreeing with scientists. However, this makes for a weak analogy argument that I find very unconvincing. Hence, my purpose in this paper is to push back against that intuition. I will do so not primarily via theoretical arguments (Olum beat me to that by two decades), but by exploring three historical case studies of controversies in cosmology in which the Presumptuous Philosopher, making use of the subjective evidence of his own existence, would have performed better than someone who merely inspected the available objective evidence in a traditional fashion. I hope that those contra-factual success stories will show the Presumptuous Philosopher in a more positive light, and erode his influence as a bogeyman in the debate about anthropic reasoning.

As case studies, I have chosen what are arguably the most significant scientific debates with implications for the number of subjects in the Universe: the one about geocentrism versus heliocentrism in the sixteenth century (section 2), the one about the existence of other galaxies in the early twentieth century (section 3), and the one about the size of the Universe in the present (section 4). I do not think that the combination of SSA and SIA is *exactly* right, and I will explain why in section 6. Nevertheless, SSA + SIA is a decent approximation of my position, and will serve in lieu of it as we explore the case studies. At the end of section 4 and in section 5, I will also make a distinction between a finitist Presumptuous Philosopher who rules out an infinite Universe a priori, and a non-finitist (henceforth, "infinitist") Presumptuous Philosopher who does not.

2 Planets beyond Earth

Consider the epistemic situation of an astronomer in the first half of the sixteenth century. The established worldview is that of Ptolemy and Aristotle: the Earth is unique and fundamentally different from the heavens. It is immobile at the center of the Universe, while the Sun, the Moon, the five planets, and the fixed stars revolve around it. There are also two completely separate sets of physical laws in operation: one for the sublunar and one for the supralunar world. Non-trivial processes can only unfold in the sublunar world, because the eternal and essentially unchanging supralunar one is inhabited only by spheres following permanent circular paths. Thus, only on Earth is life possible.[5]

However, an alternative worldview has just been proposed by Copernicus. His hypothesis places Earth in orbit around the Sun, as just one among the planets. If he is correct, then the idea of separate sets of natural laws for Earth and the rest of the Universe becomes untenable; and the complex processes that take place on Earth, including those that constitute life, are also conceivable on other planets—not just our known neighbors, but other, undiscovered ones circling other suns.[6]

How would a reasonable astronomer distribute credences between the two theories?[7] There are many factors to take into account. First, the heliocentric theory is in some ways simpler, and has several explanatory advantages.[8] One example of a fact that is better explained from a heliocentric viewpoint is the bounded elongation of Mercury and Venus: i.e., that these planets are always within a narrow angle (28° and 46° respectively) of the Sun as seen from Earth. According to Ptolemy's system, this effect is due to the centers of the two planets' epicycles always being located on the line that connects Earth and the Sun, but the system provides no explanation for why that is so. Under heliocentrism, on the other hand, the bounded elongation is readily explained by Mercury and Venus orbiting closer to the Sun than Earth does.[9]

[5] Aristotle (1984), Ptolemy (1984), and Kragh (2007, section 1.2).

[6] Copernicus (1976) and Dick (1982, section 4).

[7] Strictly speaking, reaching the conclusion at the end of this section requires consideration of the full space of logically possible theories, not just the two mentioned here. However, I believe that the conclusion would be the same, and hence that my simplification is not misleading.

[8] Swerdlow and Neugebauer (1984, 59).

[9] Crowe (2001).

The second factor to consider is that heliocentrism does not necessarily result in better predictions about the apparent positions of the Sun, the Moon, and the planets. If Copernicus can be said to offer better predictions than Ptolemy at all, that advantage is the result of the complex interplay of multiple differences between their two models. For all that our early sixteenth century astronomer knows, equally good predictions could be obtained by combining the geocentric thesis with Copernican innovations other than heliocentrism; and many of his colleagues will go on to pursue just such research programs.[10]

Third, Copernicus's hypothesis implies the existence of a stellar parallax: i.e., that the apparent positions of the stars will change as Earth revolves around the Sun. However, no such parallax can be observed. Our inability to detect this effect could potentially be explained with the aid of an auxiliary hypothesis: namely, that the distance to the stars is so overwhelmingly great that the parallax, despite existing, is undetectable with sixteenth-century instruments.[11] Still, Bayesian considerations show the absence of a visible parallax to be a point in favor of the geocentric model, within the epistemic situation of the time. This is because reasonable prior credences for the distance being so overwhelmingly great are smaller than 1; thus, while the credence for no detectable parallax on condition of the geocentric model is 1, the credence for the same (non-)phenomenon on condition of the heliocentric model is less than 1, and the empirical evidence of the undetectability of the parallax therefore shifts credence from the latter model to the former.[12]

Fourth, Copernicus's hypothesis conflicts with the best available theory of motion. This theory is Aristotle's, according to which motion is divided into natural and forced. Natural motion for a sublunar object is when it moves towards its natural place, which it will do whenever it is not already there and not constrained by another object. The natural place of the element earth (and objects that are mostly composed of it) is at the center of the Universe, while water naturally resides in a spherical shell around that center; air, in a spherical shell around the water; and fire, around the air, in the sublunar world's outermost shell. In addition to being intuitive and fitting well with our everyday experiences, this theory provides an explanation not only for why things fall, but also for why they tend to fall in the direction of the center of the Earth—an explanation which is lost when Copernicus removes the Earth from the Universe's center.[13]

[10] Westman (1975), Swerdlow and Neugebauer (1984), Crowe (2001), and Omodeo (2014, 130).

[11] Kragh (2007, 48).

[12] Note that the undetectable parallax is old evidence in this context. I am assuming that the correct way to treat old evidence is similarly to new evidence, through the use of hypothetical priors, as proposed by Lange (1999).

[13] Aristotle (1984) and Omodeo (2014).

Taking all of these factors into account, it seems that neither theory has a clear advantage. Thus, for our astronomer of the early sixteenth century, it appears reasonable to assign roughly equal credence to each.

However, the Presumptuous Philosopher disagrees. He points out that, given any reasonable credence distribution over the various possibilities that are consistent with the Copernican hypothesis, there are some such possibilities that have positive credence and imply the existence of extraterrestrial subjects. Hence, under the Copernican hypothesis, the expected number of extraterrestrial subjects is positive, whereas under the Ptolemaic-Aristotelian hypothesis it is zero. Therefore, the Presumptuous Philosopher adopts as his own credences those that result from applying the shift prescribed by SIA to the astronomer's credences. Ergo, he assigns higher credence to Copernicanism relative to the traditional alternative than the astronomer does.

Posteriority vindicates the Presumptuous Philosopher. In 1572, Tycho Brahe discovers a "new star", and demonstrates that it belongs in the supralunar world, thus providing the first clear empirical evidence against Aristotle's claim of that realm being unalterable. Corroborating evidence follows. In 1577, for instance, a comet is also determined to be supralunar (again by Brahe); and in 1609, Galileo shows that the Moon has mountains on it, and hence that its deviations from a perfectly uniform sphere that can be observed with the naked eye cannot be dismissed as optical illusions, as Aristotelians had done until then. Galileo also discovers that Jupiter has moons, disproving the thesis that all heavenly bodies orbit the Earth; and that all of Venus's phases are visible, contrary to the prediction—arising from the geocentric theory, coupled with the ad hoc assumptions needed to ensure bounded elongation—that we should never be able to see it full. In 1605, Kepler demonstrates that the road to clearly superior predictions does indeed lie in the direction to which Copernicus had pointed, but that it was just a bit farther in that direction than Copernicus himself had ventured. That is, in addition to abandoning the Aristotelian thesis of geocentrism, one also has to leave behind his dogma that all heavenly motion is composed of circles. And then Newton, in 1687, reduces Kepler's planetary laws to general laws of nature that are found to apply equally to the sub- and the supralunary realms. Thus, by the 1830s, when stellar parallaxes are finally detected, it has long been obvious to all but the most dogmatic that the Ptolemaic-Aristotelian worldview was mistaken.[14]

Hence, it turned out that the sixteenth century's Presumptuous Philosopher, employing anthropic reasoning, had more accurate credences than the astronomer who only made use of objective considerations.

[14] Drake (1978), Thoren (1990), and Caspar (1993).

3 Galaxies beyond the Milky Way

Let us move forward in time to 1921, when it is common knowledge that we live in a cluster of stars, the Milky Way, which—although large, and containing very many stars—is of limited extent. However, in addition to what are clearly identifiable as stars, another kind of object has been observed outside of our solar system, namely a number of nebulae; and their nature is in dispute. One option is that they are relatively close, roughly at the outskirts of the Milky Way. If so, they are likely clouds of gas, and at any rate they cannot consist (to any significant extent) of stars, because if they did, contemporary telescopes would have revealed as much.

Another option is that they are far away. If so, they might be galaxies comparable to our own, each consisting of additional billions of stars. This thesis is consistent with the available instruments being incapable of separating the light reaching us from so great a distance into individual stars. According to this "island-universe hypothesis," the expected number of subjects in the Universe is clearly much larger than it is according to the first one.

Let us again ask how a reasonable astronomer would distribute credence based only on objective evidence. Again, in this case, there is a great deal of evidence to consider,[15] some of it originating from the technique of spectral analysis. First, in 1912, Slipher measured a Doppler shift in the spectral lines of the Andromeda Nebula that implied that it is approaching us at a speed of 300 km/s. As this is a greater velocity than anything that had been measured in the Milky Way, Slipher's finding suggested that the Nebula is external to it.[16] However, in the nine years that have passed since then, similar velocities have been measured for stars that are definitely part of the Milky Way, undermining that argument.[17]

Huggins has discovered that the light spectra from many nebulae clearly indicate that they are not collections of stars. The spectrum from a star is an emission continuum with a few absorption lines superimposed, i.e., a spectrum consisting of light in almost all of the visible light interval. However, many nebulae have the "opposite" signature: i.e., are collections of emission lines of just a few, discrete wavelengths of light. On the other hand, he has also found continuous spectra coming from other nebulae, but he can easily account for this data without stipulating island universes. Instead, he theorizes that a star is created from a nebula, and that a continuous spectrum may therefore be emitted by a nebula that has given birth to a star but not yet been fully consumed by its offspring.[18]

[15] Shapley (1919), Berendzen, Hart, and Seeley (1976), and Kragh (2007, chapter 2).
[16] Slipher (1913).
[17] Adams and Joy (1919).
[18] Huggins and Huggins (1909).

Also, in 1885 an observation was made of a nova in the Andromeda Nebula that was as bright as the rest of the nebula. To our 1921 astronomer, it is very implausible that one star in a galaxy should be as luminous as its other billions of stars combined, so this data constitutes very convincing evidence against it being a galaxy.[19]

In addition, within the last few years, van Maanen has measured the internal movement of certain points in many of the nebulae. The clear conclusion is that nebulae rotate, and at such great angular velocity that—if they are as large as implied by the island-universe hypothesis—then their outskirts move at speeds close to that of light: another extremely implausible proposition.[20]

Based on these and other factors, our 1921 astronomer concludes, together with the majority of his colleagues, that the balance of the evidence goes against the island-universe hypothesis, and assigns it low credence. However, the Presumptuous Philosopher (who, strangely, is still alive) assigns much higher credence to there being island universes. And once again, the objective evidence eventually agrees with that assessment.

The first such evidence is found in 1925. Hubble identifies some stars in the same areas of the sky, as seen from our perspective, as some of the nebulae. In itself, this is not significant, because those stars might not be part of the nebulae, but just happen to lie in the same directions. However, these particular stars are Cepheid variable stars, and recent advances have made it possible to determine the distance to stars of that type. As the term suggests, the luminosity of these stars vary periodically, and in 1912 it was discovered that such a period is a function of its star's intrinsic brightness, making the determination of such brightness a simple task. Thereafter, by comparing the intrinsic and the apparent brightness, the star's distance from Earth can be calculated. By this method, the Cepheid variable stars discovered in the nebulae are ascertained to be at distances far beyond the limits of the Milky Way. And, because these stars are found much more frequently in those areas of the sky that contain nebulae, they are almost certain to be part of them.[21]

In 1934, an explanation of how one star can indeed compete with the brightness of a whole galaxy is provided by Baade. That is, while a *common* nova is unusually bright for a few days because it expels its outer layers, there is a separate class of novae, known as supernovae, that shine at extreme levels of luminosity, also just for a few days, in a much more dramatic process that converts a great deal of its mass into energy.[22]

As to the measurements that demonstrated the rapid rotation of the neb-

[19] Curtis and Shapley (1921).
[20] van Maanen (1921).
[21] Leavitt and Pickering (1912) and Hubble (1925).
[22] Baade and Zwicky (1934).

ulae? Well, in 1935, they are simply shown to be erroneous.[23] Thus, we now know that our galaxy is not alone—far from it—and the Presumptuous Philosopher was once again more accurate in his assignment of credences than the astronomer working according to traditional epistemic norms.

4 Parts of the Universe beyond the visible

For our third and final case study, let us consider a debate that is still not completely settled. Today, we have a much better overview of the layout of the Universe than we had a century ago, and in particular, we have a reasonably reliable estimate of the number of stars in the visible universe: $3 \cdot 10^{23}$.[24] However—as with the historical uncertainty discussed in sections 2 and 3—considerable uncertainty remains about the number of stars, and hence the expected number of subjects. This is because the above-mentioned estimate only pertains to the *visible* universe: our empirical knowledge is restricted by the fact that light has only had 13.8 billion years to reach us since the creation of the Universe. We therefore do not have direct observational evidence for either the total number of stars or the size of the Universe, and therefore, different hypotheses about these issues can still be entertained by rational epistemic agents.

Our stochastic variable for the number of stars in the entire Universe can conveniently be factored into two: the size of the Universe and the density of stars within it. We *are* in a position to estimate the latter with good precision. This is because we have discovered the Universe to be homogenous at large scales. That is, even though stars are clustered together in galaxies separated by huge voids, and galaxies are clustered together in, well, *clusters*, and *those* clusters are clustered together in superclusters, there do not appear to be any larger-scale structures in the Universe. As Ryden (2002, 10) puts it, there seem to be no superduperclusters. Of course, our direct evidence for this is also restricted to the visible part of the Universe; but it is generally agreed that extrapolation of this finding to the entirety of the Universe is reasonable. Hence, our estimate of the total number of stars should be proportional to our estimate of the size of the Universe, the factor of proportionality being the number of stars in the visible universe divided by the volume of the same, i.e., $7 \cdot 10^{-10}$ stars per cubic light year.

The other factor, the size of the Universe, depends on the shape of the Universe. The theory of relativity tells us that space can be either positively curved (i.e., the angle sum of a triangle minus 180° is positive), or flat, or negatively curved. Coupled with the assumption of homogeneity,[25] it follows

[23] Hubble (1935) and van Maanen (1935).
[24] Marov (2015).
[25] Or, to be precise: homogeneity and isotropicity.

that it is either *uniformly* positively curved, or *uniformly* flat, or *uniformly* negatively curved. The latter two options imply that the Universe is infinite, while the former means that the Universe takes the form of a hypersphere, which—just like its two-dimensional analogue, a regular sphere—"curls up on itself" in such a way that it is finite.[26] And, just as the surface area of a sphere is larger if its curvature is smaller, the volume of a hypersphere is larger if its curvature is smaller, i.e., if space is *close* to being flat. To be precise, its volume, V, as a function of the radius, R, is $V = 2\pi^2 R^3$.

The first attempt at determining the shape and size of the Universe using the framework of relativity theory was made in 1917 by Einstein himself. As a leftover from Aristotle's dogma about the supralunar world being essentially unchanging, it was still believed in the early twentieth century that the overall structure of the Universe remained the same over time. Einstein found a solution to his field equations that respected this assumption. That solution implies that the Universe is positively curved, and has a radius of $R = (2\kappa^{-1}\rho^{-1})^{\frac{1}{2}}$, where κ is the Einstein gravitational constant, and ρ is the mean density of matter and energy. Using the best estimate at the time, $\rho = 10^{-22}$ g/cm^3, Einstein arrived at the value $R = 10^7$ ly, which implies $V = 2 \cdot 10^{22}$ ly^3.[27]

Around 1930, Lemaître and Hubble discovered that Aristotle was *very* wrong: the Universe is in fact expanding. To fit with this empirical realization, a different solution to the field equations was required, and was found. This alternative solution does not by itself imply, as Einstein's did, that the Universe is positively curved. Also, that overall property—as opposed to just the radius of curvature—was now understood to depend on the density of matter and energy. Low density makes for a negatively curved space; high for a positively curved space; and one specific density in between, for a flat space. This density is known as the *critical density.* The *density parameter*, Ω, is defined as the average density divided by the critical density. Thus, $\Omega > 1$ implies a finite Universe, which is larger the closer Ω is to 1, while $\Omega \leq 1$ implies an infinite Universe.

In particular, the size of the Universe depends in a non-linear way on the value of Ω. This means that even with knowledge of that value to what might in other circumstances count as a good approximation, small uncertainties—like, for instance, the difference between $\Omega = 1.01$ and $\Omega = 1.00001$—would have a huge impact in the context of determining the expected number of subjects. Specifically, if the Universe is finite, its radius is $R = cH_0^{-1}|1 - \Omega|^{-\frac{1}{2}}$, where $c = 299{,}792{,}458$ m/s is the speed of light and $H_0 = 0.0207$ m/s/ly is the Hubble constant for the expansion of the

[26] Ryden (2002) and Liddle (2003).

[27] Einstein (1952), Einstein (1998), Kragh (1996), and O'Raifeartaigh, O'Keeffe, Nahm, and Mitton (2017).

Universe.[28] Thus, if $\Omega = 1.01$, then the Universe's volume is $6.02 \cdot 10^{34}$ ly^3 (or 143 times what we now know to be the volume of the visible universe), and if $\Omega = 1.00001$, then the volume is $1.90 \cdot 10^{39}$ ly^3 (or 4,510,000 times as big as the visible universe).

How would our Presumptuous Philosopher shift credences in this situation? To answer that question, we now must distinguish between two cases: in one, he is an infinitist, and in the other, a finitist. As the former, he would shift credence towards the entire interval from 0 to 1 without privileging any sub-interval thereof. As a finitist, on the other hand, he would set the credence for that interval at 0, but shift credences towards the values close to but larger than 1; and that shift would be strong, due to the non-linear relation between Ω and V.

Of course, the above-mentioned shifts concern the credences for the *true value* of Ω; we might also consider the shift of credences for future *scientific estimates* (based on just objective evidence), assuming that the exact value will remain unknown. Some decades ago, the infinitist version of the Presumptuous Philosopher would probably have allowed for the possibility that, even in 2022, the cosmologists would still not have determined whether Ω is larger than, equal to, or smaller than 1. The finitist, on the other hand, would not merely allow for it; he would shift a great deal of credence to that proposition. Indeed, his shift of credences for the true value towards the numbers just larger than 1 could very well be so massive that he became quite convinced that empirical measurements would not be able to distinguish among the three cases anytime soon thereafter.

Thus, when it is announced in 2018 that data from the *Plank* project's measurements of the cosmic background radiation give an estimate of $\Omega = 0.9993 \pm 0.0019$,[29] the infinitist can brag of a modest success, but the finitist Presumptuous Philosopher can celebrate a sweeping victory!

5 Further differences between the finitist and the infinitist

The differences between an infinitist and a finitist Presumptuous Philosopher are worth exploring a little further. Let us again consider the infinitist first. Assuming that the "objective credences" with which he starts out allow for the possibility of infinitely many subjects at all, he will shift *all* of his credence to such possibilities. Presumably, this will happen through his lowering, to zero, the credence of any possibility involving only finitely many subjects, and then renormalizing the rest. That is, he multiplies the credences of the possibilities that involve infinitely many subjects with the

[28] For simplicity, I will take this value for granted and not consider the history of its estimation, as I have also not done for the estimate of the density of stars.

[29] Planck Collaboration (2020).

same factor in such a way that the sum is again 1.[30] This does not imply, however, that he assigns credence 1 to there being infinitely many subjects in the Universe *now*, or at any other particular point in the history of the Universe. This is because there are different ways in which subjects could be infinitely many. The one we have thus far been implicitly considering might be called the *spatial option*: the Universe contains infinitely many subjects because it is infinitely large. However, there is also the *temporal option*: that the Universe has existed and/or will exist forever, and that therefore its history will include infinitely many subjects. In addition, there is the *numerical option*: that there is a multiverse made up of infinitely many universes, which between them have infinitely many subjects.[31] Hence, in the last of our three case studies, the Presumptuous Philosopher will probably *not* shift all his credence to the proposition that Ω belongs to the interval from 0 to 1.

While the point of this paper is to exhibit some of the Presumptuous Philosopher's success stories, this last case also contains an example of the exact opposite, if the Presumptuous Philosopher is an infinitist. As mentioned above, it was generally believed before circa 1930 that the Universe was structurally static. In particular, it was thought that it had *always* been the way it was, in the strongest possible sense of "always". In other words, the prevailing dogma of a century ago was a version of the temporal option: that the Universe had an infinite past. I call it a dogma because, rather than on any empirical evidence, this belief was based on a mere feeling that the idea of a moment of creation belongs to religion and is therefore scientifically unacceptable. Hence, an ideally rational epistemic agent in the early twentieth century would not, based on just objective evidence, have assigned a credence close to 1 to the proposition of an "always" Universe. However, the infinitist Presumptuous Philosopher would shift his credence significantly towards 1 based on anthropic considerations; and soon afterwards, that move would have been revealed to be a bad one by Lemaître and Hubble.

On the other hand, the finitist Presumptuous Philosopher—who believes an infinite past to be absurd, because it would make "arrival" at the present impossible—would have assigned the dogma a credence of zero both before and after the discovery of the Universe's expansion. Hence, *his* use of anthropic credence-shifts would not have led him in the direction of decreased accuracy in this case. Also here, the finitist Presumptuous Philosopher does better than the infinitist.

[30] Other variants of infinitist Presumptuous Philosophers could be contemplated, but I will not do so here.

[31] Because of this option, the word "Universe" in SAA and SIA should be replaced with "universe(s)".

6 Where to shift one's credence

As mentioned in the Introduction, I do not think that the combination of SAA and SIA is *exactly* right. In this section I will explain why. The disagreement also has implications for how and to what extent one should shift credences based on anthropic reasoning, and I will explore them too.

Both SAA and SIA make reference to the set of all subjects in the history of the Universe in such a way that the precise definition of "subject" becomes important to anthropic reasoning. If, for instance, the correct definition of "subject" is one that includes silicon-based creatures, then I should shift more credence to a hypothesis that implies such creatures are prevalent than if the correct definition does not. And it becomes important to determine whether a hive-mind counts as one subject or several. I do not think that this is correct.

Instead, the basic assumption I rely on is that the use of hypothetical priors makes for a sound methodology. Hypothetical priors are priors that an epistemic agent would have if they had less evidence than they actually do. I can thus use them to consider how I would update on evidence that I am already in possession of. As mentioned in footnote 12, the use of such priors was first suggested by Lange (1999) as a solution to the problem of old evidence. It is also implicit in the use of SSA in the doomsday argument: I'm supposed to form hypothetical priors that do not take my knowledge of my birth rank into account, and the conditionalization on that knowledge is supposed to shift my credences towards impending doom. I believe that the use of hypothetical priors can be taken one step further, in that it is reasonable for me to employ priors that do not take into account my knowledge that I exist. That this is reasonable has been argued in a series of papers by Horgan and Mahtani.[32]

To assess the correct anthropic credence shift, I suggest that one should consider the hypothetical priors one would have had if one hadn't taken into account one's knowledge of one's own existence and all knowledge that is specifically about our solar system, but *had* taken into account all of one's knowledge of general laws of nature and cosmology. In that hypothetical epistemic situation, one's credences are distributed over two classes of possible worlds: ones in which there is a person just like oneself on a planet just like Earth in a solar system just like ours,[33] and ones in which there is not. Presumably, such an occurrence is more frequent in that outcome space's larger worlds than in its smaller ones. More precisely, the expected number

[32] Horgan (2004), Horgan (2007), Horgan (2008), and Horgan and Mahtani (2013). Pust (2008, 2013, 2014) has argued the opposite point of view.

[33] To be precise, what is relevant is worlds where there is someone in exactly one's present mental state (including both accurate and inaccurate beliefs about oneself, Earth, and the solar system); see Meacham (2008).

of such occurrences is presumably roughly proportional to the size of the world. Hence, when one conditionalizes on one's knowledge of oneself, one's credences will shift roughly in the way prescribed by SIA when "subjects" is replaced by "subjects exactly like me". (Thus, the precise definition of "subject" does not matter.)

Actually, however, it may be more complicated than that, depending on the exact strength of my evidence that *I* exist and am so-and-so. The weakest option is that it is equivalent to knowing that *someone* who is so-and-so exists. However, if someone who was like me in all respects, except that he was created somewhere else in the Universe from different matter, does not count as *me* in the relevant sense, then my knowledge that *I* exist and am so-and-so amounts to something stronger. This depends on vexing questions of personal identity to which I do not have an answer, so I will mention the consequences of each option without making a commitment. If the content of that knowledge is sufficiently strong, it is as described in the previous paragraph: I should shift credence twice as much towards the hypothesis that the size of the Universe is such that the expected number of subjects exactly like me is 2,000, as towards the hypothesis that the size of the Universe is such that the expected number of subjects exactly like me is 1,000. This is because, if I shift by less than twice as much, then I am implicitly treating myself as modally privileged at the expense of others, as explained by Olum (2002). On the other hand, if the content of my knowledge is as in the weak option mentioned above, then the "anthropic shift factor" will equal the probability that someone exactly like me exists. It will thus be capped at 1 and will, for the finitist, only approach that value asymptotically as the size of the Universe goes towards infinity. In that case, SIA is further from the truth than in the first case.[34]

If either finitism or the strong option is correct, then anthropic reasoning should cause credence shifts not only for hypotheses about the size of the Universe, but also for those about someone like oneself being created in any given part of the Universe. This is because my existence constitutes evidence that someone like me is more easily created in a given part of space than I would expect in the hypothetical epistemic situation of not having that evidence. The probability that someone like me is created in a given part of the Universe is correlated to varying degrees with a number of other probabilities that are of interest to cosmology and exobiology, so it follows that anthropic reasoning should also have an impact on the assessment of those probabilities. Also in these circumstances is SIA inaccurate, unless the correlation with the probability that *any* kind of *subject* is created in the given part of space is 1; and presumably, it would not be rational to assign credences in such a way that it is, under reasonable definitions of "subject".

[34] It should be noted that the previous section's conclusions about the infinitist do not apply in this case.

While assessment of such correlations to a reasonable degree of precision requires expertise I do not possess, a few rough examples can illustrate the idea. The prevalence of planets around stars should receive a big credence boost from anthropic reasoning. Likewise, our assessment of how often planets develop into Earth-like ones should be adjusted upwards. The same holds for the probability of life arising on Earth-like planets, and the probability of such life evolving to become intelligent. How about the probability of silicon-based life developing on planets very different from Earth? I suppose that it would be positively correlated with my own existence in the hypothetical priors I should adopt if I "forget" about my own existence, and hence that it should also get a boost from anthropic reasoning. I suppose this because some of the factors that determine how easily life develops are presumably independent of the differences between carbon and silicon. However, surely it would not be correlated as strongly with my existence as the previous examples, because there are also factors that are dependent on the differences; and with respect to those, my evidence that I exist is only relevant to hypotheses about carbon-based life. Thus, to repeat, SIA is not quite correct, if the definition of "subject" includes silicon-based creatures. Also, the definition of "subject" does not matter to the question of how credences should be shifted.

7 Conclusion

If the original Presumptuous Philosopher thought-experiment is far-fetched, it is only because of its simplicity: the scientists are stipulated to have narrowed the field of options for the number of subjects in the history of the Universe down to just two. Otherwise, the situation resembles several historical cases, that are all such that the Presumptuous Philosopher, if he had showed up to the debate, would have outperformed traditional scientific thinking: consistently so, in the cases we have studied, if he were a finitist, and in the majority of those cases if he were not. It is thus difficult for me to see the common intuition concerning that thought-experiment as anything other than the result of a misapplication of the modesty that history has taught philosophers for other reasons.

Admittedly, acceptance of the validity of "presumptuous reasoning" brings with it some theoretical challenges. Does it force us to reject the principle of countable additivity?[35] And what happens when we ask the question "If the prior probability of my existence is less than 1, then what is it?"? Do we need to answer "zero", and therefore work with conditional probabilities that are primitive instead of defined as a fraction?[36] These are difficult

[35] Ross (2010).

[36] Hájek (2013).

questions, but not, I think, so difficult that they should make us reject "presumptuousness". Not if history is a guide.

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