THE PHENOMENOLOGY OF THE PASSAGE OF TIME

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Introduction

Aim and structure of the chapter

I describe the structure of my thesis; I introduce the four main contemporary metaphysics of time: Presentism, Eternalism, Possibilism, and the Moving Spotlight view. I briefly argue that Eternalism, which does not confer an objective 'special role' to the present, seems – *prima facie* at least – the best metaphysical candidate to fit in with contemporary physics. In the last part, I sketch the problem of the genuineness itself of the debate: is it possible to reduce all temporal facts to tenseless facts?

Four metaphysics of time

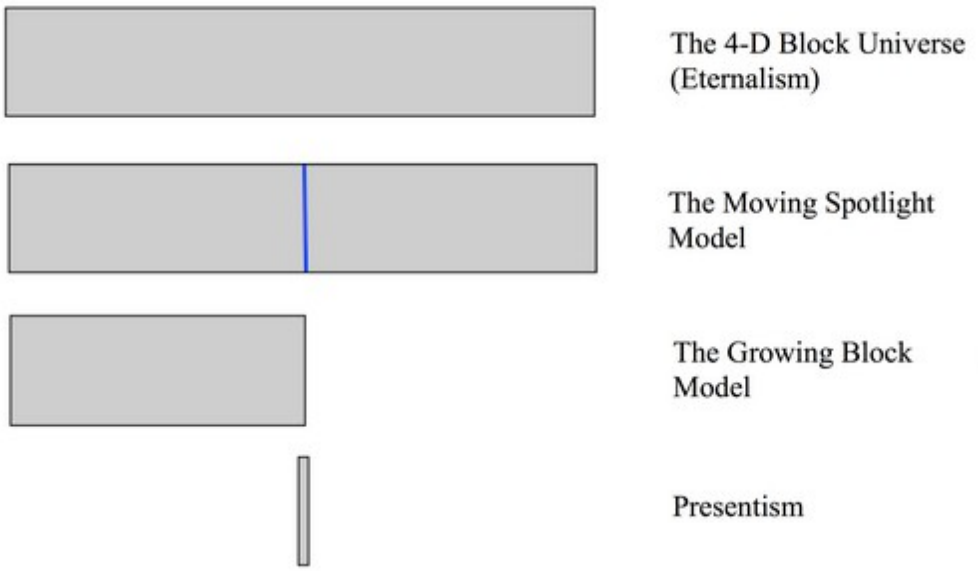
In the first chapters of my work I will illustrate and defend the Block Universe view, while in the last chapters I will develop and defend a view that describes our temporal experience in a way that is compatible with the Block Universe view. The *fil rouge* of my thesis is the phenomenology of the passage of time and our temporal experience; however, just as there are different conceptions of the nature of temporal awareness, there are different physical conceptions of the time of the universe as a whole; before looking closely at our temporal

experience, then, it is useful to take a look to the metaphysics of time, and in particular to concentrate on a point that links these two different approaches in a privileged way: temporal passage. While few deny that time seems to pass (more on that later), there are many who have denied that time really *does* pass. What does it mean that the present always changes? Are the future and the past as real as the present?

These old metaphysical questions received a growing attention after the Special Theory of Relativity. Although we intuitively attribute the present a special status, modern physics seems to provide us a new insight: as Einstein famously wrote to Besso's wife, the distinction between past, present and future seems only a stubbornly persistent illusion. If this distinction is not physically founded, what should we say about the passage or the flow of time?

Nowadays, there are four main metaphysics of time, as figuratively represented in *Fig.1*[1] (the four main conceptions of the large-scale composition of the universe; 'what there is' is in grey): Presentism, Possibilism, Eternalism, and the Moving Spotlight Model.

1 Dainton (2017) chapter 7.2, fig. 20.



Presentists hold that only the things that exist 'now' are real: past events *were* real, future events *will be* real; there is an ontological difference between the present and the two other temporal forms; there is a privileged global present that separates the past and the future.

A fundamental difference, it has to be noted, is envisaged between space and time: while everyone concede that other spatial locations (even at space-like distance) exist and are 'equally real', Presentists deny that temporal instances other than the present exist, and they maintain that their view accounts better for many of our fundamental intuitions, such as the openness of the future, the passage or flow of time, and the fact that events slip away from

us. Presentism is designed in the first instance, as Wüthrich (2012) acknowledge, “to capture salient features of our experience of temporality”[2]: it seems that in our experience the concrete reality is confined to the momentary present.

Possibilists, however, assert that this description fails to recognize a fundamental asymmetry between the past and the future: we know how the II World War ended, but we don't know if and when there will be the III World War; it seems, that is the point, that we can't change the past, while there are many open alternatives in the future. Therefore, Possibilists think that a 'growing block' picture illustrates better this situation: the past and the present are real and fixed, while the future is open; the privileged global present described by the Presentists becomes the top of a growing fixed reality: the sum total of reality is gradually increasing, by a process of moment-by-moment ‘absolute becoming’. On this view the present is the most recent addition to reality, and the interface, so to speak, between being and non-being.

Moving Spotlight theorists, on the other hand, accord reality to all times and events – past and future – but incorporate an objective passage of time in the picture, in the form of a privileged and constantly advancing present. Even if Moving Spotlight theorists, then, agree with Eternalists that both the future and the past exist, they hold that present events are somehow distinctive, that they have a particular property: they are the only events which are illuminated by,

2 Wütrich (2010), p. 442.

following the metaphor, the 'moving spotlight' of the present.

In all these three metaphysical models the present has a special role: a problem that they all share, then, is to explain how there could be an objective present which does not depend on the choice of a reference frame, as physics tell us.

Eternalists, on the other hand, don't have this problem: they maintain that the notion of a 'global present' is unsustainable after the special theory of relativity; Hilary Putnam commented: "I do not believe that there are any longer any philosophical problems about Time; there is only the physical problem of determining the exact physical geometry of the four-dimensional continuum that we inhabit"[3]. The impossibility to identify an absolute now, identical for all the possible reference frames in the universe, means in their opinion that a Block Universe is the best portrait of this situation: observers have their own *nows*, their pasts and their futures, but there isn't any general, ontological and absolute distinction between the three temporal forms. The simultaneity of – or the temporal interval between – two points in the spacetime is not defined until a coordinate system is arbitrarily chosen. Thus, there is a potential infinity of simultaneity planes passing through any spacetime point: as Savitt puts it, "we have no way to distinguish *the* present from amongst the multitude of presents"[4]. As far as their ontological status is concerned, Eternalism assigns all

3 Putnam (1967), p. 247.

4 Savitt (2017), ch. 3.

events to the same ontological status, quite regardless of the time at which they occur; there is no unique privileged present time, and there is no such thing as a *moving* present.

The Block conception of time has its advantages: it has an appealing simplicity, and accords well with Einstein's relativity theories; but the rejection of objective temporal passage is not to everyone's taste, and this is the crucial point, a point where metaphysics and phenomenology intertwine: why does time seem to pass if, in reality, it doesn't? It seems that Eternalists must have a difficult time when it comes to account for our temporal phenomenology.

As I will specify in the following chapters, these different metaphysics of time are related to the competing accounts of temporal consciousness; I am going to side with the Eternalists, and try to describe our temporal phenomenology of the passage of time in an Eternalist block universe. At first glance, this could look as an unpromising approach, since the Block Universe is typically described (by its opponents at least) as somehow *static*. George Ellis, a possibilist, is convinced that in the Block Universe time is reduced to "an illusion: it does not 'roll on' "[5]: but the Eternalists, as I am going to argue, simply claim that (from a scientific point of view, in a tenseless sense, looking at reality from 'nowhen') there is not a privileged now, a privileged way to distinguish between past and future, what was real and what will be real. Ellis' conclusion

5 Ellis (2006), p. 1798.

that in the Block Universe "all past and future times are equally present"[6] must be rejected: what does 'present' mean when it is not referred to a particular spacetime point?

The genuineness of the debate

Callender (2002), Dorato (2006 B, 2012), Meyer (2005), and Savitt (2006) suggested that the debate between Presentism and Eternalism may lack of a real contrast. There may not be, in fact, a clear sense in which the Presentist denies the existence of future events which significantly differs from the Eternalist view; when the latter affirms that future events exist, she obviously doesn't mean that they exist simultaneously with her present and past (relative to her now) objects, but just that they will exist relatively to the point in which she is located. It seems that every difference relies on the choice of a 'coordinate system': if we refer to reality from our point of view, in a tensed sense, we always take our 'now' for granted, and the present really has a special status, as the location where we are; if we refer to the world, on the other hand, from a scientific point of view, in a tenseless sense, we look at reality from 'nowhen', as

6 Ellis (2006), p. 1798.

if – following the spatial metaphor – we were not in a determined place.

The distinction between presentism and eternalism is usually sought in some formula like 'Only presently existing things exist' or 'Past, present, and future events are equally real': it is possible to argue, however, that these slogans form distinguishing significant opposed positions because of some ambiguities in the copula. As Dorato puts it, "what, exactly, is being denied by the presentist's implication that the future 'is not real' or simply 'does not exist' above and beyond than the platitude that it does not exist *now*?"[7]. If the Presentist admits that from her particular reference frame 'there will be' a future event E, and there is not – as special relativity seems to imply – a privileged global present, E is simultaneous (the 'present') to another potential observer located in another region spacelike related to E. Since there is a potential infinity of simultaneity planes, every event at space-like distance from my point of view, would belong to the set o present moments if I chose a different reference frame: from a physical perspective, it would be unjustified to privilege one particular coordinate system F and call its simultaneity plane 'reality'; but that doesn't mean that *once you are in a particular coordinate system F* everything is simultaneously real relative to F. When a particular inertial frame is considered, the Eternalist, even if she regards the whole history of the world as given in a four-dimensional Block Universe, could distinguish between events that, relative to that reference frame, already occurred from

7 Dorato (2006), p. 561.

those that will occur. But this is just to stress the possible connection between the Presentists' intuitions and the Eternalists' possibilities: obviously, the descriptions from the inertial frames have no objective value, and Eternalists usually do not insist on non-invariant structures, but rather focus on the invariant structures of spacetime (points P and regions causally connected to P).

What the Relativity Principle means is that there are no 'distinguished' observers, i.e., that none can claim to have a privileged temporal view of the universe. In particular, no such observer can claim to be 'at rest' while the others are moving; they are all simply in relative motion. Admissible observers can disagree about some rather startling things (e.g., whether or not two given events are 'simultaneous') and the relativity principle will prohibit us from preferring the judgement of one to any of the others[8]. When the Presentists claim that past events were real, present events are real and future events will be real, and that the set of present (existing) events continually change, the Eternalists see a confirmation of their belief that from a relativistic point of view all events are equally real, since there is not a privileged present that could actually found an objective distinction.

However, as Sider (2001) Dainton (2010) argued, Presentists may deny the possibility of a reduction of all temporal facts to tenseless facts about a manifold of equally real past, present and future appealing to the concept of

8 See Naber (1988).

'existence simpliciter': they can deny that tokens of sentences such as 'there once existed dinosaurs' have truth conditions involving quantification over past dinosaurs; instead, they should use sentential 'tense operators', such as (WILL) or (WAS) – like the sentential modal operators of modal logic – and argue that they are primitive. The sentence 'there once existed dinosaurs'[9], then, is not reduced *à la* Eternalist in a tenseless way, but in a way that allows the sentence to have a truth value even if it does not exist, in fact, a past containing dinosaurs, such as ' (WAS) there exist dinosaurs'. This line of reasoning easily generates cases in which there is a straightforward disagreement: even if Eternalists, in fact, claim that what they mean by 'there exists an x' is what Presentists would express by a disjunction of combinations of tense operators and present tense quantifiers [WAS (∃x) V ∃x V WILL (∃x)], this translation would not eliminate the ontological disagreement; an Eternalist would say that there exist a set containing a dinosaur and a computer, whereas the Presentist would reject the disjunction; the reason is that while Eternalists avoid to locate the set within any one time – it simply exists 'in the Block', since the Block Universe contains dinosaurs and computers as well –, Presentists point out that at no time a dinosaur and a computer could coexist. Even if we do not believe in entities like sets, the argument shows that Presentists and Eternalists do disagree on something.

Moreover, as argued specifically by Sider (2001), the idea that the debate

9 This example is Sider's (2001)

could be deflated simply claiming that the verb 'exist' is used in two different ways – in a tenseless sense by Eternalists, and in a tensed sense by Presentists –, lead to claiming that too many other ontological disputes are not genuine. Actualists and Possibilists, for example, would not disagree over whether numbers exist or not: if 'exist' is intended as 'mathematically exist', it is uncontroversial that numbers exist; if, on the other hand, it is intended as 'physically exist', it is uncontroversial that numbers don't exist. “Philosophical ontology”, as Sider comments, “on this view is an impossible discipline”[10], and he adds:

> one can meaningfully ask: do numbers or merely possible objects exist — that is, exist simpliciter ? Given this view of existence we can meaningfully ask: do dinosaurs exist simpliciter? The eternalist says they do, while the presentist disagrees.[11]

There is a single notion of existence relative to which there can be meaningful dispute, and that is the notion of 'existence simpliciter'. I will follow this conclusion, and try to argue that even conceding that Presentists have in mind a notion of existence that is truly different from the Eternalists', still they are vulnerable to powerful objections, in particular the fact that Presentism conflicts with the special theory of relativity. Presentists refer to a privileged

10 Sider (2001), p. 17.

11 Sider (2001), p. 17.

frame (even if apparently denied by current physics); 'now', in their opinion, is not indexical, but it is a property of a set of events that does not depend on the speaker's perspective. In the next chapter, I will analyze the problem of the simultaneity plane and describe, as a case-study, George Ellis' attempt to circumvent it; the result will be an argument in favor of Eternalism.

1. The problem of a privileged simultaneity plane

Aim and structure of the chapter

In this chapter I analyze, as a case study, Ellis' Possibilist proposal: in contrast to the Block Universe view, Ellis describes an Evolving Block Universe, a space-time that grows and incorporates more and more events, along preferred time-like world lines. I argue that such a model betrays the original Presentist/Possibilist intuition (that of an objective, universal present) and fail to give a strong reason in favor of the objectivity of the local simultaneity planes: Ellis' version of the Growing Block is elegant, but seems *ad hoc*. In the second part of the chapter, then, I analyze the relationship between the Growing Block and the idea that the future is open, and I argue that Quantum indeterminacy does not eliminate the fact that, in a different observer's present, there is only one, *determinate*, outcome. In doing that, my aim is to defend the Block Universe view, which I find perfectly compatible with the temporal phenomenological model that I am going to develop in the second part of my

work.

Ellis' Growing Block

The famous argument by Mc Taggart[12] for the unreality of time gave birth to a lively debate about time as an A-series or B-series; C.D. Broad (1923) sought to achieve dynamism by replacing the standard Block models by Growing Block models (instead of adding A-series properties to block models). This approach remained almost completely neglected until the American philosopher Michael Tooley recovered it in the book *Time, Tense and Causation* (1997); after that, some physicists have begun to consider some versions of the Growing Block model.

Broad, in his original exposition, considered that "a change from future to present is not a matter of an event losing the A series property of futurity and taking on the property of presentness; rather, it is a matter of the event 'becoming' or coming into existence"[13]. In his own words, when "an event becomes, it comes into existence; and it was not anything at all until it had

12 See Mc Taggart (1908).

13 Earman (2008), p. 137.

become [...]. There is no such thing as ceasing to exist; what has become exists henceforth for ever"[14]. There is something undeniably attractive about Broad's idea of capturing the intuitively felt unfolding of time by means of Growing Block models. The problems arise when we start thinking more physically of it: one could legitimately ask "how fast is the Block growing?", "where does the Block grows, maybe in a fifth dimension?", etc. There are particular 'minimalist' versions of the Growing Block that manage to escape these embarrassment, but if we consider Special and General Relativity, the difficulties seem overwhelming: when we try to construct Block models with absolute simultaneity, there is the obvious problem that current physics have banished this notion long ago[15].

George F. R. Ellis is one of the physicists that has been fascinated by the challenge of including the modern physical theories in a Growing Block account of the world. As many philosophers of time, he found attractive a theory of time that shares features of Eternalism with an account of the genuine passage of time[16]. The future, that is the idea, is unreal: it does not exist. The past, on the other side, exists. The present is then a kind of hyperplane that borders reality, the 'edge of Being'. Such a view shares with Presentism the difficulties concerning the global and absolute 'now', but has some on its own. For

14 Broad (1923), pp. 68-69.

15 There is indeed a Bohmian way to individuate a privileged reference frame, but I will not expose it here, since this preliminary part of my work serves only as an introduction to our phenomenal temporality.

16 See Tooley (1997).

example: in describing the nature of this 'genuine becoming", it seems that there are two different kinds of time[17]: time as location in the four-dimensional space-time manifold that is the present and the past, and objective time which tells you where the border is; even if it the idea is intuitive, it is not entirely clear how to actually conciliate these two different times in one organic temporal account[18]. Beyond these metaphysical difficulties, it remains the physical one, shared by Presentists and Possibilists: what about the global plane of simultaneity?

In the recent paper *The evolving block universe and the meshing together of times* (2014) Ellis takes seriously the physical challenge sketched above: "there are only two approaches to arriving at something other than a BU[19]: (1) add something novel to relativity such as a preferred frame, or (2) reject realism about Minkowski spacetime. My program specifically introduces a preferred frame"[20].

In contrast to the Block Universe view, Ellis suggests that the true nature of spacetime is best represented as an Evolving Block Universe, a space-time that grows and incorporates more and more events. The extension of the future boundary of space-time envisaged by the author takes place along preferred

17 See Braddon-Mitchell (2004).

18 Also, it has been argued that in the growing block it is almost certainly not now (our 'now' doesn't coincide with the global cutting edge now, the point at which novel events come to existence).

19 Block Universe.

20 Ellis (2014), p.27.

time-like world lines, rather than on space-like surfaces. This happens locally everywhere, determining the present time along each such world line.

The intuitive idea behind this proposal is to bypass the physical difficulty set by Special Relativity by limiting the Possibilist global 'now' to a local extension: in fact, it is well-known that for events within the light-cone (time-like distance) there is no possibility – for every possible observer – to disagree on temporal relations. The problem of the relativity of simultaneity then, if we restrict our Possibilists claims to local regions, disappears. There are two possible choices: either we regard the evolution of our present surface as taking place along any possible world lines, or – as Ellis prefers – we posit that there are preferred world lines associated with the average motion of matter (as in cosmology). Starting at the beginning of time and measuring[21] proper time 'T' along chosen world lines determines the 'present instant" at time 'T' as time passes on each of these preferred world lines. Ellis proposes that the ever-changing surface of 'constant' time (the present) separating the future and the past is given by an integral along a family of fundamental world lines. Since no physical phenomena is directly determined by simultaneity in the usual sense, whatever consistency conditions are needed to guarantee the emergence of a growing block universe would be satisfied in the universe we observe.

Obviously enough, however, this reduction of the Presentist and Possibilist claims to local regions is a sacrifice, in that it seems unfaithful to

21 See Ellis (2014), Ellis & Williams (2000) and Ellis & Hawking (1973).

Presentists' and Possibilists' intuitions: there may indeed be no globally unique evolution, because that would depend on the choice of families of world lines. As Ellis himself puts it, "different global extensions of a local region may result from different such choices [...]. There is no unique way to say how this happens relatively for different observers; analysis of the evolution is conveniently based on preferred (matter related) world lines"[22]. Given the impossibility to find a global simultaneity plane, Ellis's Growing Block envisages a 'jagged' one; but the dependency on arbitrary choices and the limitedness of the simultaneity plane induce the suspect that this Growing Block's amount to just an *ad hoc* solution.

One of the important reasons that may push a philosopher in Ellis' direction is the idea that the future is, in some sense, *open*: that it must be distinguishable from the past and the present, which – on the opposite – are fixed. In Ellis opinion, the underlying dynamical idea behind the Block Universe is that, given data at an arbitrary time, everything occurring at any later or earlier time can be uniquely determined from that initial data by time-reversible Hamiltonian dynamics, which is assumed to be the basis of dynamics of physics in general and of gravitation in particular. The future and the past are both uniquely predictable from the present because one can predict the state S(x,t) equally to the past and the future from data given at an initial time t0:

$$H: S(x, t0) \rightarrow S(x, t1) \qquad \text{for all } t.$$

22 Ellis (2006), pp. 1719-20.

However, nothing is supposed to be special about t0: it is an arbitrary choice. Consequently, nothing can be special about any particular moment; there is no special 'now' which can be called the present. Such a Block Universe would represent all the events that have happened and that will ever happen, and there's no surface that can uniquely be called 'the present'.

The point is that this Hamiltonian evolution is, in Ellis opinion, in flagrant contradiction to our experiences, as well as to mature sciences such as biology and biochemistry: at the macroscale, he maintains, the reversible dynamics is mostly not valid. The usual 'stochastic' understanding of the second law of thermodynamics should recompose the broken harmony: there must be reversible Hamiltonian dynamics also at the microlevel, but through coarse-graining and loss of micro-informations we see irreversible physics at the macrolevel. The dynamics is actually time reversible: simply, our senses are too coarse to see it.

This classical reconstruction of the micro-macro levels' interrelation is believed to be simplistic by Ellis: Quantum Mechanics, in fact, should entail a loss of information of a different kind. If the probabilistic description is all there is to say about quantum effects, the reasoning goes, then reversible dynamics would not be possible, not even in principle. The proposal, then, is to abandon the idea of the unique, fixed future, the 'real becoming' being guaranteed by quantum unpredictability: there must be a surface – global or local – of the

spacetime where this unpredictability converts to fixity. That surface is the present.

Moreover, it is argued that the traditional problem raised against Presentism and Possibilism – the impossibility to define an absolute plane of simultaneity – is very weak, since simultaneity, as usually defined, is irrelevant to physical causation.

> Consider the Mars Rover, controlled from Earth. There is a communication time delay between Earth and Mars that is about 20 min on average. What matters physically is E1 (emission of a control signal from Earth), E2 (reception at Mars and emission of reply), and E4 (reception of this reply back at Earth). Which event S is simultaneous with E2 has no physical significance: it only has psychological value. [23]

It is questionable whether this is an argument in favor or against Presentists and Possibilists (more on that later); however, Ellis argues that even if the flow lines are not orthogonal to the surfaces of constant time, this should not be a big problem since no physical phenomena are (and could be) directly determined by simultaneity in the usual sense. The Einstein field equations would determine the metric tensor of proper time: given equations of state and dynamical equations for matter, it is possible to determine the time evolution of the metric in terms of proper time along the fundamental flow lines (unique

23 Ellis (2014), p.31.

geometrically determined world lines are the set of time-like eigenlines of the Ricci tensor, which represent the local average motion of matter). The proper time integral used to define the present is taken along these preferred world lines, in order to define unique surfaces in spacetime such as the usual surfaces of constant time in FLRW cosmologies. Moreover, these equations don't bound the space-time development to be uniquely determined from initial data: it depends on the equations of state of the matter; if they involve random elements – as Ellis is interested to show – these equations would not guarantee predictability; if quantum unpredictability gets amplified to macro-scales, the space-time evolution considered is intrinsically undetermined. Thus, the development of spacetime with time – as Ellis himself calls it – takes place just as is the case for other physical fields, with the relevant time parameter being the proper time along the fundamental flow lines.

Going back for a moment to the thought experiment of the Mars Rover, I'm not sure that it is really an argument in favor of the Presentist or Possibilist. The 'psychological value' of the global extension of the present is exactly what they want to rescue and protect from an Eternalist, 'presentless' point of view. Since we are not able to move (or produce things that move) at superluminal speeds[24], I agree that the relativity of simultaneity has not a real tangible meaning for us; but Presentists and Possibilists in a certain sense do exactly the same: simply, their generalization is of a different kind: they extend their

24 This is the standard scientifical view, even if the point has been contested.

psychological now to the whole universe and make a global present out of it.

Indeterminism and the openness of the future

In presenting Ellis' conclusions, it became clear that some of them have something to do with quantum indeterminism. Special Relativity is often interpreted as strongly deterministic, while the standard interpretation of Quantum Mechanics envisages an indeterministic behavior of the fundamental structures of the physical reality. It is predictable, then, that the advocates of an ontological distinction between the future and the two other temporal instances will look for a physical foundation of their intuitions in Quantum Mechanics. So does Ellis: "this is the core of the local flow of time: the indefinite future becomes the definite past as wave function collapse takes place"[25]. We find this intuitive idea in other authors (see, for example, Pooley 2013) who try to describe a genuine openness that is settled with the passage of time, but it is in Ellis that Quantum Mechanics' indeterminism becomes a central argument: when the uncertainty of the future becomes the certainty of the past – and this is supposed to happen all the time, everywhere – there is the local present.

25 Ellis (2014), p.34.

The Growing Block, thus, would also provide a cause for the asymmetry of time: the past exists, the future not yet – not being definite. There are possibilities regarding the future, but not specific outcomes: "the equations determine the time evolution of the spacetime, but do not guarantee predictability. Indeed, if quantum unpredictability gets amplified to macroscales, the spacetime evolution is intrinsically undetermined until it happens"[26]. The present-day large-scale structure of the universe is the outcome of quantum fluctuations during the first instants of the Big-Bang, so – the reasoning goes – the specific individual outcomes that are observable today are not determined by initial data at the start of inflation. A thought experiment shows the point even better:

> Consider a massive object with two computer controlled rocket engines that move it right or left. Let the computer determine the outcome on the basis of measurements of decay products of radioactive atoms. The outcome is unpredictable in principle, because of the foundational quantum uncertainty of the photon-emission process. If the object is massive enough, it curves spacetime, and so the future spacetime structure is not determinable or predictable from current data. Selection of the specific path taken, and hence the spacetime structure that results, occurs on an ongoing basis as radioactive decay takes place in an unpredictable way. The change from uncertainty to certainty takes place at the ever-changing present, where the indefinite future

26 Ellis (2014), p.34.

becomes the determined past.[27]

In Ellis opinion, the point is that there must be something truly novel at the exact time the wave-function collapses: a Block Universe, on the other hand, would have to be time reversible; but at the quantum level, once the wave-function has collapsed to an eigenstate, we cannot tell from its final state what it was before the measurement. “The present is more real than the undetermined future, in that it is where action is now taking place: it is where the uncertain future becomes the immutable past”[28]. Ellis is convinced that if we were in a Block Universe and we had a complete knowledge of the state of the universe we could – as the Laplace demon – infer the future. This is however an old topic: in 1988 Nicholas Maxwell refers to a paper by C. W. Rietdijk (1966), and credits him with “first discovering that SR and probabilism are incompatible”[29]. In this case, Quantum Mechanics would represent a serious problem for the Block Universe.

It is now useful to mention a different type of proposal: John Norton presented the burning fuse model”, taken to be the opposite of the Possibilist's Growing Block; the future is real and the past is unreal: the 'now' is a flaming point that slowly advances upward, burning the real future that is there waiting to be burned, leaving behind anything but dust. It should motivate our pre-

27 Ellis (2014), p.30.

28 Ellis (2006), p. 1799.

29 Maxwell (1988), p. 641.

philosophic intuition that the present moment is special *and* that future moments have something more than past moments: the future states carry the capacity of being able to come to be present. The past is gone, but the unburnt future is there waiting (as the metaphor of the burning fuse shows well): the ontic statuses of past and future are the inverse of the Growing Block model. Norton's purpose, as he comments, is just to create a certain sense of unease: "my real point is that I have the same feeling about the entire debate over presentism against eternalism against growing block possibilism"[30]. Presentists, Eternalists and Growing Block Possibilists, in fact, will all agree on specific astronomical facts: they will just disagree on how the label 'real' should be applied.

The lesson, here, is that translating pre-philosophic intuitions into theoretical physical-philosophical models is a dangerous operation, which risks to – and indeed very often does – privilege some aspects and neglect some others of a more complex situation. Presentism comes from the very reasonable idea that we live and experience just the present, which is very different from the other two temporal instances; the Growing Block model translates another very reasonable idea: the past and the present are definite, fixed, while the future is not; the burning fuse model originates from the reasonable idea that the past is gone, while the present and the future are still there. These models are all reasonable, they come from very natural intuitions: but when it comes to

30 Norton (2013), pp.3-4.

translate these models into physical theories, the difficulties are overwhelming.

There are two possible ways to escape the dilemma: we could see what physics can tell us about present, past and future, and then try to assimilate it to our 'natural intuition' (and Eternalism seem the best approach in this direction); or, conversely, we could question the fact that physics tells us all there is to know about time, arguing that the physical description of the world is incomplete, because it cannot describe or describes only partially our experience of time.

There is a prevalent difficulty for the first approach: the deep dichotomy in contemporary physics between Relativity and Quantum Mechanics. While relativity is often considered to give a physical foundation to Eternalists' claims, Quantum Mechanich's description of reality is what Presentists and Possibilists often refer to. The fundamental (quantum) laws of the universe, it is usually concurrently argued, are probabilistic and not deterministic. According to this position, then, there is an absolute, physical difference between past and future events, and that's why Possibilism and Presentism are, in general, associated with the view that there is a universal and unambiguous distinction between past and future, usually global (we already discussed Ellis local proposal, which differs from this). Special relativity, on the other hand, is believed to be true only if there is no such distinction: given two events at space-like distance, there is no frame-independent way to describe their temporal relation; it depends on the choice of inertial reference frame. The often drawn conclusion

is that indeterminism and Special Relativity are incompatible.

Nicholas Maxwell, in a paper entitled "Are Probabilism and Special Relativity Incompatible?" (1985), clarifies the situations as follows:

> On the one hand there is probabilism as this has been defined above, a view which asserts that the basic laws are probabilistic and that the future is now in reality open with many ontologically real alternative possibilities whereas the past is not. This view may be renamed ontological probabilism. On the other hand there is predictive probabilism (as it may be called), a view which asserts that the future, like the past, is now in reality entirely fixed and determined even though the basic laws are probabilistic and not deterministic.[31]

I find the distinction really useful to understand why Special Relativity and quantum indeterminism are not incompatible. Whereas an ontological interpretation of the openness of the future maintains that the future is open and undecided, the predictive interpretation asserts that it is fixed even if the present state and the laws of nature are insufficient to determine this unique future. In any coordinate system there will be *one* future, and *that* is the only real: the indeterminism of the fundamental (quantum) laws, in fact, doesn't exclude the fact that there will be only *one* future. Special relativity requires that all inertial reference frames are physically equivalent; anything that is true in one reference frame, has its equivalent truth in any other reference frame.

31 Maxwell (1985), p. 25.

Predictive probabilism, as Maxwell calls it, would permit to conceive the world as 'spread out' in Minkowskian space-time, since reference frames would be physically equivalent; ontological probabilism, on the other hand, would not permit that, since it would ignore the identical physical reality of future alternative possibilities.

Presentists and Possibilists' worries about the openness of the future must then be understood as unjustified. The absence of an absolute and global (or, in Ellis's local case, not arbitrary) plane of simultaneity entails the impossibility to draw a clear-cut distinction between a fixed past and an open future; this resists quantum indeterminacy, in that the probabilistic descriptions don't eliminate the fact that there will be only one real outcome.

Consider two events at space-like distance, the first (E1) being an observer breathing and the second (E2) being the result of a wave-packet collapse: E2 could be in the (non-causal) future of E1, simultaneous, or in his (non-causal) past, depending on the choice of a coordinate system. Since there are a potential infinity of simultaneity planes passing through any spacetime point, maintaining the openness of the future would require that the same event is fixed and not fixed at the same time. Quantum indeterminacy, then, must be read just as the impossibility for an observer located at a specific space-time point to infer from the present state and the laws of nature the future development of the system, and not the real existence of various possible outcomes, or an absolute ontological difference between the future and the

past, which wouldn't be tied to an arbitrary choice. The spacetime diagram in *Fig.2*[32] represents graphically the situation: a 3-D slice of a 4-D flat spacetime defined by three axes (ct, x, and y) of the four specifying an inertial frame.

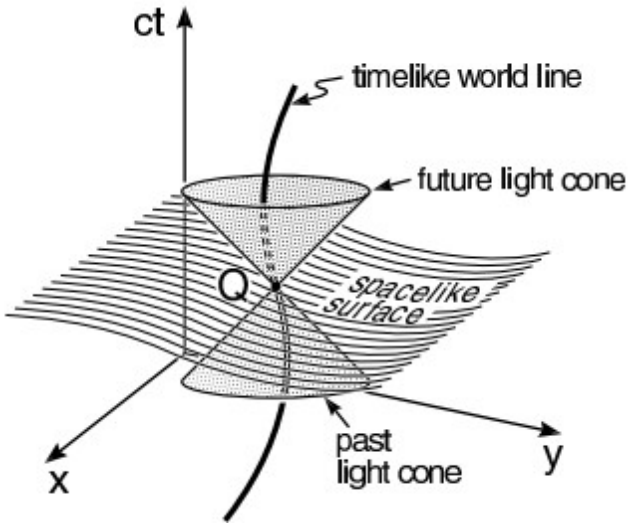


Fig.2

In the figure it is illustrated a representation of concepts such as event, light cone, world line, and spacelike surface. An event is a point in spacetime like Q; each point has a future and past light cone: the future light cone is the threedimensional surface generated by the light rays emerging from Q; the past light cone is similarly defined by the light rays converging on Q. A spacelike surface like the one illustrated defines an instant in coordinate time. Each such surface divides spacetime into two regions called the future of this surface and its past. Besides the distinction between coordinate time and proper time (the

32 Hartle (2005), p. 104.

one which is invariant in relativistic theories), the crucial problem for Presentists and Possibilists is that, while points inside the future light cone of Q are in its future and points inside the past light cone are in its past, points outside the light cone are neither.

Consider another famous attempt to show the openness of the future: Stein, in his milestone paper *On Relativity Theory and Openness of the Future* (1991), asks himself if a notion of real becoming can be coherently expressed in terms of the structure of Einstein-Minkowski spacetime. If we formulate the problem, he admits, as if the entire history of the world was separated into a part that has already become ('the past'), ontologically fixed and definite, and a part that hasn't already become ('the future'), not yet settled, we should provide a spatiotemporal criterion to distinguish, at any given stage, the definite from the not yet settled; insisting on the notion of a global present, intended as objective spatially distant actualities, would be useless, since it is fundamental to the Theory of Relativity the rejection of any such notion. Thus, "the fundamental entity, relative to which the distinction of the 'already definite' from the 'still unsettled' is to be made, is the here and now"[33].

In relativistic physics there is no distinguished notion of simultaneity for a system of particles (the typical form of a law of interaction is local, infinitesimal): consider[34] a specious present π of some percipient being, and call

33 Stein (1991), pag. 148.

34 This example is Stein's.

an event *e* contemporaneous with π if interaction (influence) can occur mutually; in Newtonian physics, the spatial extent of the set of events contemporaneous with a given specious present is infinite (and that's the correlate of our intuitive notion of a global present). But in the relativistic case the situation is different: in Stein's words, “in the theory of relativity, the only reasonable notion of 'present to a space-time point' is that of the mere identity-relation: present to a given point is that point alone-literally 'here-now' ”[35].

On the other hand, however, the set of events contemporaneous with a specious present will always be spatially extended; indeed, for all our practical purposes, it is immensely large. Stein believes that the primitive notion of present was, originally, absolutely not 'spatially unbounded': this is only a successive abstraction; the primitive notion was more plausibly similar to contemporaneity with respect to communication, mutual influence.

In the Minkowski metric we are temporally long and spatially thin; another way to say it is that the velocity of light is enormous compared to us: light travels a spatial distance that bears a very large ratio to the spatial extent of our bodies. Interactions are not instantaneous, but propagate with a speed at most equal to that of light; then, for processes with stable patterns to occur, it will be necessary that many interactions (back and forth) take place, i.e. many signals must pass in both directions to establish a regular coordination: “from this it immediately follows that the 'graining' of time with respect to which a

35 Stein (1991), pag. 159.

percipient organism can experience conscious interaction with its environment must be such that the 'moments' of time (the specious presents) are long enough to allow such signals and, therefore, light signals to travel very many times the maximum spatial dimensions of the organism together with its (relevant) environment"[36]. The incredible velocity of light, when compared to our spatial extension, lies at the basis of our abstraction of something as a 'cosmic simultaneity': in all our ordinary experience the time that we experience as a moment (a specious present, in Stein's words) is indeed contemporaneous to every event we have to do with. Stein's conclusion is that the pre-philosophical intuition of a 'cosmic present' is quite as illusory as the intuitions of the earth unsupported in space and people living upside-down at the antipodes.

I feel very sympathetic to Stein's description of the topic: not only do I think that Relativity definitively eradicated the notion of a global present from our physics; I am also convinced that the intuition itself behind the idea of a cosmic simultaneity is misleading. There is a crucial point I don't agree with, though: Stein asked to consider the 'here and now' (spacetime point) as the fundamental entity relative to which the distinction of the 'already definite' from the 'still unsettled' is to be made, thanks to which he elaborated a notion of indeterminateness (or genuine becoming, come to being). Quantum indeterminacy is a powerful tool in his hands, since it can be used to show that,

36 Stein (1991), pagg. 161-162.

even in principle, we could never calculate what is going to happen, therefore the future is not settled. From an Eternalist point of view, however, these are not insurmountable problems: the standard answer – one that I find very reasonable – is, again, that even if from a particular point of view we can't calculate what is going to happen (whether the nucleus of an atom is going to decay in the next hour or not), only *one* thing is going to happen. The Eternalist account, then, starting from a 'nowhen' perspective (i.e. without privileging any particular spacetime point), describe the entire life of (for example) a human being in a completely relational and atensional way, without any 'objective becoming' occurring, i.e. without any 'future and indeterminate events' becoming 'past and determinate'.

These are two different ways to describe what we are living. Stein's account is intuitively very appealing, since we always are in a particular spacetime point and never experience the world from a 'nowhen' perspective; nevertheless, after having excluded a global present, I find the notion of 'objective becoming' useless and very heavy from an ontological point of view. Think about the tenseless description of Julius Cesar's life. While he was experiencing it, he thought that every moment was 'the' present, and that future events were unsettled; when we think about it, though, we see his life as none of the moments he lived was truly 'the' present; he thought that his future was unsettled, but according to the tenseless description of his life that we all have in mind, his future is determined. The question, then, is: why do we differ from

him? From our point of view, our present is 'the' present, and the future is unsettled (we don't know what is going to happen; we can't calculate it even in principle); but our future will be someone's past: there is not a point in adding to the tenseless, Eternalist description of our lives a costly notion of real becoming.

From our perspective, future events don't exist yet: if, speaking of indeterminacy of the future, we only mean that the future is not completely knowable from our particular point of view, we all agree. But if we mean that it is really undetermined, we are making the error to think that our particular point of view is not only our's, but reality's too, turning our 'meeting the events' in an objective 'come into being' of them.

If we exclude that there is a unique global simultaneity plane, a unique global present advancing, how come that our local notion of becoming is indeed an objective becoming? In the recent words of Yuval Dolev (2016), "the spatially limited present's weaknesses outweigh its strengths. […] either there is no such thing as presentness, or else presentness is global"[37]. It seems that the only way to achieve an objective becoming is thanks to an objective (non-arbitrary) global present advancing; but if we share with Stein his perplexity about this abstraction (successive to our primitive notion of the present as 'here-now'), the only possibility left seems the refusal of the objective becoming and the openness of the future.

37 Dolev and Roubach (2016), pp. 24-25.

2. The passage of time in a Block Universe

Aim and structure of the chapter

What does it mean that time passes? Although the old dispute between Substantivalism and Relationism is nowadays considered obsolete, it is useful to mention it because, in answering the question, philosophers have usually in mind a 'Substantivalist-like' or 'Relationist-like' answer; it helps, i.e., to understand what kind of 'passage' we have in mind when we say that time passes. Secondly, I take into consideration some logical arguments against the objective passage of time, mainly the 'one second per second' argument, and I defend them. Finally, I consider a very influential argument in favor of the objective present and objective flow of time: our own experience of time. It seems to us as if time flows, and the most reasonable explanation of this is that there is some genuine motion of time which we experience, or in which we

partake. But we should ask ourselves: how would things seem if time didn't objectively flow?

Substantivalism-like and Relationist-like

Consider the words with which Steven Savitt opens his *Being and Becoming in Modern Physics*: "what is time, and is it real? If it is, does time flow or lapse or pass?"[38]; or this sentence by Barry Dainton: "the dispute between dynamists and eternalists is over the nature of time, how time is in and of itself"[39]. Ideas on the passage of time are connected, that is the point I am trying to make, to the ontological status we assign to this notion. In particular, our ideas concerning the passage of time are related to an old debate on its nature: in the words of Frank Arntzenius, "Substantivalism is the view that space and time exist in addition to particles and fields. Relationism is the view that only particles and fields exist, which stand in certain spatio-temporal relations"[40].

After Newton defined – in the Scholium to Definition 8 of his treatise *Philosophiae Naturalis Principia Mathematica* – the absolute, true and mathematical time ("Tempus absolutum verum & Mathematicum") as

38 Savitt (2013).

39 Dainton (2010), p. 12

40 Arntzenius (2012), p. 125.

something that in its own nature flows evenly without relation to anything external ("in se & natura sua absq; relatione ad externum quodvis, æquabiliter fluit, alioq")[41], his theses regarding the ontology of space and time have been associated to the Substantivalist position. However, as Stein (1967) suggested fifty years ago, Newton's absolutism about space amounted merely to the claim that the laws governing the motion of bodies presupposed that there are (unobservable) facts about which bodies are at rest. It should be emphasized, then, that Newton did not regard space and time as genuine substances (as are, paradigmatically, bodies and minds), but rather as real entities with their own manner of existence as necessitated by God's existence (more specifically, his omnipresence and eternality). Consider this passages by Stein:

> the general situation, with respect to the question of the empirical content of the kinematical notions that Newton calls 'absolute, true, and mathematical', appears to me to be this: these notions are part of Newton's theoretical apparatus. [...] In this respect, Newton's use of the 'absolute' kinematical notions should be regarded as of same class with his use of such theoretical notions as 'force' or 'attraction' or 'gravitation'.[42]

> The only phiiosophical procedure is to adopt that conception of space and motion on which alone dynamics can be based – which implies, in particular, [...] that considerations of force as well as of change of relative position must

41 Newton (2009), p. 11.

42 Stein (1967), p. 190.

be brought to bear in order to determine the true state of motion or rest of bodies.[43]

Those who, before or shortly after Newton, rejected the notion of absolute space, did not necessarily deny that there is a fact of the matter as to the state of true motion of any given body; they thought, rather, that the concept of true motion could be analyzed in terms of the specifics of the relative motions or the causes thereof. The difficulty (or, as Newton alleged, the impossibility) of so doing constituted for Newton a strong argument for the existence of absolute space.

Newton's position, then, looks much more refined than a simple statement of Substantivalism; nowadays, moreover, the traditional debate between Substantivalism and Relationism is to be considered obsolete: there are many more refined positions (the modal theories of time[44] for example, or structural spacetime realism advocated by Dorato[45]). In particular, the debate on the ontological nature of spacetime was animated in 1987 by John Earman

43 Stein (1967), p. 198.

44 Modal views of time describe time series as forming a logical space occupied by propositions, rather than a properly geometric space populated by entities or events or relations. The metaphysically basic "time points" in Substantivalists' accounts are abandoned both by Relationists and the Modal theorists: what they disagree about is what is needed to replace those entities: temporal relations on the one hand, primitive tense operators on the other. See Prior (1957) and Meyer (2014).

45 Dorato (2000) claims that the relational nature of the spacetime structure can be defended while arguing that spacetime exists,at least partially, indipendently of the physical objects.

and John Norton's milestone paper *What price spacetime substantivalism? The hole story*[46]; in the article, the two philosophers extended the original idea behind the 'hole argument' by Albert Einstein. Historically, the debate about the ontological nature of space and time has seen the dispute between an absolutist and a relationist position; this traditional contrast, however, had encountered in the course of history two particular concepts that have proven to be particularly difficult to manage: the physical-mathematical entity called *field*, and the nature of the metric in General Relativity.

The concept of field is a primary source of uncertainty for the traditional debate: what does it mean 'empty', if the gravitational field is everywhere? Even when we suck all the air out of a tube, there is still a physical quantity, represented by a tensor, that has a specific value for each point in space and time. The ontological categories of Substantivalism and Relationism become thus less definite: matter and space coexist; in which category, then, do we put the metric, especially after General Relativity? Is it a content or a container? The existence of the gravitational field is essential: there can't be space without gravitational potentials.

What about the fact that, instead of speaking of space and time, contemporary physics uses the notion of 'spacetime'? What does it mean that time objectively flows, then, if there is not any such entity? For an objective flow of time to exist, time must “differ from space”, as Mark Hinchliff clarifies in *The*

46 Earman & Norton (1987).

Puzzle of Change:

> The spatial analogue of presentism is the view that the only things that exist are the things that exist here. On this analogous view, Mount Everest does not exist, which is extremely implausible. Things at other places are just as real as things here. However, presentism itself is not an implausible view. Time differs from space. According to the presentist, other times are not like other places. They are not just as real as the present. Only the present exists.[47]

That's why Savitt believes that "there are grave difficulties in merely formulating a [Presentist or Possibilist] view in Minkowski spacetime"[48]. In light of all that, it would be simplistic to keep talking of Substantivalism and Relationism *tout-court*: not only the debate has evolved; the real point seems to be that there are some physical notions that simply cannot fit in the dispute.

Recently, however, there's been an increasing interest, by philosophers of time, in the temporal part of the debate: notwithstanding all the conceptual difficulties enumerated above, in fact, it is possible to articulate a Substantivalist and a Relationist version of the passage of time. What does it mean that time flows, or passes? In answering that, contemporary philosophers[49] tend to use connotations that put their answers in contact with

47 Hinchliff (1996), p. 123.

48 Savitt (2000), p. 565.

49 See for example Price (1996), Ellis (2006), Maudlin (2007), Meyer (2014), Skow (2015).

one of the two sides of the traditional dispute; that does not mean, however, that they take a side in that old debate, or that they try to 'revive it'; simply, it is useful, at least intuitively, to clarify if the notion we are interested in have 'Substantivalist or Relationist-like' characteristics: it is useful because it helps to understand what kind of 'passage' we have in mind when we say that time flows.

If we are Substantivalists about time, then, we typically believe that time independetly flows, or pass; if we are Relationists about time, we maintain that time does not exist independently of the events that occur in time (no space for an independent 'flow' or 'passage'); even the topological features we ascribe to time depend on the former choice: while, on the one hand, time's topology would depend on contingent facts about the relations among events in the world, on the other hand time would have its topological properties as a matter of necessity. Temporal relations, from the Relationist point of view, are primitives and do not depend on the existence of a temporal substance: it is evident how, in this case, there is little space for an objective and independent flow or passage of time; still, however, we could speak of a passage: the flow, in the Relationist case, would only be the succession of the events.

According to fundamental physics, the world is four-dimensional, and governed by basic laws that operate in a spacetime that has no unique division into space and time; on length scales much greater than the Planck length, the world is four-dimensional with a classical spacetime geometry (there is neither

a unique notion of space nor a unique notion of time). Which is then the origin of our subjective experience? In the words of the physicist James Hartle (*The Physics of 'Now'*)

> past, present, and future are not properties of four-dimensional spacetime but notions describing how individual IGUSes [Information Gathering and Utilizing Systems] process information. […] The past, present, and future of an IGUS is consistent with the four-dimensional laws of physics and can be described in four-dimensional terms. The present, for instance, is not a moment of time in the sense of a spacelike surface in spacetime. Rather there is a localized notion of present at each point along an IGUS' world line. The common present of many localized IGUSes is an approximate notion appropriate when they are sufficiently close to each other and have relative velocities much less than that of light.[50]

Maybe, the Relationist could suggest, we experience our life in spacetime as if time passed objectively, but we are just observers in a particular world line; despite our 'objective feelings', i.e., there is not an objective flow. The 'unreality' of the passage of time could be intended, then, just in the sense that time is nothing over and above the events that happen in succession. Temporal relations are perfectly real relations between events: thus, we must distinguish between the absence of a Substantivalist flow next to the events, and the absence of events in a proper sense. The Relationist temporal account doesn't

50 Hartle (2005), p. 101.

maintain that time doesn't exist, but simply that time is nothing over and above temporal relations. What I intend to show in this chapter is that, analyzing the passage of time and some traditional conundrums, Substantivalist-like accounts face much more problems than Relationist-like do.

As Huw Price comments, regarding the status of the flow of time "philosophers have tended to divide into two camps [...]. On the one side are those who treat flow and the present as objective features of the world; on the other, those who argue that these things are mere artifacts of our subjective perspective on the world."[51]. Presentists and Possibilists are typically those who are more interested in maintaining, in a strong sense, that time flows or passes. Their description of reality, in fact, usually involves a global present that meet the common-sense notion of 'passage of time'. However, even within the Eternalists there is a debate whether time really, objectively passes or not. This multiform debate is well described by Barry Dainton:

> there are those who believe that temporal passage is a real phenomenon, an objective feature of reality that is independent of the perspective that conscious beings such as ourselves have on things. Anyone who believes this subscribes to a dynamic view of time. Some dynamists hold that passage involves a special property of 'presentness' moving along the timeline. Others explain passage in terms of the non- existence of the future: only the past and present are real, but since reality is growing – new times are coming into being as future

51 Price (1996), pp. 5-6.

> possibilities crystallize into present actualities – no time remains present for long. Others deny reality to both the past and the future: time consists of a succession of ephemeral presents. In the opposing camp are the many philosophers who reject the claim that temporal passage is a real and objective feature of the world.[52]

If we consider an instant T, on the world line of an observer, all the events from which the observer can have received signals according to the Theory of Relativity are within her 'light cone' (since nothing can travel faster than light). Signals from events outside this light cone, i.e. at a space-like distance, can only reach the observer after the instant T, and when they do, they will lie within the observer's backward-directed light cone at that instant[53].

There are those[54], however, that argue that this is not all there is to say, that this would give a subjective, mind-dependent (and wrong) description of the passage of time; in the words of Abner Shimony, "something fleeting does indeed traverse the world line, but that something is not subjective; it is the transient *now,* which as a matter of objective fact is momentarily present and thereafter is past"[55]. The Eternalists' usual description of the passage of time, that is, seems too 'atemporal' to describe dynamical phenomena.

It seems that there are two different sorts of animated Minkowski

52 Dainton (2010), p. 7.

53 See Whitrow (1980), p. 348.

54 See Savitt (2013) for a reconstruction of the standard positions.

55 Shimony (1993), p. 284.

diagram: each seems to involve a kind of motion (of the light cone or of the transient now advancing along a world line). As Park (1972) commented in *The myth of the passage of time*, however, there is no benefit in adding the animation:

> the animated diagram may be more intuitive [...] than the atemporal one, but it contains no more specific, verifiable information. All of the science of dynamics, that is, all we know about how complex systems (including ourselves) behave and interact, is already represented on the atemporal Minkowski diagram. [56]

The non-animated Minkowski diagram may be 'static', but, as Park points out, the static diagram represents the evolution of systems along their world lines. The diagram, if Park is correct, need not itself be animated to represent dynamical phenomena.

In the Special Theory of Relativity the histories of material objects, always moving with speeds less than that of light, are represented in Minkowski spacetime by time-like world lines. As Dieks suggested[57], we can think of becoming in Minkowski spacetime as proper time along a time-like world line: the present for a point particle on a time-like world line would coincide with the particle, and a succession of presents would be the successive occurrence of

56 Park (1972), p. 115.

57 Dieks (2006).

events along that world line.

The metaphor of a 'Block Universe could be the responsible for the (unfair) accusation of having a static nature, in opposition to the 'moving present' view of time. This is misleading, as it suggests that there is a time-frame in which the four-dimensional block stays the same: there isn't. Simply, as Price puts it, “defenders of the block universe deny that there is an objective present, and usually also deny that there is any objective flow of time”[58]. Usually but not always, as I'm going to show.

What does it mean that time passes 'one second per second'?

The Eternalists' Block Universe, as I have described, can account for dynamical phenomena even without postulating 'something' that objectively flows; nonetheless, however, there are Eternalists that believe that there are good reasons to save the objective flow: Tim Maudlin, for example, declares himself an Eternalist, believes that the past and the future are unique and real, but also thinks that the four-dimensional universe is a single entity of which the

58 Price (1996), p. 13

objective passage of time, in one particular direction, is an ingredient; in his own words: “I believe in a block universe. But I also believe that time passes, and see no contradiction or tension between these views”[59]. He clearly specifies that this passage must be understood as something radically different from the advance along an arbitrary time-like world line: he believes in “the existence of an ‘objective flow of time’, i.e. the view that time, of itself and by its own nature, passes”[60]. I am not questioning Maudlin specific view on the passage of time: I am simply interested in some arguments that he puts forward in favour of this 'objective flow'. In particular, he claims that there are logical objections that could be refuted. In his own words:

> Logical objections contend that there is something incoherent about the idea of the passage of time per se: conceptual analysis can show the idea to be untenable or problematic.[61]

If it made sense to say that time flows or passes, for example, it would also make sense to ask how fast it flows – but it doesn't seem the case. We could try to reply that time flows or passes at 'one second per second', but this answer, as Price wrote, “misses the more basic aspect of the objection. A rate of seconds

59 Maudlin (2007), p. 109.

60 Maudlin (2007), p. 111.

61 Maudlin (2007), pp. 110-111.

per seconds is not a rate at all [...]. It is a dimensionless quantity"[62]. So the problem would be that it does not seem to make sense to speak of an objective rate of flow of time. But Maudlin isn't so pessimist about the 'seconds per seconds' rate:

> What exactly is supposed to be objectionable about this answer? [...] it is necessary and, I suppose, a priori that if time passes at all, it passes at one second per second. But that hardly makes the answer either unintelligible or meaningless. Consider the notion of a fair rate of exchange between currencies. If one selects a standard set of items to be purchased, and has the costs of the items in various currencies, then one may define a fair rate of exchange between the currencies by equality of purchasing power: a fair exchange of euros for dollars is however many euros will purchase exactly what the given amount of dollars will purchase, and similarly for yen and yuan and so on. What, then, is a fair rate of exchange of dollars for dollars? Obviously, and necessarily, and a priori, one dollar per dollar. If you think that this answer is meaningless, imagine your reaction to an offer of exchange at any other rate.[63]

The physicist George Ellis agrees: "The situation is just like rates of exchange of money: this is an operator with two slots, each with its own units; they do not cancel, as pointed out by Maudlin"[64].

62 Price (1996), p. 13

63 Maudlin (2007), p. 112.

64 Ellis (2014), p. 39.

Again, I am not arguing 'against' Maudlin's particular view, but I think it is interesting to examine the argument because I do think that there is a genuine difficulty here for the supporter of the objective flow: obviously, 'one dollar per dollar' would be a fair exchange rate, but just because of a logical law (the law of identity), which count even for fictional objects: a unicorn is identical to itself, and certainly I would be surprised if someone offered me an exchange rate different from 'one unicorn per unicorn'; but that certainly does not give me a clue on how much is worth a unicorn. We are in the same situation: the question was 'how fast does the time passes?': answering that it flows at 'one second per second' doesn't add anything to what I previously knew. If a dollar was only worth a dollar, money would be completely useless: the real point – what is not *a priori* – is that a dollar is worth 500ml of milk, two candies, 0.8 euros, etc.

The definition itself of rate is "a quantity, or amount or measure considered as a proportion of *another* quantity or amount or measure"[65]. I therefore think that Price has a point when he says that a rate of 'seconds per seconds' is not a rate at all. There are, of course, some refined attempts to defend this idea: one is put forward by Maudlin itself: "π is defined as a ratio of a length (of the circumference of a Euclidean circle) to a length (of the diameter). The ratio is length to length: length does not 'cancel out'. […] π itself

65 https://www.vocabulary.com/dictionary/rate

is defined independently of any *unit* of length"[66]. That is true, and a similar case is made by two other philosophers: Ian Phillips (2009) believes that "one second per second is not one second divided by one second, and it is not equal to one. One second per second is a ratio of time to unit time"[67]; Bradford Skow (2012) works towards a similar point, trying to show that the rate 'seconds per seconds' could be considered, in a certain way, more meaningful than it seemed:

> there is an interpretation of '1 second per second' that better fits the way believers in objective becoming use this expression. Its meaning is not similar to the meaning '1000 meters per kilometer' has in 'there are 1000 meters per kilometer,' but instead is similar to the meaning of '10 meters per second.' This expression does not name a number. It names a value of speed. So a second interpretation of '1 second per second' says that this expression names the value of a speed-like quantity. Of course speed is speed-through-space. And we are discussing the rate at which time passes. This rate is not a value of speed, but is a value of some other quantity. Let us call this quantity 'speed-through-time.'[68]

On this second interpretation a value of the quantity 'speed-through-time' is identical to 1 second divided by 1 second. Skow has certainly a point in maintaining that this definition, per se, is not meaningless. Some quantities are

66 Maudlin (2007), p. 113.

67 Phillips (2009), p. 504.

68 Skow (2012), p. 386.

'dimensionless' ("if Q is any quantity that is measured in units of duration then its rate of change will be dimensionless"[69]) but meaningful: think of the period of a pendulum. The period is some number of seconds, and it could change in time: the period of my aunt's pendulum could be 1 second per second in summer, and 0.9 second per second in winter[70]. The rate can be reported as *n* seconds per seconds, without being aprioristic, or trivial, or meaningless!

The point that Skow, in my opinion, missed is that we have *something else* to measure the period of the pendulum, which is not the pendulum itself. His argument try to differentiate the meanings of the two occurrences of the word 'seconds' in the expression 'seconds per seconds': the former being a sort of 'temporal distance' (how much 'temporal space' has been covered by the passing of time), the latter being the usual and common-sense unit of time (how much did it take for time to cover that certain amount of time). What is implied is that the rate could be different: two seconds per second, three seconds per second, etc.; then, the reasoning goes, if the rate is one second per second (and not two or three), this is a true piece of knowledge.

In this particular sense it is true that the rate 'seconds per seconds' is not, per se, meaningless, or trivial; but it is when it comes to measure such a particular quantity as the alleged 'objective flow of time'. The reason is very simple: you can't measure the velocity of time using time itself, just as you can't

69 Skow (2012), p. 397.

70 Temperature may modify the length of the pendulum, modifying thus the period.

measure the period of a pendulum using the time indicated by the pendulum. If the pendulum was the only thing in the world that measured time, how could we ever notice that its period changed[71]? And what would it mean to say that its period is '*n* seconds per pendulum second'? The period of a pendulum, when compared with other measurement instruments, could have a meaningful dimensionless rate; but the situation with the objective flow of time is different, in that we have not anything else to measure it, and the alleged 'rate' is bound to be, always, a priori and trivially, one second per second. Every scientists that has ever studied the period of the pendulum had a pendulum in one hand and a watch measuring the period on the other; if we remove his watch, he will still be able to measure the length of the pendulum; but if we remove the watch and close the pendulum in a box, how is he going to say whether the period is changing or not? That's the situation of the 'objective passage of time': you can't measure a thing that you are using to measure.

A similar point is made by Dieks in his Physical Time and Experienced Time (2016): “the A-theory faces the notorious problem of making sense of the motion of the Now at all: ordinary motion consists in spatial variation as a function of the independent variable 'time', but this definition is unavailable in

71 Obviously, any kind of spatial measurement of his length is not related to our thought experiment, which is relative to temporal measures. It can help thinking of a metronome in a closed box, which is more similar to our situation: over time the length of the pendulum may change, causing a change in the period; but if the metronome is our only temporal measurement instrument, how could we ever be able to say that it is changed?

the case of motion of the now itself"[72]. The usual answer we find in literature is similar to Skow's: it make sense to say that time flows with respect to itself if we introduce a sort of 'supertime' *T*, serving as an independent variable. The A-theorists 'Now' is located at time t_1 at supertime T_1 and flows at the speed dt/dT (the introduction of primitive tense operators mimic the results of the supertime approach). In the case of the pendulum, we had the time of the period of the pendulum and a supertime, which was the 'real time' (time as measured by all the other clocks); but when it comes to 'real time' itself, what is going to play the role of this 'supertime'?

I believe, however, that this is just a sophisticate form of the 'dollar per dollar' argument: Skow and Phillips tried to compare different quantities to obtain a genuine rate, as if we compared dollars with euros or yen; but while this is possible for the period of a pendulum (a pendulum and a watch are like different currencies), it is not for the passing of time, since – again – it would be just as comparing dollars with dollars: not much more than the logical Law of Identity. One dollar will always be worth one dollar, and time will always pass one second per second. I still agree with Price: this is not a rate at all.

Our experience of the passage of time

72 Dolev & Roubach (2016), p. 18.

The most influential argument in favor of the objective present and objective flow of time rests, I think, on our own experience of time. It seems to us as if time flows, the argument runs, and surely the most reasonable explanation of this is that there is some genuine motion of time which we experience, or in which we partake. But even conceding for a moment that time really passed, we should ask ourselves: how would things seem if time didn't objectively flow? The physicist George Ellis strongly believes that in a Block Universe "time is an illusion: it does not 'roll on' [...] All past and future times are equally present"[73]. In his opinion, the Block view is unrealistic because "the irreversible flow of time is one of the dominant features of biology, as well as of the physics of complex interactions"[74]. But, as we have seen before, in a Block Universe events are always at temporal locations; events in series occur at different temporal locations; why should we have different experiences? In the words of Price: "things would seem this way, even if we ourselves were elements of a block universe"[75].

With a similar idea in his mind the American physicist James Hartle tried, in the paper *The Physics of 'Now'* (2005), to give a simplified model of our perception and understanding of concepts such as past, present and future. He analyzed the processing of external informations by a robot – an IGUS,

73 Ellis (2006), p. 1798.

74 Ellis (2006), p. 1798.

75 Price (1996), p. 15.

Information Gathering and Utilizing System –, complex enough to have (something that we can call) a sufficient distinction between past, present and future. Every time interval T*, the robot captures an image of the external environment, and stores it in its (say) four registers (R1, R2, R3 and R4). The new image is stored in register R1 (the robot's 'present'); after T*, a new image is stored in R1, and the old image shifts in R2; it is easy to see how R2, R3 and R4 constitute the robot's memory of the past. After four T*, all the registers are full: the new image is stored in R1, the other images shift of one position, and the image that was in R4 is erased (forgotten). The robot uses the images to build a simplified scheme of the external environment, to make predictions, take decisions, etc. The robot may then be said to predict the future, experience the present (in R1), remember the past (in R2, R3 and R4). There is a present at each instant along the robot's world line, consisting of its most recently acquired data about the external world. The flow, or passage, of time is then the motion of information into the registers.

The point is that it is very easy to describe in four-dimensional terms[76] this simplified model, without betraying any aspects of its 'subjective experience'. “The center of mass of a localized IGUS [the robot] describes a timelike world line in spacetime. At each point along the world line, any tangent to it lies inside the light cone so that the IGUS is moving at less than the speed of

76 “For simplicity we consider the flat spacetime of special relativity (Minkowski space). But with little change it could be a curved spacetime of general relativity”. Hartle (2005), p. 103.

light in any inertial frame"[77].

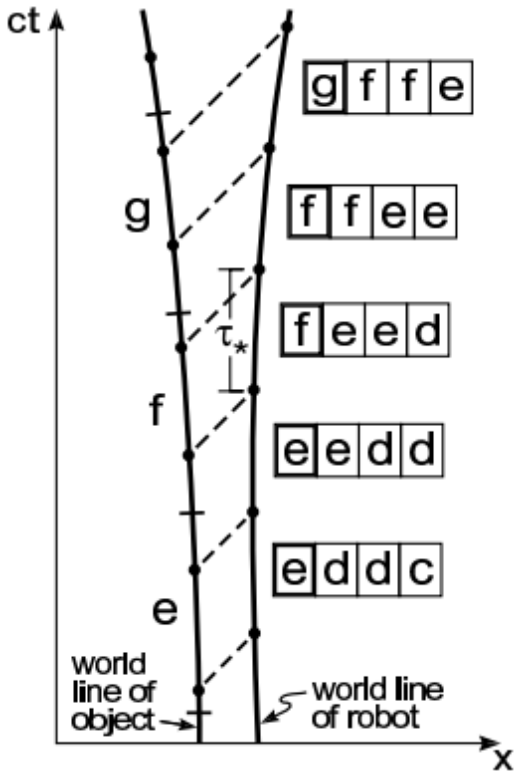


Fig. 3

In Fig. 3[78] the world lines of the robot and of an object that appears in its stored

77 Hartle (2005), p. 103.

78 Hartle (2005), p. 104.

images are represented. The contents of the four registers change after T* as described above. The most recently acquired image defines the (four-dimensional description of the) present. The object changes its shape (c, d, e, f, …) every T^ ≠ T*; the dotted lines indicate the light rays conveying the image of the object. What is crucial, then, is that "the present is not one instant along the robot's world line, much less a spacelike surface in spacetime. Rather, there is a 'now' for each instant along the robot's world line extending over proper time T*"[79]. The contents of R2, R3 and R4 constitute a four-dimensional representation of the past, while the contents of R1 (the boxes in bold) give a four-dimensional description of the robot's present consistent with special relativity. Thus, Hartle conclusion is that "there is no conflict between the four-dimensional reality of physics and the subjective past, present, and future of an IGUS. Indeed […] the subjective past, present, and future are four-dimensional notions. They are not properties of spacetime but of the history of a particular IGUS"[80].

For the reasons I described above, physics can not define an objective, global spacelike surface that stretches over the whole universe; this is well represented by the robot's 'present moment', which is not – in fact – a spacelike surface, but rather refers to the most recently acquired data; also, this notion is not restricted to one point of its world line, but it is valid for every point. There

79 Hartle (2005), p. 104.

80 Hartle (2005), p. 104.

is no reference whatsoever to a global surface that cuts the spacetime in future and past; on the contrary, the reference of the 'present moment' is directed solely to the last data acquired.

How could such a four-dimensional description be able to describe the 'common present' held by many observers separated in space? We all agree, despite Relativity, on what is happening 'now'! The answer is that we use an approximate notion of 'now', which is very useful given that we move slowly with respect to one another and that we are near. Our time scale of perception is short, compared to the time scales on which significant features of the environment vary. In the words of Hartle, "Alice and Bob can construct a common present, but it is a present that is local, inherently approximate, and contingent upon their relation to each other and their environment. This approximate common 'now' is not a surface in spacetime"[81].

As we have seen before, however, if two identical clocks near the surface of Earth are separated vertically by 1 km, in one million years the higher clock emits about three more second-ticks than the lower[82]. Two precise communicating robots (incorporating the mentioned clocks), living at such a vertical distance, would disagree on the duration of events: we can even imagine that a 'common present' is impossible for them, depending on how meticulous they decide to be.

81 Hartle (2005), p. 106.

82 Chou (2010), p. 1630.

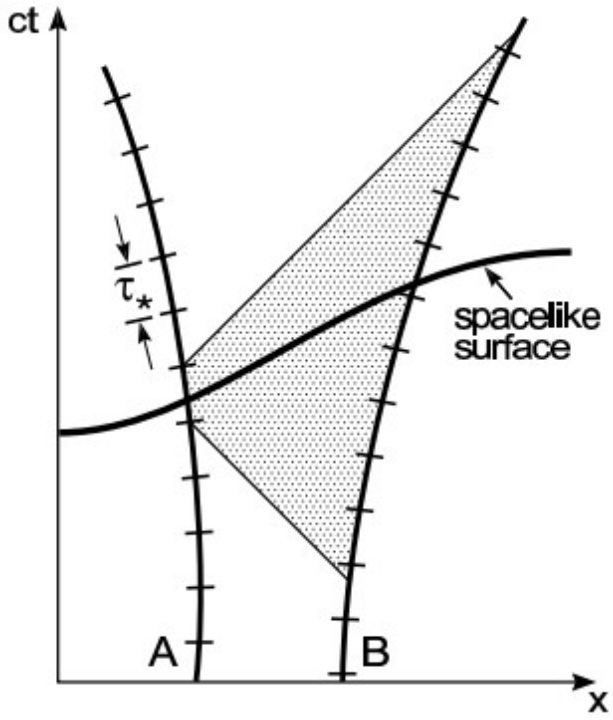


Fig. 4

Figure 4[83] shows the world lines in spacetime of A and B, two different robots; the intervals on the lines define their individual notions of 'now' (last acquired data). There are many possible spacelike surfaces that, intersecting the two world lines, would specify a notion of simultaneity between events on the lines: there is not a unique and precise correspondence between events, an objective common 'now', for the two robots. A common present would be defined by an identification of each interval on one world line with that on the other “at the same time' (to the accuracy T*), but Special Relativity allows many different

83 Hartle (2005), p. 105.

such identifications. The “ambiguity of the common present' depends on the distance that separate A and B. Consider this passage by Hartle:

> using the constant t surfaces of the inertial frame illustrated is one way to define a common present; but any other spacelike surface such as the one shown would do equally well. The range of ambiguity for intervals on B that could be said to be ‘at the same time’ as one interval on A is shown as a shaded region. The figure shows two robots separated by a distance […] over which the light travel time is longer than T*. In this situation the ambiguity in the definition of a common present is much larger than T*. However, if the distance between the robots is much smaller than cT*, and if their relative velocity is much less than c so this continues to be the case, then the ambiguity is much smaller than T*. An approximate common present can then be defined. [84]

That should make justice of our subjective perception and intuition of a common, shared, present that flows objectively; as we have seen, our intuitions and the physical-relativistic four-dimensional description can coexist.

Also, we can imagine to build different robots, that – having different 'storing rules' – could have different notions of past, present and future. To understand the concepts of past, present, and future, and how these concepts are used and shared by specific groups of IGUSes, it is necessary to understand how they employ such notions in the processing of information, how they are 'constructed' (then, how they evolved). We can even consider the creatures

84 Hartle (2005), p. 105.

living on earth as specific IGUSes that evolved 'slow with respect to light', so to have such a shared common present. To speak of a common present, however, we must agree on what we consider simultaneous: instinctively, we all agree that two events are simultaneous if they happen in the same moment; 'together', we sometimes say. The bell rang 'in the exact moment' I coughed; sure, maybe one of the two events occurred a nanosecond before the other, but it is just a matter of the imprecision of our perceptions: if we used scientific instruments, we could obtain a perfect judgment of simultaneity. The point which remains hidden in this first, common-sense description, is that it is not obvious what 'the same time' means: it's not a matter of precision of the instruments.

The standard historical reconstruction ascribes the problems that arose with simultaneity to Special and General Relativity: a mathematical form of the relativity of simultaneity was introduced by Lorentz back in 1892, and physically interpreted by Poincaré in 1900; however, there was still the 'ether': a preferred, fixed and objective frame of reference which could distinguish 'true time' from the 'apparent time' that moving observers recorded; when Einstein dismissed ether, there was no more ground for absolute simultaneity; even in a Newtonian world, however, the situation is more complicated than it seems: the problem is that every signal takes time to reach us.

In Special Relativity, then, we see the passage from a Newtonian spacetime to a Minkowski spacetime: we have only one number for the length

of the spacetime interval between spacetime points. Of course we can decompose this four-dimensional distance into spatial and temporal parts, but we need to choose a frame of reference to do that: Minkowski spacetime by itself doesn't have a preferred one on its own; that's why in relativity space and time intervals between any two given events are relative. This means that there cannot be a unique (absolute) time function that assigns time values to each spacetime point. In General Relativity, then, the geometrical structure of spacetime becomes dynamic: the geometrical properties are determined by a metrical field that interacts with the material content of the universe. Even more, there is no time *per se* and in itself[85].

The problem of simultaneity however, this is the point I am trying to make, has to do with experience, and it is a problem that was already there before Special and General Relativity: already in Newtonian physics it is possible that two events seem simultaneous even if they are not. Consider this quote from Yuval Dolev (2016):

> it makes no experiential difference which event is happening now on Alpha Centaury: but what about events happening in Tokyo, or the adjacent room? Can we seriously consider the denial that [...] during a concert the arms of the orchestra's violinists are moving together? [...] If there is any issue with the simultaneity of these pairs of events it is, to the contrary, due to the foundational role simultaneity plays in such cases. Far from not

85 See Dolev (2016), pp. 7-10.

> figuring in experience, simultaneity belongs to the perhaps ineffable substructure on which experience is conditioned. If we cannot say in such cases that the events in question are simultaneous the reason is that it is so obvious it is not clear what is being asserted. […] Early science revealed that light travels at a finite velocity […]. And special relativity brought with it the discovery that simultaneity is a frame-dependent relationship. Neither of these two complications, however, undercut the basic role simultaneity has in our understanding of things[86].

I agree with Dolev, but his words should serve as an introductory warning: it is crucial to clarify what do we mean when we speak of simultaneity. We could intend that two events are simultaneous if we *perceive* them as happening together; we could mean that two events are simultaneous if they *happen* together (without any reference to our fallible perception); finally, we could say that the two previous options collapse in the same (if two events are simultaneous, we perceive them as simultaneous). The last option is clearly not very promising; we must decide, then, between the other two: either simultaneity is about our perception (in our eyes) or it is about reality itself (in the world). I am not claiming that it is wrong to use the notion of simultaneity differently in different contexts (common-sensically in our usual life, and scientifically when doing science): I am simply interested in outlining the difference between the two because I am convinced that it is a philosophically

86 Dolev (2016), p. 28.

interesting distinction, as I will try to show.

In rejecting Dieks' Block Universe, Dolev clearly aims at a simultaneity 'in the world': no matter what the two physical complications ('early science', 'special relativity') tell us about perceiving simultaneity, we still need such a notion; but that, paradoxically, is very remote from experience.

Insisting on our pre-philosophic intuition of simultaneity is not useful: everyone would concede that during a concert the arms of the orchestra's violinists are moving together, but what's the point? Does it demonstrate that simultaneity is part of our experience? What it shows, in my opinion, is just that there are situations in which we rightly ignore the finite velocity of the signals that are reaching our senses; we also think that the image of the violinist and the sound of his violin reach us in the same moment, but whoever has ever seen a thunder in his life knows that this is, strictly speaking, false (if he knows that the two events originate from the same cause). I don't see any "basic role in our understanding of things": there are situation in which we are inclined to ignore the finite velocity of the signals reaching our senses, and situations in which we are not: Dolev itself describes profusely such situations: "it is possible that two events will seem to be simultaneous even though they are not"[87]. If it is possible that two events *seem* simultaneous event though they *are* not, that means two things for his account of the universe:

87 Dolev (2016), p. 26.

- experience is not our guide when we speak of simultaneity (why referring to the violins?);
- there must be some absolute reference thanks to which events can be simultaneous even if they don't appear so.

As regards the first point, my opinion is that Dolev has in mind a 'sentiment' of simultaneity, the primitive intuition of the 'here-now' that Stein suggested: but while it is obvious that the violins are playing simultaneously (here and now), the error – as I already said – comes when we extend cosmically this intuition, far away from the observer. It is Dolev himself, besides, that points out the possible errors of our experience when judging about simultaneity; and I find it obvious that someone who has in mind simultaneity 'in the world itself' will discredit perceptual simultaneity. The experience of simultaneity is important to him just to be reminded that we have this sentiment, this pre-philosophic intuition: but when it comes to seriously consider the experience of simultaneity, he himself rejects it as misleading.

As regards the second point we should resign ourselves to the fact that an absolute reference to ground 'simultaneity in the world' is missing. Every attempt in this direction is not really different from the stubborn defense of the ether conducted by many twentieth-century physicists. Besides, to look for an absolute reference means, in my opinion, that the deepest lesson of relativity has not been entirely absorbed.

I'm convinced that our experience of simultaneity is always, at least instinctively, an experience of 'here-now'; when we look at the sun, we rarely think: “that's just its past image, I wonder how does it really look like *now*”. This primitive approach (*everything I see is happening now*) has worked very well until the last century, when we started to have practically to do with great distances, and we had to take into consideration – even in our everyday life, think to the GPS – relativistic effects. That's why we successfully think that during a hockey match the forward and the defenseman are pocking at the puck at the same time: the distance between our experience and the events is small: seeing the two events at the same time could be very successfully considered as the two events happened at the same time; in this case, our experience is the only frame of reference for the simultaneity of the two events (the gap between our experience and the events themselves is negligible). But when we look at the light of two different stars, our experience must be integrated by the knowledge of the distance of the two stars.

If our best physics tells us that there is not a unique and absolute way to decide which moment is 'now' for the two distant stars, why should it be a betray of our primitive sentiment of simultaneity? It is the opposite: it is our will to extend cosmically our primitive notion of 'here-now' that is the true betrayal of our experience. In a certain sense, even our primordial intuition was grounded in an operational definition: everything I see is happening now; it is an implicit convention, not an absolute truth. A considerable part of the

relativistic revolution consists in the understanding that behind our natural intuition of simultaneity there is a primitive, conventional operational definition (think of Einstein famous thought experiment about the man traveling on the train and the man standing on the platform, looking their watches); a corollary of this procedure in a Minkowski universe is the relativity of simultaneity.

Asking, as Dolev does, what is happening 'now' on Mars, is not nonsensical *per se*; it becomes nonsensical if we insist that there must be only one true 'now', because it would mean that we are ignoring the operational definition of simultaneity and, ultimately, the way our experience really works. Dolev insists that "according to Dieks [i.e. in a Block Universe] simultaneity does not need to be part of our conception of reality"[88]: as I hope to have shown, this is not true. It is only a certain version of simultaneity (absolute) that is not part of our world: but who says it should be? Our experience of simultaneity doesn't need that. In the words of Yuval Dolev, "rather than treat experience as confused and inferior we should regard it as, in general, accurate, trustworthy and crucial for science"[89].

Dolev has recently (2016) argued that it is impossible to experientially vindicate the Block Universe: in his opinion, the Eternalist account hopelessly clashes with experience. Dennis Dieks, on the other hand, is convinced that in

88 Dolev (2016), p. 27.

89 Dolev & Roubach (2016), p. 32.

the Block Universe a certain notion of becoming (happening in succession of the events) could sustain passage as it figures in our experience; and this will be the subject of the next chapter.

3. Temporal experience in a Block Universe

Aim and structure of the chapter

Presentists often claim that the B-theory cannot account for the irreducibly temporal nature of our psychological attitudes, but this is incorrect. B-theorists can defend temporal versions of well-known theories of 'indexical', or 'de se', attitudes. In this chapter I will try to show that experience does not favour Presentism; this reminds me, in fact, of the story that it is sometimes told about Wittgenstein, when a student protested that it looks as the Sun is going round the Earth, and not the opposite: "what would it look like", the philosopher supposedly answered, "if it had looked as if the *earth* were *rotating*?". When we closely analyse an hypothetical life in a Block Universe, that is the moral of the story, we discover that it would look like exactly as ours; I will consider

arguments regarding the 'robust passage of time', as well as the notion of 'presentness', to claim that.

Experience and the 'robust' passage

To state that in the Block Universe time does not pass, however, might be misleading; it could make the theory sound like a mystical doctrine. After all, the view is certainly compatible with the claim that clocks indicate different hours at different times: it is probably better to say then, in presenting the theory, that the Block Universe envisages the passage of time, but only an 'anemic' one[90]: the theory lacks a 'robust' passage. It is possible, in fact, to claim that the passage of time requires something more than hand clocks indicating different numbers at different times: Broad, for example, spoke of an 'Absolute Becoming'. Those who are interested in defending a robust passage of time are those who defend 'Substantivalist-like' versions of the passage, as I have described in the previous chapter. This 'robust, Substantivalist-like' passage, however, might be intended in two, distinguished, meanings: it might be taken

90 See Skow (2015), ch. 2.

as the flow of a river, something that moves everything in it: the motion of time in the future-direction is the responsible for my aging; on the other hand, however, the robust passage of time might be intended as our motion through time: events are just there, and we come across them. What does our experience tell us about it?

In their article *Temporal experience, temporal passage, and the cognitive sciences* (2015), Baron et al. consider the following argument:

(1) We have experiences as of time robustly passing.
(2) If we have experiences as of time robustly passing, then any reasonable explanation for this relies on the robust passage of time being an objective feature of reality.
(3) Hence, the robust passage of time is an objective feature of reality.

This is intended to be an argument from experience, understood as an inference to the best explanation. Typically – but not always – Presentists and Possibilists accept the inference, while Eternalists don't: 'robust passage' is the kind of passage that involves the gaining and shedding of a metaphysical privilege ('being present', or 'presentness')[91]: the Block Universe excludes that. Obviously

91 Consider Deng (2013), p. 713: "time's passing just consists in there being a succession of times […] Let's call this the tenseless passage move. […] The kind of passage the B-theory includes is anemic (i.e. bloodless, lifeless, not the real thing). The debate is about whether there is passage of a robust kind. That's the kind that requires metaphysical privilege to be transferred from time to time. The B-theory excludes

enough, there could be a temporal succession in the Block Universe, but it's not a 'robust' passage, in that all 'nows' are ontologically on a par. BU (Block Universe) theorists have two main possibilities to reject the inference: Veridicalism if they deny (1), Illusionism if we deny (2)[92]. Following the distinction as set by Natalja Deng in her article *On explaining why time seems to pass*[93], Veridicalists argue that we do not perceive the passage of time, intended in a robust sense; Illusionists think that even if it's true that we experience the robust passage of time, this doesn't mean that indeed time robustly passes, or flows. An illusionist could also think to an inference of this kind:

(4) We have experiences of the Sun traveling around Earth.

(5) If we have experiences of the Sun traveling around Earth, then any reasonable explanation for this relies on the revolution of the Sun around Earth being an objective feature of reality.

(6) Hence, the Sun traveling around Earth is an objective feature of reality.

Obviously, the Illusionists would have a point in stating that the inference is weak; but when we consider our perceptions, how could we justify the temporal experiences? In particular, what do we mean when we say that we are seeing an object 'now'? Do we only perceive things as existing, or as presently

that".

92 See Deng (2013 B).

93 Deng (2013 B).

existing? Kriegel, in his 2015 *Experiencing the present*, argues in favor of a felt temporal orientation: in perceiving rain, one perceives it as present. But this may be due to our present-tensed beliefs that things are happening: we perceive the rain, and we also believe it to be present. Otherwise, a different, more 'Kantian' approach would be to think that this is only a matter of how we perceive. Deng call it the attitudinal view: in fearing a snake, we could say that we experience something dangerous; but the danger is part of the attitude of fearing, not of its object (what we perceive); similarly, we don't really perceive the 'presentness' of things, but perceive things with the attitude of thinking of them as present.

But then, why does the notion of a 'robust passage' seem so intuitively appealing? And what do we experience if not 'presentness'? The answer, a good one in my opinion, could be represented by a sophistication of the simplistic model sketched by Hartle, as described in the previous chapter.

A suggesting idea, put forward by Eric Olson, tries to take into account our strong pre-philosophical intuition of the peculiarity, the uniqueness and the metaphysical relevance of the present:

> Why does the present seem different from other times? [...] When you ponder the nature of the present, this temporal asymmetry gives the illusion that the time of your pondering is unique. If there were a causal asymmetery in space, it would mislead us in the same way. If it were a law of nature that light never

> travelled southwards, everything to the south of you would appear bright during daylight hours, while to the north you would see only darkness. Your latitude would appear unique: it would seem to be the boundary between the illuminated part of the earth and the dark part. If you moved north, the darkness would seem to recede, so that more of the earth became bright. The boundary would appear to move, as if the dawn were following you. But this would all be an illusion. In reality there would be no boundary between the bright latitudes and the dark ones. They would all be equally bright. Nor would the overall pattern of illumination change as you moved. It is the same with the present.[94]

What I like about this thought experiment is that the peculiar temporal asimmetry is seen as the cause of the common belief of the metaphysical uniqueness of present. We can't move through time in the way we move through space; even more significantly, we can't stay still. That's a kind of enforced motion through time that we seem to be prone to imagining. Suppose for a moment that space were one-dimensional as time. Consider x as a space coordinate, and t as a time coordinate. The two following space-time route are possible:

A. (x1, t1), (x2, t2), (x3, t3), (x4 t4), (x5 t5)

B. (x1, t1), (x2, t2), (x3, t3), (x2, t4), (x1, t5);

94 Olson (2009), p. 446.

but this last one is not[95]:

C. (x1, t1), (x2, t2), (x3, t3), (x4, t2), (x5, t1).

Recall Olson's thought experiment: I believe that the sort of passivity that we experience with respect to time lies at the basis of the common intuition of 'presentness'; at each time, that time seems special to the point that we are sometimes inclined to attribute metaphysical significance to it. It is a sort of 'edge phenomenology': since we always experience the last data acquired, we typically feel as if we are always at the edge of reality.

Many philosophers believe that such experiences tell us something crucial about our universe; Yuval Dolev, for example, maintains that the standard understanding of the block universe reveals a gap between experience and reality: reality is frozen and static, while experience is dynamic and tensed; in his opinion, Dieks' attempt to reconcile the Eternalist account with experience fails. Dieks, just as in Deng's arguments described above, denies that we experience tense or passage of time in a robust sense. Dolev starts by noting that the events that make up reality are experienced as themselves tensed: as being past, present and future: "it is not that tense is something that predicates

95 At least not in our typical experiences: if we consider time travel it is actually possible; since we are talking about phenomenology – and not the physical or metaphysical possibility of time travel, however, it seems reasonable to rule out (C).

them *as they are experienced* , rather, it is something that predicates them as they are in themselves, or at least that is how we experience them to be, as tensed irrespective of experience. [...] we experience tense as a property of events and not merely of how events are experienced"[96].

Consider a person who thinks about a past visit to Paris: Dolev maintains that, while in his ruminations the visit itself is past (the event carries 'the property of pastness'), on Dieks' phenomenological account pastness is no more than a sentiment accompanying the remembering, instead of a feature of the event. Consider this quote by Dolev:

> In the block universe the only temporal relations between events, e.g., between Max's visit to Paris and his reminiscing about that visit are relations of succession. [...] Indeed, according to B-theorists Max's visit to Paris is not past, since nothing is past (or present or future). But Max apprehends it as past. So Max's remembering the visit involves a kind of *misrepresentation* . The event is not past, yet it is apprehended as past.[97]

I find this passage quite confused: when Max is 42, his travel to Paris when he was 41 is truly, objectively past. It is absolutely not true that in a Block Universe 'the event is not past': the succession of the events is objectively true. The real point is that Max is speaking from a particular, specific point of view: when he is

96 Dolev & Roubach (2016), p. 29.

97 Dolev & Roubach (2016), p. 30.

42 and says that his visit is past, the 'pastness' of the event is not just a sentiment; the point is that the Eternalist account doesn't privilege any specific point of view. Every event is past under a certain point of view and future under another. We don't have a reason, when thinking about the passage of time, to privilege Max's point of view; but Max has a reason to privilege his own point of view when speaking about his experience.

The fact that Dolev is confusing the two different levels becomes even clearer when considering another of his statements:

> Not only are tenseless beliefs about succession insufficient practically (knowing that the train to Boston leaves 15 min after the train to NY will not get us to either train on time if we do not know what time it is *now*), they cannot capture the omnipresent and hyper-significant *emotive* role of tense, e.g., the massive emotive shift we undergo during the few minutes in the course of which a future bungee jump becomes present and then past.[98]

In the Block Universe, it doesn't make sense to ask in general “what time is it now?”, since there is not any privileged now; but that absolutely doesn't mean that, when considering a specific person waiting for a train, that person doesn't know what's the time from his particular point of view (frame of reference). A similar case can be made for the 'emotive role of tense': when we consider a specific person and the succession of his events, why shouldn't he feel an

98 Dolev & Roubach (2016), p. 30.

emotive shift while waiting for bungee jumping in a Block Universe? Dolev insists: “it doesn’t matter to us that a bungee jump is (always was, always will be) before lunch. It matters to us whether it is before or after this *present* moment. Being past (or future) is, phenomenologically more than merely being before (or after) something”[99]. I find it obvious that for me it is important if I already have done the jump or not: the point is whether is it important for a general description of the universe: if the gaining and shedding of an independent, objective metaphysical privilege (presentness) is involved.

The Eternalist can always tell if, at a particular moment, the jump was in the past or in the future of a chosen 'present' moment. There are two possible descriptions: one is generic (Eternalist description of the universe), the other is partial (every particular description of every observer at every moment); Dolev's task would be to show why the two are incompatible. Why should a relational succession of events negate, for a particular person, the possibility of experiencing those events as happening presently, and then fading in his past?

Experience, of course, is a solid guide for our thinking about time: but we should always be aware that there is the risk of mistaking our experience for an objective reality. Dolev is confusing, in my opinion, the fact that, for a particular observer that chooses a particular reference frame (a global foliation), it is possible to distinguish every event as being objectively past, present or future[100]

99 Dolev & Roubach (2016), pp. 30-31.

100 While relativistic physics tell us that there is an objective temporal order only for objects at timelike distance (if A is in the causal past of B).

with the fact that none of such a system is truly privileged, and concludes: “these tensed properties belong to the events in question, not our apprehension of them”[101].

Dieks, on the other hand, is convinced that 'becoming' is nothing but the happening of events in their temporal order: “all actual events, experiences and intuitions must be there in the block representation, exactly at the spacetime position where they actually occur. So there cannot be any conflict between experience and the block universe”[102]. Making the experience our central concern, we should ask: how could the objective motion of the 'now' appear in our temporal experience? The concepts of objective passage and becoming that are central in the A-theory do not make contact with anything we know about how natural processes work. The question, then, is how primitive tenses could help to explain our intuitions: it doesn't seem to be true that experience privileges A-theories: we don't feel time as robustly passing.

Moreover, not only is it obscure how the A-picture of time could play a role in the explanation of our experience of passage, but some A-type intuitions (as the global now) seem to be wrong. Obviously, A-theorists could always give priority to the intuition, and maintaining that physics doesn't tell everything that there is to say about time and simultaneity but, as I showed, it is controversial which is the primitive intuition about simultaneity.

101 Dolev & Roubach (2016), p. 33.

102 Dieks (2006), p. 169.

Dieks believes that change is easily describable in a Block Universe: the motion of a particle could be successfully represented by a curve in spacetime, and that worldline is characterized by different values of physical quantities along it. When we consider a person instead of a particle, these different values of physical quantities involve much more abstract procedures, such as 'waiting for' something, feeling something (as present), remembering something, etc.

Dieks' conclusion, then, is that time is entirely relational; the central question that remains is whether our experience can be accommodated in this four-dimensional B-picture[103]. Our sensation to be bound to go into the future, which is probably responsible for the usual image of a 'flow', is due to the impossibility to stop the motion of the objects, i.e. the succession of events. For the perception of a flow to be intelligible we don't need a real flow in physical reality over and above the variation in time, accommodated by the B-series. This B-type account does not refer, as I pointed out before, to any specific privileged instant in time. As Dieks notes,

> all B-type explanations apply tenselessly, in this case to each and every 'now' (specious present) along the worldline of a sentient being. But combined with the fact that these specious presents are perceived as undivided wholes, this

103 In his words: "the B-picture comprises all earlier-later relations, all causal links, and all processes of change and becoming in the sense that it specifies what properties are instantiated at each stage of every process. But could this 'static' representation of change, in which there is no moving Now, also be sufficient to explain our direct awareness of change?" Dolev & Roubach (2016), p. 13.

> account can in principle reproduce exactly what we know from direct experience: namely that we always find ourselves in a now characterized by a perceived quality of transience. […] The addition to this picture of an objective, mind independent preferred Now that is really shifting in reality would not increase our possibilities of explanation.[104]

B-type explanations of the perceived flow of time apply equally to each point along the worldline of an organism that experiences time, without singling out any preferred now. This account of the perceived flow tells us that we always experience passage when there is change (in the B-sense); our experience reflects this change.

It seems that many recent A-accounts proposed[105] are based on the very legitimate wish of supporting our intuition and experience against some mathematical and physical descriptions of reality that do not take them into account. But if the Block Universe could, and I think it can, make sense of our tensed belief and the change we experience, and it is even physically more accurate, why insisting with an A-account, intuitive but – in the end – very difficult to support? Change, within the B-account, is variation in the values of quantities during time; we experience temporal change if there is change in time, even though this objective change does not involve the gaining and shedding of a metaphysical privilege ('presentness'): in this sense our feeling of

104 Dolev & Roubach (2016), p. 17.

105 See for example Markosian (2004) or Skow (2012).

the passing of time is veridical; the next chapter is dedicated to the defense and the extension of this argument.

4. The specious present and the models of temporal perception: a proposal

Aim and structure of the chapter

What is the Specious Present? Which is its duration? And why, ultimately, do we need it to figure in our phenomenological account of temporal perception? In this chapter, after introducing the role of the Specious Present in the main models that account for our phenomenological present, and after considering the deflationary objection by Dennet (that the debate relies on the fallacy of the 'Cartesian Theatre of Mind': the idea that it is meaningful to ask where and when an experience becomes conscious), I claim – thanks to a spatial analogy – that there could be a good criterion to distinguish between a present

experience and a past experience, that there are good reasons to sustain the 'Specious Present' view (while 'snapshots' are in no sense part of our phenomenological life), and that there could be a precise way to define the nature – and to measure the duration – of the Specious Present; as I will clarify, our capability and possibility to act and react are central in this perspective.

The main argument of the chapter, then, will be that the Specious Present is the temporal window (which varies, in clock-time, from situation to situation, depending on a number of factors such as our concentration, the task we are required to perform, our physical state, etc.) in which we give one response, one reaction to the external stimuli; a particular stress will be put on the role of anticipation.

What is the Specious Present

Some philosophers argue that consciousness is confined to a momentary interval: that we never experience change, motion, succession; others think that consciousness is in fact momentary, but we are nevertheless directly aware of such features; others, finally, claim that consciousness is itself extended in time:

that even if technically 'the present' is a point on the time line, 'our present' – the phenomenological one – is extended: a *Specious Present*, a time duration – psychological or objective – in which our perceptions are 'felt-as-present', with the typical immediacy associated.

The term is traditionally associated to the American philosopher and psychologist William James: like the empiricists before him, he thought that the mind's ideas come from experience; since we have ideas of motion and duration, the reasoning goes, we should be able to indicate the experience that originates these ideas. Absorbing the results of the experimental psychology done in Germany in the second half of the 19th Century, and framing it in terms of a philosophical idea that he himself credited to Clay, James made very famous the claim that the phenomenological 'now' is not point-like, but extends over a little interval of time.

After the term was born, three main sources of ambiguity have bewildered the debate over the nature of the Specious Present:

I) the interpretation of 'present' (which present are we talking about?);
II) the difficulty of drawing a clear-cut distinction between three different phenomenological presents;
III) an insufficient clarification of whether the Specious Present refers to a duration in objective, clock time, a duration in phenomenological, psychological time, or both.

The first thing to do, then, is to state precisely what do we talk about when we talk about 'the present' (a mathematical present, a neurophysiological present, or a phenomenological one?); then, once clarified that we are talking about a phenomenological present, we must specify which phenomenological present we are referring to (the period of time to which we have a vivid cognitive access, or the – much shorter – window through which we are directly aware of change?); finally, once specified that we are considering the small duration in which change can be experienced as a whole, we should break down the nature of this duration: is it only subjective, or is it an objective, clock-time duration? Let me elaborate these three points, in turns.

The first point has a a preliminary, obvious side: if we don't clearly define what we mean with expressions such as 'present', it is possible that we speak of different things. 'Now' could mean 'in this exact moment' if I'm ordering someone to drop a gun, but could also mean 'in the last years' if I'm telling an old friend where I have been living lately. The example is extreme, but we do indeed common-sensically use such terms in very different contexts, and we usually don't bother to clearly define what do we mean. The first step, as philosophers, would be to clarify the meaning of the expression; but that's where traditionally some problems emerged. If we want to claim that an 'extended present' is part of our phenomenological life, we should clarify and define what do we mean by 'present': in particular, a clear difference should be

drawn between a *mathematical* present, a *phenomenological* present and a *neurophysiological* one. The first is the answer to the question 'what is the present in principle?'; the second is the answer to the question 'what, how and why do we experience something as present?'; the third is the answer to the question 'how does our brain process temporal inputs?' (without minding the fact that we actually experience something or not).

The mathematical present

In any duration there is a before and an after: the real, objective present must be durationless: with that in mind, Thomas Reid, underlining the contradiction between strict philosophical truths and common sense, claimed that in our ordinary life we allow 'the present' to indicate a duration, rather than – as it should be – a point-like moment. Such arguments are born from a clear mathematical *milieu*, a way of reasoning which in James opinion wasn't able to capture the immediate experience of change, persistence and motion. He tried, then, to differentiate what he meant by 'present' from this strict, objective, mathematical description of a point on the temporal line: he had in mind a

phenomenological present, a duration which is perceived both as present and as temporally extended. This phenomenological present is 'specious' in that, unlike the objective present, it is an interval and not a durationless instant.

The phenomenological present

We see a ball falling, bouncing and rising within the confines of a phenomenological Specious Present. But if we experience two events as occurring 'now', shouldn't we experience them as simultaneous? This is the problem that makes so many philosophers doubt that we can directly perceive motion; however, the demarcation between a mathematical present and a phenomenological one should give the space required to answer this reasonable worry: there is a sense in which all the contents of a Specious Present possess a sort of 'phenomenal presence'. A genuine experience of succession is obtained when we experience multiple auditory stimuli together but in succession – they are 'diachronically co-conscious'. The limits of the Specious Present, then, are determined by the extent of this co-consciousness: what I propose in this chapter is a precise way to think of (and measure) it.

The neurophysiological present

Finally, there is a much more recent deviation from the 'original' phenomenological meaning of the Specious Present: neuroscientists – or philosophers with a neuroscience interest – gradually started to focus on the way our brains process temporal inputs, without minding the fact that we actually experience something or not. Perhaps, the arguments usually go[106], there is a discrepancy between the actual characteristics of our experience and our beliefs about these characteristics. We always talk as we see things move, but maybe we are wrong. Perhaps our experience is entirely motion-free, made of snapshots, and we simply fail to see the gaps between them; many experiments seem to support such a neurophysiological interpretation.

Our temporal experience, however, can't in any sense be reduced to the functioning of the brain: what we are looking for is an account capable of explaining the cognitive temporal experience, and not merely pointing at some neurons in the prefrontal cortex and assign them the status of 'true experiences', opposed to our flawed believes. The point is made even clearer by Owen Flanagan: “suppose that neuroscientists discover that consciousness is in fact realised like a movie reel consisting of individual images, the moments of consciousness […]. It is not clear that this would or should have any impact

106 Daniel Dennet famously argued something of this sort in multiple works.

upon what we say about how consciousness seems from a first-person point of view"[107]. I take it to be reasonable to assume that we can perceptually experience temporally extended happenings, such as motions. A succession of very fast present temporal experiences – snapshots – doesn't seem to me related in any sense to our phenomenology of time. We are directly aware of intervals of time as wholes: as Barry Dainton puts it, "our experience of change is just as immediate as our experience of shape or colour"[108].

Tim Crane, in his very influential *Elements of Mind* (2001), distinguishes between a psychological study, concerned with the mechanisms of perception, an epistemological study, concerned with the ways in which perception can be knowledge, and a phenomenological study, concerned with the ways in which different states of mind differ from each other. As he puts it,

> it is important to emphasize that this approach [the phenomenological one] is not in conflict with any scientific or psychological investigation of perception; rather than asking about how the mechanisms of perception work, it asks what are the most general features of anything we could reasonably call 'perception' or 'perceptual experience' [...] I claim that these problems are independent of the psychological/scientific questions about perception, and also of the epistemological questions. The problems are phenomenological: they arise from reflection upon perception as we

107 Flanagan (1998), p. 89.

108 Dainton (2000), p. 115

experience it. [109]

I think he has a point in differentiating the areas: in what follows, some arguments will be put forward to show that there are at least some points where the neurophysiological approach and the phenomenological approach must diverge, and it becomes particularly clear when we consider the neurophysiological literature about this topic.

Visual stimuli have to trigger the light-sensitive cells in our retinas, these cells have to transmit signals through the optical nerve, these signals have to be processed by the visual centres of the brain: all these operations, obviously, take time; 'if we measure that time', the neurophysiological reasoning goes, 'we discover the extension of the Specious Present'. But when we actually try to do so, there is a clear sensation that something is missing. Libet (1993, 2004) presented results coming from the direct stimulation of the brain during neurosurgical operations, suggesting that it typically takes around half a second for a stimulus to work its way through to consciousness. However, these results have also been criticized (Churchland 1981; Gomes 1998). Pockett (2002, 2003) and Efron (1967) suggest that stimuli can produce basic sensations in as little as 50–80 msec: that would be the time required for neural processing of simple auditory and visual stimuli reaching the brain to result in experience. Koch (2004) estimates that a quarter of a second is typically needed to properly

109 Crane (2001), p. 130.

recognize an object. My point is that the real difficulty is not in the measure itself, but in what we mean by 'resulting in experience': very different measures result from different kinds of 'experiences': if we are asked to press a button in the exact moment that we see something on a screen, we perform the task in a certain time; but if we are required to press the button only when the object is green, the time required will be much more; if we are required, finally, to press the button when the object is a green square (and not a green circle, for example), we will need even more time. I could go on, but it should be clear that until we don't resolve the philosophical questions about the phenomenology of our experience of the present, physiological measures can't tell us very much, since these scientists simply don't talk of the same thing. Pockett and Efron's results derive from a very minimalist notion of experience (basic sensations reaching our brain), while Koch's result come from the idea that we have a legitimate experience only when we 'recognize an object'.

The research for the 'exact moment' at which external data become conscious experiences looks destined to fail: as all the different results listed above should show, there is a process of growing consciousness. The role of a philosophical investigation, then, is that of developing a model in which the boundaries of our present experience could be defined; neurophysiology is an essential guide, but it can't be the only instrument in our hand: we would remain with all the very different experimental results in our hands, and no criteria to choose among them. What I will propose in this final chapter, then, is

exactly this: a philosophical model to choose a certain set of experimental results over others.

Which phenomenological present?

What we should claim, in speaking of the Specious Present, is then that we are interested in describing the phenomenological present, the extended 'presentness' we experience; this is related to the second point: once clarified that we are talking about a phenomenological present, we must specify which phenomenological present we are referring to – the period of time to which we have a vivid cognitive access, or the (much shorter) window through which we are directly aware of change? Even when we look at the philosophical literature concerning the Specious Present, we find an incredible amount of different durations, from 300milliseconds to 12seconds; such an incredible difference could be explained only by admitting that not everyone is speaking of the same thing.

James himself, although mentioning the time lapse necessary to hear two auditory stimuli in succession, chooses to characterize the Specious Present as "the *maximal extent of our immediate distinct consciousness for successive*

impressions"[110] – which is 12 seconds, as he learned from the experiments of Wundt and Dietze. These experiments were meant to measure the capability to recall accurately an auditory sequence: something which is manifestly different from the direct experience of motion. James, then, thought of the Specious Present as the period of time to which we have a vivid cognitive access, while in the following literature a narrower meaning started to settle, attesting the Specious Present around 2/3 seconds.

One of the most influential figures, in this sense, is Ernst Pöppel: studying the reproduction of visual and auditory stimuli of different durations, Pöppel observed a mechanism which appeared to integrate successive events within a temporal window of approximately 2 to 3 seconds: subjects typically mentally structure auditory sequences, experiencing successive beats as a unit; but "it turns out that two beats cannot lie further apart than 2 to 3 seconds to allow subjective accentuation. Beyond this interval, it is no longer possible to mentally connect the second to the first beat, i.e., the first beat has then already disappeared into a perceptually not directly available past […]. It is as if the brain asks, 'What is new in the world?' every 3 seconds or so"[111]; analogously Elzbieta Szelag, analyzing a series of experiments in which sequences of metronome beats at different frequencies have been presented to different subjects, commented: "the results indicate an integration process, i.e.,

110 James (1890), p. 612

111 Pöppel (1997), p. 114.

temporally separated successive beats are mentally connected with each other into larger perceptual units [...]. It appears that the sensory systems can hold information up to the temporal limit of approximately 3s"[112]. While, however, everyone admits that these results are meaningful – that 2/3 seconds cycles are relevant to our brain processes – nowadays there are also philosophers of time who tend to think that a much shorter figure is a more plausible candidate for the extended feeling of presentness (while in three seconds we typically lose the feeling of direct awareness[113]).

Such authors (Dainton, Prosser, Lockwood, Strawson, Hoerl, Le Poidevin, etc.), interpret the Specious Present as the maximum duration in which change or succession can be experienced as a whole, object of a single mental act. If we take the Specious Present to be the window through which we are directly aware of change and persistence, then it is plausible to suppose that it is of the order of about a second. Even between them, however, there are differences[114] in the estimates of such a 'Specious Present': what we are trying to capture is the phenomenological immediacy associated with our complex perceptions; not an easy task, indeed. What I am proposing here is a model capable of

112 Szelag (1997), p. 122.

113 Dainton (2017, 7.1): "Clap your hands three times, leaving about a second between each clap; when the third clap takes place, are you still directly aware of the first?".

114 Dainton (2000: 171), for example, opts for half a second or less; Lockwood suggests 'a second or a second and a half' (2005). Strawson goes the other way, and suggests a figure of around 300msec (2009): there is not a widespread consense.

establishing a definite meaning for this 'phenomenological immediacy'.

The duration of the Specious Present

As for the third point (the relationship between phenomenal and objective durations), when someone maintains that the duration of the Specious Present is about one second, what does the claim amount to? Seconds are typically a measure of objective, clock time; what is the relation between this and our temporal phenomenology? Could the Specious Present be merely psychological, experiential, while not mirrored in any sense by the physiology and the mechanisms of our brain? And, secondly, is the question important, or even meaningful? I will examine this matter in depth in the third paragraph, where I will introduce the different models of our temporal phenomenology and the different 'Specious Presents' that figure in them.

Concluding, then, the presentation of the problems regarding the definition itself of the Specious Present served not only as a preliminary move to clarify the object of my research, but also to make the reader appreciate the novelty of my suggestion: what I will propose here, in fact, is meant to be a clear, definite and measurable way to think of the Specious Present.

Three models of our temporal phenomenology...plus one

All the differentiations emerged in the previous paragraph intersect in the debate regarding the models of our temporal phenomenology. The three main accounts of our experience of time and presentness are the Cinematic Model, the Retentional Model and the Extentional Model.

Cinematists reject the idea of a Specious Present. They maintain that our temporal phenomenology is a succession of momentary states of consciousness, and that is why a Cinematist would probably support a mathematical, 'in principle' version of the present: the reason to do so is that in our phenomenology we always know what comes first and what second; then, the best model to describe our temporal awareness is one in which there are momentary states of consciousness (with momentary I mean *physiologically* momentary: about 30ms, time under which we can't distinguish the order of two stimuli[115]).

Of course, it can be argued that our present experience is in fact momentary, but there are some reasons that explain why it doesn't seem so (we

115 Stimuli of around 1ms need to be separated from one another by in interval of around 30 msec if they are to be perceived as a succession – a result which holds across sensory modalities. Stimuli which are separated by shorter intervals are not perceived as distinct.

remember the immediate past, or there is a retention of the immediate past in the present experience, etc.). However, it must be noted that the notion of the instantaneous present is inspired by a mathematical way of thinking. The problem for the Cinematist, then, is that having in mind the different positions that an object occupied in time and having the cognitive understanding that it moved does not coincide with directly perceiving it moving[116].

It is to save this last intuition that the two other models of temporal experience were born – Retentionalism and Extentionalism. These models are realists about phenomenal temporality: change, succession and persistence can be directly perceived or apprehended[117]. Both Extensional and Retentional theorists agree that a temporal spread of contents can be apprehended as a unity. Not only, then, simultaneous contents can be experienced together, but even contents that are successive; contents which are apprehended as unified in this way belong to a single Specious Present.

How is it possible, however, to perceive an extended present? When we hear three close auditory tones, we seem to hear the musical phrase as present, and yet we also hear the notes as successive, and therefore as extending over an interval. How could a succession of elements – elements which are experienced

116 Obviously enough, many refined arguments could be put forward by the Cinematist to defend her position: all I'm trying to do here, however, is to present the main models of our temporal phenomenology to show how the Specious Present is present in them.

117 There is the possibility to build a 'Cinematist Realist' model, but virtually every philosopher of time who defends Cinematism is an Anti-realist about phenomenal temporality.

as *before* and *after* – also be experienced as present *in toto*? Retentionalist and Extentionalist, while accepting both the idea of an extended Specious Present, give different accounts of this apparent paradox.

Retentionalists agree that our experiences occur within episodes of consciousness which lack an objective, clock-time extension: but these episodes, they maintain, are composed by an immediate experience *and* a representation (or retention) of the recent past; the result is that the contents of these experiences represent temporally extended intervals. The stream of consciousness, then, is composed of succession of momentary states – just as the Cinematists claim: the difference, however, is that the experience of these momentary states is one of duration. The confinement to a momentary present is seen by Retentionalists as a condition for contents to be experienced together: phenomenal unity needs the simultaneous presentation of contents to a single momentary awareness.

As already Kant famously suggested, point-like visual experiences could be accompanied by representations of recently experienced visual contents; Brentano, later, argued something along this line; James himself – in the *Principles*, at least – seems to subscribe this way of thinking of the Specious Present: a temporal window which does not extend, however, over an interval of ordinary time; the Retentionalist's Specious Present possesses only an experienced extension. The temporal properties of the objects we perceive, in fact, need not coincide with the temporal properties of the presentations

(episodes of awareness) in which we apprehend them: the properties of a representation (that which is doing the representing) and the content of that representation (what is represented) can differ dramatically. Objects which are objectively past can be presented in our present experience; there is no obvious reason why the temporal properties of a mental representation need to entirely coincide with the temporal properties of the content carried by it. A distinction is usually drawn between the *content* and the *vehicle* of a representation: the former is that which is being represented, the latter is the entity which carries the representation; experiences can represent temporal features, but they also themselves possess temporal features[118].

Retentionalists, however, are typically accused to have invented "nothing but a new word"[119]: what is a retention, and in what differs from a memory? If we choose the other horn of the dilemma, however – clearly differentiating memories and retentions – we risk to multiply the experiences: shouldn't we hear-as-present a sound in all the different point-like Specious Presents that contain it?

We can think of retentions as past-directed mental representations,

118 Divergences about the content / vehicle distinction lie at the heart of the debate between Extensionalists and Retentionalists. Retentionalists believe that experiences which present us with succession are able to disguise their true temporal properties: a succession of presentations, they claim, can amount to a presentation of succession only if the contents are presented to a single, momentary act of apprehension. The Extensional approach carries no such implications: on this view, a Specious Present present is itself temporally extended. Here vehicle and content have the same temporal properties.

119 Dainton (2000), p. 155.

automatically associated with every experience; unlike memories, they do not unfold over time, and they are more vivid than ordinary memories. Modal Retentionalists, such as Husserl and Brentano (at least in his later writings), argue that there are temporal modes of consciousness: objects can be apprehended as past to differing degrees: contents appear under different 'temporal modes of presentation', some fully-present, other 'past', other 'more past', and so on. Non-Modal Retentionalists, on the other hand, maintain that all the contents within a Specious Present appear equally present – the only difference with Extentionalists being the relationship with clock-time. Both versions encounter some possible objections: Non-Modal Retentionalists lack a convincing way to describe the uniqueness and distinctiveness of our experiences: it seems we should hear the same notes many times. Modal Retentionalists, on the other hand, have the difficult task to explain, if retentions are unlike immediate experiences, how and why we have direct perceptions of change and motion: the experience of change would be somehow different from that of a shape or a colour.

Extentionalists, finally, claim that the Specious Present is not merely experiential, but extends over clock-time; they hold that the atomic unit of our perception is an extended period of time: we have an experience of succession because we directly experience the succession. The Retentionalist doctrine that diachronic phenomenal unity can only exist in strictly momentary states of consciousness is rejected, in favour of a more 'natural' model of temporal

awareness: change and persistence are incorporated in our experience in a quite straightforward way, since our stream of consciousness is composed of a succession of extended chunks of experience. The Extentionalists' Specious Present is itself temporally extended, and its parts succeed one another in time in just the way they seem to: our experiences extend over a period of real time, in a way which (almost infallibly) matches the phenomenal period it presents.

Realists about phenomenal temporality, such as Extentionalists and Retentionalists, explain the immediacy associated with experiences of change, persistence, succession, in a quite direct way; their problem however, one that Cinematists don't seem to face, is to explain the fact that the succession experienced in the extended present doesn't collapse in a temporal *unicum*: how is it possible, for contents that are all experienced as present, to be presented to our conscious life as in succession rather than simultaneously? How come that not only o*bjectively*, but even *phenomenologically*, there is a before and an after in a Specious Present? Shouldn't the extended present be experienced as a totul-simul?

How, moreover, should we divide one extended present from another? While it was obvious in the Cinematist case (every single perception, such as a note, is one present experience), it is not so obvious in the Retentionalist or Extentionalist case: how long are these extended present experiences, and how they succeed one another without giving the feeling of a continuous hiccup (which is a stream, of course, but a very unappealing one)? There is a double

dilemma, then, for the realist about phenomenal temporality: how could it be that within these wholes there is a succession, a before and an after? And how could it be that each experienced whole seamlessly gives way to the next?

In the previous chapter I have sketched a possible way out from this double dilemma; my aim here, however, is just to point out the role of the Specious Present in the main models that describe our temporal phenomenology. The three I have presented so far are traditionally considered the main ones; recently, however, a fourth model has been attracting more and more attention.

A fourth way

In the last years, another anti-realist alternative to the 'Specious Present' has been put forward. Rather than straightforwardly denying that we directly experience motion in the manner of Reid, the antirealist stance would be more plausible if a credible explanation as to *why* we believe we directly perceive change, succession, persistence etc. if in fact we do not. A route, suggested among others by Koch (2004) and particularly Prosser (2016), is the *Dynamic Snapshot Theory*, which is supposed to be an improved version of the Cinematic

model; in particular, it is claimed that motion can be directly experienced despite the 'unextendedness' of the atomic content of our experience. It is true that experience consists of a series of perceptual snapshots, one after the other (note that this could be a continuous series - we don't have to imagine experience as fragmented into countable snapshots): these snapshots, however, are not bound to be static, since even if experience has an instantaneous content, it isn't true – it is argued – that this cannot include something that can be detected over a non-instantaneous interval. The Dynamic Snapshot Theory posits a vector-like feature that durationless contents could possess: "think", as Koch suggests, "of motion painted onto each snapshot"[120].

Put it differently, even an instantaneous experience could contain vector rates of change, being then an immobile experience *of* something moving. Even if it is technically true that the atomic content of our experience (again: around 30ms, the threshold for a definite experience[121]) is a snapshot, that doesn't mean that that content has to be static. Extended processes, then, have instantaneous parts, even if the nature of such parts depends on what occurs at other time. Consider Prosser (2017):

> 'Moving' is a state that something can be in at an instant, even though it can

120 Koch (2004), p. 264.

121 See for example Wittmann (2011). Technically, then, even our point-like experience is extended, but we can understand in what sense it is a snapshot: it is like a photography in which the shutter remains open for 30ms; everything that happens in that window of time is simultaneous for us.

only be in that state by virtue of being in other places at other times"[122].

> It would, of course, take time for the brain to *detect* motion, for example by comparing patterns of retinal stimulation at different times. But it clearly does not follow from this that the resulting experience must have a temporally extended content. The necessary properties of the stimulus can differ from those of the resulting experience.[123]

When we have an experience of motion, we are in a state that has a representational content that determines the character of the experience: put it simply, when we have a visual experience of a car going at 50mph, we don't only see different photographs (static snapshots); the acquisition of the last snapshots define an experience of motion, so that in every snapshot we see, so to speak, a photograph *of a car moving*; our memory integrates the visual experience with the crucial vector of motion.

What could remain uncovered, at this point, is the difference between our experience in front of the three hands of a clock: even if slowly, the hour hand is moving as well: shouldn't motion be painted in my visual experience of the hour hand of the clock? Why, then, is my experience of the second hand different from that of the hour hand? Prosser's answer (2016) is that the motion is too slow to trigger the systems that detect motion. It makes perfect sense, indeed:

122 Prosser (2017), p. 150.

123 Prosser (2017), p. 153.

but are we still talking about a *phenomenological* present? The functioning of our brain and our visual system can tell us some extraordinarily interesting facts, but it will never tell us if our *phenomenological* present is extended or not. The key point here, one that neuroscience simply ignores, is the relationship between 'memory of the recent past' and 'direct experience of the present': the two things collapse in the neuroscientific account, which is simply directed at the unpacking of the physiological processes.

When we look at the question from a cognitive point of view, however, we clearly see that – for there to be a 'dynamic snapshot' – there must be *some kind* of retention of information: *something* must tell us that motion is painted on the present snapshot. While the traditional three models try to describe that *something*, it seems to me that the Dynamic Snapshot View – coming from a neurophysiological *milieu* – fails to consider the phenomenological present, and simply does not answer the main questions, which are 'how is structured our experience of the present?', 'what are the roles of memory and anticipation in it?', 'how long can the feeling of presentness last?'; I take it to be an argument against the so-called neuro-phenomenological approach too.

At this point, however, one could start doubting that these are meaningful questions. How is our phenomenological introspection supposed to give support to one or the other model if every model have the same capability to distinguish between different kind of experiences – simply, with different names? I agree with Prosser (2016): “it is not really clear that we must choose

between a theory that combines instantaneous contents with a short-term memory and a theory according to which there is a short-lived Specious Present"[124]. Will we be ever able to understand if our visual experience of a car going at 50mph results either from a comparison between the last snapshot and the preceding snapshots (short-term memory), or from an extended experience, or from a retention of the past experiences? But even more radically: is there a difference at all?

All the theories tell the same story about information processing: some preceding data must be combined with the last acquired data in order to produce our experience of motion. The two 'snapshot models' (Static and Dynamic) have the problem of explaining how can we directly and vividly perceive a change, which never figures in a singular snapshot; but, in turn, the two 'extended models' (Retentionalist and Extentionalist) have the problem of explaining how can there be a before and an after in a co-conscious present: if A is experienced as 'before' B, then they are not part of the same phenomenological present; but if A is experienced in the same phenomenological present, how come we know that it was before?

Of course, every model has a specific line of defense[125], but it doesn't

124 Prosser (2016), p. 136.

125 Two interesting possible arguments, for example, are sketched in Hoerl (2013). Retentionalists, it is claimed, should demarcate the difference between a relational and a representational experience: if experience is intended relationally, then the objects around us are directly constituents of the experience, which is bound to be confined in a mathematical point-like present; if experience is intended

seem that any of them contain elements capable of explaining phenomenological features that the other models can't: they simply tell the same story with different names; as I'm going to show in the next paragraph, it is very possible that the fallacy of the 'Cartesian Theatre model of the human mind' has a central role in it.

A difficulty for the phenomenological dispute

Daniel Dennet (1991) argued that the differences between the models described above concern the point at which external data become conscious[126]**:**

representationally, instead, it is defined by the way it represents things, so that even if some features of 'the-things-themselves' (the vehicle) are technically past, in our representational experience (the content) they are put together. The other horn of the distinction could come in help of the Extentionalist: while it is true that represented order doesn't necessarily coincide with the order of representations, an Extentionalist that endorses a relational view of experience doesn't have the problem of being sure that the content and the vehicle always get along with each other. Our experience, then, includes in the Extentionalist view not merely individual entities succeeding, but the temporal-extended succession of those individual entities itself; a single experience is already temporal.

126 This is Dennett's position, not mine: I think that the debate between the different models is genuine; simply, there are many ways to formulate it. I present Dennett's objection, however, because it gives an

where to put the line between memory and present consciousness. If, for example, it is a temporal extension of 500ms that, all together, is presented by our ocular nerves to our brain – let me say consciousness – so that we get to know the motion happened in front of us in the last 500ms, we have a direct experience of a temporal extended atom – and Extentionalists and Retentionalists are right; if, on the other hand, what happens is that different atoms – say, snapshots taken every 30ms – are presented in succession to our brain, we have a direct experience of a snapshot taken in the last 30ms by our eyes, and a short-term memory of the preceding snapshots – and Cinematists are right. It is very questionable that it is possible to have such a strong capacity of introspection to decide which of the two models is better; however, there are many philosophers that are not directly interested in the practical possibility of an empirical or phenomenological test; sometimes, it could just be a matter of which model is simpler, more economical, etc.

This is perfectly understandable, but in this case there is the strong suspicion that there isn't even the possibility to set up such a debate, since it seems to presuppose the fallacy of the 'Cartesian Theatre of the mind': the idea that there is a place and a moment in which the mere perceptual external data become conscious experience – as if a 'consciousness homunculus' lived inside our head and watched the data presented to him. Besides reasonable worries of an infinite regress, the point is that our conscious experience is much more

interesting insight in what I have to say in the following.

diversified and complex than this and, most of all, there isn't a finish line – a modern 'pineal gland', so to speak.

Dennett's claim, then, is that there is no sharp dividing line between memory and experience: he showed how, in cases for example of so-called 'backward masking' (experiments that underline the role of anticipation in our experience of the present – more on that later in this chapter), the project of trying to ascertain the temporal microstructure of consciousness, in an appealing but mistaken neo-Cartesian conception of experience, is misconceived. This conception entails that, for any given subject, there is always a precise answer to the question 'what is currently appearing on the stage of your consciousness?'. Dennett's arguments, it has been claimed[127], have a 'verificationist slant', relying as they do on the principle that if there isn't evidence that P obtains or not, there is not fact of the matter as to whether or not P obtains. In my opinion, however, Dennett's argument is not merely a verificationist statement: his argument is, more radically, that there simply isn't a point at which an external data become a conscious experience, or a conscious experience become a memory; it is not only difficult or even impossible to discover: there is not such a region in our brain.

There isn't any fully conceptualised experience, happening at a definite time, as opposed to the process of obtaining it: it is the process itself that constitutes our experience in its different degrees of consciousness. Our

127 See for example Dainton (2017).

cognition of the external world begins in the eye, in the ears, in the fingers; there is a process of rising consciousness, of course: but it would be vane to look for a precise locus where 'we' come to meet an external phenomenon. It is pointless to try to distinguish between the real consciousness, the real person, the one that 'knows' and 'understands', and the mere senses and nerves that, like tools and wires, bring information to it, and, even more, to ask ourselves when the 'real self' come to know something, when it is directly perceiving it or only remembering.

If the difference between the models, then, consist simply in where the finish line should be placed, the non-existence of a finish line should deflate the whole debate. There is, of course, a phenomenal character associated to our processing of the external input, but – as Prosser puts it – "we need not think that there is an answer to the question: '*when* is it like that for the subject?' […] finer-grained questions about what the subject was experiencing at some specific time simply have no good answers"[128].

A real, human experience takes time to be formed: within this extension of time, it is not clear at all what it is a direct perception and what a short-term memory: it is not even clear if there is, or should be, such a distinction. At which moment a conscious experience ends and become a memory? As Husserl taught, the theoretical/mathematical description of the present as a point on the temporal line should not be confused with our phenomenological present,

128 Prosser (2016), p. 154.

which consists in a cognitive blend of the last apprehended data and – fact that is often underestimated – an anticipation of the future: our understanding of the external environment is almost totally focused on our capability to intervene on it, or escape from it: everything, in our spatial and temporal basic observation of the world, is centered in our possibility to act.

This line of thought, however, sheds a new light on the debate about the Specious Present. If the dispute is merely about the point at which a visual information become a conscious experience and then become a memory, as we have seen, there isn't much hope. But if we intended it, instead, as a debate about the experiential 'here-now' – much nearer to our phenomenological and I would even say practical life – there is the possibility of a new dawn for it. In this case, the debate would be a genuine dispute about the best model to account for a certain phenomenal intuition, which has even a definite physiological counterpart.

The debate in a new vest

Think of *what* are our senses, and *why* we have them: animals are the structured organisms that can move. The evolutionary reason of the functional

and integrated role of our eyes, our ears, our nervous system, is to permit us to move in, intervene on or escape from the external environment or other animals. Our cognition of space and time is not unrelated to this logic: it would be an error to think of us as organisms with such and such characteristics, such and such temporal and spatial phenomenology, which are then 'lowered' in a particular world, as Adam and Eve, shaped in Eden and then fallen on Earth. It is the world itself that shaped us and our evolution in it: our understanding of it, and the possibility to act, to move, is a central part of the project.

The mechanism that underlies our capability to grab objects is a perfect example of that: before the discovery of brain neurons, it was natural to think that when we have an object in front of us – 20 centimeters or 2 meters away, it doesn't matter – we can decide to take it or not; if we decide to take it, our brain tells our arm to move and take it – or, if it is too far, tells our body to walk there and our arm to take it. Nowadays, however, we know that what really happens is much more complex[129]: there are motor neurons firing for every object in our proximity, and an inhibitory mechanism blocking the communication between them and the nerves; the motor neurons firing are not only continuously repeating to the arm 'how to' coordinate to grab the object: they are literally telling it to take it; it is only thanks to the inhibiting role of the motor cortex – region of the cerebral cortex in the frontal lobe – that we don't actually take

129 See Rizzolatti et al. (1996), Rizzolatti et al. (2000), Sinigaglia (2008), Sinigaglia (2008 B).

every object within our reach. Experiments[130] with the fMRI demonstrated how, if we move the object out of our possibility of reach, the motor neurons stop firing; of course we can still see the object and think 'I want to take it': but it is a completely different cognitive action. The curious fact is that, if we give the person a stick, with which she could reach the object, the neurons start to fire again.

The moral of the story is that our possibility to directly and immediately intervene on the external environment is something that makes a great difference for us: it is the way we are built; we have senses *for* that reason. The 'here-now', related to our particular possibilities (how long are our arms, if we carry a stick or not, ecc.), is central in our way to experience the world. At first glance, we could have thought that there isn't a clear sense in which an object is 'here': whether it is 20cm or 2 meters far, it is always 'here' in some sense. A debate regarding the exact point at which an object is 'spatially present' for us would have been meaningless: there wasn't a point at which the object changed its status and became present, we could have argued. But we aren't Adam and Eve: the 'spatial here', intended as 'what I can directly and immediately act on', 'what I can reach', makes a great difference for us, both from a neurophysiological and a phenomenological point of view. There is an extended spatial 'here' clearly distinguished and individuated, and the debate regarding different models trying to describe the situation would be meaningful. I think

130 See for example Bear et al. (1996).

that a similar point could be made in the temporal case; before turning to the 'temporal version' of this reasoning, however, let me push the argument a little further.

Think of the famous *phi phenomenon* (the phenomenon of apparent motion): if two immobile spots of light on a screen are turned on and off at certain moments (generally the interstimulus interval must be around 30 frames per second), we see – instead of the two dots – one dot moving; Dainton's conclusion is that "evidently our brains are more than happy to supply us with experiences of motion at the least opportunity"[131]; but why? Again, I think that the reason is that we have been built by nature: if we see, in the sky or in a field, a black dot disappearing and very briefly another black dot appears 30 centimeters at its left, the best explanation of that is that something is moving – and not that the first dot simply vanished in the sky, while another one miraculously came into existence; as Hoerl puts it, "temporal features of reality can enter into the content of perception in the light of the immediate implications they possess for actions"[132]; a similar point is also made by Morgan (2003): "we are not normally conscious of a blur in moving objects: nor do we see them frozen in space-time. Instead, we see recognisable objects in motion"[133]. For the same reason, we see the leaves of the trees of the same green in the morning and in the evening – while, in reality, the two perceived colors

131 Dainton (2017 B), par. 1.

132 Hoerl (2013), p. 162.

133 Morgan (2003), p. 61.

are totally different, and mostly *not* green. All our conscious perceptions contribute to a successful and homogeneous experience of the world we live in: our brain continuously tries to connect every perception to familiar experiences, experiences that it knows how to react to: that is why it is so easy to artificially create perceptual illusions in a laboratory using vanishing and appearing objects. My point, then, is that we can't think of our experiences without thinking of the way we are built: I agree with Hoerl when he claims that "in perception [...] features of reality are represented in the light of their immediate relevance for the subject's actions"[134].

The possibility to act on particular objects or events is something that makes a great difference for our experience of the external world; just as in the spatial case there is a distinct sense in which the present is the 'reachable here', I believe there are good arguments to claim that in the temporal case 'the present' is the extension of time in which we can react, form a statement, intervene on what's happening without the sensation that it is already 'too late'; some thought experiments will help me to clarify this point. All the arguments given before, about the complexity and the variegation of our temporal experience, stand: but there are also good arguments to claim that the dispute could rise again in this new vest.

If the debate consists in trying to demarcate a direct experience from a memory, there isn't much hope; but maybe we can think of our

134 Hoerl (2013), p. 168.

phenomenological present as the extended 'time of reaction'. Consider this example made by Prosser (2016):

> Imagine hearing *do* followed by, say, ten seconds of silence during which you continue to think of what you heard, followed by *re* [...]. I predict that you will have no difficulty in detecting that the first note was followed by a note approximately one tone higher. [...] Now imagine the sequence *do–re* played faster, taking only a fraction of a second. Is there any phenomenological difference beyond the fact that the sequence takes less time?[135]

Until we look for a phenomenological difference in terms of 'memory Vs experience' we won't find one, since it isn't possible to clearly distinguish these two elements of our cognitive life – since there isn't a pure experiential datum being presented to the mind; but if we, differently, set the debate as concerning the 'now-here' of our phenomenological life, it is possible to discern a demarcation, and the result – as I am going to show in the following – will favor the 'extended present accounts' of our temporal phenomenology (Retentionalism and Extentionalism), instead of the 'snapshots ones' (Cinematism or Dynamic Snapshot view); a Specious Present, that is to say, seems to be an indispensable part of our temporal phenomenology.

Think of the experiment described by Prosser; his conclusion was that there wasn't any clear phenomenological difference, besides the platitude that

135 Prosser (2017), p. 154.

one sequence took more time. Imagine that this time the experimenter asks the subject to express a preference, an 'aesthetic judgment' so to speak, between the notes of a piano: 'pick your favorite note', could be the assignment. In the first case (the note *do* followed by ten seconds of silence and then a *re*) the subject has the time to react, to consider how much she likes the note *do*; some seconds later she hears the note *re* and consider it, in turn; obviously, she has not much difficulty in acknowledging that the second note was higher. But maybe the point is another: when she hears the second note, she has already judged the first one, which then 'feel past'; from a phenomenological point of view, there is a clear, distinct sense in which the first note is past: the subject already reacted to it. In the second example envisaged by Prosser, on the contrary (the sequence *do–re* played faster, taking only a fraction of a second), we don't have the physiological or phenomenological temporal space to 'act' on the first note and then on the second: of course we know that one preceded the other, but in a clear sense we are presented with two notes and we have to make two judgments in one 'session'. We could even have some difficulty in aesthetically judging the two experiences separately (try to do it: you will have the clear phenomenological impression that you are asked to judge two things all at once). It is legitimate to have different intuitions on that, and maybe I represent an exception, but it seems to me that there is a very definite sense in which the two notes played in a fraction of a second 'feel equally present' and in which the two notes played ten seconds apart don't. I take it that William James

had in mind something along these lines when he spoke, in the *Principles*, of a 'duration-block':

> we do not first feel one end and then feel the other after it, and from the perception of the succession infer an interval of time between, but we seem to feel the interval of time as a whole, with its two ends embedded in it.[136]

In this sense we could recover Dainton's intuition of a 'co-conscious present': a temporal extension that allow us to have only one reaction; realizing to having heard two close sounds is something different from realizing to having heard one sound and nine seconds later realizing to having heard another sound, one tone higher. Co-consciousness, then, would be defined by the ratio between the temporal distance of the two sounds and our capability to react. The rate would define then an extended 'now', just as in the spatial case the length of our arms and the distance of the object (which together determine our possibility to reach something) define our extended 'here'.

A new grasp on the concept of co-consciousness would be thus reached: two very close sounds are co-conscious, in this sense, because we can have only one reaction. We don't have the time to notice that there has been a sound, and then another one: we have an experience of two close sounds. When there are many close sounds going on for many seconds, instead – for example, think of a

136 James (1890), p. 610.

piano song – what we do is finding a rhythm of many extended presents. Of course we can generate cases in which it is difficult to distinguish between one experience of two sounds or two distinct experiences, but I don't see it as a troublesome problem. Most of the times, there is a clear phenomenological sense in which something is 'present' or 'here' in this specified sense: I take it to be a promising approach to understand what the Specious Present is.

It is always possible to mathematically break down an experience and arrive at an atomic snapshot: but this is not what we have in mind when we think of an analysis of our temporal experience; we look for a model that is capable to translate phenomenological differences, instead of merely chronometric. When the Extentionalist claims that our present experience is extended, she have – or should have – in mind a notion of co-consciousness as now described. It is now the Cinematists (Static or Dynamic) that should explain in which sense our experience is point-like; besides the particular merits, however, what I wanted to show is that there is a way to reinstate the debate. Once we eliminate the Cartesian Theatre, that is to say, there still is something interesting to debate: how is our present like, why is it like that, what kind of introspection experiments could we generate to support one model instead of the other, ecc.

The question of whether our temporal experience has a temporally extended content should be rejected, rather than answered, only if we think of it as the search of a definite moment at which information 'enters' or 'leaves'

consciousness, or at which conscious experience starts and ends; if we, instead, consider the temporal content of our experience as the 'now' with which we have a particular 'interactive' role, just as the spatial 'here' that our motor neurons are so good at individuating, then the question becomes interesting again. We could ask which is the extension of our present temporal experience just as we can ask which is the extension of our reachable here; in this case, some sort of Specious Present seems an indispensable element of our temporal phenomenology. It is only *after* such a philosophical analysis that a neurophysiologist can define the nature of the Specious Present and measure its duration.

For the reasons listed above, I suggested (in the previous chapter) that it is probable that the extension of the experienced present varies, depending on the speed of anticipation, action and reaction of an organism: a sloth, I argued, has a longer experiential 'now' than us, while an hummingbird has a shorter one. Similar arguments can be extended to intraspecific differences (young / old age) or even to situations that dramatically influence our capabilities, such as car accidents or the use of powerful drugs: it is well-known the fact that in such circumstances subjects describe time as accelerating or slowing down; it is very probable that what they refer to is precisely the experiential now, modified along the lines of the alteration of their capability and speed of anticipation, action and reaction.

The role of anticipation

I want to stress the (often neglected) role of anticipation in the picture: the arguments about the phenomenological present usually concern our sensations, short-term memory and long-term memory. As Husserl rightly underlined, however, even the anticipation of the near-to-come future has an important role in the definition of our temporal present window; let me make an example, before turning to some experimental data.

When we see a soccer ball coming from a very long distance, we don't immediately feel the need to protect our face. It's really far, we might think: not only in space, but even in time (for example, the ball could be one hundred meters away, and at that velocity about ten seconds away); it comes a moment, however, in which we say to ourselves “either we move *now* or the ball is hitting our face”. What the example is meant to show is that there is a great temporal window in which the ball is far, in space and time, and we don't feel the need to take action, because it somehow concerns the 'us' of the future; however, it comes a moment in which there is a change of perspective, and the ball concerns the 'us' of the present, and we feel the need to react.

It is exactly talking of action and reaction that the role of anticipation came to the surface in such a strong way: not only, in fact, we react to something

that we have seen, or touched, or smelled – that is gone, happened, in the past –, but we also act according to what we want to do in the future. It is only keeping in mind the combination of these two elements, past and future, reaction and action, that we can understand the window of the present: and not only because they always coexist in that window, but even and more significantly because one influence the other, as some very interesting experimental results confirm.

One that I find significant, in this context, and that stresses the role of anticipation in our temporal experience of the present, is the phenomenon described by psychologists as 'backward masking': when, for example, we listen to music, the phenomenal character of our experience of a note is affected by the properties of the notes immediately prior to that note *and* after that note. Laurie Paul (2014) comments:

> How can we 'see into the future' in this way? What is the basis for this experience of foreshadowing? There is debate about the mechanism involved in the cognitive processing of these temporally clustered events. Some have argued that it is a predictive effect [...]. Others have argued that it is what is called a 'postdictive effect' [...]. What matters here is that these foreshadowing and filling-in psychological effects are empirically well-documented, even if their source is not fully understood.[137]

What I find particularly meaningful, in this context, is that this 'backward

137 Paul (2014), p. 186.

masking effect' obtains only when the stimuli are close to one another: I see it as an experimental confirmation of the fact that there is indeed a phenomenological difference in the two sequences of notes 'do-re' beyond the mere fact that one sequence takes less time; when two notes are experienced in the same Specious Present, we have one reaction to two sounds; the second sound could even affect the phenomenal character of the first one, while the same thing does not happen when two sounds are more temporally separated. A similar reasoning can be extended to the other senses[138].

Possible counterarguments and answers

A possible counterargument is that if we don't specify the length of the specious present, we haven't actually brought about any kind of improvement to the debate. A stronger version of that could be, then, that if we don't specify the length of the specious present, we don't have arguments to maintain its existence, not even from a phenomenological point of view: *affirmanti incumbit probatio*, it could be said. If we are interested in maintaining the importance of

138 See for example Saccuzzo et al. (1996), Herzog et al. (2013) for the studies of visual backward masking in schizophrenic patients.

the specious present, we should be prepared to answer the very reasonable worries about its extension. If the specious present is our phenomenological window of presentness, how extended is that window? Is it something that should be decided by a phenomenological investigation, or is it the field of neurophysiological studies?

In this chapter I have emphasized the relevance and the independence of phenomenological considerations; I want to insist on that even answering the worries concerning the existence of an upper temporal limit (the maximum temporal extension of the specious present) – while for the lower limit it is easy to say that under the time required for an external stimulus to reach our brain there can't be a specious present. How long is the specious present, then?

It depends on the situation. Just as the reachable here for us depends on a number of factors, such as the length of our arms, the fact that we carry a stick, the fact that our arms are tied, our 'reachable now', the window of presentness, depends on our disposition and ability to act and react in a particular moment. In the 'soccer ball example' described above, there is a moment in which the ball enters our window of presentness, that depends on our concentration, our ability to dodge a ball, etc. My claim is that this is not only clear from a phenomenological point of view ('either I move *now* or I am being hit'), but it would show a definite result even from a neurophysiological point of view – just as in the spatial case. While, then, I don't think we can indicate a general clock-time duration for the specious present in general, I do think that in every

specific situation we could have a definite result both from a phenomenological and from a neurophysiological point of view.

Conclusions

In the first paragraph, I have argued that there are four models trying to describe what is our phenomenological present and how it is formed: Cinematism, Retentionalism, Extentionalism and the Dynamic Snapshot View. In the second paragraph, I have argued that the differences between them disappear once we address the fallacy of the 'Cartesian Theatre of the mind': there isn't a point at which a visual perception becomes a direct conscious experience or at which becomes a memory, of which we are simply aware; in this sense, if the differences between the four models of our phenomenal temporality concern only the point of demarcation between memory and experience, the dispute should be deflated. In the third paragraph, however, I have tried to tackle the debate from a different angle: if we concentrate on our possibility to react, a different intuition of what is 'here' or 'now' could be gained. Physiological and phenomenological arguments have been put forward to explain in what sense the debate could rise in a new vest, and why our

present is extended. Finally, I have considered in the most charitable way some possible counterarguments, and see if the model described was able to answer them.

5. Feeling the passing of time: an illusion?

Aim and the structure of the chapter

In this chapter I push forward the discussion regarding Illusionism and Veridicalism: after analyzing a recent proposal to consider the sensation of the passage of time as a phenomenal modifier of our experience, I illustrate an alternative view, in line with what I have claimed so far: to explain the dynamic phenomenal character of our experience we don't need a specific sensation of passage: we always experience passage when there are phenomenal characters of change, or persistence, or duration, etc.; we do not need a supplementary experience of the passage of time to be distinguished from the experience of such features.

The phenomenal modifier view

In a recent paper (*Feeling the passing of time*[139]), Giuliano Torrengo elaborates the 'phenomenal modifier view' about time, which states that the actual feeling of the passage of time – to be distinguished from the common-sense belief or intuition that time is passing – must be understood as a modifier of the content of experience: even if there is a feature of the phenomenal character of our experience that corresponds to the 'what it is like' of the feeling that time passes[140], the sensation of passage does not correspond to a representational element of our experience. The feeling of the passing of time is understood, instead, as a primitive modifier of our phenomenology, just as a blurred or a vivid vision modify our visual experience. When I look at my desk, I experience features of the perception, such as blurriness[141], that I don't attribute to the object but that needs an object to be experienced; I can't look at 'blurriness *per se*', but I can experience it while having another visual experience, and this modification of my experience corresponds to the 'what it is like' of the feeling of blurriness.

139 Torrengo (2017).

140 This is Torrengo's “First Working Hypothesis”.

141 See Boghossian & Velleman (1989).

Analogously, Torrengo argues, every time that we have a perception – even a perception of a static object – there is a 'temporal phenomenal modifier' that gives us an experience that feels as if the world is dynamic, even if our perception didn't have a representational content of the passage of time; this modification lies at the basis of our belief that time passes.

At first glance, this solution could seem *ad hoc*; however, it is possible to argue that the notion of 'phenomenal modifier' is able to dissolve the suspects of circularity; this notion is mostly utilized in debates regarding theories of consciousness, or more precisely the so-called 'transparency of experience': the question is whether experience is non-representational and subjective or representational (transparent) of a mind-independent world. While on the one side there are those who maintain that experience is entirely subjective in character, that it involves awareness of mind-dependent (non physical) entities – sense-data which are not misunderstood with 'objects in the world', subjective qualities (qualia, sensational properties), on the other side there are those who claim that our experience is the presentation of a mind-independent world and nothing else: to experience the world to be a certain way is to represent it to be that way.

There is of course a whole spectrum of intermediate positions: there are those, for example, who – considering our own reflection on appearances – suggest that our experience relates us to the mind-independent world, but not

in a non-representational manner[142]. In this debate the notion of 'phenomenal modifier' is crucial: objections to the transparency thesis typically take the form of counterexamples, mental features of our experiences that can be introspected but are non-representational. Ned Block[143], for example, holds that we can introspect non-intentional and non-functional items such as qualia in a very different sense from that of sensory qualities: if one's vision is blurry, one could introspect the blurriness as well as the visual representata. The standard representationalist move is to insist that the visual experience represents the relevant part of the world as being blurry, but non-representationalists reply that there is a difference between seeing an object as being blurry and blurrily seeing a non-blurry object. In the former case, as when looking at a blurry painting, vision represents the blurred edges as such; in the latter, vision provides less information, and fails to represent the sharp edges. Tye[144] distinguishes similarly, but maybe even more emblematically, between nonveridically seeing a sharp object as blurry, which experience incorrectly represents as fuzzy, and seeing the same object blurrily, which experience doesn't represent so.

These cases are made to refute intentionalism: if something is seen without being represented in the content of experience, representationalism

142 See for example Martin (2002).

143 Block (1995).

144 See Tye (2003).

(or at least, some version of it) is false. When we unfocus our eyes, the argument goes, we see objects blurrily without being able to see them as actually being blurry: experience cannot be adequately described solely in terms of its intentional content, since there are areas of our visual field that become blurry without anything being represented to us as doing so. Something more than the apparent objects of perception, it is then claimed, is available to introspection: phenomenal modifiers, such as blurriness, are part of our experience without being a representational content. Not every object of our experience, then, is 'worldly' (experienced as 'being out there'): sometimes, the object of our experience could be our experience itself, a sort of meta-experience in noticing 'how' we are experiencing the world.

The debate, then, could be generated by the simple fact that we don't usually and common-sensically focus on the distinction between the apparent property of the sensory experience itself and the typical external cause of that experience, as suggested by Georges Rey in *A narrow representationalist account of qualitative experience*: consider someone who is red/green color blind, but has remained ignorant of this fact for many years, mastering the ordinary color vocabulary by having discriminated instead a property that co-varies with hue (e.g. reflectance). When this person introspects his experience of a tree, he, too, will find that

> he at least initially turns his attention to features of the tree, and will think and say that it's green (or that his experience is as of a green tree). But now suppose that he learns of his color-blindness and happens to find a treatment for it. After the treatment he is asked to introspect once more about his experience of a tree. Of course, he might think and reply as before, concentrating only on the tree. But surely he could also attend to the striking difference between his new experience and his old, and notice what certainly would appear to be a new property, not so much of the tree (he always knew it was green), but of his experience considered in itself [...]. Indeed, he would simply invoke the distinction he had long learned with the rest of us, between the ways things are and the ways they happen to appear [...]. Unfortunately, we don't always keep track of this distinction in our ordinary talk, and so our common uses of sensory related words like 'red' are subject to a systematic ambiguity.[145]

Representationalist then maintain that when, for example, we experience an oval green after-image (look at a lamp and then close your eyes), there isn't any property of looking oval or green that the subject is introspecting: there's just an experience with the intentional content 'oval green'. Representational theories of qualitative experiences have many pros[146], but they face some

145 Rey (1998), p. 437.

146 "The chief attraction of a Representational theory of qualitative experiences is that it obviates a number of problems about their public accessibility and the irrelation to the physical world: when someone experiences an oval green after-image, is there really anything green or oval in their brain? Even if there were,how on earth are these properties detected? Is there an "inner eye" that can "see"such colors and shapes? How could we ever check out such apparently "private"instances of these properties and

troubles when presented with notions such as phenomenal modifiers: something that is experienced without being a representational content of the experience.

Torrengo's aim is to introduce this particular notion in the debate regarding the sensation of the passage of time: it is very difficult to point out the representational content of the passage of time; still, a 'phenomenal-modifier-like' notion could help to overcome the difficulties; we always feel the time passing – just as, if we want, we can always focus on 'how' we are seeing the contents of our experiences – even if this passage is not a representational content.

However, the analogy with vivid or blurry vision does not seem strong: they are called 'phenomenal modifiers' because they modify our plain vision; we can distinguish between the vision of a normal apple or a blurred apple – modified, for example, by the absence of our usual glasses. In the temporal case, what is being 'modified' by this 'feeling of the passage'? How would my vision of the apple be different when 'not-modified' by the feeling of the passage? The author himself admits that it is not possible to see the apple without feeling the passage of time, whether we notice it or not: in this case, however, the analogy should be different; it would be as if we were short-sighted and never wear

determine whether two people ever have the same experience? By treating these apparent property instances as merely intentional, the only question that arises is how representations with these intentional contents could be physically realized and processed as part of a person's mental life". Rey (1998), p. 441.

glasses. Would we be able to say that the apple is 'blurry'? It does not seem so: for us, it would just be the normal visual experience of an apple. But even more radically: would we be able to say what 'blurriness' is? Would we really be "experiencing" blurriness? It is difficult to claim so. 'Blurry' makes sense, for us, just because there is the 'not-blurry'; we experience both, and call one the 'normal vision', the other the 'modified vision'. There is no reason to belabor the point: even if Torrengo's solution to the dilemma of the passage is intuitive[147], to a deeper examination the analogy with the standard phenomenal modifiers looks weak.

I think, however, that Torrengo was driven by good reasons in this direction, and that his arguments are worth serious consideration: more than in

147 Laurie Ann Paul discussed in 2010 a similar proposal on the Journal of Philosophy – although focused on a slightly different aspect – in a paper entitled *Temporal Experience*: "when we have an experience as of seeing red, there is more to this experience than just experience as of redness, that is, than just having a red quale. Along with having an experience as of redness, we also have an experience as of the *nowness* of the redness. We also have a nowness quale. In other words, when we have experiences as of redness, these experiences are not just as of redness *simpliciter*. They are experiences as of redness-now. […] All experiences combine the character of the qualitative experience caused by the relevant properties […] with an experience as of nowness. The idea is that the what-it's-like of an experience contains within it the experience as of nowness along with further experience (for example, as of redness). What it is to have an experience as of nowness is part of what it is to have an experience *simpliciter*". Her conclusion is that "the experience that is the having of a neural state is more than just an experience as of a quality like redness; it is an experience as of nowness (and of thereness or hereness) as well. With this analysis in hand, reductionists can explain the temporal experience as of nowness as (merely) a feature of consciousness". Paul (2010), pp.342-343.

the results, I am interested in the paths taken to arrive there. My aim is to answer his reasonable worries about the Deflationist thesis and show that we don't have a specific isolated sensation of the passage of time, nor do we have a phenomenal modifier feature that accompanies our perception and gives, a part from the normal visual perception of a desk, also the sensation that time is passing. The source of our belief that time is passing is not to be looked for in a specific sensation, but in the recollection and the confrontation of our minds of ubiquitous data of change. I will give some compelling philosophical reasons and medical examples to believe that.

We always experience change, not the passage of time

I will follow Torrengo's useful tripartition and individuate three main possible ways to bridge the gap between the common-sense belief that time is passing and the actual, phenomenological sensation of the passage of time: according to Naive Representationalists the passage of time is, simpliciter, an ingredient of our experience – we directly feel the passage; according to Reductionists, the feeling of passage depends on representational contents of features such as motion or change – we directly feel these features, that are responsible for the

sensation of passage (which is something different); according to Deflationists, lastly, there isn't a feature of the phenomenal character of our experience that corresponds to the 'what it is like' of the feeling that time passes – we do not feel the passage, nor do we have an indirect sensation of it.

These are three different ways to answer the "origin problem"[148], the question whether the origin of our common-sense belief of the passage of time is the sensation of the passage or something else. Representationalists claim the most straightforward thesis: we believe that time passes because it is a specific ingredient of our ordinary phenomenology; we feel that time passes, therefore we believe that it does. However, as Reductionists and Deflationists reply, there may be some other features of the content of our mental episodes at the origin of our ordinary belief, such as motion, succession, change, persistence or duration (from now on: I - V); none of these features is a representation of the passage of time. While Reductionists think anyway that there is a specific phenomenal character that corresponds to the 'what it is like' of the feeling of the passage – specifying however that the features listed above are responsible and essential for that –, Deflationists think that the only phenomenal characters experienced are perceptions of (I-V). In other words, even if Deflationists may agree that experience somehow tells us that time passes, they don't think that there is a specific sensation of the passage.

148 Torrengo (2017), pag. 5

Let us stipulate that a phenomenal character *Emov* corresponds to the 'what it is like' to have a mental episode with a content that represents motion, qualitative change or so, and that a phenomenal character *Epassage* is the specific ingredient of our phenomenology corresponding to the 'what it is like' to feel the passage of time. Deflationists claim, Torrengo argues, that we think wrongly that there is something like *Epassage*, because we often have experiences of *Emov*. But, as he points out,

> there are experiences that possess *Emov* (for example, the direct perception of the motion of the second hand of a clock), and there are experiences that lack Emov (for example, watching the hour hand of a clock). […] Now, if the belief that time flows is given by the fact that we think that Emov is the ingredient of our ordinary experiences that tells us so, then it should be the case that only the first kind of experience tells us how it feels to experience the passage of time. But that just seems wrong. Although there is no direct perception of motion or change in the second kind of experience, they don't seem to differ with respect to their ability to tell us what it is like for time to pass.[149]

Even when we don't directly perceive motion or change, he is maintaining, we still have a phenomenal character *Epassage*, we still feel time passing. That leads him to the conclusion that "all our mental episodes, perceptions, but also

149 Torrengo (2017), p. 11.

memories, imaginings and non-perceptual abstract thoughts, have *Epassage*. If there were no 'ubiquitous' phenomenal character *Epassage*, the origin of our ordinary belief that time flows would have to be limited to experiencing *Emov* or some other phenomenal character connected to direct perceptions of features such as (I-V)"[150].

However, as he admits, even when there is no experience of direct motion in front of us, we have experiences of at least one of the features (I-V); a "Disjunctivist Deflationist"[151] may argue that the associated phenomenal character of these features is confused with the feeling of passage. This version of Deflationism fares better with respect to the origin problem, but for this strategy to work there are two conditions: "(i) the features whose experiences enter in the disjunction must possess some aspect in common; (ii) there are no counterexamples to disjunctivist deflationism either – namely, cases in which none of the features listed in the disjunction are experienced, but which are still mistaken for experiences of the passage of time"[152].

I think that these are two very interesting points, and I will discuss them in turn. With respect to the first, then, what is the common feature in virtue of which any experience of (I-V) is confused for an experience of the passing of time? My answer is that the accumulation of our experiences represents a

150 Torrengo (2017), p. 13.

151 A Deflationist that claims that at least one of the features listed in the disjunction – motion or change or succession etc. – is experienced.

152 Torrengo (2017), p. 14.

frame of reference defining a continuous change: not only when there is a motion, or a succession; even experiences of persistence and duration are possible only in reference with 'something else' that is changing.

We are always moving, thinking, *changing*

Think again of James Hartle's IGUS - an Information Gathering and Utilizing System complex enough to have (something that we can call) a sufficient distinction between past, present and future: what I find interesting about this simplified model is that we humans are also actually continuously[153] scanning the environment and storing information: even if the data remain apparently identical, these data are always numerically distinct; they are *another* piece of information. This is relevant with our issue because it gives us the possibility to analyze differently the situation of the 'second/hour hands of the clock'. Hartle's IGUS sees no difference in a series of images (R1, R2, R3…) in which the

153 I am aware of the existence of different models to explain time estimation and duration perception (the most famous are probably the "Internal clock model" and Ian Phillips' "Mental activity model"); but this *querelle* is not relevant here, since everything I need to claim is that – whichever model we choose to represent our internal temporal processing – more images, even if visually identical, are at least numerically distinct; that our brain is able to distinguish between one picture and the successive acquisition of ten identical pictures.

hand of the clock is always in a different position and a series in which the hand is still: the relevant point is that it acquired different images, then R1 is 'the present' and R2, R3, etc. are the past. The situation is complicated a little by the fact, as I have described in the previous chapter, that there are different models to account for our temporal phenomenology; the accumulation of experiences, however – and the consequent phenomenal characters of (I-V) – is something that these models have in common. It is perfectly legit to have different pre-philosophical intuitions on that, and every model has its strengths and weaknesses: what really matters, for our purposes at least, is that whichever model we choose to describe our temporal phenomenology, our 'dynamical feeling' in front of the hour hand of the clock is described by the continuous acquisition of data – there is no need of a phenomenal modifier.

Consider this thought experiment: a philosopher is tied to a chair in a white room. No noises, no light stimuli apart from white lamps, which never vary their intensity: this should be the perfect scenario for a lack of 'dynamical' features. The continuous gathering of information, however, tells a different story; it doesn't matter if we are Cinematists, Retentionalists or Extentionalists: after a while, the subject has collected a lot of identical experiences (point-like or extended) of the environment. What she actually experienced was not a specific sensation of the passage of time, but the accumulation of the same perceptions; then, her experience is one of persistence, duration. Of course she common-sensically summarize it by saying that 'time passed': but she didn't

have a specific sensation of the passage, or at least nothing in the experience described above is telling us so. The conclusion is that nothing is left behind by the temporal features such as (I-V).

A legitimate question, at this point, could be: how could the subject realize that she was having the same visual experiences over and over? If there were not a temporal modifier at work, nor a specific representational content of the passage of time were experienced, how is it possible that she did not confuse many numerically distinct but qualitatively equal perceptions for one, single perception? How could we explain that after two minutes of the visual experience 'white room' the subject knows that approximately two minutes have passed?

The answer is that there are many frames of reference that make us notice that: there is always something changing, moving, while other things – such as a white room – remain immobile. These frames of reference could be represented by many things: our breaths, our proprioception, our mental activity more in general (the 'stream of consciousness' of Molly Bloom). As Barry Dainton puts it,

> it is not just in perception that we directly experience change. Thinking, as an activity, involves a continuous succession of occurrent thoughts and mental images, irrespective of whether the content or subject matter of these is continuous or fragmented. Moreover, the succession of thoughts and perceptions is itself something we experience; the succession is not just a

> succession of experiences, it is a succession within experience [...]. We also directly experience persistence.[154]

The philosopher tied to the chair isn't in a coma: she cannot help but keeping to experience the white room! *Cinematists* and *Retentionalists* would say that she is accumulating numerically distinct snapshots, *Extentionalists* that she is collecting numerically distinct extended experiences: whichever model we choose to represent our phenomenal temporality, there is an accumulation of experiences which leads to phenomenal characters of (I-V). In the words of Brian O'Shaughnessy: "even when experience is not changing in type or content, it still changes in another respect: it is constantly *renewed*, a new sector of itself is there and then *taking place*"[155]. The element that features such as (I-V) have in common, then, is this constantly changing frame of reference.

Evidences in this direction come also from recent neuroscientific experiments: researchers have identified, in two interconnected brain regions in the primates, populations of neurons that code time with extreme precision: a 2015 study by Jazayeri[156] reveals neuron-firing patterns that underlie time measurement; Howard Eichenbaum (2014) speaks of "time cells in the hippocampus"[157]: neurons that fire at successive moments in temporally

154 Dainton, (2000), p.114.

155 O'Shaugnessy (2003), p. 42.

156 Jazayeri (2015), pp. 2599–2609.

157 Eichenbaum (2014), pp. 732–744.

structured experiences; a study by Naya and Suzuki (2011)[158] examined temporal modulation of hippocampal firing patterns in monkeys performing a temporal-order memory task. The firing rate of many hippocampal neurons increased or decreased during the delay between the presentations of different objects related with temporal tasks, such that the firing pattern of the whole ensemble consistently signaled the passage of time during the delay periods. These experiments seem to indicate that even when we do not directly see a change occurring, there are neurons in our brains that fire following certain patterns ('moving, changing, counting'), defining thus a frame of reference that enables us to distinguish between a single perception and the accumulation of numerically distinct but qualitatively identical perceptions, giving rise to experiences of persistence and duration.

To sum up, my claim is that in such cases our sensation is not that of the passing of time, but that of the accumulation of (numerically distinct but possibly qualitatively identical) perceptions, which results in phenomenal characters of (I-V). I take it to be a good answer to Torrengo's claim that we need E_t: "we experience reality as if it were dynamic, regardless of whether we represent motion, change, or other temporal features occurring somewhere. This modification of the way the representational content of all our mental episodes feels underlies our belief that time passes"[159]. Hartle's IGUS showed a

158 Naya & Suzuki (2011), pp. 773–776.

159 Torrengo (2017), p. 16.

different possible answer: when we look for two minutes at a white room and feel a dynamic feature, what we are feeling are phenomenal characters of duration and persistence, due to the accumulation of identical visual data; there is no need of a 'modification' of our representational contents: the dynamic ingredient is already there.

The past is the present; it's the future too![160]

With respect to the second point – are there cases in which no features such as (I-V) are experienced, but which are still mistaken for experiences of the passage of time? – it is interesting to consider what would actually mean to experience no such features. If it could be showed, as I think it can, that without an experience of features such as (I-V) there couldn't be an experience possessing the dynamical feature we are trying to describe, it would be a significant symptom of the fact that a phenomenal experience of these features is not only sufficient for our temporal experience, but also necessary.

160 *The Past is the Present; It's the Future Too: The Temporal Turn in Contemporary Art* is the title of a book by Christine Ross, published by Bloomsbury in 2012.

Think of patients that suffer from anterograde amnesia (or, more generally, Wernicke-Korsakoff Syndrome). These individuals lose the ability to create new memories after either a traumatic brain injury to the hippocampus (and the nearby subcortical regions), the abuse of benzodiazepine drugs or a severe encephalitis; while senses and long-term memories remain intact, the patients have a partial or complete inability to recall the recent past. Without the possibility to accumulate experiences, every day is the first day after the trauma to them, and they could perform the same task one thousand times without knowing it[161]: the result is not only the impossibility to tell how many days pass, but even more significantly – at least for our present purposes – the impossibility to tell that the days are passing! Take this to an extreme level: imagine a Korsakoff patient that is able to retain only one visual point-like perception at a time (since we are trying to conceive a situation in which no features such as motion or persistence are experienced). The unfortunate patient could have the experience 'green apple on the desk', but not the 'green apple rolling on the desk' one: he would have a normal visual experience, without experiencing features such as (I-V). But would he think that time was passing? Would he feel the 'green apple on the desk' modified by a temporal phenomenal modifier telling him that time is passing?

161 Even if there is some evidence that procedural memory consolidation is still possible. See for example Downes et al. (2002).

Consider the auditory experience of an unvarying tone: “even though the tone does not vary in pitch, timbre or volume”, comments Dainton, “we directly experience the tone continuing on. It is as though, from moment to moment, there is a continual renewal of the same auditory content, a renewal which is directly experienced […]. This experienced flow or passage is common to all sensations; indeed a sensation lacking this characteristic seems inconceivable”[162]. My conclusion is that it is at least dubious that we experience reality as if it were dynamic regardless of whether we represent features such as (I-V) occurring[163]. We always experience our perceptions in sequences of more-than-one snapshots. If we replaced the perceptions, instead of accumulating them, we would also lose track of the passage of time - as the thought experiment of the 'super Korsakoff patient' shows. Torrengo himself admits that “it is not implausible to maintain that a subject with only one momentary experience would not believe that time passes”[164]. I hope to have showed that it is not implausible at all.

162 Dainton (2000), p.114.

163 Torrengo (2017), p. 18.

164 Torrengo (2017), p. 14

The origin problem: if we do not feel time passing, why do we believe it does?[165]

If the arguments presented above are sound, there are two possible reactions: either we abandon the idea that our belief that time passes is based on a specific phenomenological character (a determined 'feeling of the passage'), or we endorse the view that E_t is not to be equated with an ordinary representational feature ('red', 'hot') – but more likely, as Torrengo claims, to a phenomenal modifier ('blurry'). The problem with the first alternative is, according to him, that "it fails to account properly for the origin of the ordinary belief that time passes"[166]. While, in fact, it is obvious that a specific phenomenological character of the passage of time gives rise to the belief that time actually passes, it is not equally trivial "why we mistake an experience of continuous motion or change for an experience that tells us that time is passing"[167]. The best option, claims Torrengo, is to admit that our experiences have E_t.

165 The question itself, however, is tricky, because it threatens to shift the debate from the phenomenological side to the ontological side (which the author is, correctly, trying to avoid here). When the author asks why do we mistake an experience of change for an experience of temporal passage, we can clearly see the ontological side of the problem behind the curtain. If we *mistake* one thing for the other, it means that the two things *are* different.

166 Torrengo (2017), p. 12

167 Torrengo (2017), p. 13

It all depends, though, on what we mean by 'feeling the passage of time'. While everyone admits that we commonsensically believe that time passes, there is not such a widespread agreement on what we really mean by 'passage of time'. When Torrengo asks why we mistake an experience of features such as (I-V) for an experience of the passage of time, there is a presupposition hidden in the question: I do think that we perceive time passing, but I do not think that this sensation of passage is something different from the feeling of phenomenal characters such as qualitative change, motion, persistence, etc; and since I do not have problems to admit that we perceive these features, I do not see an origin problem.

There's no error in our perceptions, no illusion: the growing sequence of our perceptions defines experiences of change, duration, etc., and we call this 'passage of time'. When I deny that we have a specific sensation of the passage of time, I just mean that we do not experience 'something else' than features such as (I-V). It has certainly always been a useful way to express ourselves: we see the sun rise, set and rise again, and we summarize all the changes occurred saying that 'a day has passed'; but it is at least dubious the claim that we all believe that actually there was *something else* to feel passing. While it is clear that we have experiences of motion, change, persistence, it is not so obvious that we have experiences of the passing of time as a distinct phenomenal character.

Conclusions

The main reason that led Torrengo to introduce the feeling of the passing of time as a phenomenal modifier was the need to explain the dynamic phenomenal character we always experience. The alternative I have described, however, explain this feature better: an accumulation-based explanation of the perceived dynamical component of reality apply equally to each point along the worldline of an organism that experiences time, without the need of an additional specific sensation: we always experience passage when there is change, persistence, duration, etc.; we do not need a supplementary experience of the passage of time to be distinguished from the experience of such features.

6. A pluralistic account of our temporal phenomenology

Aim and structure of the chapter

In this chapter I address the question “how is our temporal experience possible”? When we hear a song, we are aware that every note is before and after another note (and that's how we remember it), but we also 'experience-as-present' more than one note at a time. Our phenomenological present isn't point-like, but in that extension, in our present, we still make temporal distinctions, such as before and after. To answer this question, I suggest an analogy with the difference drawn, in the spatial case, between the two different mechanisms of counting and 'subitizing' (the immediate visual capture of a certain number of items as a single object). My proposal is to identify two different mechanisms even in the temporal case: a temporal counting, a co-conscious experiential 'single look' of a temporal interval; and a temporal

subitizing, an atomic storing operation which organizes every event in a mathematical, point-like sequence. These two mechanisms are taken to be operative always and together: we never cease to store the events encountered in a temporal line, but we also experience a subgroup of them as present. Even if we are aware that 'the now' is point-like, and there is always a certain sense in which we experience it being so, our present experience is that of an extended co-conscious collection of more-than-one event.

Synchronic and diachronic unity

There are two macro-areas of concern regarding the phenomenology of our temporal experience: questions about synchronic unity at a time, and questions about diachronic unity over time. Not only, in fact, do we experience many successive movements of an object in front of us as fluidly reunited in a temporal extended now, our present moment; we also experience an endless stream of these 'nows', without being capable of pinpointing, locating or even remotely feeling any kind of definite boundary between them.

There have been attempts to argue in favor of a unified account, providing one answer to both questions: however, it seems that there are some structural differences that make it impossible. Oliver Rashbrook (2012) argues very convincingly that similar solutions hide two very different notions of 'togetherness'. While in fact, on the one hand, 'being experienced together' is a transitive relation in our experience of synchronic unity at a time, it is a non-transitive relation in our experience of diachronic unity over time (the continuity of consciousness tells a very different story from that of a single, prolonged experience during our waking hours). But the relation can't be both, at least not in a *unified* account of our temporal phenomenology.

There seems to be a genuine problem here. Consider the auditory experience of a fast piano song; our phenomenological experience of 'the present' is a single look, so to speak, to a brief succession of notes. We simply *can't* experience-as-present only one note at a time (remember: it is a *fast* song). Still, after one minute not only are we *aware* that we are not experiencing the beginning of the song: we also don't experience-as-present the first notes of the song. There must be in play here two very different ways to have a temporal experience: on the one hand, there is a brief but extended present, that even if distinguishes the succession of (say) three notes, comprises them all in a single temporal present experience – as the single vision of three dots on a screen: you can tell that there is one on the left, one in the center, and one on the right: still, you don't need to look singularly in turn at every one of them to tell. In this

case, 'togetherness' is a transitive relation. On the other hand, there is a completely different way to temporally experience the song: instead of a single look, it resembles much more the operation of storing the notes in succession; in this case, 'togetherness' has a whole different meaning.

It seems, then, that there are two different phenomenological processes going on: if we had absolute pitch and a prodigious, Mozart-like memory, at the end of the song we would remember perfectly the stream of the notes, being capable of saying which were played before, and which were played after; if we chose a random note, we would be able to tell which notes were in its past, and which notes were in its future; our total temporal experience of the song, then, is that of a continuous stream of temporally ordered single notes; a mathematical succession of points, so to speak.

A totally different process, however, is responsible for our direct temporal experience while the song is being played. Think of what you would answer if someone asked you, during the song, “what are you hearing now?”: instead of an ordered succession of single notes being present and successively, in turn, being stored in the past, your present experience would much more likely be that of a brief succession of multiple notes, which – even if they are in succession – are all felt as part of the same present; there are more-than-one notes in our experiential now.

Let me make another example. Suppose you live in a poor and dangerous neighborhood; one night, you got frightened by the sudden sound of two close gun shots (say, 100ms from one another). Try to imagine your temporal experience: even if you heard two separate shots, you do not experience the first 'as past' when you hear the second. Nonetheless, when the police officers interrogate you, you have no problem telling that one shot was *before* the other; you are absolutely aware that, technically, when one was present the other was in its past. Indeed, at the end of that ugly night, you remember a stream, a sequence of temporal ordered gun shots; the single experience that you had when you heard the two close shots is lost, replaced by an ordinate succession available for your memory.

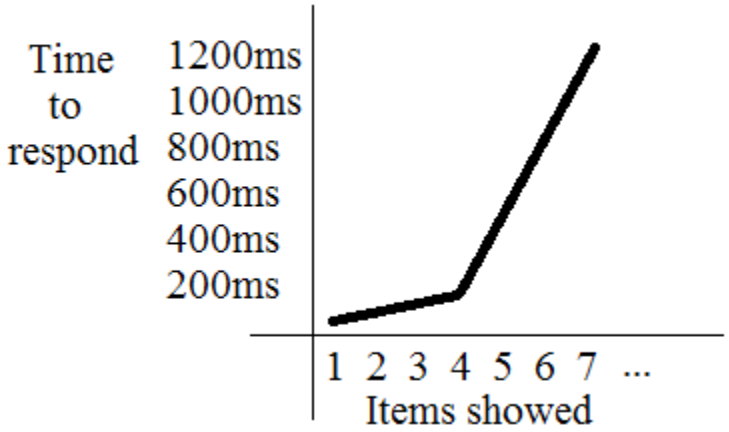
Maybe the simplest option is even the right one: if we experience two such different things, it could be because there are two different phenomenological processes going on, and our temporal experience is twofold: I propose an analogy with a spatial debate which has significantly been tackled with the recourse of such a dualism between two distinct ways of operating of our intellect: counting and 'subitizing'.

'Subitizing' is a latinism coined[168] in the mid-fifties to describe the immediate visual capture of a certain number of items, to be distinguished from the usual action of counting. The idea behind it was to see if there were a cognitive description of our everyday-life different performances in front of

168 See Kaufman et al. (1949).

streams of not-grouped and grouped numbers (4939724 and 4,939,724; car plates; bank accounts; etc.). Experimental results[169] showed a significant difference between judgments made for displays composed of one to four items, and for displays of more items; of course, response times always rise with the increase of the number of the items showed, but it is often claimed that there is a dramatic difference between the two groups[170] (see Figure 5[171]).

Fig. 5



In current scientific literature we find a lot of different models to explain these results. Sometimes (rarely) the limit between subitizing and counting is set

169 See for example Trick and Phylyshin (1949), or Camos and Tillmann (2008).

170 Inside the range 1 – 4 objects, there is an increase of the time necessary for an accurate response of about 50ms every added element; in the range +4 objects, however, the increase in response time becomes of about 300ms.

171 I drew this figure.

after the third object, instead of the fourth; given that there is never an indisputable discontinuity in the curves of response, moreover, there are even those who deny that there are two different mechanisms to determine visual numerosity. Gallistel and Gelman (1991), for example, famously claimed that even small sets of items are quantified by serial counting, albeit with faster speed than for larger sets: subitizing, then, would just be a fancy word to say 'fast counting'. Others see in our ability to subitize small groups of numbers a similarity to object recognition: Mandler and Shebo (1982), for example, argued that subjects recognize the characteristic geometric configuration of sets of objects (for example: 1, point; 2, line; 3, triangle). This pattern recognition would fail for sets of more items, at which point the subject would then start to (slowly) count. Trick and Pylyshyn (1994) attributed subitizing to the parallel assignation of pointers called 'fingers of instantiation' to each object in a visual display; these 'fingers', it is assumed, are available in a limited number (four), as it is suggested by multiple object tracking experiments. Subitizing, then, would be based primarily on preattentive processing, and be dissociated from serial counting.

A disquisition on the single models' merit exceeds the purposes of this thesis; it is sufficient to say that there seems to be a convincing amount of proofs pointing in the direction of the existence of two different mechanisms at the basis of our performances in front of a visual display of objects. A large part of that comes from experiments with patients suffering from brain damages:

crucially, it has been observed[172] that patients suffering from cognitive deficiencies resulting in the inability to perceive multiple items together, are nonetheless capable of recognizing the number of the objects in the subitizing range – while it is impossible for them to actually count objects in a scene. Stanislas Dehaene and Laurent Cohen, moreover, gathered a significant portion of the existent literature and confronted it with evidences from simultagnosic patients; their conclusion is that "the neuropsychological dissociations reported here indicate that quantification of small sets is not based on serial counting and presumably relies on spatially parallel processing (subitizing)"[173]. The absence of any quantification errors with two and three items in patients with severe deficits of serial visual exploration suggests that these sets were quantified using a parallel mechanism rather than a serial one: although these patients were completely unable to quantify sets comprising more than 3 items, they were excellent at quantifying sets of 1, 2, and 3 items; Dehaene and Cohen conclude that these patients suffered from a deficit of serial visual exploration, due to a fundamental inability to use spatial tags to keep track of previously explored locations, while preserving subitizing abilities, based then not on serial processing but rather on a parallel algorithm dedicated to small numerosities.

172 Robertson et al. (1997)

173 Dehaene and Cohen (1994).

To a similar conclusion came Maloney, Risko, Ansari and Fugelsang in *Mathematics anxiety affects counting but not subitizing during visual enumeration* (2010):

> When enumerating visually presented objects, two distinct patterns of performance emerge. For 1–4 items, performance is fast and accurate with only a small increase in response times (RTs) and typically no decrease in accuracy as a function of the increase in the number of stimuli presented […]. Conversely, for 5+ items, RTs increase and accuracy decreases as the number of stimuli presented increases […]. A deficit in either the subitizing or counting range among individuals with MA would provide evidence that HMA [high mathematics anxiety] individuals not only have a difficulty with high level mathematical processing but also a difficulty with basic numerical processing […]. We have demonstrated, using a visual enumeration task that HMA individuals differ from their LMA [low mathematics anxiety] peers on the enumeration of items in the counting but not the subitizing range.[174]

Results with normal subjects seem to replicate these clinical observations: numerosity naming time does not increase linearly with numerosity, but shows a marked increase only from more than 4 objects; errors, also, start to be noticeable at about the same point. These results are suggestive of the existence of two quantification processes, one very accurate for 1 to 4 objects, and the other whose accuracy decreases in proportion to numerosity. Studies

174 Maloney et al. (2010)

conducted on young children[175], moreover, suggest that the same phenomenon is already present in the first steps of our cognitive activity (it doesn't seem to be a matter of education or habit); similar experiments[176] involving other senses, such as tactile perception and auditory perception, have described similar results, showing a certain independence from the sensory modality.

Finally, a study conducted in 2002 by Piazza, Mechelli, Butterworth investigated whether the two mechanisms are neurally implemented as separate or functionally overlapping processes. The authors endorsed the idea that subitizing and counting are two different processes, even if overlapping in the same brain areas:

> the results demonstrated a common network for subitizing and counting that comprises extrastriate middle occipital and intraparietal areas [...]. Direct comparison between subitizing and counting showed that counting, relative to subitizing, was correlated with increased activity in this occipitoparietal network, while subitizing did not show areas of increased activation with respect to counting. Results speak against the idea of the two processes being implemented in separable neural systems.[177]

175 Chi and Klahr (1975)

176 Riggs et al. (2006)

177 Piazza et al. (2002)

From a phenomenological point of view, the feeling associated with judgments within the subitizing range are mostly described as an immediate awareness of the displayed elements, whereas when there are more than four objects this sensation is typically lost and subjects describe their action as a shift of their viewpoint around the display. Tony Simon and Sandeep Vaishnavi (1996) described two experiments in which selective eye movements were disabled by the presentation of stimuli in the form of afterimages: it wasn't possible for the subjects to count shifting their viewpoint. The results showed how even increased inspection time and facilitative stimulus configurations failed to increase the subitizing limit of 4 objects:

> afterimages of two to eight dots induced by a photographic flashgun were shown to 3 adult subjects. For more than 4 objects, enumeration errors occurred at a rate of 20%-30%. Enumeration was effectively perfect for 2-4 linearly configured dots[...]. No errors occurred in nonafterimage control conditions. Enumeration errors were attributed to failures of individuating dots to be counted due to the deactivation of selective eye movements in afterimages. [178]

As we have seen, many possible explanations have been put forward to explain such a dramatic difference between our abilities to enumerate objects. As I hope to have showed, there are very good reasons to think that two different

178 Simon and Vaishnavi (1996), p. 915.

mechanisms lie at the basis of such different performances; what I'm proposing is a temporal analogy.

It seems, in fact, that even in the temporal case there are at work two different processes: while a *temporal subitizing* is responsible for our directly experienced present – a single 'temporal look' at an extended period of time that comprises a succession of more notes (for example) in an immediate co-conscious present temporal experience, a *temporal counting* has the more elaborate cognitive task to store in succession the events perceived. It would even be possible to suggest, even if I won't examine it further here, that long-term memory and long-term projections are more closely related to this latter faculty, while the short-term memory and short-term anticipation are more closely related to the former.

What's wrong with the snap-shots?

When we commonsensically consider the way we experience the world, there is a strong temptation to think of ourselves as video cameras that start recording the day we are born and stop the day we die (there are some gray areas, such

as dreamless sleep, dreaming sleep, etc., but for the present purposes it is sufficient to consider our standard waking condition). After all, what we do seems very similar: we gather a great number of visual data – experimental results indicate that our eyes are very quick to capture flashes of light, so that in a second there would be a lot of 'frames' – and 'see' them in a rapid succession, like a movie. What is less clear, at a more careful look, is how – in this 'cinematic model' – we are going to account for perceptions of motions, for example. While, in fact, there is a distinct frame to point at when we want to know where does the experience 'I see the green apple on the desk' come from (there is a frame containing the green apple), we can't do the same with the also very familiar experience 'I see the green apple falling from the desk' (in every frame the apple is in *one* position: it is never falling[179]). If our perceptual consciousness consists of a succession of momentary experiences, we never really perceive the apple falling in the same way we perceive it 'being green'. Where, then, does this dynamical feature of our experience come from?

The present seems the most natural thing, one that we constantly experience; at a closer look, however, it seems that it can't have a duration. In any temporal interval, in fact, the initial part occurs before the later part: the present, then, must be a durationless, mathematical point between the past and the future. Now connect this thought with the fact that our experience is

179 In the next chapter, I will present the Dynamic Snapshot View, which tries to solve the problem ascribing a dynamic nature to the single snapshots.

confined to the present: our experience istelf, then, should be durationless, instantaneous, vanishing in a mathematical, non-dimensional point. Nothing, however, seems more obvious that our experience takes time.

Of course, it can be argued that our present experience is in fact technically point-like, but there are some reasons that explain why it doesn't seem so (we remember the immediate past, or there is a retention of the immediate past in the present experience, etc.). However, it must be noted that the notion of the instantaneous, point-like present, is inspired by a mathematical way of thinking, while the notion of present we are trying to capture here is connected with our experience. In the words of Barry Dainton:

> the fact that we can think of time as consisting of a succession of durationless instants does not entail that phenomenological presence is instantiated instantaneously. If the sensory present has a non-zero duration, presence will also have a non-zero duration […]. There is no denying that memory and temporal experience are connected in a number of ways, but it is another thing to hold that memory is largely or wholly responsible for our experience of time. [180]

We are looking for the best way to characterize our temporal phenomenology: is it really helpful to think to this mathematical, point-like present which leaves absolutely no trace in our experience? The point is made even clearer by Owen Flanagan: "suppose that neuroscientists discover that consciousness is in fact

180 Dainton (2000), p.123.

realised like a movie reel consisting of individual images, the moments of consciousness [...]. It is not clear that this would or should have any impact upon what we say about how consciousness seems from a first-person point of view"[181].

It is perfectly legit to have different pre-philosophical intuitions on that, but I take it to be reasonable to assume that we can perceptually experience temporally extended happenings, such as motions. A succession of very fast present temporal experiences – snapshots – doesn't seem to me related in any sense to our phenomenology of time. We are directly aware of intervals of time as wholes: as Barry Dainton puts it, "our experience of change is just as immediate as our experience of shape or colour"[182].

These are merely intuitive reasons, however. From a theoretical point of view, there are strengths and weaknesses for all the models. The Cinematic model, for example, is *prima facie* a reasonable physicalist way to describe the processes going on in our heads: what is a visual perception if not an instantaneous photography of the surrounding environment? In this case, what we would need is some account of how this successive point-like awareness of snap-shots could amount to such a smooth experience of temporal extended happenings, like motions. An anti-realist about phenomenal temporality (even if immediate experience seems to extend a short way through time, the anti-

181 Flanagan (1998), p. 89.

182 Dainton (2000), p. 115.

realist maintains that this is merely an appearance) needs a story about synchronic unity – how to build, from a succession of brief experiences, an homogeneous experience of succession.

On the other hand, a realist about phenomenal temporality, such as (typically) an Extentionalist or a Retentionalist, must explain 1) why the extended present isn't experienced as a *totul-simul* (we directly experience the succession of notes without confusing their order) and 2) how to divide one extended present from another: while it was obvious in the Cinematist case (every single perception, such as a note, is one present experience), it is not so obvious how long are these extended present experiences and how they succeed one another without giving the feeling of a continuous hiccup (which is a stream, of course, but a very unappealing one). How could it be that within these wholes there is a succession, a before and an after? And how could it be that each experienced whole seamlessly gives way to the next?

I believe that the individuation of two different processes, temporal subitizing and temporal counting, can resolve these two questions.

The overlap and the hiccup

We want to explain why a succession of three notes is gathered in an extended present experience, and simultaneously how the three notes are stored as single events in an ordered series: on the one hand a story about reunification, a strong one even – given the simplicity and spontaneity with which we experience motions, even fake ones (think of the so-called *phi experiment*); on the other hand, a story about single identification and labeling.

The best option, in my opinion, is to identify two different processes (two ways to temporally look at the world, so to speak) at the basis of such different characteristics: a temporal counting, which stores every single perception in a series and gives us the possibility not only to be aware that something has changed, but also to be aware (besides directly perceiving it as a color or a shape) that something is changing; and a temporal subitizing, responsible for our direct experience of an extended succession of events (such as motions, notes, etc.), a single overview, a look all-in-once, of the last (say) 500ms / 2 seconds (in the next chapter, more will be said about the precise extension of our present experiences).

There are two main possibilities to characterize this 'temporal subitizing': it could be seen as shifting and overlapping (we always subitize the last, say, 2 seconds of our experience), or as an hiccup-process, gathering and discarding subgroups of events (we subitize 2 seconds of our experience, then other 2 seconds, etc.).

In the first case, the process we are looking for is not one that discards all in once the extended present experience (throwing it 'in the past'), but one that creates a continuous, overlapping stream of extended perception: our present should be always constituted by the last notes of the song we are hearing, but crucially every note is part of more of these 'nows' (that's why there is an overlap); that doesn't mean that the same notes are experienced more than once, but that they 'slide away' with the accumulation of new notes.

According to the description of Barry Dainton, the overlap theory claims that the contents of our present experience possess some short duration, and consequently these contents have an intrinsic temporal organization (the contents consist of a temporal pattern). The character of these temporal patterns is itself dynamic:

> the flow or passage in experience is included in the phenomenal content of experience. The total experience that results from my seeing a ball move between P1 and P2 does not consist of stationary image of the ball at two different places. The content is a ball moving. Movement or animation is, as it were, built into the content from the start.[183]

That's why it would be misleading to think of our experience as it were made of cinematic frames: even if it is conceivable that it objectively is, our experience is nonetheless always an experience of motion or persistence. According to the

183 Dainton (2000), pp. 175-176.

overlap theory, then, every temporally extended experience is a dynamic experience; think again of a fast piano song: our experience is that of a shifting present experience, which is not made by a single note but not even by the whole song. It clearly depends on a number of factors: how fast these notes are played, how able we are to recognize patterns, rhythms, etc., but we can stipulate that our present experience is constituted by, say, the last three or four notes, which are co-conscious in a non-transitive way. In such a theory, then, our fluent experience of motions and fake motions are explained pretty well. What is missing, maybe, is the fact that we are also aware of the notes as single events: we must be, since – for the overlap to happen – we should also be able to shift our present experience of one note at a time.

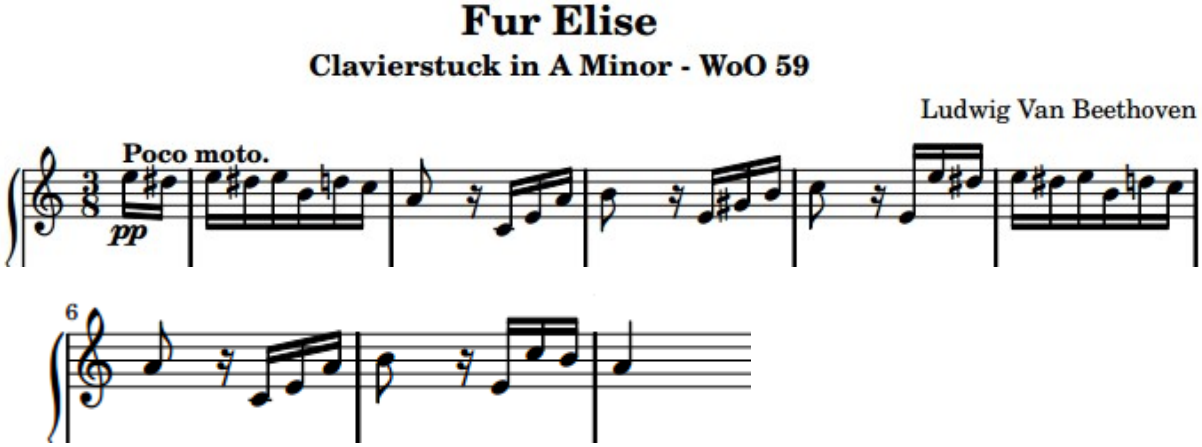
In this first case, our phenomenological now would have the short extension of our immediate experience. As Barry Dainton puts it, "there is no guarantee that the beginning and end of [the notes in a musical phrase, or the words in a line of spoken poetry] fall within the scope of immediate experience. For my own part, I would tentatively estimate the duration of my typical specious present to be half a second or less"[184]. Our phenomenological now, then, would be in the first case characterized as a shifting, overlapping subitizing of our last half second.

In a different way, however, temporal subitizing could be seen as an hiccup-process, gathering and discarding chunks of material. Think of the very

184 Dainton (2000), p. 117.

famous main theme (the right hand) in the piano song *Fur Elise*: we all know very well the song, and we experience it in subgroups of notes (see Figure 6[185]).

Fig. 6



Play it in your imagination: it is very likely that the rhythm, defined by the pauses, created in your fictional auditory experience 6 (in turn) present experiences of subgroups of notes (mi re mi re mi sol re do la / do mi la sol / re sol si do / etc.). It is just as looking to a long stream of numbers and group them in subgroups of elements (34,546,489): you don't 'shift' of one number at a time, but of one subgroup at a time. We are always looking for such ways to individuate and define our present temporal experience: even when we see a ball rolling for 20 seconds, we look for rhythms (our breaths, an external sound,

185 From http://cdn.imslp.org/images/thumb/pdfs/1e/2d1354c78c20b6ee709d246d4495e3daba38042e.png

our mental activity, etc.). The fact that subitizing is an hiccup-like process, however, doesn't mean that our overall hiccup-like experience: as Manfred Euler puts it, “everyone will agree to experience time as a continuous stream. However, a closer look [...] reveals discrete elements [...]. In our conscious experience of time continuity and discreteness are delicately interwoven”[186]. Elzbieta Szelag, analyzing a series of experiments in which sequences of metronome beats at different frequencies have been presented to different subjects, comments: “the results indicate an integration process, i.e., temporally separated successive beats are mentally connected with each other into larger perceptual units”[187]. One of the most convincing results on temporal integration comes from studies on the reproduction of visual and auditory stimuli of different duration[188]. A mechanism appears to integrate successive events within a temporal window: subjects mentally structure auditory sequences, experiencing successive beats as a unit; but “it turns out that two beats cannot lie further apart than 2 to 3 seconds to allow subjective accentuation. Beyond this interval, it is no longer possible to mentally connect the second to the first beat, i.e., the first beat has then already disappeared into a perceptually not directly available past [...]. It is as if the brain asks, 'What is new in the world?' every 3 seconds or so”[189]. Even if the cognitive process at the basis of our

186 Euler (1997), p. 159.

187 Szelag (1997), p. 122.

188 See Pöppel (1978) and Elbert et al. (1991).

189 Pöppel (1997), p. 114.

temporal experience is hiccup-like, it doesn't mean that our temporal experience is bound to be so.

In *The Continuity of Consciousness* (2013) Oliver Rashbrook analyzes the phenomenology of our 'stream of experience', claiming that it is continuous in the sense that the temporal boundaries of experience are not manifest. The continuity, then, must be intended in an 'extreme' sense: the temporal boundaries fail to be manifest in consciousness; the continuity has nothing to do with the singular components of our experience:

> the water in my kettle could remain in the same state (at a temperature of 21 degrees centigrade) continuously, in virtue of the occurrence of events—movements of water molecules—that are not themselves continuous […]. The fact that the events upon which the occurrence of the state of consciousness depends may not be strictly continuous [consciousness exhibits strict continuity if it does not have any gaps] doesn't tell us that the state of consciousness itself doesn't fill time strictly continuously.[190]

To characterize the subject's perceptual experience at a time, we need to appeal to something of shorter duration than the time for which the subject has been experiencing, but something that is nevertheless temporally extended: the temporal boundaries of our present experience, however, fail to be manifest in consciousness. Rashbrook, then, is convinced that there are, as a matter of fact,

190 Rashbrook (2013), pp. 619-620.

temporal boundaries involved in temporal experience, which “mark the period in time within which items are relevant to characterizing the subject’s experience at a time. Beyond the relevant temporal boundaries, nothing is relevant to the characterization of the subject’s experience at the time in question”[191]. There is then, in his opinion, a 'temporal field', a bounded interval of time within which items are relevant to characterizing the phenomenology of experience at a time, and outside of which, they are not; simply, these boundaries are not manifest in our temporal phenomenology (a song isn't experienced in 'temporal chunks' one after the other).

Of these two ways of characterizing our temporal subitizing – as a shifting, overlapping mechanisms or as an hiccup-mechanism, grouping elements and discarding them in chunks – I prefer the second, but all I'm interested in maintaining is simply that our temporal experience is possible as it is thanks to two different cognitive mechanisms. Of course, for the proposal to be more appealing it is meaningful to offer an analysis of how this 'temporal subitizing' could work: but I don't intend to definitively decide how it effectively operates.

191 Rashbrook (2013), p. 630.

Temporal subitizing and temporal counting

What we are looking for is an account of our phenomenology capable of explaining why we see temporal extended phenomena, such as motions, as clear and directly as colors. The account should also indicate the extension of this extended present; it should explain why we are contemporaneously capable of decomposing our auditory experience of a song in a succession of notes (point-like presents) and still composing more-than-one notes in a single present experience. A good way to characterize our phenomenology could be represented by the distinction between two different ways to temporally experience the events: temporal subitizing and temporal counting. The aim is not to sketch an *ad hoc* solution to resolve the problems of the construction of a phenomenological account; rather the opposite: it seems that many phenomenological clues point in this direction, and that's where I'm going.

When we think about the past, not only we know that event A preceded event B: we also lose the sensation of a unique temporal experience of them – we only feel them as part of an ordered stream. In our present, however, the situation is different: we can't help but subitize the contents of our perception; we can't look at a ball as being in different positions at different times: we see the motion. We can even force ourselves to consider only a point-like instant, but we can't perceive it as being so: our temporal phenomenology of the present is always extended.

As in a single vision of an image there is a left and a right, in our extended temporal experience of the present we recognize an after and a before. When we see an image containing three points we subitize: we are almost immediately conscious of the fact that there are three points; if we wish, we can also focus on every one of them singularly, 'counting' them, but we can't help to simultaneously have a general vision of the figure as containing one object on the left, one in the center, one on the right. If more objects are added, however, we lose the ability to subitize: we start to focus on little areas of the image, subitizing on those, and moving our focus (that's what we do when, for example, we group numbers as in 345,678,912).

Think of the present experience of hearing two close sounds, one much longer than the other (say, 200ms of the note DO and 100ms of the note LA). Our temporal phenomenology tells a story of one present: we had *one* experience, we didn't 'have time' to have an experience and then another one (when we experience the note LA, the note DO isn't in our phenomenological past: it doesn't 'feel past'); still, there is a sense in which we have experienced the different duration; it is as if our experience were simultaneously made of parts and still integral and undivided. The proposal, then, is to think of two different ways of experiencing the continuous encounter of a succession of numbers (events): on the one hand we 'temporally count' them, storing them singularly and attributing them a particular, point-like present, as in the series 1 2 3 4 5 6 7 8 9: every number is alone in its present; on the other hand we

'temporally subitize' them, directly experiencing a series of them as already being together, animated, and making the cinematic metaphor disappear, as in the series 123, 456, 789 – where 123 is a single experience of motion from 1 to 3: the total experience does not consist of three stationary image, but of a motion. When the subject subitizes, then, she 'knows' that the first note (DO x 200ms) was played before and longer than the LA, but what she experienced was a co-conscious present experience of 'DOOO-LA'; the first note wasn't in her experiential past when she heard the second one. The model should thus translate not only the two different temporal experiences famously discerned by Broad, but also the fact that we are contemporaneously aware that something is moving *and* feel it moving.

Even in the spatial case, when presented with a great number of objects, we simultaneously subitize and count: we shift our viewpoint around the display and keep track of our count, but we also tend to see subgroups of objects, subitizing them. Our temporal experience is continuously presenting us with events, and even if we are able to *count* them, storing them in order as if they were disposed in a uni-dimensional mathematical line (knowing which note is before and what is after), we also *subitize* subgroups of events, experiencing them in a co-conscious present, seeing them in a single look.

When we hear three notes of a song, then, there is an immediate awareness of the auditory elements, we hear them in a single, co-conscious experience; if the notes become ten, on the other hand, we lose the overall

sensation of a single experience, and at the tenth note we already feel that the first is 'past': we can't 'see' the ten notes as a single object.

Possible counterarguments and answers

An easy objection would come from the request of a precise indication of the boundaries of our temporal subitizing. I don't have an answer to that, but it isn't necessarily a flaw of the model here exposed. Experiences such as 'hearing a song' strongly suggest the existence of a present temporal window – we experience-as-present a non-point-like extension of the song, but much shorter than the song itself. When we temporally subitize, we try to keep under one, general look a duration of time (for example, many notes of a song); the operation becomes harder and harder with the passage of time and the accumulation of notes, and the first notes of the song start to slide away. But not only are the boundaries between the two way to experience the events not manifest: they could also depend, for example, on how much we are inclined to focus on the single notes rather then a rhythm; on our ability to anticipate the future; on how well we know the song, etc. My hypothesis is that there isn't an

unambiguous and unique window in which we temporally subitize, then, but I think there is, however, a clear phenomenological distinction between temporal subitizing and temporal counting: every case is a distinct one, but that doesn't mean that the two operations are indistinguishable. In chapter 4, for example, I have proposed a model that defined the phenomenological difference between the two operations, and even a way to measure the temporal window in which we temporally subitize.

Also, as I have anticipated in chapter 4, an additional hypothesis that could be made is that the extension of this experienced present depends on the speed of action and reaction of a subject: a slow subject (say, a sloth) has probably a longer 'now' than us, while an hummingbird has a shorter one. In 200ms, the hummingbird is capable of reacting efficaciously to – and anticipating – different stimuli, while the sloth needs seconds. It could be argued that typically we consider the past something with which we don't interact directly: something that is gone. Not only then, as I have proposed, the extension of our phenomenological present depends on the particular situation and the particular meaning we choose to give it, but also on our capability and velocity to anticipate and react to events.

Conclusions

The question is: how is our temporal experience possible? Many conflicting elements must coexist: our present is extended, but not a *totul simul*; it has boundaries, but they are shifting and not manifest; it is part of a seamless stream, but distinct from the past and the future.

My answer to the question is the identification of two different mechanisms: a temporal subitizing, a co-conscious experiential 'single look' of a temporal interval; and a temporal counting, an atomic storing operation which organizes every event in a mathematical, point-like sequence.

Given the great amount of changes and events experienced, the two mechanisms are taken to be operative always and together: we never cease to store the events encountered in a temporal line, but we also experience a subgroup of them as present. Even if we are aware that technically, from a physical-mathematical perspective, 'the present' is point-like, our phenomenological present gathers recent events in a co-conscious experience. The two mechanisms described are at the basis of our twofold temporal experience: the awareness that every note is before and after another note, and the 'experiencing as present' of more than one note.

Conclusions

In the first chapters of my work I have illustrated and defended the Block Universe view; in the central part, I have introduced the different models of temporal perception and defended the existence of a Specious Present; in the last chapters, I have developed a view to describe our temporal experience in a way that manages to reconcile our common-sense with the metaphysical ideas expressed in the previous chapters.

The thought that inspires the whole work is that the passage of time is a notion compatible with the Block Universe. I started describing how the model should account for this passage; during the work, however, I developed an increasing interest in the literature concerning our own temporal phenomenology, instead of the more general metaphysical modelling; it seems, in fact, that our 'dynamic' experience is a key component of the pre-philosophical intuitions of those opposed to the Block Universe View. The desired result was an homogeneous defence of a metaphysical model that keeps an eye on our common-sense.

In particular, I have tried to develop three 'original' arguments: an argument in favor of the specious present, an argument in favor of 'veridicalism', and an argument in favor of the existence of a mechanism called 'temporal subitizing'.

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