A Third Route to the Doomsday Argument

revised December 2002

Paul Franceschi
University of Corsica
p.franceschi@univ-corse.fr
http://www.univ-corse.fr/~franceschi

In this paper, I present a solution to the Doomsday argument (DA, for short) based on a third type of solution, by contrast to on the one hand, the Carter-Leslie view and on the other hand, the Eckhardt-Sowers-Sober analysis. The present line of thought is based on the fact that both aforementioned analyses are based on an inaccurate analogy. After discussing the imperfections of both models, I present then a novel model that fits more adequately with the human situation corresponding to DA. This last model also encapsulates both Carter-Leslie's and Eckhardt et al.'s models, and reveals a link with the issue of mind-body dualism. Lastly I argue that this novel analogy, combined with an adequate solution to the reference class problem, leads to a novel formulation of the argument that could well be more consensual than the original one[1].

1. The Carter-Leslie View

Let us begin by sketching briefly the Doomsday argument. The argument can be described as a reasoning leading to a bayesian shift, from an analogy between what has been termed the *two urn case*[2] and the corresponding human situation. Consider, first, the *two urn case*. According to Nick Bostrom's (1997) presentation, it runs as follows:

> Imagine that two big urns are put in front of you, and you know that one of them contains ten balls and the other a million, but you are ignorant as to which is which. You know the balls in each urn are numbered 1, 2, 3, 4 ... etc. Now you take a ball at random from the left urn, and it is number 7. Clearly, this is a strong indication that that urn contains only ten balls. If originally the odds were fifty-fifty, a swift application of Bayes' theorem gives you the posterior probability that the left urn is the one with only ten balls. (Pposterior (L=10) = 0.999990).

The *two urn case* constitutes an uncontroversial application of Bayes' theorem. It is based on the two following competing hypotheses:

($H1_{few}$) the urn contains 10 balls
($H2_{many}$) the urn contains 1000000 balls

and the corresponding prior probabilities: P(H1) = P(H2) = 0.5. Taking into account the fact that E denotes the available evidence that the random ball is #7 and P(E|H1) = 1/10 and P(E|H2) = 1/1000000, a bayesian shift ensues from a straightforward application of Bayes' theorem. As a result, the posterior probability is such that P'(H1) = 0.99999.

Let us consider, on the other hand, the human situation corresponding to DA[3]:

> (...) now consider the case where instead of the urns you have two possible human races, and instead of balls you have individuals, ranked according to birth order. As a matter of fact, you happen to find that your rank is about sixty billion. Now, say Carter and Leslie, we should reason in the same way as we did with the urns. That you should have a rank of sixty billion or so is much more likely if only 100 billion persons will ever have lived than if there will be many trillion persons. Therefore, by Bayes' theorem, you should update your beliefs about mankind's

prospects and realise that an impending doomsday is much more probable than you have hitherto thought.

It is apparent that the corresponding human situation leads to the two following hypotheses:

($H3_{few}$) the number of humans having ever lived will reach 10^{11} (*doom soon*)
($H4_{many}$) the number of humans having ever lived will reach 10^{14} (*doom later*)

Call this situation the (*human*) *situation corresponding to DA*. In this case, the prior probabilities are such that P(H1) = P(H2) = 0.5 and E denotes the fact that your birth rank is 60×10^9. An application of Bayes' theorem, taking into account the fact that $P(E|H1) = 1/10^{11}$ and $P(E|H1) = 1/10^{14}$, leads to a vigorous bayesian shift: P'(H1) = 0.999.

According to Carter and Leslie[4], the *human situation corresponding to DA* is analogous to the *two urn case*. And this leads to a vigorous bayesian shift in favor of the hypothesis that Doom will occur soon. For this reason, the Carter-Leslie line of thought can be summarized as follows:

(5) in the *two urn case*, a bayesian shift of the prior probability of H_{few} ensues
(6) the situation corresponding to DA is analogous to the *two urn case*
(7) ∴ in the situation corresponding to DA, a bayesian shift of the prior probability of H_{few} ensues

From the Carter-Leslie's viewpoint, the analogy with the urn is well-grounded. And this legitimates DA's conclusion according to which a bayesian shift in favor of doom soon ensues.

2. The Eckhardt-Sowers-Sober Analysis

A line of objection to the Doomsday Argument initially raised by William Eckhardt (1993, 1997) and recently echoed by George Sowers (2002) and Elliott Sober (2003) runs as follows. The analogy with the urn at the origin of DA, so the objection goes, is ill-grounded. For in the *two urn case*, the ball number is randomly chosen. But in the human situation corresponding to DA, our birth rank is not randomly chosen, but rather indexed on the corresponding temporal position. Hence, the analogy is ill-grounded and the whole reasoning is invalid. Eckhardt notably stresses on the fact that it is impossible to make a random selection when there exists numerous unborn members in the chosen reference class[5]. Sober (2003) argues along the same lines[6], by pointing out that no mechanism having the effect of randomly assigning a temporal location to human beings, can be exhibited. Lastly, such a line of objection has been recently revived by Sowers. He emphasizes that the birth rank of each human is not random, because it is indexed on the corresponding temporal position[7].

In parallel, according to the Eckhardt et al. analysis, the human situation corresponding to DA is not analogous to the *two urn case*, but rather to the *consecutive token dispenser* initially described by Eckhardt[8]:

> (...) suppose on each trial the *consecutive token dispenser* expels either 50 (early doom) or 100 (late doom) consecutively numbered tokens at the rate of one per minute.

A similar device is also mentioned by Sowers[9]:

> There are two urns populated with balls as before, but now the balls are not numbered. Suppose you obtain your sample with the following procedure. You are equipped with a stopwatch and a marker. You first choose one of the urns as your subject. It doesn't matter which urn is chosen. You start the stopwatch. Each minute you reach into the urn and withdraw a ball. The first ball withdrawn you mark with the number one and set aside. The second ball you mark with the number two. In general, the n^{th} ball withdrawn you mark with the number n. After an arbitrary amount of time has elapsed, you stop the watch and the experiment. In parallel with the original

scenario, suppose the last ball withdrawn is marked with a seven. Will there be a probability shift? An examination of the relative likelihoods reveals no.

Thus, according to the Eckhardt et al. line of thought, the human situation corresponding to DA is not analogous to the *two urn case*, but rather to the *consecutive token dispenser*. And in this last model, the conditional probabilities are such that P(E|H1) = P(E|H2) = 1. As a consequence, the prior probabilities of the two alternative hypotheses H_{few} and H_{many} are unchanged. Hence, the corresponding line of reasoning goes as follows:

(8) in the *consecutive token dispenser*, the prior probabilities remain unchanged
(9) the situation corresponding to DA is analogous to the *consecutive token dispenser*
(10) ∴ in the situation corresponding to DA, the prior probabilities remain unchanged

thus yielding $P(H_{few}) = P'(H_{few})$ and $P(H_{many}) = P'(H_{many})$.

3. The Analogy with the Urn

As we have seen, according to the Carter-Leslie view, DA is based on an analogy between the human situation corresponding to DA and the *two urn case*. By contrast, from the Eckhardt et al. standpoint, the analogy associates the human situation corresponding to DA and the *consecutive token dispenser*. In what follows, I shall argue that both analogies suffer from some defects and consequently do not prove fully adequate. This leads finally to reformulating the analogy more accurately.

Let us begin with the analogy with the *consecutive token dispenser*, which is characteristic of the Eckhardt et al. line of thought. Eckhardt describes the *consecutive token dispenser*, where the tokens are expelled from the urn at *constant* intervals of time ('one per minute'). Sowers describes an analogous experiment, which can be termed the *numbered ball dispenser*, where the balls are expelled from the urn and numbered accordingly, at the *constant* rate of one per minute. In this last experiment, the balls are numbered in the order of their expulsion from the urn. Nevertheless, both Eckhardt's and Sowers' experiments do not exactly correspond to the human situation corresponding to DA. For in this last situation, the humans appear on Earth at *variable* intervals of time. At this step, it is apparent that this second analogy also stands in need of refinement, in order to fit more adequately with the intrinsic features of the human situation corresponding to DA.

However, this can be regarded as a minor qualm. For both Eckhardt's and Sowers' experiments can be restated with items that are expelled at *irregular* rates instead of *constant* ones. Consider, for example, Sowers' *numbered ball dispenser*. One could consider alternatively a variation of the *numbered ball dispenser* where the tokens are expelled from the urn at *irregular* intervals of time and where the balls' numbers correspond to the rank of their expulsion from the urn. For the sake of argument, call such a variation the *irregular numbered ball dispenser*. It appears then that the *irregular numbered ball dispenser* is not vulnerable to the above mentioned objection.

Consider, second, the analogy with the *two urn case* inherent to the Carter-Leslie view. Let us begin with the characteristics of the human situation corresponding to DA. A summary analysis shows indeed that this last situation is *temporal*. In effect, the birth ranks are successively attributed to human beings in function of the temporal position corresponding to their appearance on Earth. Thus, the corresponding situation takes place, say, from T_1 to T_n, 1 and *n* being respectively the rank number of the first and of the last human. By contrast, the *two urn case* is *atemporal*, for at the moment where the ball is randomly drawn, all balls are already present in the urn[10]. Consequently, the *two urn case* takes place at a given time T_0. Thus, the situation corresponding to DA needs to be modeled in a temporal model, while the *two urn case* is rendered in an atemporal model. In short, the situation corresponding to DA being *temporal*, and the *two urn case* being *atemporal* precludes us from regarding the two situations as isomorphic[11]. At this step, it is apparent that the human situation corresponding to DA being temporal should be put in analogy more accurately with a *temporal* experiment.

Let us investigate now how the preceding inconvenient could be overcome. Consider then the following experiment:

The (synchronic and deterministic) incremental two urn case An urn[12] is in front of you, and you know that it contains either 10 or 1000 numbered balls. At time T_0, you blindly draw a ball #*e* from the urn. Then a device expels at T_1 the ball #1, at T_2 the ball #2..., at T_n the ball #*n* (the intervals of time, i. e. from T_1 to T_n, are *irregular*) Now, according to the result of the experiment realized in T_0, the device stops at T_e when the ball #*e* is expelled. At this step, you formulate the H_{few} and H_{many} assumptions with $P(H_{few}) = P(H_{many}) = 0.5$ and you try to evaluate the number of balls which were contained at T_0 in the urn. You conclude then to an upwards bayesian shift in favour of the H_{few} hypothesis.

At this step, it should be emphasized that anyone who accepts the conclusion of the *two urn case* would also accept the bayesian shift resulting from the *incremental two urn case*. It should be also pointed out that this last experiment does not face the above mentioned criticisms concerning the analogy between the human situation corresponding to DA and the *two urn case*. For it has been shown that the human situation corresponding to DA, being temporal, cannot be put in analogy with the *two urn case*, which is atemporal. By contrast, the *incremental two urn case* is a temporal experiment. Thus, the *incremental two urn case* meets the above mentioned requirements concerning the analogy and can be legitimately put in analogy with the human situation corresponding to DA. In this context, we now face a variation of DA which can be summarized as follows:

(11) in the *incremental two urn case*, a bayesian shift of the prior probability of H_{few} ensues
(12) the situation corresponding to DA is analogous to the *incremental two urn case*
(13) ∴ in the situation corresponding to DA, a bayesian shift of the prior probability of H_{few} ensues

And this last variation is not vulnerable to the above objection. The analogy with the urn is now plainly plausible, since both situations are *temporal*.

At this point, it is also worth scrutinizing the consequences of the *incremental two urn case* on the Eckhardt et al. analysis. For in the *incremental two urn case*, the number of each ball expelled from the device is indexed on the rank of its expulsion. For example, you draw the ball #60000000000. But you also know that the preceding ball was #59999999999 and that the penultimate ball was #59999999998, etc. However, this does not prevent you from reasoning in the same way as in the classical *two urn case* and from concluding to a bayesian shift in favor of the H_{few} hypothesis. In this context, the *incremental two urn case* has the following consequence: *the fact of being time-indexed does not entail that the ball number is not randomly chosen*. Contrast now with the central claim of the Eckhardt et al. analysis that the birth rank of each human is not randomly chosen, but rather indexed on the corresponding temporal position. Sowers in particular considers that the cause of DA is the time-indexation of the number corresponding to the birth rank[13]. But what the *incremental two urn case* and the corresponding analogy demonstrates, is that our birth rank can be time-indexed and nevertheless considered as random for DA purposes. And this point can be regarded as a significant objection to Sowers' analysis. This last remark leads to consider that the concrete analysis presented by Sowers does not prove however sufficient to solve DA. For the problem is revived when one considers the analogy between on the one hand, the human situation corresponding to DA and on the other hand, the *incremental two urn case*. One can think that it is this last analogy which constitutes truly the core of the DA-like reasoning. In this context, Sowers' conclusion according to which his analysis leads to the demise of DA appears far too strong. Echoing Eckhardt, he has certainly provided additional steps leading towards the resolution of DA and clarified significant points, but Sowers' analysis does not address veritably the strongest formulations of DA.

At this step, it appears that other variations of the incremental two urn case can even be envisaged. For consider the following variant:

The (diachronic and deterministic) incremental two urn case An opaque device contains an urn that has either 10 or 1000 numbered balls. At time T_1, a robot inside the device draws a ball in the urn (containing the balls #1 to #*n*) and the device expels the ball #1; if the ball #1 has been drawn then the device stops at T_1; else at T_2, the robot draws a ball in the urn (now containing the balls #2 to #*n*) and the device expels the ball #2; if the ball #2 has been drawn then the device stops at T_2; ...; else at T_i, the robot draws a ball in the urn (now containing the balls #*i* to #*n*) and the device expels the ball #*i*; if the ball #*i* has been drawn then the device stops at T_i; else at T_{i+1}, etc. (the intervals of time, i. e. from T_1 to T_n, are *irregular*). You know all the above and you get the ball #*e* at T_e when the device stops[14]. You formulate the H_{few} and H_{many} assumptions with $P(H_{few}) = P(H_{many}) = 0.5$ and you conclude to an upwards bayesian shift in favour of the H_{few} hypothesis.

In this case, the random selection is performed gradually and only made effective at time T_e. This contrasts with the synchronic version of the experiment, where the random selection is made definitively at time T_0.

Furthermore, the following variation takes into account an indeterministic situation:

The (diachronic and indeterministic) incremental two urn case An opaque device contains an urn that has 10 balls at T_1, but will ultimately have either 10 or 1000 numbered balls. The final number of balls in the urn will remain undetermined until an internal mechanism will flip a fair coin at a given time T_i ($1 \leq i < 10$). If heads, it will add 990 numbered balls (#11 to #1000) in the urn at T_i. If tails, it will do nothing. At time T_1, a random generator inside the device issues a number in the range [1, 1000] and the device expels the ball #1; if the number 1 has been issued then the device stops at T_1; else at T_2, the random generator issues a number in the range [2, 1000] and the device expels the ball #2; if the number 2 has been issued then the device stops at T_2; ...; else at T_{i-1}, the random generator issues a number in the range [*i*-1, 1000] and the device expels the ball #*i*-1; if the number *i*-1 has been issued then the device stops at T_{i-1}; else at T_i ($1 \leq i < 10$), the random generator issues a number in the range [*i*, *n*] (the total number of balls in the urn after the flipping of the coin is *n*) and the device expels the ball #*i*; if the number *i* has been issued then the device stops at T_i; else at T_{i+1}, etc. (the intervals of time, i. e. from T_1 to T_n, are *irregular*). Now you know all the above and you get the ball #*e* at T_e when the device stops. You formulate the H_{few} and H_{many} assumptions relating to the total number of balls in the urn after the flipping of the coin with $P(H_{few}) = P(H_{many}) = 0.5$ and you conclude to an upwards bayesian shift in favour of the H_{few} hypothesis[15].

The novelty in this variation is that it takes into account an indeterministic situation, namely where the number of balls present in the urn is unknown at the time where the first ball is expelled from the device. Such a variation shows that a random selection can even be made when the number of balls in the urn is unknown at the time where the random process begins. And this appears (at least partly) as a counter-example to Eckhardt's attack against the random sampling assumption in DA. As mentioned above, Eckhardt considers in effect that it is impossible to make a random selection when there exists many unborn members in the given reference class. But the *(diachronic and indeterministic) incremental two urn case* suggests that a random selection can even be made, under certain indeterministic circumstances.

However, it should be acknowledged that this only weakens Eckhardt's point, since the above experiment does not handle every type of indeterministic situation. In effect, Eckhardt could reply with an experiment of the following type:

The (diachronic and indeterministic) consecutive token dispenser An opaque device contains an urn that has 10 balls at T_1, but will ultimately have either 10 or 1000 numbered balls. The final number of balls in the urn will remain undetermined until an internal mechanism will flip a fair coin at a given time T_i ($1 \leq i < 10$). If heads, it will add 990 numbered balls (#11 to #1000) in the urn at T_i. If tails, it will do nothing. At time T_1, a random generator inside the device issues a number in the range [1, 10] and the device expels the ball #1; if the number 1 has been issued then the device stops at T_1; else at T_2, the random generator issues a number in the range [2, 10] and the device expels the ball #2; if the number 2 has been issued then the device stops at T_2; ...; else at T_{i-1}, the random generator issues a number in the range [*i*-1, 10] and the device expels the ball #*i*-1; if the number *i*-1 has been issued then the device stops at T_{i-1}; else at T_i, the random generator issues a number in the range [*i*, *n*] (the total number of balls in the urn after the flipping of the coin is *n*) and the device expels the ball #*i*; if the number *i* has been issued then the device stops at T_i; else at T_{i+1}, etc. (the intervals of time, i. e. from T_1 to T_n, are *irregular*). Now you know all the above and you get the ball #5 at T_5 when the device stops. You formulate the H_{few} and H_{many} assumptions relating to the total number of balls in the urn after the flipping of the coin, with $P(H_{few}) = P(H_{many}) = 0.5$ and you conclude that the prior probabilities remain unchanged[16].

In such a case, the drawing of the ball #5 at random gives us no grounds for concluding to a bayesian shift in favor of the H_{few} assumption.

4. A Third Route

Given the above developments, we are now in a position to scrutinize the version of DA based on a analogy between the human situation corresponding to DA and the *incremental two urn case*. As we have seen, this last version constitutes a strong variation of the argument in the sense that it is not open, first, to the charge of putting in correspondence an atemporal model with a temporal situation. This last variation is not vulnerable, second, to the objection that results from the Eckhardt et al. analysis, according to which our birth rank is not random because it is time-indexed. Let us question now whether the human situation corresponding to DA is analogous or not to the *incremental two urn case*. According to this novel formulation of DA, the question that arises is the following: are the situation corresponding to DA and the *incremental two urn case* fully isomorphic?

Let us begin with the *(synchronic and deterministic) incremental two urn case*. At this step, it appears that the part of the experiment that takes place from to T_1 to T_n proves fully analogous with the human situation corresponding to DA. Both situations are temporal and relate to numerous objects (or individuals), the number of which is that of their expulsion (or birth) rank. In this sense, the analogy proves strongly established. Nevertheless, it should be observed that some trouble emerges when one considers the situation that takes place at T_0. For in the *incremental two urn case*, a random selection of a numbered ball is made at that very moment. Such a random selection takes place with absolute certainty at T_0. But does an analogous random selection take place with the same degree of certainty at the eve of the beginning of humankind? The answer is no. For we lack any proof that the birth rank of future humans is determined by a random selection having occurred just before the beginning of humankind. In other words, has God gathered all the souls of the future humans before the existence of humankind and determined the birth rank of each future human by a random selection? Do we have any evidence that such random selection has occurred just before the birth of the first human? No. We currently lack evidence of any such random process. In the case of the human situation corresponding to DA, the occurrence of any such random selection remains fully *hypothetical*. Hence, it can be concluded that there exists an important disanalogy between the human situation corresponding to DA and the *incremental two urn case*. This disanalogy concerns on the one hand, the situation that has occurred just before the appearance of humankind and on the other hand, the experiment that takes place at T_0 in the *incremental two urn case*. While the occurrence of a random selection is known with absolute certainty in this last situation, the occurrence of an analogous random selection just before the appearance of humankind remains highly hypothetical.

The same goes for the *(diachronic and deterministic) incremental two urn case*. In effect, just as in the preceding case, the part of the experiment that takes place from to T_1 to T_n is fully analogous with the human situation corresponding to DA. But the disanalogy emerges with the consideration of a diachronic random process occurring from to T_1 to T_e. Does God diachronically proceed to the random selection of the birth rank among the remaining souls of the future humans? Just as in the previous case, we lack here evidence of any such diachronic random selection.

At this step, it is also worth evaluating alternatively the analogy between the human situation corresponding to DA and the *numbered ball dispenser*. Just as with the *incremental two urn case*, it appears that the part of the experiment that takes place from to T_1 to T_n is fully analogous with the human situation corresponding to DA. This should not be surprising because the *external* parts of both the *numbered ball dispenser* and *incremental two urn case* are identical. For an observer, there is no external difference between the two experiments. But it also appears that there exists a striking difference between the human situation corresponding to DA and the *numbered ball dispenser*. This difference concerns the event occurring at T_0. For in the *numbered ball dispenser*, no event occurs at T_0. And such a property of the *numbered ball dispenser* is known with absolute certainty. By contrast, what has occurred at the period preceding the existence of humankind remains indeterminate. Given its intrinsic nature, this period is full of uncertainty. Whether or not God has gathered the souls of all future humans before the appearance of humankind and fixed accordingly the birth rank of each future human by a random selection, remains a mere conjecture. Similarly, in the *numbered ball dispenser*, no random process is diachronically performed. Call α an event of this type, where a random selection - whether synchronically at T_0 or diachronically from to T_1 to T_e - is made. It should be pointed out that such an event seems prima facie highly unlikely. But are we allowed to rule out the possibility of any such event on rational grounds? No. For we lack evidence of the contrary. On the basis of the evidence at our disposal, we cannot consider with absolute certainty that such a random selection has not occurred, nor that it has occurred. Hence, the probability of any such event just before the birth of humankind is indeterminate, i. e. formally, $0 < P(\alpha) < 1$.

What precedes casts light on the crucial point that the experiment analogous to the human situation corresponding to DA should reflect this last property, namely that $0 < P(\alpha) < 1$. The model on which the human situation corresponding to DA is based should allow for the *hypothetical* occurrence of an event - whether synchronic or diachronic - leading to a random selection. For neither the *incremental two urn case* nor the *numbered ball dispenser* allow for this last possibility. In effect, the *incremental two urn case* is based on $P(\alpha) = 1$, and the *numbered ball dispenser* relies on $P(\alpha) = 0$. Both models do not reflect the crucial point that in the human situation corresponding to DA, the occurrence of an α-type event is purely *hypothetical*, i. e. such that $0 < P(\alpha) < 1$.

At this point, we are in a position to describe a model for the human situation corresponding to DA which is not open to the charge of not reflecting the hypothetical occurrence of an α-type event:

> *The hypothetical incremental two urn case* With a probability $P(\alpha)$ such that $0 < P(\alpha) < 1$, a device performs either a *numbered ball dispenser* or a - synchronic or diachronic - *incremental two urn case* experiment. Now you get the ball #*e* at T_e when the device stops. Given the H_{few} and H_{many} assumptions and $P(H_{few}) = P(H_{many}) = 0.5$, how would you update your prior probabilities?

Now, whatever the chosen random number, the device has expelled the ball #1 at time T_1, the ball #2 at time T_2, ..., the ball #*e* at time T_e. This last experiment presents the following property: there is no *external* difference whether the performed experiment is a *numbered ball dispenser* or an *incremental two urn case*. Let us analyze then the *hypothetical incremental two urn case* in more detail. On the one hand, the situation that takes place from T_1 to T_n does reflect the part of the human situation corresponding to DA that takes place from the beginning of humankind[17] to our current birth. On the other hand, the characteristics of the situation that takes place at T_0 (synchronically) or from to T_1 to T_e (diachronically) now correspond adequately to our current situation. In the lack of evidence that $P(\alpha) = 0$ or conversely that $P(\alpha) = 1$, we currently face a probability such that $0 < P(\alpha) < 1$. Finally, this leads to the following line of reasoning:

(14) in the *hypothetical incremental two urn case*, a bayesian shift of the prior probability of H_{few} possibly ensues

(15) the situation corresponding to DA is analogous to the *hypothetical incremental two urn case*

(16) ∴ in the situation corresponding to DA, a bayesian shift of the prior probability of H_{few} possibly ensues

in replacement of the steps (5)-(7) of the Carter-Leslie line of reasoning and of the steps (8)-(10) of the Eckhardt et al. line of argument.

At this step, it is tempting to try to evaluate the probability $P(\alpha)$. Must one retain a very small probability for α, by considering that the probability of an α-type event could have occurred before or during the appearance of humankind is very low? Or shouldn't an alternative line of reasoning be adopted? For the consideration that we are random human souls renders plausible an α-type event. Here, given the lack of current evidence, we cannot decide objectively in favor of one of the two possibilities. What remains in force is an indeterminate situation, i. e. such that $0 < P(\alpha) < 1$.

Lastly, it is worth mentioning that this situation presents a link with the issue of *mind-body dualism*. It should be noticed that the preferential choice of the *numbered ball dispenser* or of the *incremental two urn case* parallels the responses to the problem of mind-body dualism. In effect, the *numbered ball dispenser* seems best suited for those who adopt a materialist view on this issue. By contrast, the *incremental two urn case* appears more adequate for those who prefer a dualist approach. For the scenario of God drawing at random (whether synchronically or diachronically) the souls of all humans, would seem more plausible to those who believe in the mind-body duality.

5. The Reference Class Problem

At this point, it is worth recalling the *reference class problem*[18]. Roughly, it is the problem of how to define 'humans'. More accurately, it can be stated as follows: how can the reference class be objectively defined for DA-purposes? For an extensive or restrictive definition of the reference class can be given. An extensively defined reference class would include for example the somewhat exotic future evolutions of humankind, for example with an average I.Q. of 200 or with backward causation abilities. Conversely, a restrictively designed reference class would only include those humans who correspond accurately to the characteristics of, say, *homo sapiens sapiens*, thus excluding the past *homo sapiens neandertalensis* and the future *homo sapiens supersapiens*. To put it more in adequation with our current taxonomy, the reference class can be defined at different levels which correspond respectively to the supergenus *superhomo*, the *homo* genus, the *homo sapiens* species, the *homo sapiens sapiens* subspecies, etc. At this step, we lack an objective criterion to choose the corresponding level non-arbitrarily.

Leslie's treatment of the reference class problem is exposed in the response made to Eckhardt (1993) and in Leslie (1996)[19]. Leslie's response to the reference class problem is as follows. According to Leslie, one can choose the reference class more or less as one wishes, i. e. at a somewhat arbitrary level. Once this choice is performed, it suffices to adjust the prior probabilities accordingly to get the argument moving. Thus, on Leslie's view, the reference class problem can be overcome because the argument works for *all* reference classes. For that reason, Leslie's viewpoint can be termed an *undifferentiated* account of the reference class problem. Leslie's sole condition is that the reference class should not be chosen at an extreme level of extension or of restriction[20]. In sum, Leslie considers that a bayesian shift ensues for whatever reference class arbitrarily chosen, at a somewhat reasonable level of extension or of restriction.

I have expressed my own view on the *reference class problem* in Franceschi (1998, 1999). By contrast to Leslie's viewpoint, its can be characterized as a *differential* account of the reference class problem. The rationale goes as follows. For the sake of argument, let us assimilate the reference class, somewhat arbitrarily, to the *homo sapiens sapiens* subspecies. DA entails then a bayesian shift in favor of the H_{few} hypothesis for this last subspecies. Nevertheless, this does not preclude us from choosing, at an identically arbitrary level, a reference class slightly more extensive, say the *homo sapiens* species, that will survive. For the extinction of the *homo sapiens sapiens* subspecies could well be followed by the survival of the *homo sapiens supersapiens* subspecies. More generally, for whatever chosen reference class, I can still choose a slightly more extensive class that will survive. And it should be pointed out that it has the effect of depriving the original argument from its initial terror. At this step, it should be apparent that the consideration of a *differential treatment of the reference class problem* renders the argument innocuous. Finally, this gives a way of accepting its conclusion by rendering the argument less counterintuitive than in its original formulation.

At this point, it should be pointed out that an empirical test of a *differential* account of the reference class problem can even be made[21]. In effect, a confirmatory instance of this last account can be exhibited. For consider, first, the case of a neandertalian[22] who would have implemented a DA-like reasoning. If he had identified, at a somewhat restrictive level, the reference class with the subspecies *homo sapiens neandertalensis*, his anthropic prediction would have then been successful. But the corresponding prediction would have failed if he had chosen, at a slightly more extensive level, the species *homo sapiens* as a reference class. And this appears as a confirmatory instance of the *differential* treatment of the reference class problem and as a disconfirmatory instance of the *undifferentiated* account. Furthermore, another confirmatory instance can be pointed out at present times. For consider, at a greater level of restriction, a reference class consisting of all *homo sapiens sapiens having not known of the computer*. Doesn't there exist serious grounds for considering that this last reference class is promised to a nearest extinction?

Now this last line of reasoning can be combined with the conclusion of the above developments concerning the analogy with the urn. Let us recall the conclusion of the amended DA mentioned above: for a given reference class, a bayesian shift *possibly* ensues. In effect, it has been shown that DA only possibly works, for a given class. And this leads to a novel formulation of the argument. For if there existed a given reference class for which the argument were conclusive, there could well exist a more extensive class for which the argument would fail. This vindicates the differential treatment of the reference class problem and finally renders the argument innocuous, by depriving it of its initially associated terror. At the same time, this leaves room for the argument to be successful for a given reference class, but without its counterintuitive consequences.

To sum up now. What results from the foregoing developments is that the Doomsday Argument must be weakened in two ways. First, the analogy underlying the argument must be defined more accurately. Once this task accomplished, the bayesian shift associated with the Doomsday Argument must now be seen as a *possible* inference from the premises, and not as an absolutely certain consequence. Second, the reference class problem must be taken into account, thus leading to the conclusion that the Doomsday Argument could work but without its originally associated terror. This has the effect of rendering the conclusion of the argument less counter-intuitive than in its original formulation. Given these two sidesteps, it seems that the resulting novel formulation of the argument could be more consensual than the original one.

Lastly, what precedes casts light on an essential facet of the Doomsday Argument. For on a narrow sense, it is an argument about the fate of humankind. But on a broad sense (the one I have been concerned with) it emphasizes the difficulty of applying probabilistic models to real-life situations[23], a difficulty which is usually largely underestimated. This opens a path to a whole field of practical interest, whose philosophical importance would have been unravelled without John Leslie's robust and courageous defence of the argument[24].

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[1] The solution to DA presented here is a somewhat condensed and enhanced version of the ideas developed in Franceschi (2002), that also discusses at length the problems related to DA: *God's Coin Toss*, the *Sleeping Beauty problem*, the *Shooting-Room Paradox*, the *Presomptuous Philosopher*.

[2] Cf. Korb & Oliver (1998).

[3] From Bostrom (1997).

[4] More precisely, Leslie considers an analogy with the *lottery case*.

[5] Cf. (1997, p. 256): 'How is it possible in the selection of a random rank to give the appropriate weight to unborn members of the population?'.

[6] Cf. (2003, p. 9): 'But who or what has the propensity to randomly assign me a temporal location in the duration of the human race? There is no such mechanism.'. But Sober is mainly concerned with providing empirical evidence against the hypotheses used in the original version of DA.

[7] Cf. (2002, p. 40): 'My claim is that by assigning a rank to each person based on birth order, a time correlation is established (...).' and also (2002, p. 44): 'The doomsday argument has been shown to be fallacious due to the incorrect assumption that you are a random sample from the set of all humans ever to have existed.'.

[8] Cf. (1997, p. 251).

[9] Cf. (2002, p. 39).

[10] It could be pointed out that a small amount of time is necessary to perform the bayesian shift, once the problem's data are known. But this can be avoided if one considers ideal thinkers, who perform bayesian shifts at the time when they are informed of the elements of the situation.

[11] I borrow this terminology from Chambers (2001).

[12] From now on, for the sake of simplicity, I refer to one single urn (containing either 10 or 1000 balls) instead of two, since it is equivalent to the original *two urn case*.

[13] Cf. Sowers (2002, p. 40): 'My claim is that by assigning a rank to each person based on birth order, a time correlation is established in essentially the same way that the stopwatch process established a correlation with the balls.'.

[14] This can be equivalently rendered with the following computer algorithm: at T_1, draw randomly a number between 1 and *n*; if 1 is issued then display 1 and stop; else at T_2, draw randomly a number between 2 and *n*; if 2 is issued then display 2 and stop; ...; else at T_i, draw randomly a number between *i* and *n*; if *i* is issued then display *i* and stop.

[15] To give an example. At the beginning, the urn contains 10 balls. The following random sequence is then issued: 325-125-88-816-524-9-7. At T_6, the coin lands tails and the number of balls in the urn is left unchanged. The device stops at T_7.

[16] To give an example. At the beginning, the urn contains 10 balls. The following random sequence is then issued: 2-9-6-8-5 and the device stops at T_5. At T_7, the coin lands heads and 990 balls are added in the urn.

[17] To be accurate: from the beginning of the chosen *reference class*.

[18] For a treatment of the *reference class problem*, see notably Eckhardt (1993, 1997), Bostrom (1997, 2002, ch. 4 pp. 69-72 and ch. 5), Franceschi (1998, 1999).

[19] In the part entitled 'Just who should count as being human?' (pp. 256-63)

[20] Cf. 1996, p. 260: 'Widenings of reference class can easily be taken too far.' and p. 261: 'Again, some ways of *narrowing* a reference class might perhaps seem inappropriate.'.

[21] This is congruent with Elliott Sober's (2003) attempt at empirically testing the assumptions resulting from DA.

[22] Cf. Franceschi (1998, p. 243).

[23] This important underpinning of the argument is also underlined in Delahaye (1996). This is also the main point of Sober (2003).

[24] I am very grateful to Pr. Claude Panaccio and Daniel Andler for comments on an ancestor version of this paper. I especially thank Jean-Paul Delahaye for very useful comments and discussion. I am also indebted to Elliott Sober for detailed comments on an earlier draft. I thank Nick Bostrom for very helpful discussions on the reference class problem.