

Measuring and Classifying Levels of Futures

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This is a paper dealing with methodological and foundational issues in the realm of Futures Studies. It provides possible metrics for the temporal coordinate in the cone of plausibility. As a consequence, some adaptable scales to classify levels of future with respect to a certain time interval relevant to measure the future of humanity are suggested.

Keywords: cones of plausibility; levels of future; flexible cosmological decades (cosmological σ -years); scale; methodological and foundational issues in futures studies

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Introduction

Profound and deep inquiries on the notion of future have a substantial role considering that they are able to empower humanity to establish strategies and mechanisms to manage its own development through time and future. So, besides the pertinent techniques to study particular attempts to foresight in the context of specific domains, the importance to clearly understand possible types and kinds of future seems to be relevant, essential and somewhat evident. In this sense, departing from an analysis of the concept of *future* based on an inquiry on different approaches to the subject, this paper suggests and provides a tool to classify possible futures according to a given specific and limited time interval.

The main result of this article on the foundations of methodological issues in Futures Studies is inspired on previous researches such as the Kardashev Scale (Kardashev, 1964) and the Barrow Scale (Barrow, 1998) to compute and order knowledge and possible technological expansion and developments of a civilization. These scales are useful to precisely organize and provide resources to give a general perspective and surgical measure of the technological level of a given (conceivable) civilization. Kardashev scale, originally, classify three types of civilization according to the ability these civilizations have to manage and control planets, stars and galaxies, respectively (Kardashev, 1964). Barrow scale, otherwise, classify seven types of civilizations according to technological abilities they have to manage and handle

smaller and smaller objects: from entities to the size of themselves up to quarks and even the very basic specific framework and constitution of spacetime (Barrow, 1998). Moreover, Barrow (1998) seems to organize four types of future with respect to the duality given by resources provided by Nature and knowledge we have about it. Combining these, let's say, numerical classifications with qualitative classifications of types of futures based on cones of plausibility proposed by Taylor (1988), Hancock & Bezold (1994) and Voros (2003), the central motivation and aim of this paper is to introduce possible metrics to distribute and control forms, types and levels of future taking time intervals into account. The intervals considered are adapted from those based on cosmological decades introduced by Adams and Laughlin (1997, 1999). So, this research establishes rather a quantitative than qualitative approach to futures. These are regularly classified according to time intervals, not in pure forms such as possible, preferable, probable futures, and so on. By the way, these pure forms are the main essential feature of the traditional cones of plausibility.

Time intervals giving rise to timescales dealing with future (and past) are frequent in science and they are used to measure a plurality of things: ages of the universe, geological processes, life on Earth, technological development etc. In this research, adaptable timelines based on interval scales are used to measure levels of futures allowing us to comprehend the limits, directions and values of our investigations concerning, especially, supposed long-term or far distant futures. But these are long-term futures for the humanity, not for the universe. In order to reason about possible timelines concerning the long-term future of the universe there are many substantial works in cosmology (for instance, Adams & Laughlin, 1997, 1999).

In this way, the structure of the paper is divided in two parts: the first one presents and discusses some inspiring and rich contributions to the study of the future. The second one introduces possible metrics to partition cones of plausibility using a kind of flexible cosmological decades adaptable to reason about the future of humanity.

1. Perspectives on futures

From the scientific and empirical viewpoints, time, however, should not be explored alone, assuming that it is part of a complex hybrid combined entity mixing space and time: spacetime. This one is something containing three spatial coordinates x, y, z and a temporal dimension t . In this sense, spacetime should be understood and thought as a special four dimensional object of the form $\langle x, y, z, t \rangle$ (Einstein (2015) and Penrose (2005) for general issues concerning spacetime). Therefore, futures vary in the coordinate t when we consider an order relation and take an instant t' such that $t' > t$. There is no need to consider and talk about spacetime if we are investigating future, but it is important to have a general view on the subject. The vision of time as something encoded in an unique entity combined with space is the rule rather the exception in the context of sciences. This gives rise to the fundamental temporal notion of light cone (Penrose, 2005). This notion can be divided into two directions: past light cones and future light cones. This last one plays an essential role in Futures Studies, especially because some authors proposed a cone of plausibility, based on a future light cone, to deal with and classify types of future (Taylor (1988), Hancock and Bezold (1994) and Voros (2003)). Future, therefore, is something which exists potentially, and we do expect that at least a part of this potentiality will become actual in due time.

From the logical perspective, the notion of future may be studied and investigated from different dimensions. For instance, this concept has a precise and interesting understanding inside the context of formal logic: Prior (1957) originally has proposed a logic able to deal with time and, as a result, future can be thought inside this framework. In some temporal

systems, the notion of future can be understood as a modality applied to a linguistic entity yielding to the following situation: let p be a proposition, and let F be an operator which scope is p . Then, Fp means “it will be the case that p ”. Consider Fp and an ordered set of instants $\{t_1, \dots, t_n\}$. Then, Fp is true in a given instant t_i if and only if there is an instant t_j such that $t_i < t_j$ and in t_j we have that p is true. Informally, a sentence Fp is true in a given instant if there is a (possible) instant in the future in which the sentence is true. This is compatible with the regular idea that we all have when we think about the future. Despite the fact that time can be studied alone in the context of temporal/tense logic, it can naturally be combined with space leading to formalisms to model spacetime. Future, thus, is a complex network of conceivable possible worlds in which a given sentence will be true or false.

From the philosophical viewpoint, time, as well as future, has an autonomous and spontaneous metaphysical existence. Notwithstanding, to determine the configuration and behavior of the future is a very complicated issue, especially if we ignore the cosmological principle and take into account and consider, for instance, Hume’s problem (also known as the problem of induction introduced in Hume (2007)) according to which there is no necessary connection between a cause and an effect (i.e. it is not possible to deduce, with certainty, the future departing from the past and the present). Imagination and conception can always be used to control and simulate what is logically possible (Costa-Leite, 2010). Therefore, the future, be it whatever, is always measured and determined by what is logically possible, not merely by what is physically possible. In this precise sense, conceivable futures are controlled by logical mechanisms which establish what are the possible facts with respect to a given theory. In the traditional reading of time as an arrow departing from an initial point, future is the way in which the arrow goes, it is the flow, despite the fact that there is not a terminal object called the future, as it is always a becoming. Future is, of course, not entirely determined by the present, but certainly a part, a fragment of it can be characterized, even if vaguely, taking into account pieces of the present reality. Otherwise, studies on the future would not be possible.

All these three perspectives are interesting and give clues to understand the limits and scopes of our investigations with respect to the future. As the concept of future is rich and hybrid, and it can be approached from a great variety of perspectives and domains, in order to study it we need to use tools to guide us in the network and complex nature of futures. It seems that, although future has been studied from many viewpoints, a general framework to organize and manipulate possible particular periods of futuristic scenarios in the context of Futures Studies and the future of humanity – not in cosmology and in the future of the universe – has still room. Instead of predicting and foresighting particular futures, from now on we attempt to provide a tool to be used as a roadmap to manage and understand futures by means of infinitely many possible scales to introduce metric and classify futures labelling specific periods of future displayed by cones of plausibility.

2. Classifying, ordering and organizing futures

Initially, a general, abstract and complete framework is introduced to serve as background for a panoramic scale. Generality and abstraction allow the application of the scale to precisely posed contexts in Futures Studies. Considering cones of plausibility such as those of Taylor (1988) and Hancock & Bezold (1994), we verify that these authors even consider time intervals inside future light cones, but the intervals are reduced to dozens of years and, as such, they are not so expansive and large as possible intervals that could be taken into account. Thus, in some sense, we can think about the next classification as a tool able to in-

depth slice cones of plausibility, generalizing previous mentioned perspectives: the suggested interval scale slices pieces of future light cones (instantiated by cones of plausibility) using powers of generalized base σ such that, for each application, a particular $\sigma > 1$ should be considered trying to reach expressive forms of future. The fragmentation and slicing of cones of plausibility uses flexible cosmological decades (i.e. *cosmological σ -years*) and then it follows the approach developed by Adams and Laughlin (1997, 1999). These authors consider τ and η to introduce scientific notation to measure time in years proposing then cosmological decades represented by η in the identity $\tau = 10^\eta$ years. Then, they provide a wide and enlarged timescale structured in powers of base 10 to capture the totality of possibles ages of universe, following a timeline up to what they call the dark era of the future of the universe. The next introduced scale to deal with specific issues in the future of humanity can be viewed as a particular and specific cut in the scale of Adams and Laughlin. Their scale, however, is used to handle the total timeline of the universe, from the very past to the ultra almost infinite future.

Let t be a given year and each σ^η with $\eta \in \{0, 1, 2, 3, \dots\}$ corresponds to years. As such, it measures a certain amount and flow of time based in years. Years are the natural selection assuming that it is the current measure used by humanity, and it is something that makes precise and clear sense from our viewpoint, as our duration in spacetime is limited. So, we are directly concerned with the future of humanity. A *flexible cosmological decade* is a kind of generalized cosmological decade changed with an extra varying amount of years t and a general number σ for the base of the logarithm. The only adaptation concerning the original idea of cosmological decade by Adams and Laughlin (1997) is that now for *cosmological σ -years* we have something of the form

In this sense, $\tau = (t + \sigma^\eta)$ years. This is a very particular kind of flexible cosmological

$$\eta = \log_\sigma \left(\frac{(\tau - t)}{\sigma} \right)$$

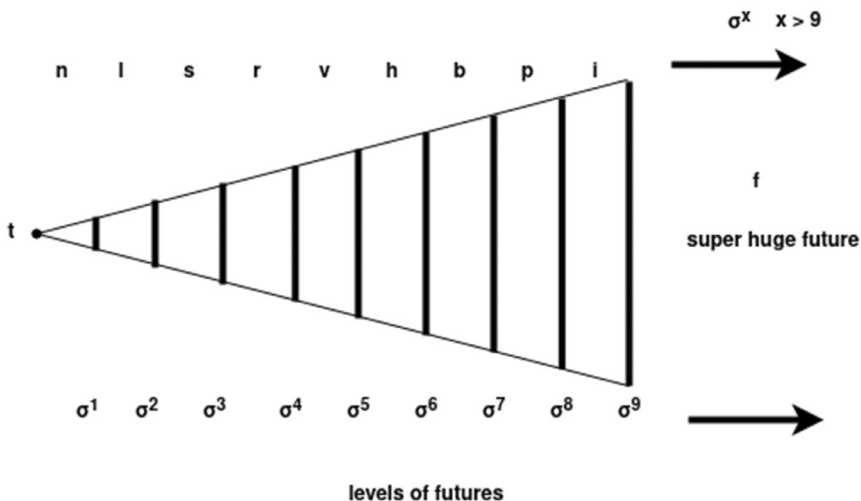
decade because the parameter t is not fixed. In the original proposal of Adams and Laughlin (1997, 1999), they use a strict and rigid t dividing the whole timeline of the universe in some eras. In the cut presented here, a generic, abstract form of an interval scale to estimate, classify, order, name, and organize cones of plausibility containing forms of futures is proposed. Each particular choice of a t and a σ gives rise to a specific scale. But in a rather generalized version, the pure form of the scale is the following:

- Type I Future: $t < n \leq t + \sigma$ (negligible future);
- Type II Future: $t + \sigma < l \leq t + \sigma^2$ (low future);
- Type III Future: $t + \sigma^2 < s \leq t + \sigma^3$ (shallow future);
- Type IV Future: $t + \sigma^3 < r \leq t + \sigma^4$ (regular future);
- Type V Future: $t + \sigma^4 < v \leq t + \sigma^5$ (relevant future);
- Type VI Future: $t + \sigma^5 < h \leq t + \sigma^6$ (heavy future);
- Type VII Future: $t + \sigma^6 < b \leq t + \sigma^7$ (reasonable future);
- Type VIII Future: $t + \sigma^7 < p \leq t + \sigma^8$ (profound future);
- Type IX Future: $t + \sigma^8 < i \leq t + \sigma^9$ (intense future);
- Type X Future: $t + \sigma^9 < f \leq t + \sigma^\eta$, for $\eta > 9$ (super huge future).

Fixed a particular t and a particular σ , it is clear that the lower we go into the scale, our

predictions and foresight capacity concerning humanity seems to be clearer and clearer, but this of course strictly depends of the content of the prediction. The deeper we go it becomes super difficult to say what will happen, at least if we consider human expectations and projects. Notice also that nothing is said about the content of the intervals $n, l, s, r, v, h, b, p, i$ and f , as this task has to be conducted for the applied engaged and able futurist. The letters $n, l, s, r, v, h, b, p, i$ and f correspond to futures with respect to a given year t . This gives rise to the set **FUT** containing long periods of dilated futures as objects and each interval has a great number of years. There is an obvious order $<$ separating levels of future. It is a natural consequence that a cone of plausibility could be layered and sliced by the above levels of future, generalizing temporal issues raised by Taylor (1988) and Hancock & Bezold (1994). Now, we could also think using a function. In this sense, let t be a constant, $\mathbf{N}$ the set of natural numbers, x a variable, and let g be a one variable function $g : \mathbf{N} \rightarrow \mathbf{FUT}$ with domain the set of natural numbers $\mathbf{N}$ and **FUT** as codomain such that $g(x) = t + \sigma^x$. By means of applications of this function (which generates flexible cosmological decades) we can find lower and upper borders of a given interval in the abstract scale. It is clear that it could be extended to a two-variable function, but there is no need to perform this. The above mathematical *future function* serves as an underlying mathematical tool to formulate the scale based in flexible cosmological decades. Figure 1 can be viewed as a reduced, restricted, two-dimensional and metric version of cones of plausibility, which can be found in Taylor (1988), Hancock & Bezold (1994) and Voros (2003). Moreover, it is worth noting that the limit of the function $(t + \sigma^x)$ when x tends to infinity is infinity. This fact leads us to think that there is a relationship between great ages and super huge future. That is, the abstract upper borders of super huge future in some sense are too large that for us they coincide with a kind of eternity. If the powers tend to infinity, then we could enter into eternity by means of a physics of eternity in the sense of Adams and Laughlin (1999). Though, we have to be aware that the field of Futures Studies cannot be reduced to a chapter of Cosmology, but to reach substantial results in Futures Studies, it is conjectured that we have to take into consideration expressive ages like those provided by *cosmological σ -years*.

Figure 1: A cone of plausibility divided by *cosmological σ -years*.



Notice that in order to apply the scale we have to consider a given fixed time t (but this t is

not absolutely fixed and it varies according to specific uses). So, it is with respect to this t that the scale should be used. Now, let's apply the methodology to partition cones of plausibility taking as a starting point our current year 2023 (i.e. a fixed $t = 2023$). Let's select a relevant σ to think about the future of humanity from our viewpoint. It seems that $\sigma = 4$ sounds to be a good choice. Therefore, if t is 2023 and $\sigma = 4$, then 2027 belongs to its negligible future, and then the year 2039 corresponds to its low future and so on. In this way, we can consider an application of the scale based in the current year 2023 as follows:

- Type I Future: $2023 < n \leq 2027$ (negligible future);
- Type II Future: $2027 < l \leq 2039$ (low future);
- Type III Future: $2039 < s \leq 2087$ (shallow future);
- Type IV Future: $2087 < r \leq 2279$ (regular future);
- Type V Future: $2279 < v \leq 3047$ (relevant future);
- Type VI Future: $3047 < h \leq 6119$ (heavy future);
- Type VII Future: $6119 < b \leq 18407$ (reasonable future);
- Type VIII Future: $18407 < p \leq 67559$ (profound future);
- Type IX Future: $67559 < d \leq 264167$ (intense future);
- Type X Future: $264167 < f \leq 2023 + 4^\eta$, for $\eta > 9$ (super huge future).

The scale, it is obvious, can be applied for any kind of t , as it has a good plasticity to be adapted to very divergent timelines, considering that the departing point is a generic t : the initial point t is not, mandatorily, fixed. As a consequence, it is interesting to note that many results in the domain of Futures Studies are developed and located in the borders of their low, shallow and regular futures depending of a particular choice of a t and a σ .

Some other issues that could be raised are the following: first, from one side, pure cosmological decades are not good to reason inside the realm of Futures Studies because these decades are too large. They are relevant for, let's say, Cosmology and Big History. For instance, a human being reaches, with good luck, at most, a regular future in existence considering t as his or her birthday and a small σ . But, from the other side, cosmological decades provides a unified perspective on time and, as we human beings are objects inserted in the universe, our size gets a precise dimension when even *cosmological* σ -years are considered. Anyway, other measures could be proposed using different exponential functions: $t + 2^x$, $t + 5^x$ and so on. It would be straightforward to design these divergent scales, and maybe, why not, other exponential functions would be more compatible with human futures. There are theoretically infinitely many ways to measure time inside future light cones of plausibility. Second, if we consider temporal operators as those of Prior (1957), we could divide them in nine operators (or more if one wants), one for each kind of future. This could be done like this: let p be a sentence and F_r a temporal operator. Then we could adapt Prior's idea and say that " $F_r p$ " means that p is true in a point of its regular future and so on. Semantics and logics for this and other similar situations could be easily elaborated.

In any case, we can apply an instance of the general scale to relative particular years. For example, we can evaluate now some articles exploring the future using the suggested general scale above. In each case, a particular t is assumed and we use, for the analysis, $\sigma = 4$. Take, for example, Bilgin (2011) published in 2011. So, in this case $t = 2011$. The article explores the year 2020. So, it was an article on the low future. Consider, for instance, Son (2013) published in 2013. So, $t = 2013$. It deals with the year 2030. So, this article when it has been published it was a research on aspects of its shallow future. The original cone of plausibility

proposed by Taylor (1988) goes up to its shallow future, as well the improvement of the cone suggested by Hancock & Belzold (1994). Wright (2018) has $t = 2018$ and the author evaluates 2100. Thus, it is also about its regular future. Glenn (2000) published in $t = 2000$ attempts to reach its relevant future. It is rare to find studies going through all levels of the scale when we are dealing with the future of humanity. One exception is Stager (2012) who attempts to go up to forms intense future, which are called by the author as *deep future*. One interesting task is to check the scope of validity of articles dealing with Futures Studies in the realm of the scale proposed here.

Conclusion

This methodological and foundational paper provided a reflection concerning classifications of types of future. As a byproduct, adaptable scales based in intervals to measure, name and classify conceivable futures with respect to time intervals were suggested. This enables us to have a panoramic and comprehensive view concerning our own goals. The idea can be viewed as a methodology to provide substantially many temporal sliced cones of plausibility generalizing and complementing works of Taylor (1988) and Hancock & Belzold (1994) by means of *cosmological σ -years* (i.e flexible cosmological decades adapted from the original idea of cosmological decade by Adams and Laughlin (1997, 1999): we have used this strategy to divide cones of plausibility in order to explore the formal structure of the future of humanity. Besides that, it gives a methodology to model, slice and shape futures relevant for human concerns. It also displays a tool to organize and manage future scenarios inspired by the scales of Kardashev (Kardashev, 1964) and Barrow (Barrow, 1998). Using the mechanisms in this paper, researches on Futures Studies (which should not collapse with a fragment of Cosmology) can be equipped with a roadmap to establish levels and particular scopes in a determined class of inquiries: researches on futures could take into account a particular scale to state what are the levels of future which are studied and considered in a given specific and particular investigation. In order to perform this task, futurists can select a fixed t and a special σ as suggested by this article or futurists have to decide what is the best way to introduce metrics in cones of plausibility. Anyway, we need a stable highway to explore the potential levels of future.

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