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Abstract

How should we, the present generation deal with the interests and harms of the future generations? Considering remoteness in time has, in itself, "no more significance than remoteness in space" (Parfit 1984:357), what Cass Sunstein calls "The Principle of Intergenerational Neutrality"(PIN) will provide a good starting point.

There is an extensive debate on whether using the social discount rate is against PIN. However using the social discount rate is not the only unfair way of dealing with the interests of the future generation. Even without making any use of the social discount rate, the present generation would behave in an unfair way, in some cases, by assuming the independence of the event, which is the standard assumption in the probability theory. In this paper, we will show how this happens by considering two lotteries, the freedom lottery and the survival lottery.

Before revealing the results, we must address two perplexing problems concerning future generations. First, who are the people who comprises the future? The identities of the future generations, as D. Parfit (1984) suggests, will change depending upon the policies we, the present generations, choose (Non-Identity Problem). Second, what are the preferences of the future generations? Because they have not formed any yet, we cannot make use of their preferences as a basis for our decision (Non-Preference Problem).

To determine their identity, we treat future generations not as individuals but as species or groups. Instead of individual preferences, we will use freedom and survival as the benchmark of interests for the species.

We will then examine two kinds of lotteries: the freedom lottery and the survival lottery. In these lotteries, the independence of the event does not hold, that is, the probabilities of becoming unfree or being extinguished greatly vary from generation to generation. The later a generation's turn to draw the lot, the higher the probability of becoming unfree or extinguished. As this disparity of these probabilities among generations shows, we, as the present generation that draws the lot first and is in the most advantageous

position, have a special responsibility toward future generations.

Introduction

How should we, the present generation deal with the future generations' interests and harms? Since remoteness in time has, in itself, "no more significance than remoteness in space" (Parfit 1984:357), what Cass Sunstein calls "The Principle of Intergenerational Neutrality"(PIN) will provide a good starting point. It states that the "members of any particular generation should not be favored over the members of any other"(Sunstein 2007:245).

However, a good starting point does not guarantee that we will be guided toward a destination, because the PIN leaves many voids to be filled. One problem is whether the PIN justifies the social discount rate, which tells us to discount the interests of future generations because they are remote from us. This problem, although apparently trivial, is quite difficult because "refusing to discount will often injure, rather than promote, the interests of future generations" (Sunstein 2007:246).

The social discount rate is easy to notice and has been discussed extensively in many research studies. However, it is not the only way in which we might violate PIN. In this paper, we will reveal another way of violating PIN: discounting the probability of harming the future generations rather than the interests. If we should focus not on the interest but on the expected value of an alternative by multiplying the interest and the probability of the alternative, as the expected utility theory claims, discounting the probability of being harmed has the same effect as the social discount rate, although being a subtle way of discounting. In this paper, we will show how this discount is made when we assume the independence of the event where this assumption does not hold[1].

Before revealing the results, we must address two perplexing problems concerning future generations. First, who are the future generations? Their identities, as D. Parfit (1984) points out, will change depending upon the policies we, the present generations, select (Non-Identity Problem). Second, what are the preferences of future generations? Because they have not formed any preferences yet, we cannot base our decision on them (Non-Preference Problem).

In section 1, we address these problems, but we cannot solve them entirely. The only thing we can do is to show the way out of these problems. To fix the identity of the future generations, we treat them not as individuals but as a species. Instead of individual preferences, we will use freedom and survival as the benchmark of interests for the

[1] Two events are stochastically independent if the occurrence of one event does not affect the occurrence of the other.

species.

Next, we will examine two kinds of lotteries, that is, the freedom lottery and the survival lottery in sections 2 and 3, respectively. In these lotteries, the probabilities of becoming unfree or being extinguished vary from generation to generation. We will show that the later a generation's turn to draw the lot comes, the higher the probability of becoming unfree or extinguished is.

Certainly these are all-too-simple models, and nobody can deny that they are based on unrealistic assumptions. However, even from these over-simple models, we can draw some implications for intergenerational justice. In section 4, we try to clarify them.

1. Problems and the way outs

Who are the future generations?

The standard theory for rational choice under uncertainty would be the Expected Utility Theory (EUT), which states that we should maximize the total sum of expected utility of the participants[2]. In order to apply EUT to a lottery, whether it is an intergenerational or intragenerational one, we need to know 1) the participants, 2) the probabilities of an alternative state of affairs, and 3) the utility assigned to each alternative.

While in some textbook cases it might be easy to apply these elements, at least in the context of intergenerational justice, these elements are elusive and difficult to fix. First, who are the participants? In the context of intergenerational justice, this question is hard to answer, because, as Parfit rightly puts it, we "can affect the identities of future people, or who the people are who will later live"(1984:355). In sum, "in the different outcomes, different people would be born"(1984:359).

This fact makes the problems of intergenerational justice cumbersome and complicated. Imagine we compare two policies, say A and B, which will affect future generations. When we choose A, people X will exist and Y will not, but if we choose policy B instead, people Y will exist and X will not.

If we stick to axiological individualism, which considers individual values to be the sole building blocks in axiology and believe that the justification of some group values such as justice should be constructed by piling these blocks, we get stuck on what Parfit calls the Non-Identity Problem. How can we compare policies A and B? Can we ignore the well-being of people Y, when we examines the policy A because Y will not exist? Some will find it plausible to ignore the interests of people Y, because people who do not exist

[2] While there are some variants in EUT, it would not be necessary for our present analysis to delve deeply into the differences.

can neither be benefitted nor harmed. However, this will justify many egoistic policies by the present generations, as long as the policies provide slight interests to people X[3]. Instead if we take the well-being of Y into consideration, what is the reason for doing so?

The first time I came across the Non-Identity Problem, it reminded me of some counterintuitive phenomena in quantum mechanics. According to the Heisenberg principle, or the uncertainty principle, we cannot simultaneously determine the position and momentum of a sub-atomic particle. Similarly, the identity of future generations is uncertain and we cannot simultaneously have people X and Y[4].

It should be noted, however, that this principle does not say "everything is uncertain." What is interesting about this principle is that it indicates the exact location where the uncertainty occurs and suggests a way out of the Non-Identity Problem. According to the uncertainty principle, this type of uncertainty occurs only when we measure sub-atomic events and would disappear when we measure super-atomic events.

By the same token, the uncertainty of the identity of the future generations occurs when we focus entirely on them as individuals, and would disappear or decrease when the generation as a group comes into our focus. Even when some individuals are replaced by others within the generation, the generation itself survives. By shifting our focus from individuals to generations or species, we can arrive at a fixed point.

What is their well-being?

The second problem we have to address when we examine the issues of intergenerational justice, is the Non-Preference Problem. This problem arises from the fact that future generations have not formed their preferences yet, and we cannot resort to considering their preferences as the criteria for their interests[5].

Unfortunately, the shift of the focus from individuals to the generation or species would not make the problem easier to solve. Even worse, it will make it more difficult. It is often said that only individuals have their interests, well-being, pain, and desires[6], and species cannot have preferences so long as we presume axiological individualism. Without recourse to the preference of the future people, how can we estimate the

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[3] See Parfit's “Depletion” problem. Parfit (1984:361).

[4] My impression is reinforced when Parfit uses the analogy of the Newtonian theory. See Parfit (1984:371).

[5] Certainly, if we rely upon the objective list theory of well-being (Parfit 1984), this problem will not occur. Our strategy in this paper is quite similar to the objective list theory in that the direct reference to the individual preferences is avoided. However, our use of the objective list is limited to a small area, and we have no ambition of explaining all well-being in this manner.

[6] We refer to them collectively as "preferences."

expected "value" or "utility" of outcomes for them?

In dealing with the Non-Preference Problem, it should be recalled that the standard probability theory is based upon narrow welfarism, according to which actions, rules, and policies should be evaluated solely on the basis of their impacts on human welfare[7]. While narrow welfarism had been dominant in the rational choice theory, we can now see the clear and powerful departure from welfarism in political philosophy, which emphasizes on the value of opportunity. There are important contributions made by Sen (capability), Rawls (primary goods), and Dworkin (resources), to name just a few. By relying upon some of these benchmarks, we can fix the well-being or value of an expected outcome for future generations. These benchmarks have something in common: they emphasize the importance of an opportunity that is provided by resources, and do not refer to individual preferences directly. In this respect, they will provide a certain clue for the way out of the Non-Preference Problem.

Thus the first criterion we will use for interests is the opportunity. We will make this criterion clear in the next section. However, before that, we should make some qualifying remarks. We have no intention to deny the relevance of preference altogether in a measurement of freedom. Certainly, there should be good reasons to refer to preference in the measurement of freedom. Rather, our claim is that up to a certain point, we can measure the degree of freedom or unfreedom of an agent without invoking the preference of the agent. It would suffice for our purpose here to remain in the territory where we can measure the freedom of an agent without help from his or her preference[8].

The second criterion for interests of the future generations is "survival" or "no extinction." It may sound strange, but when we regard human beings not as individuals, but as a species, it seems natural to suppose that the ability to survive in a given environment (fitness) should be counted among the main interests of the species.

In sum, to deal with the Non-Identity Problem, we shift our focus from individuals to generations and species. To deal with the Non-Preference Problem, we focus on freedom and survival instead of preferences as the interests of the generations.

Even if we successfully evade the Non-Identity Problem and the Non-Preference Problem in these ways, we still have to address the problems concerning probability. We will turn to these problems in sections 2 and 3.

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[7] On the concept of consequentialism and welfarism, see Sen (2002).

[8] For various views on the relationship between freedom and preferences, see papers by Laslier et al. (1998) among others.

2. Freedom Probability

Elementary School Lottery

Let me describe a happening from the past. When I was in elementary school, the pupils made a fuss over who should draw the lot first. As you might expect, most of the pupils wanted to draw it first. Then, the teacher, getting angry with us, told us that the order did not matter, and everybody had the same chance.

By applying narrow welfarism to the elementary school lottery, the elementary school teacher implicitly assumes that what matters in the lottery is what we results in the end, that is, the prize, while other things such as the process of getting it and the availability of alternative options has no direct moral significance.

Relying upon narrow welfarism, we can easily show that each pupil has the same chance of winning regardless of the order she draws the lottery. The urn contains six balls, one red ball and five white balls. Each pupil picks one ball from the urn, and if she picks the red one, she will get the prize. If I remembered correctly, the prize was a notebook. Everyone (Miss One, Miss Two, . . . Miss Six) has the same chance of winning, which is 1/6. Miss One's chance of winning is 1/6. Miss Two's chance of winning is also 1/6 (5/6 multiplied by 1/5 is 1/6), and so on. "So all you have the same chance." said the teacher triumphantly. To tell you the truth, at the time, this did not sound right to me and I am still not entirely comfortable with it. This paper is partly my criticism of the teacher.

The Concepts

As we claim in section 1, we have some reason to go beyond narrow welfarism, at least in the context of intergenerational justice, because the future generations have not formed their preferences yet. Once we shift our focus from utility to freedom and survival, the elementary school lottery can be interpreted in quite a different way.

With regard to the measurement of freedom of choice, there is an extensive amount of literature in social choice theory. However, we do not have to delve deeply into the problem; instead, for our purpose, it would suffice to confine our attention to the concept of unfreedom, which is discussed there. The concept of unfreedom can be defined in terms of its necessary conditions for a person to choose freely. When a menu from which a person chooses does not satisfy one or both of the following necessary conditions, the person has no significant choice. The first necessary condition is called "Principle of Choice" and the second is called "Principle of Significant Options."

The principle of choice states that in order for a person to choose freely, her menu must have at least two options. If the menu from which she chooses contains only one option, the value of choice it offers is nil (Pattanaik and Xu 1990), because she is forced to choose that option and cannot do other things. The famous distinction between the fast and the famine made by Amartya Sen would be a good illustration of this principle. People who abstains from food have the options of eating, and are completely different from those who are devoid of the option and suffer from famine.

The second condition is the principle of significant options. Even if the menu from which the person chooses contains several options, if the options are mutually indistinguishable, the value of choice it offers would be nil, because no significant act of choice is possible there. If you have a dozen beers of the same brand in your refrigerator, adding another dozen will not particularly increase your freedom, because the beers are indistinguishable and you cannot choose among them in a significant way.

Thus, we define a person's situation as unfree when the menu from which the person chooses does not satisfy either the principle of choice or the principle of significant options[9].

The Calculation

To illustrate these two principles, let us reconsider the example of the elementary school drawing. The participants are six pupils. The urn contains six balls, one red and five white. Each pupil picks one ball from the urn, and if the red ball is picked, that pupil will win the prize. What is the probability that each pupil become unfree in this lottery?

In the case of Miss One, she will never become unfree. Since her menu contains six balls, it satisfies the principle of choice. Further, since her menu contains two kinds of balls, white balls and a red one, it satisfies the principle of significant options. From this, we can estimate that her probability of becoming unfree is zero.

As for Miss Two, since her menu contains five balls, it satisfies the principle of choice. However, when and only when Miss One draws the red ball, Miss Two's menu will contain five indistinguishable (white) balls. In this case she is not free, because her menu does not satisfy the principle of significant options. The probability of this occurrence is 1/6, and we can estimate that Miss Two will be unfree with a probability of 1/6.

By repeating the same exercise, we will obtain the results shown in Table 1. Miss Six's menu deserves a brief explanation. Because it contains only one ball, regardless of whether it is a red or white one, she is unfree from the principle of choice. In this respect, she does not choose the ball, but is forced to pick the last ball. We can thus estimate her

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[9] We have no intention to claim these two conditions as the sufficient conditions for a person to be free. In other words, it is possible for a person not to be free even if her menu satisfies the two conditions we mention.

probability of unfreedom as 1 (certain).

Miss One	Miss Two	Miss Three	Miss Four	Miss Five	Miss Six
0	1/6	2/6	3/6	4/6	1

Table 1: Unfreedom probability

It might be objected that Miss Six is not unfree when the last ball is red, because the red ball is exactly what she wants to draw. However, giving people what they would have chosen is not the same thing as giving them significant choice. The choice from a singleton (a unit set) is a so-called Hobson's choice and not worthy of being called a choice.

From the above table, it is clear that the unfreedom probabilities vary depending upon the order of the participants in the lottery, while all participants have an equal chance of getting the prize. The later a participant's turn to draw comes, the higher her probability of unfreedom becomes. If the pupils should be proud of being free agents, they have reason to go beyond narrow welfarism, and to make a fuss over the drawing order.

The same can be said of the intergenerational lottery, which includes six generations as the participants. It is different from the elementary school lottery because while in the elementary school lottery the participants could change the order of the drawing, this cannot be done in the intergenerational lottery, and we will always be the generation that draws the lot first. Therefore our probability of becoming unfree would be the lowest.

In the case of the elementary school lottery, the pupils can introduce a fair procedure to decide the drawing order outside the elementary school lottery and by following it[10], the unfairness inherent in this disparity might be corrected in part or eliminated completely. In contrast, in the case of the intergenerational lottery, the drawing order, that is, the generational order is prefixed, and cannot be changed in accordance with any fair decisions made by the participants.

Does this disparity impose a special obligation upon us? At least, we, the present generation have to give due consideration to the future generations. Lockean Proviso, which tells us that we should leave "enough, and as good" for other generations, might be a good starting point from which to draw an outline of this obligation. Although mathematically speaking, one of the easiest ways to fulfill the duty imposed by Lockean Proviso would be to put the ball back into the urn, practically speaking, it would be very

[10] For example, the pupils can decide the drawing order by introducing a certain procedure such as rock-paper-scissors, majority rule and so on.

difficult to fulfill it[11].

3. Survival Probability

In order to assign a probability to alternative states of affairs, we have to fix the sample space. However, in the context of intergenerational justice, this is quite a complicated matter.

Let us examine another example that will also reveal the importance of the drawing order, that is, the intergenerational Russian roulette. The participants are six generations and only one of the generations is picked up and extinguished. The generation that will be extinguished is decided by the drawing, and the generation that picks the red ball, will be extinguished in one way or another. Finally let us suppose that once the lottery starts, no generation is allowed to stop it or withdraw from it. In sum, each generation is forced to draw a lot when its turn comes. While being an extremely fantastic example, an atomic power plant that explodes once in six generations, would be a good example of it as stated in section 1. What is, then, the survival probability of the intergenerational Russian roulette?

The Common View

The common view answers to this question in the following way. It says that each generation has the same chance of winning (5/6) and losing (1/6), as is the case with the elementary school lottery. Let us suppose that the benefit of the lottery (denoted by B) is much higher than the cost of the lottery (denoted by C) so that (5/6) B< (1/6) C. In this case, is it rational for each generation to participate in the lottery? The common view would say so.

By claiming this, the common view implicitly assumes that Table 2 represents the case. G1 in the table is the first generation that draws the lot first, and C1 is the case in which the first generation picks up the red ball and will be extinguished. W is the winner, and L is the loser.

	C1	C2	C3	C4	C5	C6
G1	L	W	W	W	W	W
G2	W	L	W	W	W	W
G3	W	W	L	W	W	W
G4	W	W	W	L	W	W
G5	W	W	W	W	L	W

[11] Leaving "enough, and as good" options to future generations might be impossible in some cases and impose a high cost on us in other cases.

G6	W	W	W	W	W	L

Table 2: The common view

As far as the table above is the case, regardless of the generational order, each generation has the same chance of winning, and if the prize is huge enough, it would be rational for all generations to participate in the lottery. However, this is deceptive sophistry to justify the shifting of burdens onto future generations, because it ignores an important fact (on purpose?): once the antecedent generation is extinguished, the subsequent generations will not exist. Although the common view assumes that in C1, generations from G2 to G6 are the winners, it is absurd to think of these generations as the winners because non-existent generations cannot receive the benefit. Thus, the common view seems to be wrong.

The Inclusive View

We should not include non-existent generations among the benefited generations. So far it seems obvious. What is not clear is how to deal with a non-existent generation in the sample space. We can conceive of at least two plausible ways to treat non-existent generations: one is the inclusive view and the other is the exclusive view[12].

According to the inclusive view, non-existent generations are included in the sample space and treated as losers. This view is intuitively plausible, because non-existent generations are losers in the sense that what is gambled in this lottery is existence, and non-existent generations can be considered as paying the cost in advance. At least, having no opportunity to draw should be considered among the costs. If we accept the inclusive view, Table 3 represents the case.

	C1	C2	C3	C4	C5	C6
G1	L	W	W	W	W	W
G2	L	L	W	W	W	W
G3	L	L	L	W	W	W
G4	L	L	L	L	W	W
G5	L	L	L	L	L	W
G6	L	L	L	L	L	L

Table 3: The inclusive view

Compared to Table 2, you will observe that there are a large number of losers in Table 3. Not only that, there is a considerable disparity in the probability among generations. Table 4 shows the winning rates of each generation. The later the generation comes, the lower its survival probability becomes. The disparity of the probability would make the

[12] Both views have some strengths and weaknesses, and we vacillate between them.

intergenerational conflict of interests among different generations fiercer. Let us suppose the prize of the intergenerational Russian roulette is huge. Then for some generations, such as G1 and G2, it might be rational to participate in the lottery. In contrast, for the other generations, such as G5 and especially G6, it makes no sense to participate in the lottery. In 5/6 of the cases, G6's turn will not come, and in 1/6 of the cases, while it does, the urn contains no other ball than the red ball. Thus, whether one of the ancestors drew the red ball or G6 draws it, G6 has no chance of getting the prize.

G1	G2	G3	G4	G5	G6
5/6	4/6	3/6	2/6	1/6	0

Table 4: survival probability (the inclusive view)

The Exclusive View

The second way to deal with non-existent generations is through the exclusive view, which excludes non-existent generations from the sample space. While the inclusive view treats non-existence as the cost, the exclusive view does not take non-existent generations into account. The exclusive view has some intuitively plausible parts. If we find some plausibility in the claim that non-existent generations cannot receive benefits, it seems plausible to claim that they cannot pay the cost either[13].

If we take the exclusive view, Table 5 reflects the case. In this table, non-existent generations are excluded from the sample space and denoted by hyphens. As before, W is the winner, and L is the loser.

	C1	C2	C3	C4	C5	C6
G1	L	W	W	W	W	W
G2	-	L	W	W	W	W
G3	-	-	L	W	W	W
G4	-	-	-	L	W	W
G5	-	-	-	-	L	W
G6	-	-	-	-	-	L

Table 5: The exclusive view

Table 6 shows the survival probability of each generation calculated on the exclusive view. Compared with Table 4, which shows the survival probability calculated on the inclusive view, the disparity in the probability among generations decreases, but persists (Table 6). Particularly for G6, it would not be rational to participate in the lottery. It should be noted that whichever view we take, the expected value of the lottery

[13] The inclusive view would face difficulties here. Why non-existent generation can pay the cost but cannot receive the benefits needs to be explained.

for each generation greatly differs. The later a generation's turn to draw comes, the lower its probability of getting the benefit becomes.

G1	G2	G3	G4	G5	G6
5/6	4/5	3/4	2/3	1/2	0

Table 6: Survival probability (the exclusive view)

As stated in section 3, the disparity in the unfreedom probability will disappear when each generation, after picking a ball, puts it back into the urn. What will happen if each generation does the same thing in the intergenerational Russian roulette? Does the disparity disappear? Unfortunately, not. The survival probability of G1 is 5/6. G2 can pick a ball only when G1 survives. Additionally G2 wins the lottery with a probability of 5/6. Thus, it can be said that the survival probability of G2 is 25/36. Table 7 shows the survival probability of each generation calculated in this manner. To facilitate the comparison, we calculate them to three decimal points. As is clear from Table 7, the putting-the-ball-back strategy, while decreasing the disparity to a certain degree, does not eliminate it completely. If we want the expected value of this lottery to be equal among the participating generations, we need to use other strategies.

G1	G2	G3	G4	G5	G6
.833	.694	.578	.482	.401	.334

Table 7: Survival probability (putting-the-ball-back into the urn)

4. Final Remarks

Since Parfit advanced the Non-Identity Problem, it has been widely recognized that the choice of the present generations will influence not only the interests but also the identity of future generations. In this paper we try to show that the probability of benefitting or being harmed is also influenced by our choice, at least in some cases.

The main finding of this study is that by assuming the independence of the event, the present generation loads the dice against the future generations at least in some cases. The first thing we should do is to recognize the existence of the conflicts of interest among the generations, which narrow welfarism and the assumption of the independence of the event have disguised. We, as the generation that picks the lot first, have an incentive to embark on a wager, because it might be rational for us to participate in the lottery. Furthermore, none of the other participants would complain about anything we do. As dead men don't bite, the future generations cannot bite us either. Thus, it is easy and sometimes rational for us to take a risky gamble. In this sense, we can be dictators in these intergenerational lotteries.

Then, should we stay away from risky gambles, as some proponents of "the precautionary principle" claim? Apart from the weakness of the precautionary principle[14], it would be, however, too hasty to deduce the complete prohibition of all the risky gambles from the conclusion of this paper. By counteracting the strong influence of narrow welfarism and the assumption of the independence of the event, which tends to justify some of the risky gambles, the conclusion of this paper, hopefully, tilts the present generation in a conservative direction. However, prohibiting the risky gamble altogether is an entirely different matter.

First, the assumption of the independence of the event, while being a standard one, is not the necessary assumption for the probability theory. We can use the concept of probability without assuming the independence of the event. When the expected value of the risky gamble outweighs the expected value of refraining from the gamble, the risky gamble might be justified in some cases without the assumption of independence.

Second, it should be noted that this paper simplifies the difficult task of determining the identity and the well-being of the future generations. So the above conclusion should be seen as an approximate or heuristic solution, and no more. We must admit that we do not have an algorithm to decide what we should do for the future generations. However, it should be noted that whatever algorithm we design, we must recognize the very nature of the issue carefully. Without it, any design of an algorithm would be of no value.

Between the precautionary principle and the expected utility theory, a vast region is left, and this is the area we should explore. Before the exploration, we need to overcome our fixed ideas about the territory. The purpose of our paper is to work on the preparation for such an exploration.

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[14] As for the critical examination of the precautionary principle, see Sunstein (2005).