

Let us hug to us as closely as we like that there is real succession, that rivers flow and winds blow, that things burn and burst, that men strive and guess and die. All this is the concrete stuff of the manifold, the reality of serial happening, one event after another, in exactly the time spread which we have been at pains to diagram. What does the theory allege except what we find, and what do we find that is not accepted and asserted by the theory? Suppose a pure intelligence, bred outside of time, instructed in the nature of the manifold and the *design of the human space-time worm*, with its mnemonic organization and the strands of world history which flank it, and suppose him incarnated among us: what could he have expected the temporal experience to be like except just about what he actually discovers it to be? How, in brief, could processes which endure and succeed each other along the time line appear as anything other than enduring and successive processes?
D.C. Williams, "The Myth of Passage"

Passage, Flow, and the Logic of Temporal Perspectives

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The topic

One of the most persistent debates both inside and outside of philosophy about the nature of time concerns the relationship between the manifest, flowing time of everyday experience and time as it appears in our best current physics, as one dimension in a static manifold of events.ⁱ The debate about whether these conflict centers and, if so, which has priority is deeply hindered by the fact that descriptions of temporal experience tend towards the metaphorical. In describing the experience of time, people often speak of the quality of passage and the felt whoosh of experience.

It's hard to get any traction without an exact, literal account of the content of temporal experience.ⁱⁱ As John Norton has said:

"The real and troubling mystery lies in asking what more can be said. ... It is not at all clear how properly even to describe the passage of time in precise terms."ⁱⁱⁱ

"We usually end up describing passage with metaphors that prove circular and then, in desperation, gestures."

I'm going to inject a little formal precision into the discussion of passage. I'm going to suggest that we can resolve some of the issues with an examination of the logic of temporal perspectives. Much has been written about the human experience of time. From Proust to Eliot and Joyce to Khayyam, there is no shortage of literary attempts to capture the complexity of our temporal experience. The goal here to something quite different, viz., to strip away the complexity and get a schematic formal understanding of the logical contours of that experience. We want to obtain a kind of logical skeleton, or schema, of the structure of the experience of beings that process temporal information the way we do.^{iv}

The first two sections will be descriptive phenomenology. In the third section I'll offer the interpretation of flow and passage, and in the final sections I'll draw some general lessons for metaphysics.

The Perspective *at a Time* (TEMP)

At different points in our histories, we experience time from different perspectives in the way that we experience a spatially located object, or space itself from different perspectives. And to what I mean by 'the logic of temporal perspectives' is the formal relations between the contents of representations of time from different perspectives.

We start with the temporally Embedded Momentary Perspective (TEMP), which is a representation of time relativized to a particular moment in a psychological history: a snapshot of time, taken from the here and now. A simple and natural view would have it that the sensory surfaces register information about the environment and relay it to the mind where it produces experience in the way that a video camera registers and relays information to a screen so that we have real-time covariation of states of the world and states of the screen. Over time, one representational state replaces another, each reflecting the more or less occurrent state of the environment. Although a person watching the screen will remember the passing images and piece them together in his mind to arrive at an idea of how the screen changed over time, there is no representation *of time* on the screen itself, no *accumulation of information* on the screen, the content displayed on the screen doesn't have a dimension representing time.

That's not how it actually works. The brain is integrating information over an interval so that the representational content has temporal breadth (just as the representational content of every temporal cross section of a moving frame of reference has spatial breadth). There is dispute about how exactly to characterize that content. Almost no-one working scientifically in the field denies that we directly perceive motion, and the received view is that the immediate, uninferred contents of perception span a finite temporal interval. Instead of thinking of perception as generating representations of the momentary state of the environment, cognitive scientists have begun to:

"Reconceive the job of the perceptual system as producing representations that attempt to capture temporally extended *processes* (or, synonymously, *trajectories*) in the environment."^v

Trajectory estimates don't just represent parts of processes that are already completed. There is a forward-looking, anticipatory component to their content that allows us to prepare reactions to meet expected circumstances. The perceptual system of the baseball player running for a fly ball makes a computation that anticipates where the ball will be. He *sees* (non-inferentially perceives) what his brain anticipates, and so he sees literally where it is going.

Now embed perceptual consciousness in a psychological stream whose full description includes the contents of memory. The temporal content of perceptual states spans a short interval, but they are embedded in a psychological context with very long scope, both in the forward and backward direction.

And that, in its turn, is embedded in an impersonal history that is unbounded in both directions. What we do at the personal level in forming a conception of history to some extent mirrors what perceptual processing does on a very small scale in forming a conception of change over the interval of a specious present.

Like perception, memory is a tremendously complex, and very incompletely understood. In its most general meaning, memory is the process in which information is encoded, stored and retrieved. There are many different processes in the brain that satisfy this description, and scientific questions about what these processes are and how they work are in early stages of understanding. At the conscious level, things are almost as complex, but there are two recognizably different types of memory – known, respectively as episodic and autobiographical memory – that are especially important for our purposes. Episodic memory allows information from past experience to collect in the mind by making records of past events as you experienced them, often in the form of recollected images, sights, sounds and smells. Autobiographical memory gives that information autobiographical form, summarizing, constructing, interpreting, and condensing life experiences, to produce a more or less coherent narrative sense of a personal past.^{vi}

Memory is notoriously reconstructive and famously selective. Each moment is only very partially and selectively reified in the next, and reification doesn't merely copy, but transforms its objects. We forget, fill in, and embellish. But we do represent our pasts, and re-represent them with every passing moment, reexamining, reevaluating, and reorganizing them in an ongoing process of self-definition. Some of us do this more than others, but all of us do it to some degree. The notion of veridicality that is relevant to assessing autobiographical memory is not straightforward. In some cases, we can assess memories for truth or falsity. If I remember going to the store on a day in which I didn't, I remember falsely. But generally, we need a notion more general than forensic accuracy. An honest or fair representation employing thick ethical concepts is a more subtle matter than a bare transcription of fact. The sorts of mistakes that we are apt to make in memory tend to be self-serving: e.g., are remembering a fight or disagreement in a self-serving way. Search the Times book review for critical discussions of autobiographies to see the complex judgments rendered in critical discussions of autobiographies. Remembering the early stages of a failed marriage as an unending series of attacks on you, for example, or remembering someone as having been a closer friend than they were. The way that we paint our pasts can be misleading or revealing in all of the ways that a portrait can be false or faithful to its subject.

The contents of memory grow by 'accretion of fact' moving up the temporal dimension of a psychological history with the addition of new memories. We do forget things, but if memory is working properly, we remember more than we forget. The result is an asymmetric arrangement, with information accumulating in memory along the temporal dimension, representation and re-representation of the same events in every

momentary cross section of experience. It is very easy not to see the temporal depth of even momentary states of consciousness, to forget that it isn't just distributed lengthwise along our world-lines, but contained in every temporal cross section, like a series of Russian Dolls, each sandwiched between two others, and each containing internally a representation of those that precede it in the sequence to which every stage adds. Compare this structure with the representational states of a system without a memory, say a guided system navigating by an internal map of space, but not representing its past or future. The epistemic states of such a system follow one another in an ordered sequence, but the representational content does not have a temporal dimension. There is no explicit retention of information in the content of the states. Each replaces the next there is no representation of time at any point in its history, no representational state whose content takes them all into view and integrates them into a history in which they are simultaneously represented in a temporally ordered form. There is not a well-defined internal *point of view* at any point in the system's history whose content spans past, present and future.

Here, schematically, is how to build a system whose representational states have this structure: start with a system that is receiving perceptual input from the environment, add a temporal dimension to its representational states, allow memory to work recursively on those states, first storing them as snapshots of passing experiences (not just images of what one saw, but the full lived content of the experience with all of the thoughts and feelings that were present) and then organizing them into an explicit autobiographical history whose contents are always being reconsidered and retrospectively modified. Now take a temporal cross section of the resulting stream and you have the contents of the TEMP. We have the perceived present, which is itself (recall) a state with some temporal breadth. With the nested memories lining the context in which the perceived present is encountered. The opening lines of Eliot's *Four Quartets*^{vii}, and the whole of the poem itself are a haunting meditation on the depth of that momentary content, but there is nothing better than Proust's *A la Recherche du Temps Perdu* for conveying the full richness of recoverable content.^{viii} When Descartes wrote, "I think, therefore I am", he wrote as though his consciousness contained only the lone thought.^{ix} But the temporal content of a normal person's thought at any given moment contains not just the occurrent thoughts and experiences, but memories of earlier ones, with an order imposed by autobiographical memory, embedded in the larger narrative of history. And all of this structure – the occurrent thoughts and experiences, the episodic memories, the personal history, and the impersonal history in which it is embedded – is present – in a more or less definite, more or less explicit form - in every momentary part of the psychological life of a normal human adult.^x This structure is not typically part of the foreground of thought, but it is present in a form that allows it to be accessed partially and more or less on demand. The contents of memory are like psychological time capsules, providing each momentary cross section of an evolving consciousness with a compact, backward-looking representation of its own past.

But we don't just represent the past. We also represent the future. We have expectations and plans and fears and hopes. Those are tacked on to our representations of the past, and they too evolve over time, as we learn more about the world and about ourselves. The right way to think of one's view of time is as an evolving representation of history as a whole, with past and future portrayed in different epistemic castes.

The events of one's life are encountered from multiple perspectives, first in anticipation, later *in praesentia*, and finally in retrospect. And it is not just the events, but also the perspectives themselves that we represent. Later perspectives have earlier perspectives as constituents. Earlier ones have later ones as constituents. You remember anticipating what it would be like to look back on your early years. You know what it is like to feel sadness at the memory of years of regret attached to expectations for a relationship in light of what actually came to pass. States like this have an exceedingly complex temporal structure of iterated nesting. That kind of structure isn't easy to come by. That kind of structure of at structure has to be built up by passing through those stages; anticipating them, experiencing them, viewing them in retrospect, through all of one's changing fortunes. And you can probably recognize that a lot of the more interesting emotional phenomenology attaches to states with this kind of complex content. If we took a temporal cross section of the contents of a persons consciousness at a particular point in time it would be this rich in temporal content. It would be a view of history, centered on a moment separating remembered history from anticipated future.

The Perspective *Over* Time (TEVPoV)

So much for the TEMP. Then, we obtain the Temporally Evolving Point of View (TEvPoV) – that is, not just the view from a particular moment in a life, but the progression of views over a life as a whole - by stringing together temporally embedded points of view in an order defined by their frame-defining temporal parameter. This is just like taking snapshots of time as it appears at different moments and then stringing them together in temporal order and running them through a film projector. The contents of TEvPoV capture how time appears over the course of a day, a year, or a life. Formally, the contents of the TEMPs relate to one another as representations *of* time *from* different static frames. The content of the TEvPOV represents the view of time from an *evolving* frame. Compare TEvPoV with the view of space from the perspective of a moving frame of spatial reference. As you move through space, you see an object – a table, say – from different perspectives. Changes in the content of experience as one moves around the object are explained by changes in the frame. The only difference between the TEvPoV and a moving frame of reference is that the spatial dimension is replaced with time.

Some important features to note. First, we noted that perception isn't like a film camera that projects an image of instantaneous state of the environment on the screen of consciousness. It integrates information over a temporal interval so that the *content* of any perceptual state spans a finite region of both space and time. What you see (using that locution to refer specifically to the contents of the representations generated by your brain) is movement and change, which belong not to points, but *intervals* of time and *regions* of space. There is no more basic experience from which these are pieced together as the experience of a month is pieced together from experiences of days. The disputed points are whether that content includes a future component and whether acts of awareness are themselves extended.^{xi} I have sided with Grush on both points because I find the account phenomenologically convincing the data from temporal illusions persuasive. But we can slot in an extended account model or deny that there is any future temporal content without changing much. These are issues about how the brain processes temporal information, and however they get sorted

out; there is nothing metaphysical at stake. The phenomenology of flow – whether it is properly captured by the continuous, direct, experience of flux as I have portrayed it, or one of these other models – is perfectly compatible with a Parmenidean metaphysics.

Second, over time, as one viewpoint is exchanged for another, asymmetries in long-range temporal vision appear. There is an epistemic asymmetry: the past is remembered whereas the future is inferred. And there is a closely related practical asymmetry. Inject the capacity for decision-governed behavior into a system that is representing the world and you have a system that is not just a consumer of information, but a *producer*. By transforming information into decision and decision into action, the mind becomes not just a passive observer in history, but also an active participant. Decision becomes a source of information that is neither perceptual nor memory-based. And because our beliefs about the future hinge in part on the outcome of our own deliberations, our beliefs about the future can't be stabilized until our own decisions are. We experience the world as an open system with a fixed past and a future that (in the literal sense) awaits decision.^{xii}

In any case, once we get the process up and running, we can add supervising processes that generate further structures. A continuous cycle of reflective representation and re-representation, preconceiving our histories, planning, acting... and so on. We add differences in emotional attitudes to past and future, and all of the narratively structured emotions like surprise and regret and hope and fear. And we begin to get something close to the full-felt quality and content of our inner lives.

Formal Relations

So now we have a schematic description that captures the temporal contours of our own experience, with the important asymmetries in place and their connections to perception and action. The next task is to find an interpretation for flow in content-level structure, and here we want to look at the content both at and over time. At a time: The fact that the content of experience at any instant spans a finite interval means that the world as perceived at any moment *as* moving, changing, constantly in flux.

Over time: The fact that the TEvPoV is evolving, in the precise sense that the frame is centered *on* different point of time *at* different times gives us a formal interpretation of McTaggart's Moving Now. The "Moving Now" is not itself a moment in time, or an object of any sort. It is a fixed point in the evolving point of view of the agent. McTaggart's argument was, very simply, that there is no way to consistently integrate the B-series and the A-series, no way to consistently identify points across the two-series at all times. The trick is simply to let the function that integrates the A-series' and B-series itself evolve, where we are careful to define evolution in a non-question-begging way. The identity function maps the contents of a given A-series representation into the B-series. It is given by identifying the point in the B-series on which a given A-series representation is centered. And it evolves in the sense that there is an A-series representation associated with every location in the B-series the A-series is centered on different points of time at different times. This can be described non-question-beggingly in either atemporal or dynamic terms.^{xiii}

I preferred to put it in terms of reference frames. There is a frame-dependent representation of time associated with every point along a psychological history of a situated being, and the frame evolves in the sense that it is centered on different points at different times (or points). This can be described non-question-beggingly in either atemporal or dynamic terms.

The personal experience of time over history relates to the physical conception as a frame-dependent to a frame independent one. If we take what is invariant under transformations among all of these temporal perspectives within a life, we get the everyday public image of time; i.e., calendar time, the temporal analogue of the view from nowhere. The only way of integrating the TEMP's located along a psychological history is to see the viewpoint itself as evolving. At any given moment, what we call the present is the moment on which a calendar is centered. It 'changes' in the sense that it has different values at different times.^{xiv}

The Generator of a Point of View

Neither Newtonian physics nor relativity recognizes a fundamental asymmetry in nature.^{xv} So the physical basis of the epistemic and practical symmetries have come under close scrutiny. The epistemic asymmetry is relatively well understood.^{xvi} More work needs to be done to understand the nature of the practical asymmetry but within this framework both asymmetries get explained together in a story that is part physical science and part cognitive science. The physical sciences will tell us how a certain kind of system – a system that gathers information, stores it, and uses it to guide its behavior - arises in nature. The cognitive sciences will tell us how the experience of such a being is structured by the epistemic and practical asymmetries introduced by its point of view.^{xvii} Let's call the processes that structure the experience of a particular kind of being the generator of a point of view. A point of view is a generalization of the notion of a reference frame. If a frame-dependent representation represents a space in terms that are implicitly relativized to a location, orientation, state of motion, the generator of a point of view represents a space in terms that are organized around distinctions that have epistemic or practical significance to the systems that use those representations, but do not represent invariant structures of the landscape represented.^{xviii}

We can find in the literature, a useful, schematic rendering of the generator of a point of view for a being whose epistemic and practical situation in a device that James Hartle introduced into the discussion of time called an information gathering and utilizing system (an IGUS, for short).^{xix} An IGUS is a physical system that has sensors of its environment and uses the information coming through its sensors to navigate. We can describe its workings in mechanical terms, but we are interested in the formal relations between the contents of perception and the absolute structures on which those contents operate, so we describe its workings in computational terms.

Hartle's example of an IGUS that works as follows.^{xx} It has $n + 1$ memory locations P_0, P_1, \dots, P_n which we call 'registers' comprised of a time series of (coarse-grained) images of its external environment. At times separated by intervals t^* the image in register P_n is erased and replaced by the image in P_{n-1} . This is then

erased and replaced by the image in P_{n-2} , and so on. For the last step, the robot captures a new image of its external environment from its sensors and stores it in register P_0 . So, at any given moment, the robot possesses a coarse-grained representation of history of its environment extending over a time $(n + 1)t^*$, which it uses to make predictions about its environment at times to the future of the data in P_0 and direct its behavior based upon these predictions. It does this in two steps employing two different, ongoing processes of computation: U and C.^{xxi} U uses sensory information to update the image in P_0 . C uses the image in P_0 as the setting for a decision procedure. If we pay attention just to the changing contents of register P_0 and the processes that operate on those contents, we get something that corresponds to a stream of consciousness. We see an evolving image of the world used to fuel a decision process that guides the gross movements of the robot.

The only addition I made in my discussion was to fill out the internal representational environment a little and emphasize that in us, it is not just the image displayed on the canvas of consciousness (the content of the register P_0 , perhaps with some auxiliary records of stored in back registers about earlier contents), on which decision operates. Those images are used to fuel an evolving autobiography, which adds a further layer of quite complex processing that involves much more than passive recording. There is a very complex form of self-definition involved in autobiographizing. This evolving autobiography – which takes the lion's share of conscious mental energy, most ordinary people spend their conscious waking lives, aside from the immediate demands of attention rehearsing and reinterpreting their pasts, planning and reconsidering plans, reflecting on their stories and planning their future – is what really guides decision. This degree of explicit temporal content makes every appearance of being a uniquely human cognitive adaptation. Other animals have internal information-bearing states that mediate stimulus and response. What our minds do is add a temporal dimension to those states with enough room to explicitly represent our whole histories, and let deliberative processes work on those states to select action. And it is in the space opened up by that added dimension in the contents of our representational states that the concept of self as a thing with a past and future, and plans and projects, takes shape. that explicit temporal content is cumulative, evolving, and continuously subjected to the ongoing process of reflexive self-definition.

The device is – as Hartle notes – simple enough to be easily analyzed, but complex enough to generate representational states with some of the realistic complexity of our own experience. And it can act here as a formal schema that stands in for the much more complex cognitive processing that goes on in us. That formal schema is what mediates the Heraclitian character of experience with the Parmenidean character of Time itself. It is what plays the role of the transformation between a frame-dependent and frame – independent represent of space.

What Time is *Really* Like

Suppose that you think that from formal point of view, we have a resolution of the apparent conflict between two ways of representing time; time represented in a frame-independent way and time represented in a

certain kind of reference frame. It is very tempting here to raise the question of which of these two views represents how time *really* is. Defenders of the priority of the phenomenological conception insist that the atemporalist vision is just an abstract representation of a ‘really’ or ‘objectively’ or ‘mind-independently’ flowing time. According to George Ellis, for example, the history of Being is “ongoing irreversible development of time itself.” And John Norton recently: “The passage of time is a real, objective fact that obtains in the world independently of us. ... It has all the marks of an objective process whose existence is independent of the existence of we humans.” A defender of the Parmenidean conception hold that time really is static; any impression of flow is an illusion, an artifact of perspective. So here is Gold: "We ought to eliminate this flow idea from the real picture, but before we can eliminate it we ought to understand how it arises. We should understand that there can be a self-consistent set of rules that would give a beast this kind of phony picture of time." the embedded agent sees a world in progress, unfolding, full of possibility and unrealized potential. But really, this is all illusion, an artifact of ignorance.

I fail to see how there could be any substantive question about which of these is correct. From the frame-dependent perspective of TEvPoV, the atemporal representation is a static representation of an evolving reality. From an atemporal perspective, TEvPoV is an evolving representation of a static reality. There is a perfect symmetry. Each is implicit in the other, obtainable from it by a transformation akin to the transformation between a frame-dependent and frame-independent representation of space. The idea that one of these is more ‘real’ than the other is just a mistake. There *is* a well-defined sense in which the TEvPoV is less objective; viz., the TEvPoV represents time in a frame-dependent manner and that the specifically Heraclitian features of time (passage and flow) turn out to be frame-dependent.

The TEvPoV contains more information of direct practical relevance to the situated agent, because it represents the events in history at large to those in the evolving here-now of the agent’s internal time, and the ‘here-now’ of the agents own internal time has direct (representationally unmediated) connections to perception and action.^{xxiii} Time passes from the evolving point of view of an IGUS in the same way that the rows of houses pass by the passengers on a train. It is an illusion only if we think that it is time itself, rather than our perspective on time that changes over a life, which is to say only if we think that we have a fixed perspective relative to the Absolute structure of time, and I see no reason to convict our ordinary ways of thinking and speaking of that mistake. Indeed, whatever we say in philosophical moods, we all have a good working knowledge of how to integrate temporal information across perspectives that shows that we are *not* making such a mistake.

We have become accustomed to the fact that physics represents the world at an increasingly fine level of resolution, with the result that a lot of what is simple at the level of experience turns out to have a hidden substructure, and gets reconstructed from more fundamental structures. But physics doesn’t just go deeper. There is also a progression towards an increasingly Absolute conception of the world, one that aims to capture the intrinsic structure of Being. This progression works by taking what is invariant under transformations between perspectives, where ‘perspective’ is now widely construed to include relations to any

feature of ourselves, our sensory states, our situation, or our local environment. And it is part of the logic of that progression that increasing amounts of the structure that is at the forefront of human thinking about the world gets reconstructed as implicitly relativized to our situation in the world.^{xxiii} It should not be surprising that structure that has the most immediate epistemic and practical import for us should be at the forefront of human thinking about the world, or that structure that has the most immediate epistemic and practical import for us should end up being, in this sense, perspectival. We care directly about what is happening nearby and soon. Notions of absolute location in space-time come later and only as hooks on which to hang information about places we are not at.

There is a tradition in physics that dismisses frame-dependent or coordinate-dependent structure as *unreal*, but that tradition has to be very delicately interpreted. It is dismissed as unreal in cases in which the frame is a virtual object with no physical significance, and the distinction between frame-dependent and frame-independent content is a separation of structure in the mathematical object used to represent from what it represents. But when reference frames represent real features of the situation of viewing agent, the frame-dependent content has physical significance as implicitly relating the objects of representation to his situation. There is nothing illusory about the fact that Paris is far away, or quinoa is healthy. But from a more absolute perspective these get reconstructed as relations to a location and particular kind of physical constitution. What happens in the progression towards an increasingly absolute conception of the world is that implicitly relational structures are explicitly relativized. What we did here was to reconstruct the dynamic features of time as frame-dependent. We found that when we move to a level of description that captures only what is invariant under transformations between temporal perspectives; the dynamic features of time are reconstructed as relations to the evolving point of view of the agent.

When we read novels we make the easy transition from the point of view of the reader to the point of view of the participants. It's a formal transformation that I'm uncertain why there is such psychological difficulty in making this transition in the case of time. One part of it is the tendency to think that structure that is frame-dependent (in the relevant sense) is *unreal*. I've said why that is a mistake.^{xxiv}

I used to think that there is something that is missing in this way of resolving the conflict, that it defines away a substantive issue. I now think that there is a sense in which the problem arises because the solution exists. And the more interesting question is why the problem proves so psychologically resilient. The debate between the flowing time of everyday experience and the static time of the Block Universe has a stubborn way of reasserting itself as a substantive and all-important metaphysical disagreement, even in my own mind. It is a reminder of the constant tension in the human between the transcendent and embedded viewpoints, which is in its turn the product of the peculiarly human form of mindedness.

Generalizing the Lessons

This paper has been about sorting out some of the formal relations between time as it appears from the evolving point of view of experience and time as it appears from the Absolute (or temporally transcendent) perspective adopted by physics.

Once we have a handle on the formalities, we apply the distinction between the Absolute structure of time and those features of our experience of time that turn out to be frame-dependent, and it emerges that flux and flow and all of the so called 'dynamic properties of time' turn out to be frame-dependent. There is nothing illusory about the frame-dependent content. Changes in the point of view from which time is viewed over the course of a life are as real as changes in the point of view from which space is one moves through it. It is just that the invariant structures are the static relations captured in the Block Universe.

What this reconstruction does is prompt a generalization of the everyday notion of perspective to something with the logical complexity of the generator of a point of view; no longer a static transformation, but a process. And in so doing, quell the dual tendencies to either reify or reject features of temporal experience as illusory that are actually implicit in the physical conception, as the way time would appear from the perspective of (a certain kind of) embedded creature.

There are some lessons here about how to address arguments that physics is inadequate to some aspect of experience. Philosophers sometimes speak as though the problem is that if one lays the atemporal view of the universe alongside a representation of temporal experience, one doesn't find anything in the atemporal representation that *corresponds* to flow. But this is the wrong account of how physics relates to phenomenology. What physics owes to phenomenology is a non-reductive reconstruction of the contents of the point of view of the agent that tells us how the representational states of an evolved system with a particular combination of epistemic and practical needs would be organized.

To transform an account of the Absolute structure of time into a view of time from the perspective of an embedded agent, we have to understand perspective from which time is viewed in experience both at a time and over the course of a personal history. The transformation is not a static mapping, but a generative procedure that produces a stream of content in which time is represented from a point of view that evolves relative to the fixed background of Absolute time. Formally, the case of time precisely mirrors that of space, with a single dimension in place of space's three dimensions and with the added complication that experience is *extended* in the very dimension *represented* in its content.^{xv} Once we add the epistemic and practical asymmetries that a creature storing information about its past and making decisions about its future bears to time at different points in its life, we have something that begins to look recognizably like our own temporal experience. The asymmetries are introduced by the agent's perspective. They are asymmetries in her practical and epistemic relations to events, not asymmetries in the intrinsic nature of the events being represented. They vary from one person to the next, and from one moment in time to the next.

There is an assumption built into many of the current practices in analytic metaphysics that for every element of belief or experience, there should be a corresponding element of Being, i.e., that we should be able to take account of what there is in a perspective-free or Absolute conception of the world and find something that corresponds to every structure that is present at the level of experience. But there are all kinds of reasons that we shouldn't expect extensional correspondences that are that are readily apparent when you look at the transformations wrought by the generative procedure. Relating the world as it appears in physics to phenomenology requires nothing less in general than the generative procedure, iterated over time, to allow structure to (i) train up the schema, (ii) accumulate in the content, and (iii) evolve over time. The training up period builds a lot of structure into our models of the world in the form of invariant patterns stabilized out of experience in the training period (expressed in a mature theory as about dispositions, capacities, chances, and dispositions) used to guide expectation and action. Information about the way things generally hang together gets built into our representations of the way they are in the here and now, so that information gets all mixed up and spread around in a manner that precisely confounds those nice, discrete mappings. The accumulation of content means that even momentary representations have content that spans all of history. And the evolution means that a static domain is experienced as in flux.

Separating of 'the products of the processing' from the absolute structures on which that processing gives us an account of the phenomenology that neither reifies the features that turn out to be frame-dependent, nor dismisses them as illusory. The picture we end up with is very close to Ramsey's. What changes or evolves is not time, or Being, but a probability distribution and an evolving catalogue of practical possibilities defined over Being that represents the changing epistemic and practical relations an IGUS to the events in history as we trace a path up its world line.^{xxvi} The mistake that opponents of the atemporal conception make is to reify in the absolute structure of time features that belong properly to the point of view of such a being.

The discussion of time here can serve as suggest as a model of how to do metaphysics in a different way. Reductions and search for truth conditions are replaced by account of the generative procedure that relates the absolute structure of the world to the experience of an IGUS.

ⁱAt least on length scales much greater than the Planck length. It is not unlikely that significant departures are needed to attain a theory of quantum gravity. For controversy about whether physical time is Parmenidean, see Price, Huw, *Time's Arrow and Archimedes' Point: New Directions for the Physics of Time* (Oxford University Press, 1996) and Markosian, Ned, "Time", *The Stanford Encyclopedia of Philosophy* (Winter 2010 Edition), Edward N. Zalta (ed.), URL = <<http://plato.stanford.edu/archives/win2010/entries/time/>>. And for discussion of time in quantum gravity, see Butterfield, J. *The Arguments of Time*, Oxford Clarendon Press 1999.

ⁱⁱ<http://www.pitt.edu/~jdnorton/Goodies/passage/index.html>, p. 1

ⁱⁱⁱ Ibid. p. 1.

^{iv}By 'experience', I don't just mean the raw sensory phenomenology. I mean the full evolving contents of consciousness, including the thoughts, emotions, and feelings that make up the everyday flux of mental life in both quality and content.

^vGrush, Rick (2007). *Time and experience*. In Thomas Müller (ed.), *The Philosophy of Time*, Frankfurt: Klosterman. Grush, R., (2005), p. 15. The *locus classicus* of the view that the contents of perceptual states have temporal extension, see James, W., (1890), *The Principles of Psychology*, New York: Dover.

^{vi} There is also procedural memory and semantic memory, which are exercised respectively when you remember a learned skill like riding a bike and then you consciously recall impersonal factual information as in studying for a test, again. These are heuristic divisions only and they are not exhaustive. For something much more nuanced, see John Sutton, *Philosophy and Memory Traces: Descartes to Connectionism*, Cambridge University Press, 1998, and also <http://www.macqs.mq.edu.au/members/profile.html?memberID=237/>

^{vii} "Time present and time past
Are both perhaps present in time future,
And time future contained in time past." (Eliot, T. S. "Four Quartets 1: Burnt Norton." *Poetry* X. Ed. Jough Dempsey. 13 Jul 2003.

^{viii} *In Search of Lost Time*. General Editor: Christopher Prendergast. London: Allen Lane, 2002 (6 vols)

^{ix} For the second clause follows if that is what the "I" of the first clause refers to.

^x To say that this structure is present in a more or less definite, more or less explicit form in every momentary part of the psychological life of a the life of a consciousness with autobiographical memory is (emphatically) *not* to say that it is fully present in an entirely explicit form in every waking moment of our conscious lives. The psychological presence of this sort of autobiographical content in day-to-day activity is rare and the degree to which it is present at all varies from one person to the next. Some people do carry a self-concept of Proustian complexity, but others have a relatively thin sense of the story of their lives. For strong claims, see Bruner, J. (1987). 'Life as Narrative', *Social Research* 54, pp. 11–32. Dennett, D. (1988). 'Why everyone is a novelist' *Times Literary Supplement* 16–22, September. Macintyre, A. (1981). *After Virtue* (London: Duckworth). For critique of the strong claims, see Strawson, G., "Against Narrativity", *Ratio (new series)* XVII 4 December 2004. The claim here is simply the weak and uncontroversial claim this structure is implicit in the ability to think about ourselves as autobiographical subjects and the representational forms we employ in practical deliberation.

^{xi} See for example Grush, Rick, 'Internal models and the construction of time: Generalizing from state estimation to trajectory estimation to addresses temporal features of perception, including temporal illusions', *Journal of Neural Engineering*, 2: 209–218. Dainton, B., (2008), 'Sensing Change', *Philosophical Issues*, 18: 362–384. See also Andy Clark "Whatever Next? Predictive Brains, Situated Agents, and the Future of Cognitive Science", *Behavioral and Brain Sciences* (in press), Chuard, P. 2011. Temporal Experiences and Their Parts. *Philosopher's Imprint* 11.

28. Ian Phillips, *The Temporal Structure of Experience*, in D. Lloyd and V. Arstila (eds.) *Subjective Time: the Philosophy, Psychology, and Neuroscience of Temporality* MIT Press, 2012.

^{xii} Joyce, J. (2002), "Levi on Causal Decision Theory and the Possibility of Predicting One's Own Actions", *Philosophical Studies* 110: 69–102. "Decision and the Open Future", in *The Future of the Philosophy of Time*, Adrian Bardon (ed), Oxford University Press (2012), Ramsey, F.P. (1978), "General Propositions and Causality", in *Foundations: Essays in Philosophy, Logic, Mathematics and Economics*, D.H. Mellor (ed.). London: Routledge & Kegan Paul, pp. 133–51, Price, H., "The Direction of Causation: Ramsey's Ultimate Contingency", From David Hull, Micky Forbes and Kathleen Okruhlik (eds.), *PSA 1992, Volume 2* (East Lansing, Michigan, Philosophy of Science Association), pp. 253–67.

^{xiii} The remarks here are a generalization of Chapter 10 in *The Situated Self* (OUP, 2007), integrating the A-series with the B-series by a transformation from a frame-dependent to a frame-independent one where the frame is defined as above; an evolving frame, or if you like a frame centered on the Moving Now, which is interpreted in four-dimensional terms as a fixed point in the mapping between the invariant representation and the various temporally embedded perspectives on time embodied in the different stages of the psychological history of a human being.

^{xiv} From the point of view of the special theory of relativity, the common present of calendar time is local and inherently approximate notion, contingent on our being sufficiently close to one other and moving with relative velocities much less than that of light? The personal present of an individual human at any point along its world-line is the moment on which its representation of time is centered. It 'changes' in the sense that it has different values at different points along its world line.

^{xv} Before we can say whether quantum mechanics incorporates such an asymmetry, we need a solution to the measurement problem and an understanding of the ontology. Even if quantum mechanics does impart a temporal asymmetry to nature, it is likely to be washed out by decoherence at the level at which cognitive processes operate.

^{xvi} There is lively dispute about the details, the bulk of the scientific community thinks that an explanation of this asymmetry based on the thermal gradient and additional contingent will be correct. See Albert, David Z., *Time and Chance*, Harvard University Press, 2000, and the review by Nick Huggett in *Notre Dame Philosophical Reviews*, <http://ndpr.nd.edu/news/23401-time-and-chance/>

^{xvii} For a start at this part of the story, see Andy Clark "Whatever Next? Predictive Brains, Situated Agents, and the Future of Cognitive Science", *Behavioral and Brain Sciences* (in press).

^{xviii} Except, of course, insofar as the systems that use those representations are themselves part of the landscape. They appear in the absolute structure of the world in a form that is explicitly relativized to the situation of their users.

^{xix} "The Physics of Now", *American Journal of Physics*, Volume 73, Issue 2, pp. 101. Hartle himself took the device from Murray Gell-Man, though it has become more closely associated with his own name.

^{xx} Notions of representational content invoked in the description of an IGUS is one that applies to robots and computers as surely as humans.

^{xxi} The letters C and U are chosen to signal the corresponding unconscious and conscious processes in us.

^{xxii} From a four-dimensional point of view, that extra information is reflexive information, and it has a quite complex logical structure. See Perry, John, *Reference and Reflexivity*, and my 'Reflexivity, Fixed Points, and Semantic Descent: How I Learned to Stop Worrying and Love Reflexivity', *Acta Analytica*. 2008.

^{xxiii} It is sometimes alleged that the scientific vision of the world loses contact with what matters from a human perspective. There is some justification for this, but it is not quite accurate. What is true is that if we equate the scientific view of the world with fundamental physics, the fundamental structures are very far removed from anything that has immediate epistemic or practical significance for human beings. These appear at somewhat higher levels in the edifice of the scientific view of the world.

^{xxiv} Another – and I think this is perhaps the deeper source of the tension – is the connection between time and possibility. The view of history from the perspective of a moment in it is deeply connected with the sense of openness and possibility, a sense that there are yet any number of ways that history could play out and that what happens next hinges on the here and now. The temporally transcendent perspective seems to wash all of that out, flattening a rich tapestry of evolving possibilities into the thin hard line of actual fact. On the relationship between the atemporal and the *amodal* perspective, see my “Is the Atemporal Conception of the World also Amodal”, in Abrams, forthcoming.

^{xxv} In physical terms, space-time is more fundamental than either space or time, so that we should really be talking about the relationship between the Absolute structure of space-time and the view from a frame of reference that is moving relative to the fixed structure of Absolute space-time.

^{xxvi} And if anything flows in this picture, it is information, flowing in through perception, over the field of belief, and into the decision procedures and back out into the world in the form of action.