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Analysing Time-Consciousness:
A New Account of the Experienced Present

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Declaration of Authorship

I declare that this thesis has been composed solely by myself and it has not been submitted, in whole or in part, in any previous application for a degree or professional qualification. Except where stated otherwise by reference or acknowledgment, the work presented is entirely my own.

Signed

Camden Alexander McKenna

1 October, 2022

Notes on Publication

Parts of this thesis have been published, in modified form, as articles in academic philosophy journals. The relevant articles are the following:

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Abstract

This thesis presents a novel theory of temporal experience. While time as measured by the clock is a perennially popular topic, the time of experience remains relatively neglected and poorly understood despite its centrality to our existence. This thesis therefore sets out to address the following questions:

- 1) How should we characterize experiential time and the experienced present?
- 2) How might such distinctively temporal experience arise in the first place?

While the first of these is a “what is it like” question, and thus in the realm of phenomenological analysis, the second is ostensibly closer to the realm of scientific inquiry in that it concerns an empirical phenomenon. The goal of this thesis is to synthesize plausible answers to both of these questions. As to the first question, there is already a lively debate ongoing in the philosophy of mind between various camps, each offering what they see as the most plausible analysis of the phenomenology of time. Regarding the second, there is an interdisciplinary investigation of mechanisms at various levels of abstraction, notably the levels of neurophysiology and information processing.

This thesis proposes, among other contentions, that the time of experience is best characterized by a combination of retentional and extensional phenomenological analyses. This means the actual temporal extension of experience and its correlates determines, to some degree, the felt temporal character of experience. At the same time, perhaps the greater part of temporal phenomenology is determined by content: mental processes can be *about* temporal properties in addition to their primary contents and the way they are so partially determines the temporal character of experience as well. This analysis dovetails nicely with contemporary theories of consciousness that maintain the brain is fundamentally a complex predictive engine actively and adaptively guiding behavior. The thesis thus represents a multi-level framework for understanding the experience of time and the mechanisms underpinning it. It is my hope this perspective advances the debate on time-consciousness and can guide further work towards understanding this most fundamental aspect of our lives.

Lay Summary

This thesis begins by describing what is commonly called the “experience of time” but may more properly be called “temporal experience” or “time-consciousness”. The reason the “experience of time” is not an accurate description is because “time” itself does not feature as an object of our experience in the traditional sense. Rather, time is the way we experience everything we experience. This contention will remain a background orientation of this thesis as it progresses.

In attempting to describe temporal experience, we quickly discover it is extremely complex and difficult to nail down through introspection alone. Thus, the thesis commences with a great deal of conscientiousness regarding those things which are to be explained (the *explananda*) by the theory that will eventually be proposed. The first goal of this thesis is therefore a plausible description of the temporal character of experience as we find it.

The thesis argues that experience must be successive given the type of creatures we are and the world we inhabit. From there the analysis of our experience becomes ever more fine-grained. The thesis contends that the experiential present, that is, what we take to be “now”, is not an instant as is commonly assumed but rather a *window* of time. This window of time that we take to be “now” is underpinned by a real span of time occupied by experience itself, as opposed to a span of time merely represented as such. Nonetheless, the thesis maintains that the content of mental states also plays a role in explaining some of the features of experienced time described earlier in the dissertation, including felt continuity and the “sense” of succession (as opposed to the “fact” of experiential succession).

Connecting the analysis of temporal experience to contemporary scientific approaches, this thesis then proposes that understanding the mind as a prediction-generating, action-guiding engine provides further insight into the cognitive mechanisms that ultimately construct the experienced present for us as subjects. The proposal is therefore a thesis both about how we ought to understand temporal experience and a thesis about how we might best explain it.

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This dissertation would not have been possible without the love and support I have received from many people over many years. First and foremost, I would like to thank my family for their steadfast encouragement every step of the way, from my first philosophical speculations as a child until today. While the questions may have changed since then (slightly), I am grateful beyond measure to my parents for nurturing within me an insatiable curiosity about the world. This is the motive force that gets a project like this off the ground in the first place and for that I am forever grateful.

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Finally, I would like to dedicate this dissertation to my family for staying the course with me and keeping me sane and healthy through good times and bad. In particular, I'd like to dedicate this work to my grandmother Gloria McKenna, who turned 100 on the day this dissertation was submitted (October 27, 2022) and knows more about time than I could ever hope to.

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Chapter 1: Introduction

Around 400 CE, Augustine asked “What then is time? If no one asks me, I know what it is. If I wish to explain it to him who asks, I do not know,” (*Confessions* XI, xiv). In part, Augustine’s confusion is a semantic one. The semantic problem is that our word “time” is ambiguous between several different concepts, many of which, but not all, refer to aspects of our own multifaceted experience. To avoid confusion, conceptual analysis can help us to narrow down what exactly it is we mean to speak of so we can avoid falling into confusion whenever we speak about time.

One “time” is the time of physics, which is often what people first consider when they think of the “real existence” of time. The consensus view on the concept of time in physics has gone through a number of changes and evolutions throughout its history. The notion of a physical absolute time (i.e., a universal temporal reference frame) was commonplace from Aristotle’s era through Newton’s and beyond. Following Einstein, the contemporary relativistic understanding now considers there to be no universal reference frame. Instead, space and time constitute a unified manifold: spacetime. In the 20th century, how “time” or “spacetime” operate under quantum mechanics became its own vexing question, along with how to reconcile quantum phenomena and phenomena on a macro scale that appear to behave relativistically.

So far, we have been speaking of time conceptualized as existing apart from and independent of ourselves, which is to say, as a feature of the universe we find ourselves in. This sense of “time” commonly flies under the more specific banner of “clock time” (or, sometimes, “objective time”). “Clock time” just refers to whatever it is that a clock measures and is the primary concern of physicists and metaphysicians.

Whilst clock time is fascinating in its own right, of more immediate concern to us as living subjects is the time of our *experience*, which naturally is also the source of many of our intuitions about time beyond ourselves. Here we encounter our first major conceptual distinction: “clock time” vs “subjective time”. Augustine’s question, however, applies equally well to either of these concepts. What do we mean by “subjective time”? It seems all we know is that there is at least *something* that we notice upon introspection and label “time”.

One thing we call time is our abstract conception of time itself. For instance, one might conceptualize time in their life as having certain qualities—receding faster and faster as we age, for instance, or presenting us with a vast fearful unknown ahead and an ossified

history behind. But these broad conceptions seem to rest upon a firm and immediate phenomenological foundation. Our immediate temporal experience includes, among other things, our memory and imagination. We recall events we have already experienced in the present and we project future eventualities and can simulate them now. Both of these mental activities have a distinctive phenomenology—a certain way they are like to the subject.

However, neither memory nor imagination seem fundamental to our experience of time, at least at first glance. It seems there are more basic phenomena still. The bare succession of experiential events, for instance, or what we might call the “passage of time” that lends to our experience that familiar feeling of rolling inexorably into the future and away from the past, an experience itself beyond the ability of metaphor to effectively capture¹, seems to be at the heart of what is meant by “time.” This fundamental way that we experience the world, namely, in time, on a constant basis, has been termed “time-consciousness” by Edmund Husserl (1917), which is an apt label. Time-consciousness is not necessarily consciousness *of* time, nor is it just time itself in a metaphysical sense, nor does it exhaust the possible mental activities that have to do with time. Rather, time-consciousness is the way that our experiences are had. Just as we say visual experiences are spatial in character, we can say all of our experiences are *temporal* in character. Having experiences in this temporal manner is what it means to be “time-conscious”, and it is of the nature of experiences that they are so.

We have disentangled multiple senses of “time” and landed at “time-consciousness” as most fundamental to our own experience. Still, it seems Augustine’s question is just as reasonable to ask as ever.

What then is *time-consciousness*? In other words, how are we to understand this temporal experience that we have? This is the guiding question of the present work. Historically there have been many attempts to answer this question from many different angles, whether philosophical, scientific, theological, etc., many of which we will consider.

¹ The metaphors we use to elucidate experiential time are unusual in that they are themselves inscrutable without appeal to the temporal processes they are meant to describe. For instance, the only way to understand the metaphor of the “stream” of consciousness is through the stream of consciousness itself. Accordingly, it is unclear to what degree the metaphor serves to explain the phenomenon, when it is itself underwritten by the phenomenon it is meant to explain (for a lengthier discussion of this point see Merleau-Ponty 1945: 477-479). This is quite different than ordinary cases of analogical explanation (e.g., “a family is like a tree”) where the *relata* are independent. Nonetheless, metaphors like “stream of consciousness” give us words where previously we might have had none.

However, strong interest in the analysis of the phenomenology of time-consciousness *per se* has only really come into its own over the last century and a half or so.

Nonetheless, the metaphysics of time continues to attract much more interest and attention philosophically. However, given that the time of experience is so central to our existence—even, as I will argue, an enabler of this existence—the study of time-consciousness warrants much more attention than it has historically received. It is possible the sheer difficulty and degree of confusion surrounding the topic has dissuaded investigators. Nonetheless, there has recently been a limited resurgence of interest along with a shift, among some thinkers, towards seeing issues of temporal experience as crucially bearing on many other philosophical problems, particularly in the philosophy of mind. It is my hope that the present work contributes to the renewal of interest in the philosophy of *subjective time* (time for the subject) and the repositioning of the questions surrounding the topic towards the center of philosophical discourse.

We can see the many attempts to analyze the experience of time as occupying different “levels”. Some of these levels are “high up” in the sense of embodying abstract characterizations of the structure of our phenomenology. In other words, they give some account of our temporal experience beyond just saying that such a thing exists. These analyses are usually geared at answering puzzles about our experience or providing an explanation for certain phenomena in our experience. We can call this the macro-phenomenological level of analysis. Examples of this sort of analysis would be the breaking down of our temporal experience into, for instance, a successive structure or observing that we experience the present as an extended duration (the so-called *specious present*).

The macro-phenomenological level stands in contrast to what Barry Dainton has called the “micro-phenomenological” level of analysis (Dainton 2010), which represents an even more fine-grained description of the constituents of our temporal experience. This level has probably exercised philosophers more than any other over the last century or so. It is at this level that determinations about the internal composition of experience are made, which may not be manifest to introspection, but which may nonetheless turn out to be required for experience to be as it is. The influential “retentional” phenomenological analysis of Edmund Husserl (1917), which claimed experience exhibits an invariant tripartite temporal structure, falls largely on this level (much more on the details of that account later).

Furthermore, there are also implementation-cognizant accounts, coming largely from the sciences (especially cognitive science, neuroscience, and psychology), which themselves occupy varying levels of analysis. Accounts can be given at the functional level, for instance

concerning information processing, perhaps outlining a possible mental computational strategy that is meant to result in a particular kind of temporal experience. Accounts can also be given of alleged neurophysiological correlates of the experience time, as in “internal clock” models. Accounts given at these levels are not necessarily mutually exclusive, and, ideally, should hang together coherently to give a complete picture of how temporal experience works for us.

The goal of this thesis is to propose plausible phenomenological analyses of the experience of time on both the macro and micro levels, which not only solve longstanding conceptual problems, but also dovetail nicely with an information processing implementation that I will introduce here as well. The overall picture should be a coherent theory of temporal experience on several levels of analysis that accommodates relevant phenomenology, with advantages over rival explanations and practical implementation-level implications.

This thesis takes a broadly adverbialist position on the experience of time overall.² Temporal adverbialism, as I define it, is the thought that time itself is not experienced but rather we experience things in a temporal way. In keeping with this adverbialism, I have tried to avoid the phrase “time perception,” which may lead readers to mistakenly view time as an object of perception like any other. Unlike adverbialism about some other aspects of perception (e.g., color vision), the position that time is not perceived *per se* but rather we perceive temporally appears to be very widespread if often implicit³, with similar ideas suggested at least as far back as Kant.

On the macro-phenomenological level, the proposal here endorses the specious present and the centrality of succession to temporal experience, as well as the apparently felt passage of time for the experiencer. On a micro-phenomenological level, the proposal is a hybrid theory that combines the most appealing aspects of the positions known as retentionalism and extensionalism, while attempting to shed the disadvantages. Briefly, extensionalism is the idea that experience itself is extended over an actual duration of clock time, and we experience an extended present as such in virtue of this extension. Retentionalism, on the other hand, typically maintains that the actual temporal extension of our experience is explanatorily irrelevant, with the character of our experiences depending

² Note there is no connection between adverbialism about temporal experience and adverbialism as a theory in the metaphysics of (clock-) time.

³ As recognition dawns that there is “no dedicated sensory system for time” that picks up on particular properties of the world (Seth 2021: 134), this sort of adverbialism becomes an increasingly attractive position.

instead on the content of “intentions” that may be oriented to different times (having content *as of* the just past, etc.), which themselves can have any particular ordering in time and are often schematized as existing together simultaneously and instantaneously, though representing different times to the subject.

As a hybrid view, this proposal suggests the actual extension in clock time of the intentional entities posited by retentionalism *is* explanatorily relevant to the experiences we have. Specifically, the actual temporal extension forms the basis for the duration of the specious present, which would otherwise be inexplicable. Such a hybrid fits nicely with currently prominent “predictive” approaches towards mind and brain function. These approaches provide information processing level accounts that could underpin the phenomenology analyzed above in a coherent way. I will accordingly offer a sketch of what one such account might look like.

The plan of the thesis is as follows. **Chapter 2** will explore what I call the “phenomenological desiderata” for an account of the experience of time. In other words, this chapter will try to identify those features of experience that a good theory of time consciousness needs to accommodate and ideally explain, i.e., the explananda of the theory.

Chapter 3 will look beyond the contingent features of our actual experience to the kinds of constraints on any possible experience in our world. More specifically, in this chapter I will argue that experiential succession is a requirement for agentive subjects, and most plausibly any subjective being in this world. It is thus paramount that our theory of time consciousness makes this core feature fundamental and not an ad-hoc or “bolt-on” module.

Chapter 4 will review the high-level “classic” analyses of the phenomenology of temporal experience. These include the standard categories of extensional, retentional, and cinematic views. This chapter discusses the advantages and shortcomings of each and ultimately concludes that none of them on their own are satisfactory.

Chapter 5 will look in greater critical detail at a recent attempt to rehabilitate the cinematic view in the form of what’s known as the “dynamic snapshot theory.” I will argue here these attempts are misguided and rest in large part on a mistaken interpretation of a class of illusions known as motion aftereffects. With the snapshot theory in its various permutations in disrepute, we are left with “specious present” views as credible analyses of time-consciousness.

Chapter 6 offers several positive arguments in favor of a hybrid view that combines the best elements of two of the classic phenomenological analyses, namely retentionalism and extensionalism, which both endorse the so-called “specious present”. This chapter argues that

a hybrid extensional-retentional analysis (ERA) of temporal phenomenology can escape the pitfalls of each of its component views individually while reaping their respective benefits, and additionally provide a plausible implementational story informed by recent developments in cognitive science.

Chapter 7 continues to develop the analysis given in the previous chapter with a more thorough consideration of how such an account might come to be implemented at the information processing level. Here I argue that predictive approaches to brain/mind function that have become ascendant in recent years naturally dovetail with the kind of hybrid account of temporal experience proposed earlier. Specifically, this chapter proposes a model of “Temporality as Iterative Expectation Revision” (TIER), that aims to avoid some of the problems associated with other recent computational approaches to the implementation of phenomenological analysis.

The thesis then concludes in **Chapter 8** by recapping the steps taken to arrive at the view proposed here and considering the significance of such a proposal in a larger philosophical and empirical context. I suggest that, ultimately, subjective time is the result of the ongoing processes constructing our experiential reality. This means that, properly understood, time is not an object of perception but rather the way we experience the world.

Chapter 2: Phenomenological Desiderata

1. Introduction

There are many things we should want from a theory of temporal experience. How well our theory can satisfy this list of demands goes a long way to determining how good the theory is. The things that we desire from our theory we can call *desiderata*. This chapter considers phenomenological desiderata. Phenomenological desiderata include features of our subjective experience of time that should be explained (or explained away) by our theory. Phenomenal features are aspects of “what it is like” for us to experience time subjectively. If the theory does not explain these phenomenological features, or, worse, predicts that different subjective experiences should occur than those that do, then the theory needs to be revised. It is therefore imperative that the targets of explanation are well characterized and clarified.

The aim of this chapter is to identify the temporal features of our experience that a successful theory should in some way be able to explain. Further analysis might reveal that some of these features overlap or have an asymmetrical dependence on other features; for instance, simultaneity may be subordinate to the larger phenomenon of temporal unity. However, if we consider the phenomenology in a deliberately uncritical way for now, some of the most obvious temporal features of experience would include the following:

- a. Passage
- b. Events
- c. Simultaneity
- d. Continuity
- e. Endurance
- f. Temporal Unity
- g. Intervals/Durations
- h. Succession
- i. Global Feature of Consciousness
- j. Variability
- k. Abnormal Phenomenology

These features will each be described in detail in this chapter. While the above list⁴ represents obvious phenomenological features of temporal experience, there are other more contentious aspects that have been advocated by philosophers and psychologists in the past. These include what Barry Dainton (2010) has called the “micro-phenomenology” of time-consciousness, referring to the structure of our experience that is perhaps less immediately apparent to us as subjects. Such features include the structure of the so-called *specious present*. The notion of the specious present, popularized by William James, is that the experienced present is not instantaneous as we might commonly believe, but rather comprises a finite *span* of time (James 1890: 609-610).

Also controversial is Husserl’s contention that the phenomenology of subjective time exhibits a *tripartite structure* including what he calls *retentions*, *primal impressions*, and *protentions* (Husserl, 1917). For Husserl, anticipations of the future and traces of the past are an essential feature of the way we experience events. Following Husserl, Merleau-Ponty proposed phenomenological *presence-in-absence*, referring to the notion that the unrealized future and nonexistent past are nonetheless present in experience in some way (as a kind of *looming* perhaps)(Merleau-Ponty 1945). The present work is committed to the veracity of the phenomenological features introduced by James, Husserl, and Merleau-Ponty and attempts, as most other contemporary views also do, to explain these features as well as the others. The reasons for taking such features seriously will be discussed in greater detail later, while for now we will focus on more uncontroversial features of temporal phenomenology.

a. Passage

Augustine was one of the first philosophers on record to consider time as a subjective experience as opposed to an external phenomenon of the physical world.⁵ Augustine’s early phenomenological analysis represents the intellectual origin point for investigations of subjective time and provides us with important insights that remain relevant for contemporary theories of temporal experience. Augustine recognized that, “It is in you, O

⁴ Various authors have emphasized or left out some of the features presented here. Ernst Pöppel, for instance, mentions only duration, non-simultaneity (implying also simultaneity), temporal order, past and present, and change, which, by his lights, subsumed the passage of time (Pöppel 1978).

⁵ Heraclitus arguably preceded Augustine in this endeavor when he spoke of the flowing river into which we cannot step twice, but he did not distinguish between time as a subjective phenomenon and a metaphysical process. Aristotle, as well, had a view about objective time, namely, that “before and after” are derived from change, which is itself derived from magnitude (Aristotle, *Physics* IV 11, 219a14-19).

mind of mine, that I measure the periods of time. Do not shout me down that it exists [objectively][editor's note retained],” (*Confessions*, Book XI, Chapter XXVII). Augustine thus makes a distinction between how time appears to us and the dynamics of the mind-independent world: “I measure as time present the impression that things make on you [the mind] as they pass by and what remains after they have passed by—I do not measure the things themselves which have passed by and left their impression on you,” (ibid.).

In other words, we feel time passing, whether or not it actually does. Augustine’s observation of passage makes use of a common spatial metaphor⁶, with the experienced passage of time seeming to involve a kind of “motion” with a future-facing trajectory in which we are inexorably swept up. This feeling of passage has led to many of our best-known metaphors for time, from the “river” of Heraclitus to the “stream of consciousness”⁷ and the oft-invoked folk imagery of paths, roads, ships, and journeys through life.⁸

Despite its apparent ubiquity, the sentiment that we feel time passing, as foundational and unassailable as it sounds, is not universally accepted. Simon Prosser (Prosser 2016) and Bradford Skow (Skow 2011), for instance, believe the experience of the passage of time is an illusion. Further, Prosser thinks the very idea of passage is incoherent. Regardless of whether the passage of time turns out to be an illusion or not, a good theory of subjective time must explain why it *seems to us* as if time passes. In other words, to what do we owe this deeply held and nearly universal intuition that experienced time has an essential movement-like quality and trajectory to it?

Even in antiquity, Augustine saw that the subjective passage of time presents serious philosophical difficulties. On this subject, he posed the following series of questions:

[H]ow is it that there are the two times, past and future, when even the past is now no longer and the future is now not yet? But if the present were always present, and did not pass into past time, it obviously would not be time but eternity. If, then, time present—if it be time—comes into existence only because it passes into time past, how can we say that even this is, since the cause of its being is that it will cease to be? Thus, can we not

⁶ There is some evidence that in conceptualizing time humans have hijacked parts of the brain usually employed in the service of spatial mapping, so it’s no surprise that the most natural metaphors we reach for when talking about time are spatial ones (see Gijssels and Casasanto 2017).

⁷ The phrase “stream of consciousness” may have been coined by Alexander Bain (1855: 359) but is widely attributed to William James (1890), who popularized the concept. The notion of the specious present, which comes from E. Robert Kelly (Anonymous 1882), known to James as “E. R. Clay”, followed a similar historical course.

⁸ For example, Fitzgerald ends *The Great Gatsby* with a particularly evocative and melancholic metaphor: “So we beat on, boats against the current, borne back ceaselessly into the past,” (Fitzgerald 2004: 180).

truly say that time *is* only as it tends towards nonbeing? (*Confessions*, Book XI, Chapter XIV).

If the past is no longer and the future is not yet in existence, the question thus arises of how we can experience a *flow* of time. We have a feeling that, even though the past and the future are nonexistent, nonetheless they form a part of our experience in that the present is felt to constantly slip away into the past and the future is felt to constantly become the present.

Beyond the holistic feeling of passage, there is a further specification of experiential “passage” involving direct perception of time’s passage through the experience of change. C. D. Broad described a now rather famous example of the hands of an analog clock. According to Broad, we do not merely perceive that the second hand was in one place and then, later, is in another, different place. Rather, there seems to be a phenomenology of change itself—it is a directly experienced feature of the second hand that it is in motion. As Broad puts it, “...we do not merely notice that something *has* moved or otherwise changed; we also often see something *moving* or *changing*,” (Broad 1923: 351). This stands in contrast to the hour hand, which is never *perceived* to be changing but only *believed* to have changed based on an inference from the difference between its spatial locations at different times. The experience of the second hand thus involves a distinctive phenomenology of change while the experience of the hour hand does not. Whether the same mechanism underpins the phenomenology of change for the objects of experience and the general phenomenology of time passing is a subject we will take up later but suffice it to say for now that caution is warranted to avoid conflating these two experiences.

b. Events

One of the most obvious and undeniable features of subjective experience—so obvious it is not always remarked upon—is that *things happen*. Experiences of things occur at certain times and over certain lengths of time. Furthermore, temporally extended processes, like exploding fireworks, seem to be grouped together such that we are aware of one process, although we can break a process into component processes as well (one firework explosion made up of smaller explosions for example). We can call these experiential processes that occur at times and over time “events.” Straying from the phenomenology momentarily for the sake of elucidation, we might usefully think of events as Barbara Tversky and Jeffrey Zacks do: as subjectively experienced “chunks” of information, which, in perception, amount to an

“integrated unit of space and time,” (Tversky and Zacks 2013: 83). There seem to be phenomenological boundaries to these processes. Vague and fuzzy though the boundaries might sometimes seem to us, nonetheless we apprehend a difference between the exploding firework and the subsequent stillness of the night sky. There will be more to say from a theoretical standpoint about the mechanism underlying subjective events and how event boundaries are determined in later chapters.

c. Simultaneity

Experiences do not always occur serially—they can also feel as if they are occurring at the same time, for example, visual experiences of mouths moving and auditory experiences of the sounds they produce. At any given time, many experiences are simultaneous, from ongoing ambient noise to the tactile response of fingers on a keyboard, to the concurrent internal monologue directing those fingers and the caffeine-induced inner restlessness that inevitably spurred them to action in the first place. Consciousness is always marked by a jostling cacophony of experiences. While there will be more to say about simultaneity in **section f**, where it will return under the guise of “synchrony”, simultaneity is a more introspectively obvious temporal feature than the more theoretically loaded “multi- and intra-sensory temporal integration” and so occupies a position closer to the beginning of this exposition of desiderata.

d. Continuity

Not only do we feel as though we are moving through time into the future, but there is also a distinct feeling of continuity between what has just happened, what is happening, and what will happen. There is a first-personal subjective continuity (we are continuous with both our past and future selves) and continuity between all the other events that we experience through time. As William James put it many centuries after Augustine, subjective continuity means that, “even where there is a time-gap the consciousness after it feels as if it belonged together with the consciousness before it, as another part of the same self... [and] the changes from one moment to another in the quality of the consciousness are never absolutely abrupt,” (James 1892: 231). A good account of the experience of time should ideally also explain how this feat—the problem of continuity—is pulled off.

Experiences happen over very short timescales, very long timescales, and timescales of varying length in between. What's more, experiences that occur over very short timescales (say, the time it takes to inadvertently burn oneself on a saucepan) seem phenomenologically distinct from experiences that occur over very long timescales (say, an overnight train journey). Nonetheless, we don't seem to experience any discontinuity between experiences at different timescales. On the contrary, our experiences feel *seamless* and it's hard to say when one ends and another begins. But how does the brain achieve this smooth integration of timescales—for example the continuity between timescales like that of the proposed specious present of 200 ms and a few seconds? Wanja Wiese has called this problem “The Interface Question” and formulates it this way: “How can I experience recent events as being seamlessly connected to present events?” (Wiese 2017). Ideally, our theory of temporal experience should be able to provide an answer to this question.

e. Endurance⁹

In our experience, events and objects exhibit *endurance* or *persistence*, which is to say, we are aware of them lasting for some non-instantaneous length of time. A classic example of an enduring event, given by Sean Kelly, is an experience of a singer holding a note (Kelly 2005: 228). Contrariwise, Wanja Wiese gives the example of a surprising “bright flash” as an example of a “punctual event [which] is not experienced as part of an enduring event,” (Wiese 2017: 16). It is debatable whether such events as a flash of light are really experienced without the event seeming to have any endurance whatsoever, but we may remain agnostic on this point for now.

Regardless of the possibility of punctual events, Wiese makes an important further point about the relationship between continuity and endurance that is more theoretical than phenomenological. Wiese contends that “continuity implies endurance: when we experience a temporal continuum, we experience a dynamic event, in which a higher-order event is experienced as enduring through change,” (ibid.). The phenomenon of continuity is therefore dependent on the phenomenon of endurance—any continuity of events would be impossible without their ability to endure in our experiences because events must endure to subsume other events that are felt to be continuous in virtue of their being subsumed by the enduring,

⁹ This discussion concerns the apparent phenomenological feature of events that they seem like they *last* and not the metaphysical concepts of endurance and perdurance, which concern ways that identity can persist through time.

higher-order event. There is thus a kind of “nesting” of enduring events that allows for continuity. Wiese’s example of an event experienced in a smoothly temporally continuous way is the sound of a musical instrument playing notes “legato” as opposed to “staccato,” (ibid.). The note events are perceived as an uninterrupted “*continua*” but also as belonging to a single, overarching higher-order event enduring through time, without which, there would be no experience of continuity.

The experience of endurance is therefore quite central to temporal phenomenology. However, experiencing something *as* enduring is not simply a matter of events or objects persisting in the external world: the brain must somehow apprehend these things as being so. Persistent objects in the external world need not be perceived that way, after all; indeed, we can imagine experiencing the world in a strobe-light fashion fairly easily, and there are disorders of temporal awareness that involve such unpleasant occurrences.¹⁰ So a central phenomenon to be explained by a good theory of temporal experience is how subjective endurance arises.

f. Unity

Another important temporal feature of experienced events is that we experience events in a unified way. This unity is both multimodal and intramodal, both synchronic and diachronic. As Shaun Gallagher and Dan Zahavi express it, “Experiences never occur in isolation. We are not faced with a mere aggregate of temporal atoms. The stream of consciousness is an ensemble of experiences unified both at any time, and over time, both synchronically and diachronically,” (Gallagher and Zahavi 2010: 72). For example, an event like the explosion of a firework incorporates visual, auditory, and if one is standing close enough to the explosion perhaps even olfactory, somatic (owing to the shockwave), and thermoceptive (owing to the heat) information into a single experience felt as one event at a particular time and over a period of time. Despite significant differences in processing speed across the senses and differences in the speed of signals through the environment (photons move faster than airwaves, for example), the perceived event is still experienced as unified synchronically (i.e., at the same time) and diachronically (i.e., over time). Experiences also exhibit *intramodal* unity, i.e., a unity of the information perceived by one kind of sense perception, for example, the different colors of the firework, or the color and the motion of the explosion.

¹⁰ One such disorder is called *akinetopsia* and will be discussed in much greater detail in Chapter 5.

The phenomenon of unity naturally leads to the question of how the brain pulls off such a feat, integrating all of this temporal information from an array of senses to make a whole, seamless experience. While multisensory integration in general faces a similar problem, there is a special problem when it comes to binding *temporal* information, rather than binding the contents of experiences. The latter involves binding content, like binding a voice to a face, while the former requires more. In temporal binding, not only is the content (voice and face) bound together, but also structural features, like the timing and duration of the content, are synced up. This suggests a different process is responsible for the timing of a voice and the movement of the face to be synchronized than in the traditional multisensory integration case. We can call the question of how such a process works the “temporal binding problem” (in contrast to the more general “binding problem”).¹¹

To illustrate the complexity of the temporal binding problem, Jean Vroomen and Mirjam Keetels compare binding in the regular case to the temporal case. Binding is more likely to occur in general if “information from different modalities share[s] more (amodal) properties,” (Vroomen and Keetels 2010: 871). If many properties are shared, then there is a high probability that the source of the information is the same across modalities. This principle is known as the “assumption of unity,” (ibid.). Temporal properties like simultaneity are the most important shared properties in determining whether multisensory information should be bound together (ibid.). However, when it comes to binding temporal information itself to establish synchrony in perception, the assumption of unity breaks down on pain of circularity. The normal recourse to shared temporal properties becomes uninformative when temporal properties are the properties at issue in the case of temporal integration. There are further complications: besides the fact that, “no sense organ registers time on an absolute scale” the way a retina is sensitive to wavelengths of light, there are also “differences in physical and neural transmission times,” for example the speeds of sound and light and the immediate transmission of information in the case of the sense of touch (ibid.).

To date no single mechanism has been described that can explain how synchrony is established in experience. While explaining synchrony would be a desirable feature of a theory of subjective time, it may be that the process of integration is unrelated to the mechanism responsible for other aspects of temporal phenomenology like continuity and

¹¹ One “solution” may be to deny there is in fact any temporal binding problem. For instance, one might be committed to the notion that there is no fact of the matter about when perceptions are had (no temporal integration) but only about when they are judged to have occurred. This thesis would then place the binding problem further ‘downstream’ in higher-level processing.

succession. For this reason, temporal unity is a phenomenological desideratum that requires special attention.

Note that the kind of unity described here is narrowly circumscribed, relating only to the binding of experiences together. In a wider sense, it is often commonly thought that all the various kinds of temporal phenomena, including “simultaneity, successiveness, temporal order, duration, and temporal perspective” are unified into a single experience of time (Block and Zakay 2001: 59). However, as Barbara Sattler argues with reference to the Ancient Greek conception of time, such a sense of the unity of qualitatively different temporal phenomena has not always been so obvious. Sattler argues intellectual history provides strong evidence that “our notion of time as unified is not something we gain directly from experience,” but rather a malleable “interpretative or theoretical overlay” that has changed through the course of history (Sattler 2017: 19). If this is correct, it serves as a reminder that we must be cautious about which temporal features we take as basic, fundamental explananda for our theory.

g. Intervals

Another aspect of our experience of time is that we are conscious of intervals, which is to say durations, lengths, or spans of time.¹² Beyond mere awareness of intervals, most of us can measure them as well. But this phenomenological fact introduces problems of its own.

Augustine considers that we are wrong to say, for example, that a hundred years is a long time past, because what is past no longer exists, and what does not exist cannot be long. And yet it won’t do to say it *was* long either, because that implies a century can happen, when it cannot, at least not all at once. He determines that no time can be present, and thus, no time can exist, except an infinitesimally small point. As Augustine explains, “If any fraction of time be conceived that cannot now be divided even into the most minute momentary point, this alone is what we may call time present. But this flies so rapidly from future to past that it cannot be extended by any delay. For if it is extended, it is then divided into past and future. *But the present has no extension whatever* [emphasis added],” (*Confessions*, Book XI, Chapter XV).

“And yet,” Augustine writes, “we do perceive intervals of time, we do compare them with each other, and we say that some are longer and others are shorter,” (*Confessions*, Book XI,

¹² Once again, the spatial metaphors appear inescapable—as previously mentioned, it may be our neural hardware is specifically configured to conceptualize time in this way, piggybacking on space.

Chapter XVI). Thus, a conundrum arises: on the one hand we seem to have the brute phenomenological fact that we are conscious of intervals of time, and on the other we have strong *a priori* grounds for holding that the present cannot have extension, because if it did it wouldn't be present. How is it possible that intervals form a part of our experience?

Augustine's frustration with this antinomy is apparent in his colorful prose: "My soul burns ardently to understand this most intricate enigma," (ibid.). As demonstrated by debates between "snapshot" and "specious present" theorists, discussed in Chapters 4-5, Augustine's burning worry has continued to vex philosophers down to the present day.

h. Succession

An apparently obvious fact about our experience of time that nevertheless requires some explanation is that we experience events one after another, in succession. At first glance it might seem there's nothing extraordinary about that—things in the universe just come one after another, regardless of one's metaphysical commitments. The problem is that, while succession may be a feature of the universe we inhabit, a mere series of events is neither necessary nor sufficient to generate a phenomenology of succession. As James put it, "a succession of feelings, in and of itself, is not a feeling of succession," (James 1981: 591). Dan Dennett illustrates the point further by disentangling representational content from the representational vehicle of that content: "the representing by the brain of *A before B* does not have to be accomplished by: first: a representing of *A*, followed by: a representing of *B*. The phrase '*B after A*' is an example of a (spoken) vehicle that represents *A* as being before *B*, and the brain can avail itself of the same freedom of temporal placement," (Dennett 1993: 149). For this reason, it is within the realm of possibility that the actual temporal order or metaphysical structure of the universe around us is completely different (even reversed!) from that we experience. We needn't even commit ourselves to representational ways of thinking for James' problem to stick—we need only consider that events that occur in succession too quickly (like a bullet) or too slowly (like an hour hand) do not result in a feeling of succession (Kiverstein 2010: 161). No matter the temporal structure of the universe or the status of representations, the feeling of succession stands in need of some explanation.

i. Global Feature of Consciousness

Temporal phenomenology is not unique to sensory perception. Our imaginings, our dreams, our recollections of memories—in short, all conscious experiences, are structured by time. It is quite difficult to imagine how this could not be the case, but nonetheless something must be occurring in the brain to make it so. The global presence of temporal phenomenology throughout consciousness is not only something to be explained, but it is also an indicator of the kind of mechanism we should be looking for—namely, a mechanism that is not isolated to a specific region or function but likely low-level and widely distributed.

j. Rates and Variability

Another salient phenomenological feature of temporal experience is that time seems to pass at a certain rate, and this rate can feel highly variable. The idea that these rates or speeds at which things happen fluctuate frequently is enshrined in common sense, for example in the old adage “time flies when you’re having fun.” As it turns out, copious experimental attention to subjective temporal variability has revealed that not only does time fly when we’re having fun, it is also affected by innumerable other variables. For empirical investigators, timing tasks have been the most fruitful and most studied experimental paradigms in the field of subjective time research. This is because in these tasks we can compare the subject’s behavior or reports to an objective measure (clock time). Other phenomenological features of temporal experience are harder to investigate because of the absence of an “objective” criterion to measure them against and from which they might diverge (e.g., continuity, succession, endurance, etc).

The modulation of rates of passage is often subjectively discernable (and renowned in folk wisdom) while at other times the changes “go unnoticed, but nevertheless show relatively strong effects when measured,” (Noreika et al. 2014: 536). Factors affecting subjective rates of passage apparently include but are not limited to age (Wittmann 2005), gender (Espinosa-Fernández et al. 2003), body temperature, heart rate, time of day (Hancock and Hancock 2014), interval duration (Hancock and Rausch 2010), awe (i.e., “the emotion that arises when one encounters something so strikingly vast that it provokes a need to update one’s mental schemas (Keltner and Haidt 2003)” (Rudd et al. 2012)), cultural differences (Arman and Adair 2012), interference from other modalities (Chen and Yeh 2009), various emotions (Droit-Volet and Meck 2007), personality traits like impulsivity (Wittmann and

Paulus 2008), the amount of change or variation that occurs within an interval (Hansen and Trope 2013), migraine headaches (Vicario et al. 2014), exogenous oxytocin (Colonnello et al. 2016), bare physiological arousal (Mella et al. 2011), repetition (Matthews and Gheorghiu 2016) and routine (Avni-Babad and Ritov 2003), subjectively felt speed of movement (Zhang, Jia, and Ren 2014), hypnosis (Bowers 1979), and of course boredom (Noreika et al. 2014). Additionally, drugs of many kinds are known to influence the experience of time, including marijuana, alcohol, stimulants (Meck 1996), depressants (Shahabifar and Movahedinia 2016), and psychedelics (Aronson 1959). Depending on the variable in question, the rate or speed of the passage of time is felt to either slow down (time dilation) or speed up (time contraction)—for example, having fun results in time contraction (time flies) while a boring statistics lecture would result in time dilation (slowing to a crawl).¹³

What can we take away from this extreme variability? For one thing, temporal variability is the rule rather than the exception. Subjective rates are in a constant state of flux depending on a huge array of factors. Because of this, we might consider that the most plausible mechanism would occur at a very low level in the implementation to be modulated by such a wide variety of different variables. Furthermore, the mechanism or mechanisms involved could be widely distributed throughout the brain and/or entire central nervous system to be sensitive to said variables, perhaps extending well beyond the systems responsible for conscious experience.

Studies on the variability of subjective time must be treated with caution, however. We must be wary of the difference between judgements about intervals, which could be retrospective and influenced by distortions in memory, and the feeling of the speed of subjective passage at the times in question. Unfortunately, these two processes are often difficult to disentangle experimentally, especially when a subject is asked to self-report. In such cases it can be impossible to determine definitively if the effect is on a subject's memory of the event, the original experience of the event, or both. Other issues concern whether the effects are task-related or would remain in natural conditions and also whether the effects vary or even reverse depending on the timescales considered.

¹³ As an amusing aside, a mathematics professor colleague of my mother's kept a sign on his office door that read, "If I only had one more day to live, I would spend it in my statistics class because it would feel like a lifetime."

k. Abnormal Phenomenology

So far, we have been describing temporal phenomenology under more or less normal conditions. However, there are well-documented cases where the experience of time is known to deviate substantially from the neurotypical case. These deviations represent explananda for a theory of temporal experience as well and may also offer clues as to what is going on at the processing level.

We can divide phenomenological deviations into several categories. First, there are the chronic mental disorders, which, although often associated with other disturbances to normal functioning, have implications for the experience of time. A non-exclusive list of such disorders might include schizophrenia (Carroll et al. 2008), depression (Bech 1975), bipolar disorder (Bschor et al. 2004), ADHD (Barkley et al. 2001), anxiety disorders (Mioni et al. 2016), personality disorders (Berlin et al. 2005), autism (Allman et al. 2011), and dyslexia (Ben-Artzi et al. 2005). Second, there are disorders specifically related to the experience of time, like dyschronometria and akinetopsia. These are uncommon and usually occur as symptoms of a larger problem or a direct result of lesions to specific areas of the brain. Third are various supposed “illusions of time” which occur in normal subjects as well as other temporary alterations to the normal experience of time instigated by external factors like hypnosis or psychoactive drugs. We will now turn to investigating some of these disorders in greater detail.

2. General Disorders Affecting the Experience of Time

Many disorders of the mind seem to affect the experience of time. There are however methodological difficulties common to all of them that make any assessment of the impact of these disorders challenging. Because it is not possible to experience what the afflicted subject is experiencing, we have to rely on inference to determine what’s going in their perception.

Self-reporting by the subject might seem like a good basis for inference, but this method invites complications. Rather than a guide to the subject’s experiences at the time in question, self-reports might instead only be able to indicate the subject’s *memory* of the experience or ability to *imagine* future experiences. Indeed, if self-reporting were a good guide to subjective experience, we should expect the reports to match objective data collected from experimental timing tasks. In fact, mismatches between the data collected in the experimental tasks and self-reporting are common in certain populations, a fact which was noted as far

back as 1932 when Aubrey Lewis found accurate judgments on timing tasks often belied self-reported distortions of temporal experience (Lewis 1932). A further worry is that, even in the experimental task, it is really the subject's ability to make judgements about their experience of time that is tested rather than directly testing their experience of time, and their experience and their ability judge it accurately might deviate. However, so long as the subjective experiences of other minds remain inaccessible to observers, we have to make do with suggestive but ultimately inconclusive inferences based on experimental timing tasks, self-reporting, and in some cases, neuroimaging and trans-cranial magnetic stimulation (TMS). If retrospective timing tasks, prospective timing tasks, and self-reporting coincide, we may consider this a suggestive but not definitive indicator that the data do actually reflect the subject's temporal experience.

2.1 Schizophrenia

Schizophrenics have problems estimating time intervals when compared to the general population. These problems can include “a breakdown of temporal order of external events or an altered speed of subjective versus objective time passage,” (Noreika et al. 2014). Self-reporting has shown some variance in the distortion experienced by schizophrenics, from time dilation to rare reports of time stoppage (Freedman 1974). It is hard to make sense of anecdotes of time stoppage, and it's difficult to say if this is related to akinetopsia, which is actually a motion perception disorder, or something else. However, consistent overestimation of time intervals at all timescales in experimental tasks suggests time dilation is the most common subjective distortion experienced by schizophrenics regardless of subtype (e.g., paranoid vs. non-paranoid, chronic vs. non-chronic)(Tysk 1983). Furthermore, fMRI studies have shown that schizophrenics exhibit “timing-specific fronto-thalamo-striatal dysfunction” when administered duration discrimination tasks (tasks where subjects judge differences between two durations)(Volz et al. 2001), which indicates a neurological underpinning to this population's altered sense of timing.

2.2 Depression and Mania

Self-reporting from those afflicted by depression seems to support the notion that they experience time dilation as well (Bschor et al. 2004). On the other hand, in mania, time contraction is reported. However, here there is a mismatch with objective testing: in a study

by Bschor et al., both manic and depressed experimental groups made judgements about the length of long intervals as if they were experiencing time dilation, with manic patients exhibiting greater overestimation of intervals than either the depressed or control groups (ibid.). Although sadness is also correlated with the overestimation of durations, the effects produced by sadness alone are much less pronounced than those observed in depressed or manic patients, indicating a further process beyond emotion is responsible for temporal modulation in those cases (Gil and Droit-Volet 2009). In both schizophrenia and depression then, as well as other disorders not detailed here, there seem to be deviations in the normal functioning of the mechanism responsible for subjective time which result in distorted phenomenology and judgements of time compared to the normal case. A better understanding of how these disorders affect the brain could therefore also help to reveal the mechanism underlying temporal phenomenology.

3. Specific Disorders of Temporal Experience

3.1 Akinetopsia

Akinetopsia refers to a disorder that limits the ability to perceive motion, either entirely or to some degree. Akinetopsia can leave the affected person with experiences they describe as being like a series of static images or frames passing, similar to a very low frame-rate film or strobe light effect (stroboscopic vision). Although most cases are stroboscopic, in very rare circumstances those affected report certain moving things, like flowing liquid, to be static when they are not.

The neurophysiological situation in such cases is instructive. In one patient exhibiting the more extreme form of the disorder, researchers observed “bilateral lesions affecting the lateral temporo-occipital cortex and the underlying white matter” and concluded on this basis that, “movement vision is a separate visual function depending on neuronal mechanisms beyond the primary visual cortex,” (Zihl, Cramon, and Mai 1983). In particular, damage to region V5 (or MT) in the occipital lobe appears to be implicated in Akinetopsia. In monkeys, cells in the V5 region “preferentially respond to the direction and speed of stimulus motion,” (Heywood and Kentridge 2009). In humans, another region called hMT+, “adapts to motion of complex patterns while lower visual areas adapt to motion of the components (Huk and Heeger 2002),” (Heywood and Kentridge 2009). Activation in these areas isn’t limited to veridical cases of motion either: “Both MT [V5] and hMT+ respond to illusory afterimages

of visual motion and the latter is also activated when observers view ‘implied motion,’ where motion is represented by static pictorial cues. Moreover, the perceptual after-effects are abolished when transcranial magnetic stimulation (TMS) is applied to hMT+,” (ibid.).

The upshot of cases of akinetopsia is that they offer examples of temporal experience and motion experience coming apart. Despite the inability to perceive motion and change, motion blind subjects continue to experience time passing along with the other phenomenal features of temporality. Another consequence of akinetopsia is that certain motion illusions, which are often presented as illusions of time,¹⁴ should be reevaluated as illusions of motion affecting the visual pathway, which do not necessarily have direct relevance to the temporal phenomena.

3.2 Dyschronometria

Dyschronometria refers to a sustained inability of a subject to accurately estimate durations of passing time. This phenomenon often presages the onset of dementia and can be caused by cerebellar ataxia. It is unclear exactly what the impaired process behind this disorder is, but it could be that, rather than a disorder of subjective time *per se*, it is instead a disorder of memory that affects the subject’s ability to judge and report on passing intervals. That is to say, it could be that in most cases of dyschronometria the subject simply forgets they were supposed to be engaged in measuring a duration before they are able to measure it. This would mean that the explanation for dyschronometria should, properly speaking, come from a theory of memory and not necessarily from a theory of temporal experience *per se*.

4. Temporary Distortions

4.1 Psychoactive Drugs

Psychoactive substances are often associated with extreme distortions of time. Early studies on LSD use, conducted in laboratory settings, produced a range of striking subjective reports, for example: “there was a feeling of eternity, of timelessness”; “both past and future seemed very far away”; “[it was] as though there were not time at all, and yet the time seemed to pass slowly,” (Kenna and Sedman, 1964). In objective timing tasks those that took LSD consistently underestimated the duration of intervals across a range of timescales,

¹⁴ Much more on this in Chapter 5.

indicating time contraction, despite subjective reports of time feeling slowed down (Aronson 1959). Another interesting phenomenon from LSD studies was that, in one study (Boardman 1957), subjects who took LSD and were asked to estimate whether a sound had lasted a second or not reported that, “it was difficult to maintain a stable concept of a second under LSD,” (Noreika et al. 2014: 536). Unfortunately, many early studies suffered from poor methodology and few participants, making the results difficult to interpret. Compounding these problems is that replication is now virtually impossible following the moratorium on LSD studies. Suffice it to say that LSD and other psychoactive drugs are capable of profoundly altering the functioning of the mechanism responsible for temporal experience.

4.2 Illusions

There are several kinds of perceptual illusions that might have implications for a theory of temporal experience. Among these, by far the most notable and vexing are known as postdictive effects. These are counterintuitive cases where events occurring after a stimulus seemingly affect the subject’s perception of that earlier stimulus. Some of the most prominent postdictive effects are the illusions of apparent motion (also known as the phi phenomenon)(Kolars 1972: 1–15), metacontrast marking (Bachmann and Francis 2014), the flash-lag effect (Mackay 1958; Eagleman 2000), and the cutaneous rabbit illusion (Geldard and Sherrick 1972). In the case of apparent motion, two stimuli, separated in space, are presented in succession, and the subject perceives that the earlier stimulus is moving to the place of the other. This phenomenon is extremely robust and allows us to perceive successive static frames as continuous movement, like in a flipbook or while watching a film or animation.¹⁵ Mundane though such experiences seem to us, they conceal a paradox, namely that our perception of motion seems to depend on the existence of a future stimulus.

A particular version of apparent motion, known as color-phi, has garnered special attention because of Dan Dennett’s use of the phenomenon in arguing against the doctrine of the Cartesian Theater (i.e., the idea there is a perceptual end-point in our mind that we watch like an audience watches a performance)(Dennett 1993: 114). Even more so than run-of-the-mill apparent motion, color phi is a striking demonstration of “postdiction”. In color phi, two spatially separated stimuli (in practice, dots) of different colors are presented, one after the

¹⁵ For demonstrations of apparent motion see https://en.wikipedia.org/wiki/Phi_phenomenon#/media/File:Lilac-Chaser.gif and <https://www.youtube.com/watch?v=V8A4qudmsX0>.

other. Subjects not only report motion of the stimulus but a change in color that takes place midway through the motion of the stimulus. Of course, neither motion nor a color change halfway through actually occurred. Yet it seems as though the color and placement of the final stimulus influences the perception of what is happening before its onset (the motion and color change of the first dot), which is a highly counterintuitive result. For the moment, we needn't discuss all permutations of postdictive effects. The important thing is that they all share the feature of seeming to show that later events can have an impact on "present" perceptions. Our theory of temporal experience must therefore accommodate these bizarre phenomena.

Although postdictive effects are sometimes considered illusions of time, we should be clear that this is not entirely accurate nomenclature. In illusions, there is a mismatch between perception and reality, such that we take our perception to be inaccurate or non-veridical—a misperception. Usually this involves perceiving the wrong properties of perceptual objects, for example, seeing pavement as liquid on a hot day. In the case of postdictive effects, however, as Valtteri Arstila points out, "the effects do not demonstrate that temporal properties *per se* (e.g., simultaneity and duration of stimuli) are misperceived. Instead, the temporally interesting feature of these cases depends on our view concerning the 'normal' order of neural processing and the timing of experiences," (Arstila 2015: 206). In other words, the temporal features are preserved—the presented stimuli occur in their veridical succession, over a certain amount of time, etc.—the strangeness is just that we don't expect earlier perceptions to be affected by later events. The surprise is therefore a function of the way we expect processing to work (i.e., sequentially with a definite perceptual endpoint), rather than a misperception of any temporal feature of the object. Of course, it must be said that in a non-temporal sense, these are still illusions, but illusions of the senses rather than illusions of time: in the apparent motion case, for instance, we have visual misperceptions, seeing an object as changing colors, occupying various spatial locations, and moving even though the object itself does not exhibit any of those behaviors.

5. Conclusion

This chapter has described various phenomenological features that a good theory of temporal experience should seek to explain. These include the feeling of time passing, experiences of events, simultaneity, continuity, endurance, intervals, temporal unity, succession, prevalence throughout conscious experience, variable rates and timescales, and occasionally abnormal temporal phenomenology. We find this temporal phenomenology not only in perception, but also in memory, imagination, and all other areas of conscious experience. Contemporary theories of temporal experience must be evaluated against their ability to provide explanations for the phenomenological desiderata presented here. Before moving on to such an evaluation however, further constraints on the space of theoretical possibilities must be considered, and this will be the subject of the next chapter.

Chapter 3: The Succession Requirement

1. Introduction

While the previous chapter considered desiderata for a theory of temporal experience, this chapter will consider constraints on possible temporal experience. Specifically, this chapter will argue that successive experience, mentioned previously as a phenomenological desideratum, is a fundamental constraint on experience for agents, and likely any subject that can exist in our world. As a result, we should look to place succession, indispensable as it is to experience, at the core of any theory we might produce to account for experience *at all*, let alone so-called “temporal experience,” which, seen in this light, no longer appears to be a mere subspecies of experience but rather the grounds for its existence.

In an oft-quoted passage, William James claims “the unit of composition of our perception of time is a *duration*, with a bow and a stern, as it were—a rearward- and a forward-looking end. It is only as parts of this *duration-block* that the relation of *succession* of one end to the other is perceived.” (James 1890: 609-610). This quote and the section of *The Principles of Psychology* from which it is extracted have come to be seen as embodying an initial statement of the doctrine of the specious present, which is the idea that the experienced present has some kind of temporal extension. However, there is a further contention in the above quote that Jan Almäng (2014: 364) has noted. Besides the claim that the present is a “duration-block,” as opposed to a “knife-edge”, James also claims that our temporally extended present has a *successive structure*.

This latter claim is often overlooked because we ordinarily take it for granted that experience is successive, whereas we ordinarily do not take it for granted that the perceived present has a duration. For Almäng, James’ succession claim, when made precise, amounts to the following: “That with which we are perceptually presented is given as having temporal parts, which are presented as succeeding and preceding each other in time.” (Almäng 2014: 364). This characterization of the succession claim is a minimal description of how we contingently experience the world over time, asserting only what is meant to be obviously manifest.

I think the succession claim can and should be stronger still. I will argue that, for agentic subjects at least, the successive structure of experience is not merely contingent but nomologically necessitated. I will argue for constraining the possibility space of temporal

experiences, endorsing what I call the Succession Requirement for agents (SR), which holds the experiences of agentic subjects in our world must have the same basic temporal structure, namely, a successive structure. To be clear, this is not to say there is no variation in the content of temporal experience (subjective time dilation and contraction, for example, are well-documented¹⁶). Rather, SR holds that the basic successive *structure* of temporal experience must remain constant across subjects in this world that we would consider to be agents, where by “successive structure” I mean a temporal organization or *ordering* of the content of experience.

While the proposition that we experience the world in successive fashion may be very intuitive, the stronger modal claim that we *must* experience the world in this way is not. Just as it is not obvious that experienced succession is necessary for agency, non-agency also does not follow in an immediately obvious way from non-succession. Nonetheless, I maintain there are very compelling reasons to believe SR holds. I will focus on three of these here. The first is that successive experience is the only perspective from which an agent can navigate a world that includes causality¹⁷ as a feature, as non-successive experiencers would not be able to stand in the appropriate causal relations to their actions. Second, a physically grounded informational asymmetry between past and future means that any non-successive experiencer would lack the requisite epistemic status for agency as we understand it. Third, only successive experiencers are capable of the kind of mental attitudes that ground agency—a fact rooted in the processive nature of experience.

The Succession Requirement, if it holds, has a number of surprising and significant implications. Perhaps the most surprising and least intuitive is that it implies a temporal “God’s-eye-view” is actually sub-optimal in several ways. Agents like us occupy a privileged position in our temporal perspective, which is specifically adapted to handle the real physical asymmetries of the universe we inhabit. On this view, were an “eternalist perceiver” (a vision of God promoted by medieval and pre-medieval philosophers and theologians) to exist in our universe, this entity would be hamstrung by a temporal perspective that entails a degree of causal and epistemic impotence.

A further consequence is that SR reveals the central place of succession as an enabling condition for agency. Rather than an accidental feature, the successive experience of the temporally extended agent turns out to be a *sine qua non* for agents like us. We can then

¹⁶ See Grondin (2010) for a scientific review.

¹⁷ Although I am speaking of causality as a feature of our world, this should not be interpreted as a claim that “causal laws” exist independently of regularities in nature.

move from just describing temporality as a fact of life to a perspective that sees it as an important enabler of the kind of perception and action that allows us to thrive in this world.

Lastly, it may be that SR can actually be extended further. Although I will focus on the Succession Requirement for agents, I think it is likely that SR is a precondition for selfhood as well. Unfortunately, there are nearly as many definitions of the self as there are selves (real or illusory), so this project will largely be left for the future. However, due to the close connection with the current topic, I will take some time at the end to argue that J. David Velleman's (2015: 187) suggestion, inspired by Buddhist thinking, that we reject the enduring self and see human experience as consisting of "successive momentary subjects, each timelessly entrenched in its own temporal perspective," may be off the mark for precisely the reason that such a move invokes a plethora of non-successive experiencers, none of which can be the agents we take ourselves to be.

In making the case for SR, I will first elaborate on the concept of succession (Section 2) and then describe SR's philosophical precursors (Section 3). Next, I will show that certain apparently radical variations in temporal phenomenology collapse either into non-successive experience or successive experience, and that non-successive experiences of the kind attributed to God in the medieval period and appearing in certain popular works of fiction represent the sort of counterexamples that must be headed off in order for SR to hold (Section 4). I will then argue that non-successive experiencers (NSEs) cannot be agents because they (1) lack the appropriate causal relationships for agency, (2) exhibit the wrong sort of epistemic status for agency, and (3) lack the requisite agentive mental attitude of intentionality. Because agency is not compatible with non-successive experience, the succession requirement must therefore obtain for agents in this world.

2. Succession

As long as an experience is sequentially ordered, we can say an experience is *successively structured*. One kind of successive structure is quite familiar: first one thing is experienced as happening, then another thing, and then another, and so on. Another kind of successive structure might be the following: first one thing is experienced as happening, then another thing, then the first thing is experienced again, then another thing, then the second thing is

experienced again, and so on.¹⁸ Or we could reverse this order.¹⁹ However, these latter possibilities are still successive in the sense of being experiences that precede and succeed one another, even if those things might occur in an unusual order.

It is customary in such discussions to point out another of James' oft-quoted statements, viz. "a succession of feelings, in and of itself, is not a feeling of succession," (James 1890: 628-629; cf. Hoerl 2013 for critical analysis). We can grant this received wisdom here because SR is meant to be a necessary condition for agency and is not being posited as a sufficient condition for the temporal phenomenology of succession. SR is concerned with whether the experiences of agents must *in fact* occur successively and not primarily with whether they are felt to be successive.²⁰ Nonetheless, even if James is right, it is still plausible that SR is necessary for the feeling of succession, though not sufficient. I would also maintain it remains an open question whether or not, as a contingent matter, succession in and of itself *happens to be* sufficient for the experience of succession, even if it is not necessarily so.

As indicated above, the experienced succession need not be an expected ordering. What is experienced also need not be a sequence of *different* things. The content of experience can remain the same, while the structure remains successive. Identical experiences had at different times can be seen as analogous to otherwise identical things lined up, occupying different locations in space; in both cases, a structural order is maintained despite the constituents being identical (though not identical with respect to temporal or spatial position respectively).

For experiences to be successive, it is furthermore not required that the ordering of our experiences corresponds to any kind of veridical ordering of worldly events. The most well-known everyday example of non-correspondence is in dreams, which are still experienced

¹⁸ Strange experiential sequences like these are on display in the Kurt Vonnegut novels *Slaughterhouse-Five* (1969), whose protagonist becomes "unstuck in time" living through temporally jumbled episodes, and *Timequake* (1997), in which the inhabitants of Earth in 2001 are transported back to 1991 to live the decade all over again exactly as it took place.

¹⁹ The many works of speculative fiction concerning backwards succession, such as Philip K Dick's *Counter-Clock World* (1967), Martin Amis' *Time's Arrow* (1991), and more recently Christopher Nolan's film *Tenet* (2020), employ narrative structures that illustrate why "reverse" experience does not constitute a counterexample to the succession requirement. In these works, experiences of backwards succession are by necessity shown to us through successions of progressively further past sequences of events. They seem backwards to us because causation is perceived by the characters to operate in reverse, but still there is one event after another (e.g., it may be the egg goes up from the frying pan into its shell instead of vice versa, but this is an abnormality not of successive ordering but of *what* is so ordered).

²⁰ C.D. Broad contrasted the feeling of succession, e.g., looking at a clock's second hand, and actual succession, e.g., looking at an hour hand, which, though exhibiting successive positions, is not immediately felt to be successive (Broad 1923: 351).

sequentially even if the dream-events themselves seem to have a nonsensical order corresponding to nothing in particular. There are also cases of illusions that suggest we experience non-veridical event ordering in our waking lives. These include the so-called postdictive effects, in which we can seem to perceive events in a different order than that in which they actually happen.

What would it take then, for experience to be non-successive? In contrast to SR, I define Non-Succession (NS) as the proposition that agentive subjects need not have successive experiences. Non-succession is just a case where experience lacks a sequential order. In this scenario, no experiential events precede or follow one another, so there is no linear organization to experience. Alien as this may sound, claims abound alleging such experiences. It has, for instance, become a cliché in writing about life-and-death situations to describe the experience as one where “time stands still.” A study by Wittmann et al. (2017) found that 120 out of 196 (61%) of assessed reports of near-death experiences gathered from a public repository mentioned a “feeling of timelessness.”²¹ Free-divers (Luecke 2020)²², users of hallucinogenic substances, and adept meditators have all reported “timeless” experiences as well (Wittmann 2018: 63-74), with proficient meditators in one study claiming they had achieved states wherein “time lost its linearity”, “there was no time”, or they “felt outside time and space,” (Berkovich-Ohana et al. 2013: 912).

A common rejoinder is that this reported “timelessness” is not to be taken literally. Instead, when scrutinized, such experiences turn out to be cases of extreme time dilation (see, e.g., Arstila (2012), on time dilation during life-threatening accidents). However we make sense of such reports, one upshot of SR is that these claims *can't* be both literal and true if they purport to involve non-successive experience.

3. One Damn Thing After Another: A Brief History

Philosophers have occasionally gestured in the direction of a Succession Requirement in the past but have stopped short of expressly arguing for it. John Stuart Mill, for instance, observed that “Sensations exist before and after one another. This is as much a primordial

²¹ These proportions are roughly consistent with earlier studies conducted by Bruce Grayson on the same topic, which found 74% (Greyson 1990) and 64% (Greyson 1983) of subjects reporting something to the effect of “time stopped” during their near-death experience.

²² For example, one freediver interviewed by Suraiya Luecke reflected that “[The dive] does feel like somehow it happened outside the kind of linear passage of conscious time,” (Luecke 2020: Supplemental Appendix 6).

fact as sensation itself,” (Mill 1865: 198). While Mill does not explicitly contend that successively ordered sensations are a primordial fact of sensations for all agents that have them, human or otherwise, the flavor of the Succession Requirement lurks nearby.

We can see something of this idea in the work of other early empiricists as well. For John Locke, succession and duration are derived from experience, much like other ideas. Locke thought that “Reflection on [the] appearances of several ideas one after another in our minds, is that which furnishes us with the idea of SUCCESSION: and the distance between any parts of that succession, or between the appearance of any two ideas in our minds, is that we call DURATION,” (Locke 1694: I.xiv.3/p. 239). On the Lockean view, our memory of the actual “train of ideas which constantly succeed one another” thus forms the basis for an inference, following reflection, to the idea of succession (*ibid.*).²³

Hume took Locke’s idea, which anticipated James’ “stream of consciousness,” and applied it in a more radical way. According to Hume’s “bundle theory,” minds are “nothing but a bundle or collection of different perceptions, which succeed each other with an inconceivable rapidity, and are in a perpetual flux and movement,” (Hume 1740: 1.iv.6). Shaun Gallagher (1998) observes that, for Hume, “It is not simply that there is a stream of ideas *in* the mind; rather, the stream of ideas *is* the mind,” (Gallagher 1998: 9). If this is correct, then without such a succession, we do not have minds. If having a mind and being a subject amount to the same thing, then, on such a view of experience, the Succession Requirement holds. However, in keeping with Hume’s antipathy towards metaphysics, he does not argue this characterization of minds is an *a priori* necessity for agency or subjectivity. Hume would instead be content with the descriptive claim that impressions indicate this streaming succession just is the case for our minds.

Inspired by Hume, Kant took a revolutionary position. For Kant, succession is not an idea derived from or simply given in experience, but rather the concept of time is an *a priori* necessity for experience, i.e., the condition for the appearing of appearances in the first place (Kant 1787: B46). It is tempting to read Kant’s “concept of time” as the necessarily successive structure of experience, but this is not clear enough to confidently assert. However, Kant does say that “time” is an invariant “form” of intuition, and that this form is necessary for experience. In Kant’s system, the forms—space and time—are the fundamental grounds for experiences. Without these forms to order phenomena, distinguishing between particulars becomes impossible (Strawson 1966/2007: 49). Kant held not only that time was

²³ See Bardon (2019) for further discussion.

necessary for experience, but that time is *only* the scaffolding of phenomena, without discernible mind-independent existence as a thing in itself.

Kant's work does not represent ideal support for the Succession Requirement, even if it may appear he is getting at a similar contention. For one thing, Kant is not concerned with agency *per se*. Secondly, Kant's position on temporality is deeply embedded in his transcendental idealist system. In claiming that successive experience is necessary for agents, we need not also endorse the claim that time is only an *a priori* pure intuition or "form," as part of a larger view with all its attendant innovations. Finally, the arguments Kant presents on this topic are brief and not terribly conclusive (Kant 1787: B46-B47). Some further justification for the Succession Requirement is needed.

4. Non-Successive Experiencers (NSEs): The Eternal Thought Experiment

The view that non-successive experiences are possible has an ancient pedigree, dating back at least to Augustine (354-430) and Boethius (c. 480-525). Although Augustine had previously postulated that God's apprehension is non-successive in character (*Confessions*, Book XI), Boethius introduced the now classic conception of God's existence as a *totum simul*, i.e. as "everything simultaneously/all at once," (Thiselton 2005: 38). According to Boethius, God enjoys "the complete possession all at once of an illimitable life," (*The Consolation of Philosophy*, Book V, Prose VI).

Henry Chadwick (1981), in his study of Boethius, interprets the doctrine of the *totum simul* as a contrast with our limited human experience: "For us, events fall into past, present, and future time. God is outside time. For him the knowledge of temporal events is an eternal knowledge in the sense that all is simultaneous present," (ibid.: 246). In other words, God is always aware of all things that ever happen. Such a view became the standard medieval understanding after Thomas Aquinas (1225-74) proposed a similar interpretation in his *Summa Theologiae*, which proposed God is immeasurable, without present, past or future, and "simultaneously whole" (Ia, Qq. 10, art. 2).

One might think there is some ambiguity in this medieval and pre-medieval understanding of God's temporality. Should we interpret Boethius as saying that, unlike humans, for God there is no privileged present, but events still retain some kind of order? I would argue this is not, or at least *not only*, the contention of the doctrine of the *totum simul*. Far from only *existing* over an infinite span of time that includes the event ordering with which we are acquainted, statements from Boethius about God's experience such as "all is

simultaneous present” indicate God *experiences* everything at once, rather than in successive fashion. From the point of view of the subjective being of God, all is one experience, rendering the sequential ordering of events moot from the divine perspective. God’s experience comes down to a single non-successive experience comprehending the infinite at once without a subjective distinction in order. There is no sense of one thing occurring *and then* another thing occurring for such a being. To say this total comprehension is *of* an ordered sequence is already to impose temporal order upon a subjective experience that supposedly lacks it.

The Boethian understanding of God’s mode of eternal existence helps to accommodate God’s omniscience, omnipresence, and temporal boundlessness (as the originator of time). However, Aquinas recognized that such a view entails God’s incapacity to change (Ia, Qq. 10, art. 2). This incapacity appears inconsistent with the conception of an acting, omnipotent supreme being. As Anthony Thiselton puts it, “if eternity denotes *totum simul*, might this not be understood to impose a static mode of being onto God, who then cannot act, or interact, purposively as a living and promissory God?” (Thiselton 2005: 77). Although Aquinas accepted that God’s perfection required changelessness, it seems as though admitting this property limits God’s ability to intervene in a way that could be understood as properly agential. We shall see in the next section that this worry is justified.

Recently there have been more secular illustrations of non-successive experience. In Ted Chiang’s (2002) short story “Story of Your Life,” and its 2016 film adaptation *Arrival*, earthlings are confronted by bizarre seven-limbed creatures called heptapods that experience all the events in their lives at once. These creatures employ a strange non-sequential written language called Heptapod B. The human linguist tasked with translating this language eventually learns how it is used and becomes able, like the heptapods themselves, to experience her “past and future all at once,” (Chiang 2002: 167). As she explains it, “I perceive—during those glimpses—that entire epoch [the 50 years of her life] as a simultaneity,” (ibid.).

We can call such hypothetical subjects that experience time “all at once” non-successive experiencers (NSEs). The peculiar club of NSEs counts not only Chiang’s heptapods but also previously mentioned notables like the God of Augustine, Boethius, and Aquinas, as members. The kind of subjectivity in *Story of Your Life*, though ascribed to extraterrestrials, is ultimately of the same form as the *totum simul* encountered earlier, though restricted to a mortal life.

One might think it is possible for entities to experience what we experience as time in a similar manner to the way we experience space. As Barry Dainton explains, “the fact that we don’t perceive time itself doesn’t mean that time is necessarily unperceivable: there may be logically possible worlds where space-time is substantival, as easily perceived by its inhabitants as any other part of the material furniture of their world. But our universe is not of this kind,” (Dainton 2011: 385). There is nothing problematic here for SR so long as these subjects experience our fourth dimension atemporally as well as a higher temporal dimension of meta-time that allows for succession.²⁴

Kurt Vonnegut (1969) imagined just such meta-experiencers—Tralfamadorians—in his novel *Slaughterhouse-Five*. These Tralfamadorians, actually ancient hyper-intelligent robots, are described as existing outside of time, and able to “see in four dimensions,” (Vonnegut 1969: 26).²⁵ As Vonnegut describes them, “The Tralfamadorians can look at the different moments just the way we can look at a stretch of the Rocky Mountains,” (Vonnegut 1969: 23). This means Tralfamadorians see humans “as great millipedes—‘with babies’ legs at one end and old people’s legs at the other,” (ibid.: 75). Hypothetical entities like these experience our familiar four dimensions through a further dimension that allows for successive experience. As such, they do not violate SR the way heptapods do and would not constitute effective counterexamples.

5. Challenging the Possibility of Non-Successively Experiencing Agents

Since Anscombe agency has commonly been thought to involve acting “intentionally,” where intending is often specified as having a “reason for acting” (Anscombe 1957: 9). Furthermore, according to standard “event-causal” theories of agency following Davidson (1963), an act’s being intentional, i.e., its having been done for a reason, means that there is a certain kind of causal relationship between the agent’s mental states (e.g., desires and beliefs)

²⁴ We can imagine the relation between ourselves and such higher-dimensional beings would be like that between the inhabitants of “Flatland” (a two-dimensional world), and ourselves. If a three-dimensional object like a sphere passes through Flatland, the inhabitants only ever see a growing, then shrinking, two-dimensional circle. The concept of Flatland was introduced in a satirical novel by Edwin Abbott (1884).

²⁵ Vonnegut’s (1959) novel *The Sirens of Titan* also features Tralfmadorians. In that novel, the Tralfamadorian has an ordered, successive experience like ours, while his human friend Winston, who got himself stuck in a “chrono-synclastic infundibulum,” experiences time all at once like heptapod.

and actions.²⁶ The right sort of causal relationship for agency is one where the agent's intentions are causally connected to its actions, which are meant to bring about a particular effect.

If something like this account of agency is on the right track, then several serious challenges to the possibility of non-successively experiencing agents become apparent. Specifically, I will argue intractable setbacks for NSE agents arise from a faulty causal relationship between the purported agent (the NSE) and the events the agent is meant to cause. Beyond this, NSEs also lack the epistemic status we typically associate with agents. Furthermore, because of their stipulated non-successive mode of experience, NSEs lack the requisite mental states, like intentions, necessary to ground agency. These three problems together suggest NSEs would be incapable of agency given the nature of the world we live in. If non-successive experience is indeed impossible, then we should conclude the Succession Requirement must hold for agents in our world.

a. Causal Distance and Direction

NSEs face two major obstacles to agency stemming from causality: the problem of causal distance and the problem of causal direction. I will first address the problem of causal distance. Consider a hypothetical non-successively experiencing entity named Abbott.²⁷ Abbott, like us, is temporally extended. Only the part of Abbott temporally adjacent to an event such that a causal connection can be made between the organism and the event is capable of directly experiencing it.²⁸ The various temporal parts of Abbott thus could enjoy

²⁶ Schlosser (2019) helpfully distinguishes between the uncontroversial standard *conception* of agency as “the capacity to act intentionally” and the standard *theory* of agency, which fleshes out intentions with a causal account. It is not the aim of this section to argue in favor of the standard conception or standard theory, which has been done elsewhere (e.g., Davidson 1963), but rather to investigate what these require.

²⁷ Abbott is a heptapod in *Arrival* (2016) and also, serendipitously, the author of *Flatland* (1884). In the film, Abbott is paired with a heptapod companion named “Costello”; whether the writers of *Arrival* were also consciously alluding to *Flatland* through the name “Abbott” is unclear.

²⁸ The notion that causes and effects must be temporally adjacent has been widespread since at least Hume. Hume’s view of the causal chain has it that, “whatever objects are considered as causes and effects are contiguous; and [...] nothing can operate in a time or place which is ever so little removed from those of its existence” (1740: I.iii.2). Cf. Brand (1980), Huemer and Kovitz (2003), and Mumford and Anjum (2011), who argue that simultaneous causation is possible, and Maslen (2018) for why it isn’t. Regardless of whether simultaneous causation is possible at the point of direct causal interaction, it is not physically possible to have an *experience* that is simultaneously or immediately caused by environmental events because of signal transmission. Nonetheless, events and their perceptions should be causally connected, albeit mediately.

experiences of each time *at* each time, but there is no way of integrating the experiences had *at* each time as a diachronic unity spanning Abbott's life. This is because a causal connection between the parts of Abbott that are temporally distant from the experienced event and the experiencing, temporally proximate parts of Abbott cannot be made such that a unified consciousness over both temporal parts might obtain. This kind of connection would require that events exhibit unmediated and temporally bidirectional causal efficacy, regardless of the temporal distance between the events. However, such "spooky action at a temporal distance" is generally seen as physically impossible.²⁹ Short of adding a further dimension to bridge the gap, and thus allowing for a kind of succession in this new dimension, it is difficult to see how the requisite causal circumstances for diachronically unified consciousness over Abbott's lifetime would be possible in the world as we know it.

To see why Abbott would only have the relevant experiences of a time *at the time that the experienced event takes place*, it is helpful to consider the eternalist metaphysical picture of time more closely. An NSE is stipulated to exist across and to experience multiple times together, but this would not be possible if only the present exists (as presentism maintains). The eternalist position that we live in a block universe does allow for NSEs, however, as they can then spread out over and experience different times in a fully real sense.

In a four-dimensional block universe, time is not like a landscape to be traversed (Williams 1951: 470). It *takes time* to perceive, let alone traverse, a landscape. A traversal of time that skips directly over certain sections necessitates another dimension to allow for the process of traversal. Sticking to a four-dimensional metaphysical picture, the experiencing being, which cannot avail itself of illicit "temporal skipping," needs to be *at a particular time* to experience events at that particular time directly (i.e., not through memories, imagination, or simulation). However, most of the temporal parts of an NSE are too causally distal to the events the NSE is meant to experience. These parts cannot therefore comprise a diachronically unified subject with one integrated experience.

Besides temporal proximity to causes, we should also expect an agent to be embedded in causal chains in the right way. If an agent were not so embedded and the subject were not affected by worldly causes, its perceptions would be of no use to guide adaptive action, as they would not carry information about the environment. The subject should therefore be

²⁹ Cf. Adlam (2018), who argues against what she calls the "almost ubiquitous" assumption of temporal locality among contemporary physicists. However, Adlam is not explicitly concerned with causality nor with macroscopic physical processes and, as Ismael (2016: 132) has argued, these are the relevant physical processes with respect to agency.

embedded such that the effects of the environment arrive successively and then the subject can respond *in light* of those effects. There is thus a practical impetus to experience things successively: appropriate, informed action is enabled by the sequence of information flowing in from the environment. If part of the function of subjectivity is to integrate disparate information about the world and our bodies to adaptively guide behavior, then experiencing things in sequence is the temporal mode best suited for that function.

Causal direction poses another problem for NSEs. Consider a human translocated to a world where the temporal direction is reversed. The subject's perceptual apparatus would not be able to pick up signals from the world. The direction of causation would make subjects from our world "blind" to the reversed world and vice-versa. This is a problem for contact between subjects or worlds with differing temporal directions³⁰, but, for similar reasons, it is also problematic for contact between subjects or worlds with a temporal direction like ours and subjects or worlds without a temporal direction at all. If NSEs are understood as not obeying the normal causal directionality of our world, then they would be incapable of meaningfully acting in it. Although this problem fades if we accept that, physically speaking, NSEs follow the normal causal direction, new problems then arise.

Our familiar causal direction turns out to be rooted in the physical nature of our universe, which exhibits causal asymmetry. Craig Callender, following David Lewis, has framed causal asymmetry in terms of counterfactual dependence: "Future outcomes depend upon actions now whereas past outcomes do not," (Callender 2016: 259). This causal asymmetry is not just an anthropocentric illusion. As Jennan Ismael has argued, when we assess effects of interventions in the physical world from a macroscopic perspective, an emergent pattern of temporal asymmetry arises which is not present in fundamental laws of physics, but which ensures that the "direction of determination" is from past to future and not vice versa (Ismael 2016: 134). As Ismael puts it, "local macroscopic interventions of the kind that correspond to visible human actions affect the macroscopic future but leave the past visibly unaffected," (Ismael 2016: 132). We can then "exploit" these real temporal asymmetries in the activity of the physical components of the universe (which we can call "causal direction") to act appropriately for our own ends (Ismael 2016: 129). The kind of regularities that we exploit are not mere correlations but related to, as Ismael says, "asymmetries in the way that information propagates from past to future," which are

³⁰ See Norman Swartz (1973) on the Temporal Ozma Problem for the impossibility of contact between temporally divergent beings.

ultimately grounded in the thermodynamic gradient, i.e., the gradual increase in entropy over time in the physical universe (Ismael 2016: 135; 142).

For an NSE, subjective time is stipulated not to have a particular direction, because all times are experienced at once, as opposed to successively. Experienced time would therefore not “flow” forwards or backwards. However, causation, understood as above, remains a feature of the world they and we are supposed to share. The perceptual peculiarities of the hypothetical NSE would still be subject to the direction of causation, underwritten by macroscopic temporal asymmetries resulting from the thermodynamic gradient. While for us, events in the world apparently *cause* our perceptions of events, in an atemporal world or for a purportedly atemporal being, perceptual experience cannot be so caused.³¹ The subjective experience of the NSE is explicitly atemporal in that it is detached from the ordinary direction of determination, but, like us, their physical existence inevitably succumbs to the familiar causal flow, precluding their stipulated atemporality.

If we think that experiencing a lifetime “all-at-once” means experiencing a range of times at once, then NSEs are confronted by the causal problems outlined above. However, if we think the “all-at-once” experience of an NSE refers instead to a single “static” experiential state that is itself extended over time, then one might think some causal worries can be avoided. Such a state would remain entirely changeless through time, while maintaining causal efficacy at any given time and being the effect of worldly causes at any given time. The latter kind of entity, call it a diachronic-state NSE, is not what our literary examples had in mind, but still represents an important possibility to defuse. Furthermore, one might think we can avoid causal problems by taking the radical step of shrinking our NSE down to the mysterious world of “spooky” quantum interactions, disregarding that agency may well be an emergent macroscopic phenomenon. However, neither move can avoid the further problems with which any kind of NSE must contend, to say nothing of their *prima facie* implausibility.

b. Epistemic Asymmetry

In our lives we are confronted by an apparently unavoidable epistemic asymmetry between past and future, in that we have knowledge of the past, but the future is opaque

³¹ To illustrate, consider an NSE’s experience at t_1 of a later event at t_5 . At a minimum this would require the later event at t_5 be causally connected to the experience at t_1 , but as we have seen, this is nomologically impossible. This problem confronts the NSE at any given time, because at any given time they are stipulated to experience all other times.

(Ismael (2016: Ch. 6); Callender (2017: 260)). NSEs, however, are stipulated to exhibit epistemic symmetry. I will argue that one result of NSEs' unusual epistemic condition is that they cannot be said to make *choices*. If being able to make choices is a necessary capacity for agency, then NSEs are not agents on this count. I will also argue that enjoying such epistemic symmetry is impossible in our world anyway because epistemic asymmetry, much like causal asymmetry, is grounded in the physical structure of the universe. Far from a shortcoming, it is precisely this epistemic asymmetry that *enables* us to act in ways associated with agency. These considerations lead to the counterintuitive conclusion that NSEs, including the medieval Christian conception of God, would actually be *limited* in what they are able to do in fairly significant and startling ways. The ways in which NSEs are limited include being unable to deliberate, predict, plan, attempt, and choose, among other abilities that rely on the epistemic asymmetry we take for granted.

In the context of agency, we can say a choice is the result of a decision process selecting between multiple events to make one or more of them come about (Ismael 2016: 152). Making choices is an ability we like to believe we exercise routinely (though of course not all of our actions are choices, e.g., reflexes). An illustrative example is investing. Investment choices are typically grounded in inductive inferences, predicting future performance in light of what is known about the past. Now let's say that Abbott, as an enterprising heptapod, opens an investment firm. Needless to say, this would be the biggest money-maker on Wall Street. Abbott is, after all, privy to the future to the same extent we are to the past, as he enjoys epistemic symmetry with respect to time. In fact, Abbott's situation is *even better*—whereas we rely on corruptible records and fallible memories for information about the past, Abbott can immediately perceive every historical and future price at any given time. This is clearly a recipe for financial success.

However, Abbott is unable to make investment *choices* because he does not make a decision in order to bring about a later event. As far as Abbott is concerned, the investment is already, at any given time, perceived as invested. Or, at least, that's the nearest description we can give for Abbott's fundamentally tenseless experience. There is not even a sense for Abbott that he *will* (or *did*) invest in a particular asset as, from his perspective, it would always be as if he is in the moment of buying the asset, forever catching himself in the midst of high finance. We can see that, because of this untensed mode of experience, for Abbott no process of deliberation takes place, no prediction, no decision making, no attempt to bring about an event, and no selection process. These actions all presuppose the utilization of past information in service of enacting future outcomes in an unrealized future. Actions of this

type are not only rendered irrelevant by epistemic symmetry but would be impossible except as charade.

This is not merely a problem of omniscience. Knowing how things are going to play out does not necessarily preclude choice. For instance, I might have insider information such that I know tomorrow exactly what will happen, and I may know that I will capitalize on this information by purchasing a certain asset, but nonetheless *I* will still choose to buy it.

Abbott is in a different predicament. Abbot is not just omniscient but temporally *omniceptive* (to coin a term), meaning he perceives every time at once. Experiencing all times immediately is a stronger epistemic position than just knowing what happens, because experiential knowledge outstrips ordinary propositional knowledge. For Abbott it would be as if, at any point in time, he sees his portfolio including everything his investment company has ever bought, is buying, or will buy. With the entire temporal extension of the portfolio immediately transparent and immutable, there are no choices available for Abbott to make. If making choices is essential for agency, we can see then that NSEs fail to satisfy this condition. So, while Abbott's foray into finance might be exceedingly lucrative, it would not be empowering.

An NSE also does not *try* to do things. Trying requires a desire for an eventuality to come about in addition to the possibility it does not. However, from Abbott's perspective, trying would be nonsensical. Abbot might for example join an expedition to the South Pole, but he will not *try* to arrive there because, from his perspective, he is always already there (or not—he might expire *en route*, in which case, for him, he is already dying in Antarctica from the time he comes into existence).

Likewise, NSEs have no need to deliberate or plan for the future, as they are supposed to experience what we call the future as if it were what we call the present, making planning redundant (although Abbott could of course make a show of assessing an earnings report, going through the motions of an investment decision and fooling his clients). Indeed, NSEs *cannot* deliberate or plan because it is impossible for them to perceive an open future. From an NSE's perspective, there is simply nothing to plan *for*.³²

It is likely that NSEs lack many more capacities often associated with agency that rely on epistemic asymmetry as well. One of these is the ability to “temporally decenter,” or take a temporal perspective that is different from one's own (McCormack and Hoerl 1999: 174). Callender, as well as L. A. Paul, maintain this temporal decentering ability is crucial to the

³² See also Ismael (2016: 144-153) concerning our open future and the practical asymmetry of choice.

emergence of the self, understood here as a “narrative center of gravity” (following Dennett 1993: 418), and the agential perspective (Callender 2016: 255-259; Paul 2017: 263-264). Reflection on an NSE’s circumstances reveals they would be deficient in this regard. For a being that experiences its entire life at once, there can be no question of taking different temporal perspectives because that being takes all of its possible temporal perspectives at any given time. There is no picking and choosing moments of its life to experience. The heptapod cannot revisit its “past” or imagine its “future.” Being able to do these things requires successive experiences.

A related issue connected to the NSE’s “closed future” is that, as Callender points out, “All of our evidence is confirmatory of the idea that our decision is the causal trigger that leads to, or brings about, the event. Anything prior to that decision can be trumped by the decision itself. [...] Part of what it is to be an agent is to have this sense of freedom, a sense that other future options are in some sense live,” (Callender 2016: 260). This same feeling does not apply to our past, about which we cannot change our minds and expect a different outcome. However, for an NSE there is no special epistemic status for the future. It is experienced like any other time. It is therefore plausible that, for an NSE, there would not be a *sense* of agency either.³³

A small wrinkle appears in these epistemic considerations, however, if a finite NSE’s action takes place beyond the scope of its experience, e.g., after death. Infinite NSEs, like the medieval Christian God, would be omniscient over eternity, but finite NSEs, like heptapods, could still be ignorant of those things which take place after their life ends. Thus, regarding circumstances beyond the scope of their total experience, an NSE runs into the same epistemic asymmetry we do and consequently may appear more like an agent, albeit from beyond the grave.

Even so, there are still reasons for thinking any NSE’s epistemic setup just wouldn’t work in our universe. An NSE faces no pressure to gather information to guide its action and yet it is this task our minds appear to have evolved specifically to carry out. The reasons we face an epistemic asymmetry are also not an accidental feature of our human minds. Once

³³ A further asymmetry that may be relevant to our sense of agency, and which NSE’s lack, is the attitudinal asymmetry between past, present, and future events, or what Callender has called the “Temporal Value Asymmetry” (Callender 2017: 264). This asymmetry refers to the difference in our attitudes towards and evaluations of events depending on our temporal relation to those events. So, while we might sensibly think to ourselves “Thank goodness that’s over!” after surviving a harrowing Antarctic expedition, an NSE would not say the same (see also Prior 1959, who put our temporal value asymmetry to work against eternalism).

again, there are physical facts constraining us. As Ismael puts it, “what explains our greater knowledge of the past than the future is that along [the thermodynamic] gradient, inferences from the present, surveyable macroscopic state of the world to its past [...] are much more powerful inferences than inferences from present to future,” (Ismael 2016: 143). Ismael goes on, “the thermodynamic gradient makes it possible to create records in the environment that will carry information to our future selves,” (Ismael 2016: 145). What the gradient *does not do* is make it possible to carry information from our future selves to our past selves, which is what an NSE needs to do to exist as a diachronically unified entity. To us, the future is not only epistemically inaccessible but seems as if it has not yet occurred and will come to be shaped by us. The propagation and accumulation of information apparently works in one direction, such that even if the future already exists in some sense, *it might as well not* to any being in our universe. This is a potentially insurmountable obstacle to the actual existence of an NSE. An upshot of this is that our own successive mode of experience should be seen not as limitation, but on the contrary, an enabler of a kind of existence that is uniquely suited to thrive in the world we live in.

c. Intentionality

As mentioned previously, on standard accounts of agency, agents need to have particular kinds of mental states. Specifically, agents need to be able to form intentions and act on them, and these intentions should be causally related to the eventual actions. I will now argue non-succession precludes the formation of intentions, thus ruling out agency as traditionally understood. NSEs should be seen as incapable of forming intentions for two main reasons. One is a fairly straightforward worry related to the problem of epistemic asymmetry. The worry is that, while we intend future events to come about as a result of our actions, the future is not available to an NSE as a domain of uncertainty. It then does not make sense for an NSE to *intend* that future events come about, as these events have no special status and are experienced directly. Just as we do not form intentions concerning the past, NSEs would not form intentions about the future.

A second, more troublesome worry is rooted in the ontology of mental states like intentions, itself intimately related to the ontology of experiences. Experiences are not static, unchanging entities, but evolving processes defined, at least in part, by their dynamism. To make this thought more ontologically explicit, we can follow O’Shaughnessy (2000: Part I.2) and Soteriou (2013: Ch. 6), who claim experience is “not merely a *continuous existent* across

time, [but] an activity and therefore also a *process*, and thus occurrently renewed in each instant in which it continues to exist,” (O’Shaughnessy 2000: 42).³⁴ Occurrent processes are defined by being *successively present* (Soteriou 2013: 139). Unfolding processes, as opposed to states, also allow experienced events to have duration, i.e., to take time. If we agree that experience should be defined in this way, then an NSE is incapable of experience as such. This is because, for a non-successively experiencing being, every event of its life is supposed to be experienced all at once at each moment. There can then be no individuable experiences at different times, separately caused by different events or that cause different events at different times. Instead, there would be just one state.

While the above calls into question the very possibility of non-successive experience, one still might think a non-experiencing entity could be an agent. It is perhaps still possible with this understanding that NSEs have intentions, provided *intentions* are not necessarily processive. If an intention is just a set of dispositional facts, for instance, this could be the case. Abbott could still exhibit an innate set of non-qualitatively felt dispositions that occupy a causal role(s). However, such dispositional properties do not seem distinctive of those entities we consider to be agents, nor relevant to their status as such. Inanimate objects like toasters also have dispositions to behave in certain ways but seeing toasters as intentional agents does violence to our ordinary concept of agency (cf. Dennett 1987).

I would argue instead that mental states like intentions must be occurrent processes. One reason for thinking this is the case is that intentions have a distinctive cognitive phenomenology—it *feels like* something to intend to do something, and it *feels like* we are the ones doing it.³⁵ There is an urge towards action preceding and ostensibly precipitating the action. For genuine agents, it is not just that we act because we are disposed to do so, even if dispositions play a role. Mental states like intentions are, at least in part, *experienced*, and as such, must be processive for the same reasons as experiences. Without this experiential component, the NSE lacks a critical element involved in our understanding of intentions, and thus also fails the intentional criterion for agents.

Beyond the inappropriate cognitive phenomenology, the changeless intentions of an NSE would be unable to play the role of cause to all the actions of the subject. In order to do

³⁴ See also Bartlett (2019), who argues nearly all philosophers of mind hold that experiences are processive, even if this is not explicitly stated. As I have indicated in this paragraph, the process view of experience may shut down the possibility of NSEs *a priori*, not just as agents, but in any sense. However, one can remain sceptical of the process view of experience and the arguments in this section concerning intentions should still apply.

³⁵ See Horgan (2011) for further discussion and defense of the cognitive phenomenology of agency.

so the state would have to exhibit differing causal powers and susceptibilities at different times, which it can't do without changing in some way. However, for the NSE, there can be no change in intention, as a change in intention necessitates an experiential succession.³⁶

Now, it may appear this problem is avoided if a mental state can change without the NSE's experience changing. So long as we accept there are subpersonal mental states such a contention seems eminently plausible. However, the *kinds* of mental states that are most relevant to agency are not subpersonal ones. It is personal-level mental states that must have the appropriate causal role, otherwise we are hard pressed to distinguish automatic reactions from the actions of an agentive subject. As a result of these considerations, we should think NSEs are incapable of forming dynamic intentions and thus also incapable of the kind of intentionality that agency requires.

One might think there may yet be ways of salvaging agency for NSEs. For instance, NSEs might have *sui generis* non-processive intention-like states that occupy the functional role of an intention without phenomenal character. These non-processive, non-experiential states might be causally related to actions and their effects. Limited to a changeless state extended over time, and correspondingly limited in causal power, without cognitive phenomenology, experience, or the various abilities predicated on epistemic asymmetry, such an entity would stray radically from our ordinary understanding of agency.

d. NSEs and Non-Standard Theories of Agency

We might still wonder how NSEs would fare on a non-causal approach to agency (e.g. Melden 1961; O'Connor 2000). On such accounts, the agent need not stand in any particular causal relation with their actions. Understanding agency in this way doesn't let NSEs off the hook for several reasons. One is that the problems of causal asymmetry are not only problems for agency, but also problems for the NSE's existence as a diachronically unified subject. There just cannot be direct causation between temporally distal events or non-directed causation on the macroscopic scale, yet these conditions must obtain in order to furnish the NSE with the experience it is stipulated to have. However, even ignoring these causal issues, an NSE would still run into epistemic asymmetry problems and the problem of non-intention.

³⁶ As Merleau-Ponty puts it: "Change presupposes a certain position which I take up and from which I see things in procession before me: there are no events without someone to whom they happen and whose finite perspective is the basis of their individuality," (Merleau-Ponty 1945: 477).

Suppose however we agree with Anscombe (1957: 9) that intentional actions are those which are done for a reason, but reject the standard contention that agency also requires a special causal connection between intention and events. Perhaps then, it might seem, NSEs can at least avoid the problem of non-intention. We might think a non-successively experiencing being may still have reasons to act in certain ways, even though such reasons may have to be as “ever-present” to the NSE as the NSE’s experience.

I do not think such a move would be successful. Appealing to reasons requires the subject enjoy certain mental states, including belief states. However, as discussed earlier, these mental states have a distinctive cognitive phenomenology that suggests they must be processive in character and so not the kind of thing that can be had at a single moment. Instead, it is essential that beliefs are experienced successively. Perhaps more importantly, though, is that for an agent to act according to reasons, the reasons should *precede* the action. Unfortunately, non-succession makes this impossible by definition.

e. Losing Your Self in the Moment

So far we have been considering experiential succession as a precondition for agency, but it is likely experienced succession is also a condition for selfhood. While I think this idea is somewhat intuitive, it is not universally shared. J. David Velleman, for instance, drawing on Buddhist thinking and Derek Parfit’s “neo-Lockean” account of persons (Parfit 1984: 281), maintains “the existence of an enduring self is an illusion,” (Velleman 2015: 175). For Velleman, however, the emphasis is on *enduring*. An enduring self persists through time in such a way that it is whole at any given time. Though this might be how we ordinarily conceive of ourselves, Velleman argues selves are in fact not like this at all. Rather, selves should be seen as *perduring* objects, in that they persist by the succession over time of individual temporal parts.

Recognizing ourselves as perduring entities, Velleman hypothesizes, could induce a radical and potentially liberating perspective shift. As he puts it: “Suppose that I could learn to experience my successive moments of consciousness — *now* and *now* and *now* — as successive notes in a performance with no enduring listener, no self-identical subject for whom these moments would be *now* and *then* and *then again*,” (Velleman 2015: 187). Your present self, in this scenario, “would think of itself, and each of the subjects with whom it communicates by memory and anticipation, as seeing its own present moment, with none of them seeing a succession of moments as present,” (ibid.). This present self, and indeed each

momentary self on such a conception, should by now look very familiar. What we have here is a collection of non-successive experiencers together comprising what we mistakenly think is an enduring self.

Velleman goes on to claim that for one's present self, "time would no longer seem to pass, because [one's] experience would no longer include a subject of its passage — just successive momentary subjects, each timelessly entrenched in its own temporal perspective," (ibid.). As tentative evidence for this, Velleman cites research on "flow-states" during which we tend to "lose awareness of time's passing" and lose self-awareness to boot (Csikszentmihalyi 1990). Velleman is concerned with the extent to which we can shift our perspective towards the perduring self and whether this could console us and alleviate suffering. While Velleman ultimately admits that, as far as we ordinary humans are concerned, "we can't stop the self from seeming to endure," (Velleman 2015: 192), I would argue the thought experiment itself is incoherent, insofar as it presents NSEs not only as possible but as our fundamental constituents.

We have already seen that NSEs cannot be agents. We would therefore be remiss in applying agential language to the time slices of Velleman's hypothetical scenario. The notion of self does not apply here either. If we identify the agentive self with a "locus of control," (Ismael 2016: 101), then without successive experience such a self does not exist, given the arguments of previous sections. Other conceptions of the self also fail to obtain without successive experience. Consider, for example, that there are a number of essentially processive actions, such as "seeing," "thinking," and "communicating" which can't be said to be things that a *momentary* subject is ever capable of doing. There are predication errors in describing a momentary self as interacting with its environment, itself, and other subjects. The reason for the errors in predication is that the appropriate grammatical subject to which the predicates would be applied has dropped out of existence by failing to extend over time. We need that subject to exist wholly at multiple times, not only at one time, in order to predicate of that self the processive actions we typically want a self to be able to do.

A more accurate description of the consequences of fully realizing the perduring self would be an *absence* of an experiencing self. Non-successive experience is not just nomologically impossible for agents, it also entails non-selfhood. This does not mean a state of non-succession isn't possible; it may be, but only if we eliminate both selves and our agency. This sort of total "ego-death" is reported by users of hallucinogens (see, e.g., Nour et al. 2016) and is arguably the goal of some forms of transcendent meditation. Many Buddhist

traditions³⁷, for example, do not seek a scenario like Velleman describes, with its multiplicity of selves, but instead seek “no-self” (Sanskrit: *anātman*).³⁸ If the truth is that we are perduring rather than enduring entities, fully realizing this truth would be more world-shattering than Velleman’s thought experiment suggests.

There are potential ethical consequences here as well. If SR is true, as I have claimed, of both agency and selfhood, then it is likely NSEs would not be appropriate targets of moral judgment. Because non-agents do not have a claim to moral responsibility, it would make as much sense to call an NSE’s actions “good” or “bad” as it would to describe a toaster this way. Taking the thought to its most provocative conclusion, if we consider our most famous alleged NSE—the medieval Christian God—it seems we have to say claims like “God is good” involve errors in predication as well.

It should be plain that I am not claiming selves or agents necessarily *exist* in any strong sense. What I *am* claiming is that, for such things to exist in an ontologically strong sense *or* as some sort of illusion³⁹, it is paramount that we as subjects enjoy a successively structured experience. There are, of course, very many different conceptions of “self,” and exploring the role that the temporal structure of our experience plays for each of these exceeds the scope of the present chapter. However, I hope this brief excursion has highlighted the potential extensibility of SR to domains beyond agency.

6. Conclusion

I have argued that successive experience is necessary for agency in our world. I have tried to demonstrate this by showing that non-successive experiencers are nomologically impossible. Non-successive experiencers face several intractable problems for agency. These include being too causally distant from causes and effects and being inconsistent with causal direction. In addition, non-successive experiencers lack the epistemic asymmetry associated

³⁷ There is great diversity within Buddhism, but the concept of “no-self” is widespread, appearing for example in the *Dhammapada*, believed by the faithful to be a record of Buddha’s own words. The interpretation of this concept is naturally the subject of much debate. See Baggini (2018: 175-188) for an accessible overview.

³⁸ D. T. Suzuki, for example, quotes a poem by the Zen master Bunan: “While alive/Be a dead man,/Thoroughly dead;/And act as you will,/And all is good,” which he then expounds upon: “To love God is to have no self, to be of no-mind, to become ‘a dead man,’ to be free from the constrictive motivations of consciousness,” (Suzuki 1986: 16).

³⁹ Dennett (1993), for example, claims the self doesn’t exist except as a kind of “virtual self.” For this we need to construct a serial narrative out of a jostling effervescence of mental activity. So it is that, even for the illusory self to exist, successive experience comes along with it.

with agency. Finally, non-successive experiencers are seemingly incapable of having mental states like intentions, which are essential to agency. After establishing the Succession Requirement for agents, I then suggested that SR can likely be extended to selfhood as well, and perhaps further.

In this world, it is reasonable to think that agency is impossible without succession and that agentive subjects require a successive temporal structure in their experience. We can expect, therefore, that agents we encounter in our world will enjoy the same kind of successive temporal structure that we do. Entities without a successive experiential structure, on the other hand, should not be considered genuine agents.

Chapter 4: The Classic Models of Time-Consciousness

1. Introduction

We now turn from describing subjective time and isolating its most fundamental features to considering competing analyses of temporal experience. Broadly speaking, high-level models of subjective time fall into one of three categories: cinematic, retentional, or extensional. We can refer to these as the “Classic Models.” The explanatory target of these models is temporal phenomenology, which is to say, they aim to accurately analyze the structure of our experience of time. The three classic models are typically presented in opposition to each other, with the assumption that one of them can offer the correct account of temporal experience. However, the classic models are neither mutually exclusive nor jointly exhaustive, but rather represent the most prevalent contemporary and historical positions. This chapter will consider what makes these classic models distinctive and why each is ultimately unsatisfactory on its own. This chapter also defends the doctrine of the specious present but finds that neither of the classic specious present views sufficiently accounts for temporal phenomenology as we find it. The next chapter (Chapter 5) will continue the defense of the specious present against a recent challenger, the dynamic snapshot view, while the following chapter (Chapter 6) will return to the classic models and argue that a hybrid extensional-retentional model is the best way forward.

Models of the experiential structure of time are supposed to illuminate or resolve questions about how our oft-paradoxical temporal phenomenology can be as it is. In other words, they attempt to answer how we can have experiences of continuity, succession, etc.—those phenomenal features that constitute theoretical explananda, which have already been discussed at some length. We can think about the various models of subjective time as resulting from different answers to questions like the following: “If we really are capable of directly apprehending temporally extended phenomena, how is this possible? What must our consciousness be like—what features and structures must it possess—for this to be possible?” (Dainton 2014: 101). For so-called extensionalists, the answer to the above question is that the experience of time is *itself* extended in time. For retentionalists, the experience of time is *not* extended in time (or at least needn’t be). Rather, in retentionalism, the content of a succession of intentional mental states or processes, each *representing* an extended experience, grounds the phenomenology of extended time. In contrast to both of the former views, the cinematic model has it that our experiences are analogous to frames in a movie,

each a mere moment in succession without necessarily representing an extended experience. A basic schematic of the three models is provided in the figure below:

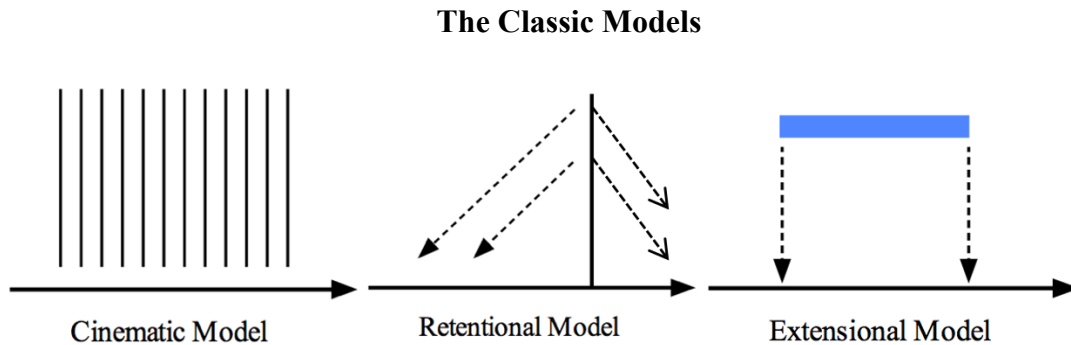


Figure 1: The cinematic model involves a succession of conscious instants mapping onto moments in time. The retentional model shows trailing retentions and protentions (dotted arrows). The entire temporal structure of the retentional model comprises the specious present. Some retentional models do not include protentions, though Husserl’s view, which is the progenitor of the type, does (Husserl 1917). The extensional model shows a conscious state occupying an interval (blue bar), which maps onto a duration of clock time. Adapted from Dainton (2017).

2. The Specious Present

All the classic models position themselves in relation to the now orthodox⁴⁰ doctrine of the “specious present”. It will be useful, therefore, to introduce this concept before considering the models themselves. William James initially popularized the term “specious present,”⁴¹ to refer to the interval of time that a subject takes to be “now,” in contrast to the objective present of physics, which we can call “clock time.” James’ insight was that, for the subject, the present is *not* instantaneous like an “invisible knife-edge,” but *lasts* a certain amount of time (James 1890: 609).

⁴⁰ See Kent and Wittmann (2021) on the predominance of the specious present view. They claim that, despite criticism of the specious present by White (2017) and Arstila (2018), among others, the idea of a specious present is convincingly borne out by contemporary empirical studies (e.g., Lloyd 2012; Berkovich-Ohana and Glicksohn 2014; Northoff 2016) and remains a standard theoretical assumption.

⁴¹ Although James was most responsible for popularizing the term “specious present,” he claims the originator was a “Mr. E. R. Clay” who is now thought not to have existed—instead, the attribution rightfully belongs to cigar manufacturer and amateur philosopher E. Robert Kelly who published an anonymous book called, “The Alternative: A Study in Psychology” in 1882 (for more historical background see Andersen 2014).

While the extensionalist and retentionalist models can both be seen as different ways of accommodating the specious present, the cinematic model is usually construed as opposing the specious present doctrine. Because it only posits *instantaneous* or *momentary* experiences, like frames in a film, the cinematic model lacks an obvious mechanism for accommodating a subjective present that occupies an interval. It could be the case that some collection of these successive momentary experiences is meant to constitute an overarching subjective present beyond the experiential moment itself, but this takes away some of the dialectical force of the model, which emphasizes a succession of “nows” each of which corresponds to a moment in actual time. Potential reconciliation notwithstanding, a tradition of “cinephiles” disputing the specious present has arisen, and their objections will be the focus of the next section.

Multiple considerations, both *a priori* and empirical, originally motivated the doctrine of the specious present. Most pressing was the problem of change and succession, i.e. the problem of accounting for how feelings of change and succession can arise from mere successions of moments. To overcome this problem, James popularized the view that we perceive the present not as a single infinitesimally short moment but as an interval or span with “a rearward- and a forward-looking end” (James 1890: 609). For there to be an experience of change and succession, James thought there must be an interval wherein change or succession can occur because the experience of these things essentially involves a contrast of multiple states. The resultant “duration-block” constitutes the fundamental “unit of composition” of our temporal experience (ibid.). James adopted the term “specious present” for such an interval because, as a length of time, it does not correspond to the “objective” present as traditionally understood (i.e., as an infinitesimally narrow interface between the future and the past). There is thus a mismatch between what we subjectively *take to be present* and the supposed instantaneous present of the world itself.

Moreover, there must be information about past and future states contained within the present in order for us to experience things *as* fading into the past and arriving from the future. Barry Dainton has called this now widely accepted idea “The Principle of Simultaneous Awareness”: we must be simultaneously aware of more than an instantaneous present for us to be able to experience a succession at all (Dainton 2006). The word “simultaneous” is hazardous here as it does not necessarily imply subjective simultaneity, i.e. that we experience two things at the same time, but rather that more than one moment must

be co-conscious or present in mind at the same time.⁴² The past and future must be in some sense *contained within* the experience of the present, whether that present is momentary or otherwise, in order to give the present its distinctive phenomenal character.

So far these have been essentially *a priori* considerations. James also noted from anecdotal and experimental evidence that people really did report and act as though the present occupied an interval of time. An interval conception of the present is evident in common parlance, as Thomas Reid (Reid 1785), and later Shadworth Hodgson, who James quotes in a footnote, observed: “the present moment is often extended practically to a few seconds, or even minutes, beyond which we specify what length of time we mean, as the present hour, or day, or year, or century,” (Hodgson 1878: 248–254). We tend to speak as if the present is a variable length of time—when we say, for instance, that someone is living in a new house now, it does not imply that they are there at this very moment, but that they inhabit this new house through some nebulous duration we conceive of as being present. Of course, linguistic quirks do not necessarily tell us anything about our phenomenology, but they at least indicate that the specious present is not such a foreign concept as it initially appears.

James also thinks little introspection is necessary to reveal that the phenomenology of temporal experience is characterized by the specious present. As he says, “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,” (James 1890: 610). We *feel* as though a certain space of time is held in mind at the same time. This allows us to perceive a musical note as having succeeded from an immediately prior note, with the expectation that it’s moving in the direction of a different note. The phenomenal character, or feeling, of a certain note is, on such a view, different if it occurs in isolation rather than in sequence because the character of the phenomenal present is not determined by one isolated moment but by an interval.

It should be noted the timespan of the specious present constitutes the present of *phenomenally conscious* perception, which involves any experience where there is “something it is like” to have such an experience.⁴³ The specious present is *not* the time between when an event occurs and when the central nervous system is able to produce

⁴² James quotes Volkmann for a more representationalist spin on this same thought: “if A and B are to be represented *as occurring in succession* they must be *consciously represented*; if we are to think of them as one after the other, we must *think* them both at once,” (Volkmann 1884: §87).

⁴³ This terminology follows Nagel (1974).

behavioral reactions. Lag in processing time can vary depending on the implicated neurons, e.g. from between 10-30 ms for some behavioral reactions independent of conscious awareness and 30-60 ms for saccadic reaction times (Frost and Pöppel 1976). The specious present, however, is a domain specifically concerning the interval the phenomenally conscious subject takes to be the present—the present which is always a part of our experience of anything and is in that sense a constant feature of consciousness.

While experiments have helped to give us a range of possible neural processing times, it is much less clear how we should answer the question of how long the specious present is. James himself seems to indicate a range of as little as three quarters of a second (James 1890: 615), corresponding to the “minimum amount of duration which we can distinctly feel,” up to 12 seconds as “the maximum filled duration of which we can be both distinctly and immediately aware,” (James 1890: 613). Meanwhile, modern commentators have come up with intervals of their own: Dainton maintains the specious present would be roughly .5 seconds long (Dainton 2006), Lockwood gives an interval of 1 to 1.5 seconds (Lockwood 2007), Pöppel and Bao cite studies that converge on a 30 millisecond window for “primordial events,” that constitute buildings blocks that come together within the 2-3 second window of the subjective present (Pöppel and Bao 2014). Wittmann (2014) accepts a similar window of approximately 3 seconds, while Grush (2005) advocates a smaller figure of 200 milliseconds.

However, if we remember that the specious present was initially proposed as a way of dealing with the problem of succession, then a good place to start in nailing down the length of the interval is to look at the threshold below which we can no longer experience successive events. If Dainton is right that “two knocks” can be experienced as successive when the interval between them is greater than half a second but not below, then it seems half a second is approximately accurate as a duration of the specious present (Dainton 2011). A short timescale of such a magnitude is adequate for the explanation of succession, but as Arstila and Lloyd point out, there remain other aspects of the phenomenology of time consciousness that can occur over longer durations, e.g. continuity in the stream of consciousness, which would then have to be accommodated by something beyond the specious present (Arstila and Lloyd 2014a).

Many experimental attempts to specify a precise length for the specious present use reaction time paradigms. Such designs rely on the implicit hypothesis that relevant cognitive processes are sequential, or linear forms of information processing. However, cognition involves parallel processing. The experimental design of reaction time studies unfortunately encourages the suppression of the effects of parallel processing in favor of a superficial

linearity, as Pöppel and Bao describe: “the experimental setup may select one activity from these parallel operations and shift it into a frame of sequentiality; by doing so, the experimenter may be seduced into concluding that other activities that have not been selected are in fact nonexistent,” (Pöppel and Bao 2014: 245).

In fact, there may not be a definite answer to the question of how long the specious present is, but instead only a variable, context- and task-dependent range. We should expect this interval to be subject to a high degree of modulation, much like other neural processes, contracting and dilating depending on circumstances, for example as we encounter and resolve life-threatening situations. The experience of time is likely not as unified as it appears, with “intra- and multimodal mechanisms that have different temporal characteristics” resulting in varying durations of the specious present depending on exactly which phenomena and which modalities we are investigating (Arstila and Lloyd 2014a). Because of the various functions and processes occurring in the brain, there might not in fact be *one* specious present, but many, depending on the task, although there may be approximate upper and lower bounds for these intervals determined by physical constraints on their underlying neural processes.

2.1. The Ambiguity of The Specious Present

A further source of tension among commentators on the specious present is that, from a conceptual standpoint, the doctrine as initially presented in *The Principles of Psychology* is ambiguous between at least two interpretations.⁴⁴ Extensionalist and retentionalist models can both be seen as attempts to resolve this ambiguity and accommodate the specious present in

⁴⁴ For more on the inherent ambiguity in James’ presentation of the specious present, see Arstila and Lloyd (2014) and Le Poidevin (2015). According to Le Poidevin, the two biggest sources of confusion are over (1) whether James thought “the specious present” refers to the object of the experience, namely a duration in time, or the way in which that object is presented to us” and (2) at least 4 potential disambiguations of James’ contention that the specious present is “immediately sensible.” Le Poidevin concludes that we could define the specious present, while remaining true to James’ own words, in the following four ways: “1. the span of short-term memory”; “2. the duration which is perceived, not as a duration, but as instantaneous”; “3. the duration which is directly perceived—i.e. not through the intermediary of a number of other, perhaps instantaneous perceptions”; and “4. The duration which is perceived both as present and as extended in time,” (Le Poidevin 2015). Arstila and Lloyd also see an inherent ambiguity between an extensionalist and retentionalist reading, and even a modified form of the cinematic view where the (normally instantaneous) frames themselves occupy some duration (Arstila and Lloyd, 2014a: 310). The latter “cinematic” interpretation is dubious, as it is not clear why we should continue to think of this as a cinematic view and not a form of extensionalism if the experience is extended, but ultimately this is a terminological dispute.

different ways, with each claiming to better capture the phenomenal character of temporal experience. Towards the beginning of James' chapter on the perception of time, it seems we are meant to take the notion of a temporal interval or duration quite seriously indeed, to the effect that we should see the present as being grounded in experiences that are themselves extended in time. James' contention that a "duration-block" comprises the fundamental unit out of which consciousness is composed seems suggestive of such an interpretation (or, as James puts it: "the original paragon and prototype of all conceived times is the specious present, the short duration of which we are immediately and incessantly sensible [i.e. aware]" (James 1890: 631)). This is essentially the extensionalist reading and is the simpler of the two. Extensionalists accommodate the specious present by proposing that all experiences are essentially extended in time, occupying some minimal duration, and these intervals are successive in some way, perhaps overlapping, perhaps not, depending on the author.

However, as James continues his investigation, it becomes clear that he has a rather more sophisticated model in mind. Especially when quoting Volkmann and Ward, James seems to endorse a succession of representations. On this reading, at any given time, multiple representations are present and the "*content* is in a constant flux, events dawning into its forward end as fast they fade out of its rearward one, and each of them changing its time-coefficient from 'not yet,' or 'not quite yet,' to 'just gone' or 'gone,' as it passes by," (James 1890: 630). As he proceeds, James emphasizes more and more the incessantly "fading" or "passing" nature of "instants of consciousness" (James 1890: 630), which he describes in a footnote (paraphrasing a certain M. Guyau) as "*trainees lumineuses* in the mind like the passage of shooting stars. Each image is in a more fading phase, according as its original was more remote. This group of images gives duration, the mere time-form, the 'bed' of time," (James 1890: 632–633).

So it seems that, by the end of the chapter, James has settled on a view that sees a succession of momentary representations, progressively fading into the past and renewed from the future, grounding a structure of experience *as if* it were extended over time. This structure remains invariant "like the rainbow on the waterfall," as events pass through consciousness (James 1890: 630). According to such a view, the duration block of the specious present results from the character of the contents of representations, which at any moment simultaneously represent things as being past, just-past, imminent, etc, and which are *not themselves extended*. These are the seeds of Husserl's more fleshed out view of retentivism, as we shall see later. A further possible interpretation is that James was introducing what we would now call a "hybrid" model, with experience literally extended

over an interval in addition to having representational content grounding the experience of “passing” time. Ultimately, though, it is not necessary to settle the question of what James himself was thinking; we need only see that the specious present as presented in *The Principles of Psychology* is amenable to several different understandings and is not tied up with any particular classic model.

It is useful, however, to identify a “minimal specious present”—one that any model seeking to do justice to the concept should be able to accommodate. This minimal doctrine would consist of the following propositions: 1) the subjective present is not the same as the objective present (hence “specious”) and 2) the subjective present consists of an interval of time. Criterion 2 can be accommodated in multiple ways: retentionalists would say we experience the present *as* extended, while extensionalists would say our experience is itself extended. A hybrid view would say both ways of accommodating this criterion are ultimately correct, but we will come to that in greater detail in the coming chapters.

2.2. Objections to the Specious Present

Besides the ambiguity in the original presentation, some critics of the doctrine of the specious present believe the concept itself and the arguments for it are confused. One vocal proponent of such a view is Simon Prosser, who thinks that “every current version” of the specious present ought to be rejected (Prosser 2017: 147). Prosser has two main objections. The first is that the notion of the specious present is at the very least unclear, and likely incoherent because of its inadvertent commitment to the spurious Cartesian Theater view. Second, Prosser thinks the arguments made in favor of the specious present are unsound. These objections are ultimately unconvincing, as we shall see. The contention of this chapter, agreeing with James, is that the specious present constitutes a fact of temporal experience that must be accommodated and explained by models of subjective time.

Prosser disputes one specific argument in support of the doctrine of the specious present that has been particularly influential. He identifies C.D. Broad’s discussion of subjective time as the archetypal exemplar of this type of reasoning. Broad pointed out there is a distinct phenomenology of change in the sense that we do not experience simply *that things have changed*, we seem to experience *change itself*. For example, “to see a second-hand *moving* is a quite different thing from ‘seeing’ that an hour-hand *has* moved. In the one case we are concerned with something that happens within a single sensible field; in the other we are concerned with a comparison between the contents of two different sensible fields,”

(Broad 1923: 351). That we have such a phenomenology of change, involving as it does comparison between two times, presents a *prima facie* rationale for the notion that we must experience the present as an interval rather than as discrete instants, which on their own would not be sufficient for an experience of change.

Based on the kinds of sentiments expressed by Broad, James, and others, Prosser believes we can paraphrase the primary *a priori* argument in favor of the specious present as follows:

[P1] Motion, and indeed change of any other kind, essentially takes time. [P2] An experience whose content consisted in the state of the world at an instant could only have in its content that which could occur within the instant. [C1] It thus could not include anything essentially extended in time. [C2] Therefore, given that motion essentially takes time but can be perceived, the content of an experience cannot be an instant... similar arguments can be given by appealing to anything perceptible but essentially extended in time (Prosser 2017: 147–148).

Prosser thinks such arguments are unsound because he believes P2 is false: the experiential content of an instantaneous state can include non-instantaneous content. As he puts it: “they fail because they mistakenly assume that an experience with an instantaneous content can have, in its content, only that which could occur instantaneously. This is simply false, for extended processes nevertheless have instantaneous parts, even if the nature of such parts depends on what occurs at other times. All that can be concluded from such arguments is that the surrounding temporal context must be detected by the system that produces the experience,” (Prosser 2017: 148).

Quite rightly, Prosser does not think the requirement of sensitivity to temporal context rules out the possibility of instantaneous contents that represent change. He believes that instantaneous experiential content can, on its own, include “motion-like” or “change-like” properties that can underpin the experience of change without appeal to an interval. Prosser appeals to the “dynamic snapshot” theory advanced by Valtteri Arstila (Arstila 2018) to illustrate this possibility. The dynamic snapshot theory is a variation of the traditional but currently unpopular cinematic model, which sees experience as unfolding in a frame-by-frame manner like a film. Traditionally, one of the main problems with the frame-by-frame, or “static snapshot,” view is that a series of instants in succession don’t seem able to account for the phenomenology of change, because change takes time and instants do not (Prosser 2017: 147). The dynamic snapshot theory hopes to overcome this worry.

Prosser is committed to some form of intentionalism.⁴⁵ This is the idea that the phenomenal character of an experience (what it's like) is determined wholly or in part by the representational content of that experience. The notion of content is notoriously fraught, but for now we can accept Prosser's definition that "the content of an experience is what the experience is *of*," (Prosser 2017: 149). According to Prosser, changing and being in motion are, "state[s] that something can be in at an instant, even though it can only be in that state by virtue of being in other places at other times. So the motion of an object, including its direction and rate, could be part of the content of an experience, even if the content of that experience concerned only what was the case at one specific time," (ibid.). In other words, the content doesn't need to change for the content to be *of* change. Prosser claims the animus towards the snapshot view is inspired by a failure to understand the latter point. Instead of extending the content of experience, the dynamic snapshot view contends there are vectors, with a rate and direction, encoded at instants representing all continuous changes, from movement over time to changes in pitch or color.

Prosser appeals to the so-called waterfall illusion (Wohlgemuth 1911) and similar motion after-effects⁴⁶ to justify the dynamic snapshot theory empirically. In these sorts of illusions, viewing non-moving visual scenes (e.g., a static picture) after some kind of sustained movement results in the non-moving visual scene appearing to move. Prosser says that, in these cases, "motion is experienced even though relevant aspects of the content of the experience remain constant," (Prosser 2017: 150).

Prosser's appeal to this empirical data is open to two immediate objections. The first is that the way he describes the phenomenology may be inaccurate. There is no mistaking the so-called motion of a motion after-effect for motion under normal circumstances over time. Even to call it motion is a little misleading—it could equally be called an "apparent spatial warping without an actual warping." Whatever we call the phenomenal character of the

⁴⁵ The terminology surrounding representation and intention is complex and inconsistent between authors. Here "intentionalism" refers to claims that the phenomenal character of an experience is either identical to or supervenient on the representational content of that experience. In some corners, this same idea has been termed "representationalism." It is implied by intentionalism that all phenomenally conscious experiences have representational content. A further form of intentionalism, which we can call "partial" intentionalism, maintains only that phenomenal character is partly determined by representational content, and leaves open the possibility of phenomenally conscious states with no representational content. All of these are in contrast to anti-intentionalism or anti-representationalism, which claims representational content does not determine phenomenal character and phenomenally conscious mental states needn't have representational content at all.

⁴⁶ Cf. Exner 1875 and Thorson et al. 1969. An example can be found here: <http://www.michaelbach.de/ot/mot-adapt/index.html>.

motion aftereffects, we would not confuse such experiences with experiences of actual motion because it just isn't an experience of motion. Ultimately, the characterization of the phenomenology of motion after-effects is contentious, and while the illusion seems to this author quite unlike veridical motion, that is not to say everyone will have the same intuition (indeed, Prosser does not). This equivocality does not speak in favor of Prosser's own use of motion after-effects as a data point, though.

Secondly, it is not clear that the content of the experience in the motion aftereffect case *does* remain constant. If the subsequent static image seems to become increasingly warped or move towards the subject as a result of exposure to previous motion, then there *is* a change in the experiential content, even if the actual physical image does not change. Changes in experiential content do not require a change in an external object to occur, and Prosser does not seem to want to equate experiential content with physical objects anyway presumably. Indeed, for strong intentionalists, who think phenomenal character is wholly determined by representational content, it wouldn't be possible for the illusory phenomenal character to occur *without* a change in the content. These latter objections will be considered in greater detail in the next chapter, in which a more robust criticism of the recently prominent dynamic snapshot theory and its misplaced appeal to motion aftereffects will be given.

Unlike Arstila (2018), Prosser is ultimately not much interested in whether he is telling the right story about the waterfall illusion. What is important to him is that "the very possibility of such an explanation illustrates the possibility that computational processes in the visual system could yield the content that the object *is moving* (with velocity v) at a specific time," (Prosser 2017: 150). For what it's worth, this is correct. The dynamic snapshot theory is a possibility. But, and this is something Prosser does not deny, the specious present is also a possibility, even if we grant *a priori* arguments of the form outlined earlier cannot establish the specious present as a *necessity*. What we are interested in, though, is *plausibility*— how likely is it that the view is correct? If there are independent reasons beyond *a priori* arguments for establishing the specious present as an actuality, then, practically speaking, we should pay more attention to it than a possible but counterintuitive and poorly supported snapshot theory. So far Prosser has provided little to recommend his alternative beyond its possibility.

That Prosser admits the dynamic snapshot view "cannot explain the experience of discontinuous changes" does not help the cause either, especially when the specious present arose in the first place as a simple way to accommodate all kinds of change in an intuitive,

phenomenologically consistent way. Discontinuous change (e.g., an immediately perceived change from blue to green) is a problem for the dynamic snapshot theory because the vector encoding at instants would not be relevant when there is no rate or direction of change at any instant. Rather than reject the dynamic snapshot theory, Prosser thinks it is instead more likely the brain employs various different systems in the detection of different kinds of changes.

In fact, the doctrine of the specious present has empirical evidence behind it as well. The literature on postdictive effects, for example, where the experience of a percept is modified by a *subsequent* stimulus, indicates there is something like an interval of time experienced as present where percepts might all be considered to be “now”, but the temporal order is not yet fixed. By physiological necessity, there must also be a “window of temporal integration” that allows information from various modalities to synchronize, and the instant-by-instant view seems unable to accommodate this as well (see Vroomen and Keetels 2010 for an overview of empirical literature regarding this “window”).

One thing Prosser makes sure to acknowledge is that “perception has a finite resolution” and this applies to time as well as space (Prosser 2017: 148). Just as there is a minimal level of detail we can detect through vision, so there is minimal period of time within which we can’t tell the order of things. Now it may be that for many who uphold the specious present doctrine, especially those less troubled with the philosophical implications, the idea of a “minimal temporal resolution” is simply what they mean by the “specious present,” and it is the duration of this minimal resolution that the experiments have uncovered. This kind of interval though, is importantly different from the specious present as it does not *necessarily* satisfy criterion 2 of the minimal definition outlined earlier. The specious present requires that the experienced present occupies an interval of time, but it could be there is a minimal temporal resolution that is not experienced *as* an interval, but rather all of its content is as of a single moment, which would be contrary to the specious present view. For the minimal temporal resolution to be a specious present, we must experience that finest interval as an interval, which is not necessarily implied by the notion of a minimal temporal resolution, however likely of a consequence it may seem.

For Prosser, misplaced faith in the doctrine of the specious present is a symptom of an even greater conceptual confusion that Dan Dennett originally brought to light (Dennett 1993: 101–111). This confusion is the often tacit but supposedly widespread commitment to the “Cartesian Theater” model of perception, which involves a privileged seat for the subject, who, like an audience, watches as things occur on the perceptual stage. Dennett originally

disputed that such a conception accurately captures conscious experiences, which he thought actually do not occur to the subject at determinate times but only ever as a procession of competing “drafts” with no endpoint or completed scene for a subject to “view.” As Dennett explains, in this Multiple Drafts Model, “all varieties of perception—indeed, all varieties of thought or mental activity—are accomplished in the brain by parallel, multitrack processes of interpretation and elaboration of sensory inputs. Information entering the nervous system is under continuous ‘editorial revision’,” (Dennett 1993: 112).

However, in the case of time things are not the same as with garden-variety percepts. Prosser seems to make the mistake of thinking time is like one of these many other inputs we detect that the wrongheaded Cartesians believe play out on the stage—in other words, for Prosser the metaphor of the Cartesian Theater applies to time just as it does with other experiences. Indeed, he seems to equate the experience of time with the experience of change. For example, on Prosser’s view, the detection of “transients” (“rapid changes in luminance or colour of the retinal image”) constitutes the detection of time in a way that explains our experience of discontinuous change (Prosser 2017: 151). But time is not like other things that can be detected by sense organs. It is pervasive—rather than being a player *on* the stage for us to view, it *is* the stage and the whole production, the scaffolding that makes both the Cartesian Theater and the competing multiple drafts model possible. While there doesn’t seem to be any obvious reason why the specious present shouldn’t be compatible with experience ultimately being constituted by multiple drafts, it *does* seem like any kind of cinematic or snapshot model invites the Cartesian Theater metaphor—on such views, after all, we experience a series of instants that pass like frames on the screen of a cinema.

Another positive feature of the specious present is that it remains neutral on the status of representations. Whereas Prosser talks extensively of “content,” an anti-representationalist could still maintain there is a specious present without thinking about experiences as having representational content, which confuses things significantly when we begin talking about temporal phenomenology. What we subjectively think of as “now” might really be an interval of time. Does this mean the contents or the vehicle of representation, or both, are extended over an interval, or that the interval itself is the content of representation? We need not commit to a position on representations of time while accepting the specious present, and, indeed, as we shall see later, it is better that we don’t.

3. The Cinematic Model

In contrast to specious present views, the cinematic model contends we are directly aware of events as they occur on a momentary basis, as if we were watching a film. In the standard formulation, “our streams of consciousness are composed of continuous successions of these momentary states of consciousness,” (Dainton 2017). The actual succession of momentary states is supposed to account for the experience of succession. The cinematic model has its virtues, with simplicity foremost among them. We have a series of instantaneous experiences mirroring a series of instants in the external world, just as we might expect pre-theoretically. The setup is intuitive and the analogy with films or flipbooks is easy to understand. It represents a default, naïve, or common-sense understanding of the structure of subjective time. As Ian Phillips puts it, taking naïveté seriously means that “the stream of consciousness inherits the temporal structure of the events that are its contents. You ‘take in’ the temporal structure of the events you are witnessing in witnessing them,” (Phillips 2014: 139).⁴⁷ Because of this simplicity, in the absence of countervailing considerations, we might be inclined to hold onto something like the cinematic model.

Problems with the cinematic model emerge quickly upon closer inspection. Probably the most discussed defect is that the model fails to explain the experience of succession. As Kant⁴⁸, James⁴⁹, Husserl⁵⁰, and many others⁵¹ have pointed out, an actual succession is *insufficient* to produce an experience of succession. As James Mill put it, “One idea, upon this supposition [that of a mere, actual succession], would follow another. But that would be all. Each of our successive states of consciousness, the moment it ceased, would be gone forever. Each of those momentary states would be our whole being,” (Mill 1869: 369).

⁴⁷ Phillips also attends to illusions: on a naïve view, there is still matching between experience and “the *apparent* temporal structure of the objects of experience,” which, he thinks, is all the naïve view requires. He also rightly clarifies that not all cinematic views are naïve (one more sophisticated view will be discussed here later), and not all naïve views need be cinematic, so long as there is a “*direct* link between the temporal properties of perception, and its temporal content [emphasis added],” (Phillips 2014: 145).

⁴⁸ Kant 1781: B46.

⁴⁹ James expresses this idea particularly eloquently: “...between the mind’s own changes *being* successive and *knowing their own succession*, lies as broad a chasm as between the object and subject of any case of cognition in the world. *A succession of feelings, in and of itself, is not a feeling of succession. And since, to our successive feelings, a feeling of their own succession is added, that must be treated as an additional fact requiring its own special elucidation,*” (James 1981: 628-629).

⁵⁰ Husserl 1917.

⁵¹ Including Thomas Reid (1785), Sir William Hamilton (1861), Shadworth Hodgson (1878), Wilhelm Volkmann (1884), Rudolf Hermann Lotze (1887), Maurice Merleau-Ponty (1945), etc.

Besides being insufficient, neither is actual succession *necessary* for the experience of succession. Daniel Dennett somewhat famously illustrated this by disentangling representational content from the representational vehicle of that content. We can take “representational vehicle” to refer to “the sub-personal, functional, or neurobiological realizers of experience,” which bear the content of experience, understood as whatever the experience is of, e.g. particular objects and properties (Kiverstein and Arstila 2013: 446). As we have seen, Dennett’s claim is that “the representing by the brain of *A before B* does not have to be accomplished by: first: a representing of *A*, followed by: a representing of *B*. The phrase ‘*B after A*’ is an example of a (spoken) vehicle that represents *A* as being before *B*, and the brain can avail itself of the same freedom of temporal placement,” (Dennett 1993: 149).⁵² The logical possibilities for how the brain generates temporal phenomenology are therefore not constrained by the actual temporal order of worldly events.

Although Dennett and his predecessors have opened up the logical possibility that the temporal order of events in the world is radically and systematically at odds with the order of our experiences, it must be noted that too radical a divergence, too often would seem to be implausible as an adaptive solution to life’s problems. Our concern is primarily with the order of experiential events on shorter timescales, namely, timescales near the minimum required for the experience of successive events. On these timescales, empirical observations have indeed recorded some very counterintuitive anomalies in the experience of temporal order. Unfortunately, the cinematic model has trouble accounting for such phenomena because on that view experiences are independent of temporal context, with each experiential event just matching a corresponding worldly event and not further shaped by events around it.

So-called “postdictive effects” represent a particularly prominent and thorny class of apparent temporal mix-ups. Postdictive effects are cases of perceptual illusion in which a later event appears to influence the character of a prior perceptual event. Examples of postdictive effects include the flash-lag illusion (Mackay 1958) and apparent motion (or “phi” effect, cf. Kolars 1972). In one version of the flash-lag illusion, a red square moves from the left to the right side of a black screen. At exactly the time the red square reaches the middle of the screen, a green square flashes directly underneath the red square. However,

⁵² The problem of succession does not have to be stated in the language of representation, although it is most apparent when it is. Sequences or series abound in the environment (take any series of events in time or space as examples—a row of trees or a playlist of songs), but a mere succession of elements, as far as we can tell, does not carry with it any subjective experience of one element coming after another.

rather than perceive one square lined up precisely on top of the other as it is presented in reality, subjects report experiencing the red square ahead of the green one, which should not be possible if experiences match the events in the world in a 1:1 way as on the cinematic model. Instead, it seems the further motion of the red square that takes place *after* the flash of the green square appears to influence the experience of prior events, namely, the perceived position of the red square at the time of the flash itself.

The example of apparent motion illustrates a similar problem for the cinematic model. In one type of apparent motion, color phi (previously mentioned in Chapter 2), a subject is shown a blue dot in the upper left corner of a screen and then a blank screen and then a red dot at the bottom right-hand corner of the screen. Rather than two dots, subjects report seeing a blue dot *move* across the screen to the bottom left corner and change to red in the middle of its path across the screen. Here is a case in which the subsequent presentation of the red dot seems to affect the perception of what occurred previously, i.e., the movement of the blue dot and change of color on its way to its destination in the bottom right corner. However, this phenomenon only takes place within a certain timeframe, as Kiverstein and Arstila describe:

If the temporal gap between *A* and *B* [the two stimuli; in the above case, blue and red dots] is too short (less than 50 milliseconds) we are likely to perceive the stimuli as simultaneous. If the interval is too long—400 milliseconds or longer—the illusion is weak and *A* and *B* will usually be perceived as two distinct stimuli. When the temporal gap is between these limits (it works best when the interval is between 50-200 milliseconds), *A* and *B* are fused into a single stimulus *C* and we experience the illusory or apparent motion of *C* from the location at which *A* is initially presented to the location of *B* (Kiverstein and Arstila 2013: 446).

A much more commonplace and less surprising example of apparent motion occurs when a flipbook is flipped through or film is played. In this case, the existence of subsequent frames or pictures appears to affect how we view previous ones, e.g. whether we view them as in continuous motion or static. If a frame or page is seen on its own, which is to say, without an event on either side of it (i.e. a very low or zero frame-rate), the image is seen as static. However, if the image occurs in a context where subsequent, changing frames occur within a short enough temporal remove of the original frame, the image is seen to move.

While a naïve cinematic model has no way to easily account for these kinds of phenomena, cinephiles can simply deny that postdictive effects are what they seem to be at first glance. The problem for the cinephiles is that the experience should be set as soon as the requisite processing takes place, which means they would predict, to take the case of color

phi, an experience of a blue dot in one corner and a subsequent experience of red dot in another place. However, rather than admit future events or anticipations thereof are influencing the character of the experiential present “moment,” proponents of the cinematic view might claim that we actually *don’t* experience a blue dot changing to a red dot and moving continuously from one corner to the other. Instead, we experience it just as they predict and then later *revise* our memory of the event leaving no trace of the original experience to report to experimenters or reflect upon. This process would all have to take place extremely quickly for us never to be aware of the original experience at all or be able to “catch” it and report it. While the jury is still out about the cognitive mechanisms responsible for postdictive effects, the “memory wiping” response looks strained when compared to those of the other models, which have no problem accommodating for these phenomena, with the retentionalist model even predicting their occurrence.

Alternatively, the cinephile can claim that the final experience is the result of subpersonal processes. This leads to another problem, however, which is that this means during the intervening time between the appearance of the first dot and second in actual time, we should still be experiencing something. If that “something” is not the continuous movement of the dot and its changing color halfway (and it should not be, on the cinematic view, if future events are irrelevant to present experiences), then why do we only have an experience as of the continuous movement of the dot and its changing color halfway? The subpersonal process response leaves us in the unfortunate position of “waiting” for the appearance of the next dot before we have any experience. To avoid such an unpalatable outcome, it seems the cinematic model again has to invoke a form of memory wiping to explain why we do not have the experience it suggests we should have in the color phi case. Apart from saving the view, it is unclear why such ad-hoc memory wiping would take place in cases where postdictive effects are observed and not in the normal case.

Besides failing to easily account for the phenomenology of succession and postdictive effects, the cinematic model also has little to recommend it in accounting for many of the other phenomenal features we associate with the subjective experience of time. A succession of instantaneous experiences is difficult to reconcile with the phenomenology of continuity, for example. What is it that allows these instants to feel like they are streaming rather than like a disjointed series, when the latter is the actual case according to the cinematic model?

Cinematic theorists have a number of possible answers to this question. A particularly implausible response is that all of these phenomena are the results of inferences made on the basis of, “conceptual knowledge combined with sensible clues to past and future to be found

here and now at the scene of the time,” (Arstila and Lloyd 2014b: 77). Unfortunately, such a strategy conflates two very different kinds of subjective experiences: explicit inferences from long-term memory do not typically result in the kind of vivid phenomenology that the models of subjective time generally try to explain. As in Broad’s oft-invoked example of the hands of the clock, it is not merely that we surmise the second hand is continuously moving the same way we surmise that the hour hand must be on the basis of its being seen in two different places at two different times, rather we have a further, vivid experience of continuity that calls out for explanation. Inference does not appear to be the right mechanism for producing the appropriate phenomenal character of our experiences.

A more parsimonious response for the defender of the cinematic view is to appeal to temporal resolution. Discrete instants of experience seem to us as if they are continuous with each other just because their succession occurs too quickly for us to notice, in much the same way we are unable to see individual pixels on a screen or frames of a movie.⁵³ If low temporal resolution is responsible for experiences of continuity, though, then we should expect that in some conditions (e.g. neurological disorders) all of our experience might slow down to a speed where its fundamentally discrete character becomes readily apparent. As of yet, conditions like these remain elusive.⁵⁴ That being said, the temporal resolution reply remains a live possibility.

Another way of answering how continuity arises is through appeal to memory. By invoking memory, adherents of the cinematic model can claim that, while experiences themselves might be discrete, they are bound together in memory, which furnishes us with a continuous narrative of events for us to consciously reflect upon. Traces of events stored in memory are also helpful in establishing a sense of trajectory, in that current events can be compared with previous ones to establish a direction of “flow.” The iterative fading of events into the past is supposed to be explained in this way as well. This “memory view” does however seem to stand in contrast with our experience, which, in the present moment, certainly doesn’t *seem* to be an artifact of memory access but a rather more direct connection

⁵³ The temporal resolution response dates back at least to Thomas Reid (1785) and Dugald Stewart (1792).

⁵⁴ Akinetopsia, also known as “visual motion blindness,” (discussed in more detail in the next chapter) is an extremely rare condition that is sometimes reported to have this disjointed, strobe-like phenomenal character, but is actually a visual processing deficit typically resulting from lesions to the occipital lobe. Akinetopsia does not affect other modalities or the subject’s global experience of time—subjects still report experiencing that time has stopped *for a certain length of time*, indicating that temporal experience continues as normal even though the visual image might be static. See Zeki (1991) for a review of this unusual phenomenon.

with our sensory apparatus. The case of those who are severely memory-impaired is also instructive here—though unable to recall old memories and form new ones, nonetheless amnesiacs experience the passage of time as others do.

While we can distinguish between kinds of memory, e.g. episodic, procedural, and working memory, among other proposed divisions and taxonomies, it seems clear at least the first two of these are poor candidates for the job asked of them by the “memory view” permutation of the cinematic model. Working memory is most promising in this regard but also the least well understood. Working memory is supposed to be active only over short timescales and does play a role informing our present behavior. A further worry, however, is that it seems the memory view collapses into a model wherein nearly all or maybe even all of subjective experience *is* just working memory. While this allows for the possibility that the memories comprising most of our present experiential content can potentially shift around in their order, it also means a departure from the naïve view that gave the cinematic model its appeal.

An additional, more conceptual concern with the cinematic view, at least as it has been formulated here, is whether it even makes sense to speak of “instantaneous” or “momentary” experiences. Physical constraints on neural processing speed set a bottom limit on the duration of clock time that will have elapsed between discrete experiences, precluding a matching of successive moments of objective time (assuming there are such things) with subjective time. Although some sort of matching could occur at a temporal remove from objective time, this leaves out a potentially infinite number of “instants” of objective time that would have occurred between discrete experiences. The notion of an experience arising “at an instant” likewise presents difficulties if we think that processes involving activity in many areas of the brain result in conscious experiences. After all, it takes some non-zero amount of time for any neuron to transmit electrochemical signals, meaning the many interacting processes responsible for experience cannot communicate information to each other or be completed at a single instant.

It is wise not to see the processes as “completed” and packaged as discrete moments of experience. To think there is some “endpoint” of processing that occurs at a particular instant (and in succession) falls prey to the fallacy of the Cartesian Theater, implying some “homunculus” or further subject is viewing the final experiences, and the explanatory regress that follows. Indeed, the metaphor of the cinema that gives this model its name suggests this

very problem.⁵⁵ A related worry is that positing a succession of experiences to explain phenomena like continuity is really akin to positing a further, internal flipbook to explain our experience of flipbooks. Ultimately, the cinematic model lacks a decent explanation for how it can result in the expected temporal phenomenology and appears to create more problems than it solves.

4. Extensionalism

Extensionalist models claim our experience exhibits an actual extension over time, and this fact explains our temporal phenomenology. As Dainton puts it, on these views, “our episodes of experiencing are themselves temporally extended, and thus able to incorporate change and persistence in a quite straightforward way” (Dainton 2017: 3). Rather than a succession of instants, as in the cinematic model, in extensionalist models our experience “extend[s] a short distance through ordinary clock-time, in just the way [it] seem[s] to,” (Dainton 2017: 4). For extensionalists, we apprehend an extended present and this explains why the present seems to have duration (i.e., a specious present), as James suggested it has and must have. This is in contrast to retentionalist views in which we do not apprehend an extended present but apprehend the present *as* extended.

Extensionalism can be construed in a direct realist way by maintaining we directly apprehend an interval of time without anything representing that interval (i.e., the experience itself is extended and this gives the experience the character of being extended). Indeed, one of the major motivations for extensionalism is that we needn’t appeal to representational content to explain temporal phenomenology, a feature that lends the model more credibility for those that consider the notion of representational content nebulous and explanatorily impotent with respect to phenomenology.

4.1. The Discrete Block Model

The Discrete Block Model is an extensionalist model that simply sees experience as “a succession of specious presents laid end-to-end in the manner of a line of building blocks,

⁵⁵ While not everyone agrees that Dennett’s Cartesian Theater represents a dissatisfactory understanding of the way the mind works, the prospect of the infinite regress that comes from positing a subject “watching” successive frames of experience as if at the cinema should be cause for great concern (see Dennett 1993: 107).

or bricks in a wall,” (Dainton 2017). The experience of a sequence of sounds would be something like the series A-B, C-D, E-F..., where each pair represents a specious present and each specious present is arranged end to end. Because the sections are up against each other but do not overlap, the model is called discrete. Notable advocates of the Discrete Block Model include Sprigge (Sprigge 1983) and possibly Whitehead (Whitehead 1929). In order to account for the direct perception of change and succession (the thesis of “phenomeno-temporal realism”) the extended temporal intervals (the specious presents) are invoked to contain more than one event that is experienced in succession or as changing. This co-consciousness of events over the duration of the specious present is meant to allow for the phenomenology of succession, continuity, and change. This model therefore has the advantage of simplicity, accommodation of the specious present, and an explanation of the phenomenology that occurs within individual duration blocks.

However, in the Discrete Block Model, the phenomenology is *not* accounted for over multiple specious presents. In essence, this model runs into the same problem that the cinematic model does in connecting its momentary, static snapshots. A succession of specious presents, in and of themselves, like a succession of moments, is not sufficient to ground an experience of succession, continuity, change, etc. In the Discrete Block Model, we end up with “a *succession of experiences*, but there is no *experience of succession*” as Dainton puts it (Dainton 2017). In the case of continuity the situation is the same: on the one hand, the gapless structure of the discrete block model is enough to give us a real continuity, but not *an experience of continuity*. If PT-realism is true, then the Discrete Block Model insufficiently accounts for the basic phenomenological features of temporal experience.

4.2. The Overlap Model

The Overlap Model is a kind of extensionalist model designed to overcome the problems of the Discrete Block Model. It has been advanced by Bertrand Russell (Russell 1915), John Foster (Foster 1979), and Barry Dainton (Dainton 2006), among others. The problem of accounting for continuity across the transitions between specious presents is dealt with here by invoking further specious presents (duration blocks) that overlap each other. Rather than only a discrete series of specious presents A-B, C-D, E-F, etc., the Overlap Model posits further specious presents, B-C, D-E, etc. overlapping the others. Importantly, this does not involve a redundant tokening of the parts (e.g., two D phases) but rather the overlapping specious presents share common parts with the specious present they overlap.

There are no *additional* experiences beyond the sequence posited in the original discrete block model, rather there is an additional *experiential relationship* (Dainton, 2017). In other words, in the newly posited overlapping specious present, the set of experiences that is experienced as co-conscious is expanded to include those in the overlapping duration blocks (B-C, D-E, etc.). As Dainton puts it, “it is now being supposed that D and E are connected by the relationship of diachronic co-consciousness, whereas it was previously held that only C-D and E-F were so related,” (Dainton 2017). However, not *all* experiences are diachronically co-conscious on such a model, but only those that share in an overlapping specious present (e.g., A and F are not co-conscious, which would be phenomenologically inaccurate).

As it stands, this model is too simple. The overlapping specious presents can include *parts* of any given experience too, so there can be a dense overlay of potentially infinite specious presents accounting for varying overlapping intervals of potentially differing lengths across and within different modalities (limited by the brain’s physical constraints).

There are several advantages to this type of view. Dainton notes that the Overlap Model “allows change and succession to be directly experienced in a clear and unambiguous manner, and so fully satisfies the requirements of realism,” just as other extensionalist models do (Dainton 2017). Furthermore, there is phenomenological continuity within and across specious presents. Dainton also claims the Overlap Model satisfies the so-called “Immediacy Thesis,” which states that phenomenological features like change and succession can be apprehended just as well as other phenomenological features like shape and color (Dainton 2017). This is because the source of these phenomenological features is just the relationship between normal experiences and therefore no higher-level inference is required. A phenomenologically accurate picture of which experiences would be diachronically co-conscious and which would not be (i.e. those not adjacent) also emerges from this picture. At the same time, the overlaps explain how phenomenological features like continuity can persist *across* and not only *within* specious presents.

However, there are also drawbacks to the Overlap Model. We might think, as Shaun Gallagher and Galen Strawson do, that the model does not have phenomenological support because the overlapping specious presents are undetectable (Gallagher 2003; Strawson 2009: Ch. 5). Inherent in the model is the assumption that any phenomenological indication of overlap must be absent because that would mean phenomenal continuity hadn’t been achieved, when the fact of phenomenal continuity is the very thing the Overlap Model was enlisted to explain. There is therefore no way of determining, on the grounds of experience, if such a model is accurate and also no support to be found in experience for the model. It

appears the Overlap Model was not generated directly out of a consideration of temporal phenomenology, but rather on *a priori* grounds as an answer to what must be the case for continuity to hold given temporally extended experiences. There is something apparently *ad hoc* about this formulation. Although the proponent of the Overlap Model thinks that phenomenological continuity is itself evidence for such a view, this could equally be evidence for other non-extensionalist models, such as retentionalism—making any such “evidence” neutral between the two views.

It might also be that the overlap model is unnecessary. As Ian Phillips has pointed out, variations in the content of experiences alone (e.g., changes in the trajectory of a bird overhead) can be sufficient to differentiate duration blocks (Phillips 2010). We needn’t appeal to further, subjectively undetectable relationships between parts of experiences to explain the phenomenology. However, as Dainton observes, we still need to answer, “why it is that we are only directly aware of change and persistence over short intervals, rather than the several hours through which a typical stream of consciousness extends,” and, “by holding that the diachronic co-consciousness relationship only extends for a short interval the Overlap theorist can meet [sic] this need,” (Dainton 2017). Compared to the Discrete Block Model, then, the restriction to short timescales and the simple explanation of the phenomenology of continuity ultimately leaves the Overlap Model as the more compelling extensionalist model.

4.3. Reflections on Extensionalism

Further objections can be leveled against extensionalism in general, and its construal of a temporally extended specious present. One problem, dating back to Meinong, is that of the unity of experiences within the specious present (Meinong 1899). As Dainton paraphrases the issue, “if a specious present extends through (ordinary) time, the parts or phases of which it is composed—let us designate them [P1, P2, P3, ... Pn]—will be distributed through time. The question then arises as to what unifies these components. If nothing unifies them, we are left with a succession of experiences, but no experience of succession,” (Dainton 2017). In essence then, we are left with the very problem the specious present was meant to solve in the first place. Attempts to solve this problem often look like exercises in infinite regress. For instance, one may think that the unifier is the “single episode of awareness” within which the experiences are co-conscious, but the parts of that episode awareness likewise occur successively in time so the problem of *their* unity now rears its head. A further appeal to “a higher-order act awareness” unifying the episodes of first-order awareness runs into the same

problem. However, if the original awareness of the temporal parts of experience is not extended but momentary, there is no regress. Such a view seems to endorse the previously mentioned Principle of Simultaneous Awareness (PSA), which states that all the various temporal aspects of an experience are present simultaneously in consciousness (i.e., within a momentary awareness) for experience to have its dynamic quality. The problem with this line of thinking, however, is that we are essentially discarding the original temporal extension that is definitive of all extensionalist models.

The extensionalist can avoid the above outcome by rejecting the principle of simultaneous awareness. They can simply say that co-consciousness of temporal phases *needn't be limited* to momentary awareness but can be extended in time. Indeed, that is the conceit of the extensional specious present, that the episodes within it are co-conscious. There just isn't any reason to think phenomenal unity cannot be achieved over a temporal interval, just as it can be achieved synchronically at any given moment. We can therefore reject the supposition, that "synchronic phenomenal unity—the sort of unity which obtains among simultaneous momentary contents—is the only mode of phenomenal unity," (Dainton 2017). We might wonder, however, how exactly the extensionalist thinks diachronic phenomenal unity can be achieved, but this is apparently no more of a problem than trying to explain how synchronic phenomenal unity can be achieved—both require some heretofore inexplicable feats of integration on the part of the brain. Nonetheless, if the phenomenology seems to suggest a temporally extended specious present, as James initially thought, this is a fact in need of explanation and not explaining away. The extensionalist therefore rejects the privileging of moments as the only temporal unit capable of unity. In doing so, extensionalism accords with a view of distributed brain processes as *taking time* and not finishing their job by generating individual experiences on a moment-to-moment basis. The latter runs the risk of falling into the trap of the Cartesian Theater mentioned earlier in the discussion of the cinematic model, which we might think is an unrealistic vision of the way the brain works.

Another objection is that the notion of a temporally extended specious present gets the phenomenology wrong on the level of experiences that occur within the interval of the specious present (Pelczar 2010). The idea is that, because the extended specious present is supposed to account for the phenomenology of succession, change, and continuity, on the specious present view, none of these aspects exist for momentary experiences *within* the specious present itself. Moments are therefore not dynamic but static if we endorse the extensional specious present. However, as Pelczar points out, there are no such discernible

static experiences at any timescale. Our experience appears to have the phenomenology of succession, change, continuity—in short, dynamism—all the way down, and extensionalism does not account for this fact in a satisfactory way, in contrast to retentionalist models. However, the extensionalists can avail themselves of an easy response, namely that, indeed, such static moments *are* impossible and *don't* exist in our experience. They are phenomenologically inaccessible because we only ever experience the unity of the specious present and not the component pieces within it in isolation.⁵⁶ Another option is to just see Pelczar as begging the question and hold that, in fact, experiences are *not* essentially dynamic. We may not experience them as such because of the way they are unified in the specious present, but this does not mean they are essentially dynamic, only that they are always experienced that way by us because of the large-scale temporal structure. Another, albeit counterintuitive, response is that punctate experiences, static or not, are in fact impossible because, as Dainton puts it, “consciousness has the structure of *atomless gunk*,” and this gunk is “infinitely divisible, but not possessing point-like parts” (Dainton 2017). We might think something about the physical actuality of the neural substrate of consciousness rules out this scenario, but in any case, we find that extensionalism has several plausible ways of handling the objection that it gets the character of micro-experiences wrong.

5. Retentionalism

According to retentional models, “our experience of change and succession occurs within episodes of consciousness which themselves lack temporal extension, but whose contents present (or represent) temporally extended intervals and phenomena” (Dainton 2017: 3). The elements of the temporal structure in a retentional model exhibit intentionality (in Brentano’s sense): *directedness* towards the future, past, or present (cf. Brentano 2015: 92). Consequently, unlike under the cinematic model, in the retentional model the contents of consciousness “*appear* to [but don’t] possess a brief temporal depth [emphasis added],” (Dainton 2017: 3). However, like the cinematic model, the retentionalist does not see experiences as temporally extended but momentary. Alternatively, a retentionalist may see experiences as having some temporal extension, but this extension would be completely irrelevant to phenomenology (in contrast to the extensionalist). The retentionalist endorses

⁵⁶ This response echoes Husserl’s contention, in reference to his retentionalist view, that the individual *parts* of the structure of temporal experience can never be isolated—we only have experiences as a temporal unity.

the Principle of Simultaneous Awareness and insists that the various temporal aspects of an experience are present simultaneously at each moment. The apparent temporal extension of the present (i.e., the specious present) results from the temporal character of intentions or representations, which carry content *about* the later, earlier, and simultaneous events, at each moment.

While the idea of retentionalism might predate Husserl (as we saw, a view like this can be seen in James), retentional models really took off following Husserl, who coined the term “retention.” Like James, Husserl realized the experience of duration is not entailed by “a succession of isolated, punctual, conscious states,” (Gallagher and Zahavi 2010: 75). *Now* for us must be more than a monadic time-slice with no relation to what came before or will come after because such a momentary, fleeting instant could never be experienced as part of the rich temporal flow we find ourselves in.

Husserl took his investigations beyond James, however, and focused particularly on the internal structure of the experienced present itself (i.e., what James called the specious present). Husserl held that merely experiencing an interval is not enough to explain how we experience time as passing. As Gallagher and Zahavi put it, the experience of duration must essentially involve “more than that which is given right now—it must be co-conscious of that which has just been, and that which is just about to occur,” (ibid.). Husserl therefore proposes a threefold internal structure of present experience including what he calls “protentions,” “retentions,” and “primal impressions,” (Husserl 1917).

Our immediate perception includes within it information about what came before (retentions), information about what will come next (protentions), as well as “primal impressions,” which are “directed toward the now-phase of the object,” (Zahavi 2003: 83). All of these elements are directed at different temporal phases, namely, past, present, and future, and therefore exhibit intentionality, at least in Franz Brentano’s minimal sense of “direction towards an object,” (Brentano 2015: 95). It is only the temporal structure of the whole unit, with forward looking and backward-looking edges, that imbues experiences with the impression of time’s passage: a static moment, without the other elements, could not in itself constitute an experience, for experiences necessarily occur over time, as a passage. Thus it must be that, as Evan Thompson puts it, “the threefold structure is invariant and present synchronically as a unified whole throughout the course of experience,” (Thompson 2010: 319).

In Husserl’s scheme, protentions are constantly slipping into the present, the present is constantly fading away into retention, and retentions to further back retentions, along with

potentially infinitely more fine-grained movements. In this way the present is constantly becoming the past and the past is constantly becoming the further past, and so on. Dainton expresses a simple characterization of retentions consistent with most retentional views: “retentions [are] a special form of past-directed mental representations that are triggered in an automatic (and involuntary) manner after each momentary phase of experiencing,” (Dainton 2017). Unlike retentions, which have definite intentional content specified by the just-past temporal phase, protentions are “unfilled or indeterminate” as they concern yet-to-occur events, but still “involve a sense of anticipation,” (Thompson 2010: 319).

It is important to reiterate, for the retentionalist, all the phases of the temporal structure of experience are present *at once* in a single moment (that is, they exhibit co-consciousness). This is not to say they result in an experience of simultaneity, however, but an experience exhibiting different temporal aspects at the same time (e.g., the bow and stern of the specious present to which James alluded). Despite intentionality giving us an experience *as of* an extended specious present, “all variants of the [retentional] approach have this much in common: they compress the experiencing of change into momentary (or near-momentary) phases of consciousness,” (Dainton 2017). Extensionalists do not see an asymmetry between experienced extension and extension over clock time, whereas retentionalists see a radical divergence in this regard; for retentionalists an extended experience (a specious present) can occur in a moment of clock time.

5.1. Reflections on Retentionalism

It is worth noting that extensionalism is a more intuitive option for those that think we can directly and immediately perceive succession, continuity, and the other phenomenological desiderata outlined earlier. Extensionalists accommodate this by allowing that our experiences fundamentally consist of units of duration of real time. This seems to be the most natural way to accommodate temporally extended phenomenology. For Dainton this intuitive appeal of extensionalism speaks quite strongly in favor of that view: “By contrast, the Retentional view can seem almost perverse: why think that our apparently immediate experience of change and persistence is in fact packaged into momentary (or extremely brief) slices of experience? Since it is by no means obvious how this can be, Retentionalism is *not* the obvious way to go,” (Dainton 2017). It is therefore important for retentionalists that they provide reasons for why their view is superior to extensionalism and/or for why extensionalism is implausible.

Retentionalists face an explanatory burden in accounting for how a momentary experience can exhibit the phenomenal character of an extended experience. As discussed above, this is most often done through appeal to representations, but this appeal in itself might be considered a point of weakness if we think the notion of representation is overly vague and/or explanatorily impotent with respect to the specifics of the phenomenal character for which it is responsible. However, depending on preexisting metaphysical commitments, momentary units can also be considered an advantage for the retentionalist. For subscribers to presentism, which is the claim that only the present really exists, usually as a kind of moving interface between the nonexistent past and future, a momentary view of subjective time like retentionalism is essentially a requirement (Dainton 2017). At the very least, an interval view like extensionalism, where consciousness is spread out over objective time, is not so obviously compatible with a metaphysical commitment to presentism.

A further advantage of retentionalism is the strong commonsense intuition in favor of the Principle of Simultaneous Awareness. It seems that, for us to be conscious of anything, including temporal phenomena like succession, all the contents of consciousness must be present simultaneously at each moment—otherwise, they would be inaccessible to consciousness. To take an example, an experience of a continuous, flowing piece of music in the present must include at any given moment some kind of information about which sounds came before and which sounds are expected to come after (in addition to the knowledge *that* sounds have come before and are expected to come after). Without that information, experiences would be disconnected and unrelated. The retentionalist view maintains that multiple intentions (i.e., retentions/primal impressions/protentions plus retentions of retentions etc.) are held in mind at the same time, and these all constitute our present experience, giving it the distinctive temporal character which it otherwise could not have. While it may be that co-consciousness across an interval, as the extensionalists assert, is possible, retentionalists need only appeal to synchronic unity (phenomenal unity at one moment). Their position is thus simpler in at least the one sense of not having a further, more counterintuitive kind of co-consciousness to explain in the shape of diachronic phenomenal unity.

Rick Grush believes another major advantage of retentionalist models is that they can account for postdictive effects like the flash-lag effect better than extensionalism (Grush 2005). Recall that these counterintuitive situations involve later stimuli affecting prior perception, which *prima facie* should be impossible according to a naïve cinematic view. The problem for extensionalism is that the percept only occurs once and is not subject to change

over the course of the temporal interval. Our experience now, on such a view, should not be influenceable by future events. On the other hand, retentionalism allows for aspects of future events to influence the character of the present experience. For retentionalists, a dense succession of retentions-impressions-protentions comprises our experience, so if one of these elements changes with incoming information, it can affect the whole of the present experience. For instance, a red circle presented in an opposite corner of a screen from a previously presented green circle may alter retentions in such a way that the whole present experience has a different character than it otherwise would. More specifically, expectations, which might be fundamental both to protentions and retentions, might shape both of these in light of incoming information, altering the resulting experience as a whole. The plethora of intentional entities involved in the retentionalist view allows for a very malleable phenomenology.

One extensionalist response to the problem of postdictive effects is that the lag in perceptual processing time allows these effects to occur. In this way, later stimuli can affect processing such that the resultant experience changes as conflicting, new information enters the system, but only before the processing of a “whole” experience is complete. Such an appeal has the advantage of explaining why such effects only occur within extremely short timescales (usually sub 200 ms), where retentionalists seem to have a problem accounting for why postdictive effects don’t occur over much longer timescales.

A final problem for the retentionalist is the problem of surplus content. Dainton explains the essence of the problem: “if retentions have the same force and vivacity as ordinary (presently occurring, first-order) experience, as they do in the non-modal variant, there is a risk of flooding consciousness with enormous quantities of surplus content — content which we have no reason to suppose exists,” (Dainton 2017). All that content carried by retentions and the other intentional entities just doesn’t seem to figure in experience in the same kind of way as present experience, rather, it seems, as James had noticed, more “faded” in some sense. The retentionalist response to this problem is to endorse a “modal” form of retentionalism, whereby retentions and their kin are *not* like ordinary experiences. Indeed, historically this has been the most prominent form of retentionalism, with Husserl speaking of retentional contents being experienced as “more” or “less” past, and not as present. However non-modal retentionalists like Geoffrey Lee also exist, who believe that “*all* the contents within a single specious present appear equally present in the phenomenal sense, as well as successive,” (Dainton 2017). This view runs headlong into the problem of surplus

content but does at least have the virtue of making temporal features like succession as vividly present as any other feature of experience.

6. Comparison

It is now possible to compare the classic models and assess their strengths and weaknesses. Owing to the numerous objections previously considered, an unsophisticated version of the cinematic model is the least convincing of the classic models. Its most commendable feature, simplicity, is just not enough to make up for its other shortcomings in explanatory value and consistency with phenomenology.

Extensionalism on the other hand maintains some degree of simplicity in its appeal to features of experience to explain subjective time, without positing an intentional intermediary. The present feels extended because our experience is itself extended. While co-consciousness within the span of the specious present can account for certain aspects of temporal phenomenology within that interval, extensionalism runs into problems accounting for things like continuity over and above the duration of one specious present. How the specious presents are connected to resemble something like a holistic experience becomes a major problem for extensionalism's viability. Essentially, the problems of succession and continuity encountered by the cinematic view are just moved one step up, so that now we talk of problems of the integration of specious presents. One way around this, which cinephiles can also avail themselves of, is to simply bite the bullet and accept that experience is fundamentally "chunky" and discontinuous, but we simply don't notice, much as we don't notice visual saccades. However, this seems to disregard an initial phenomenological consideration, which is that there do seem to be experiences of things like succession and continuity over and above their mere occurrence, and these call out for explanation.

Retentionalism, though more ontologically extravagant than extensionalism in its commitments to representations and a complicated "nesting" tripartite structure of temporal experience, offers a solution to the problems the other models face. Besides more easily accommodating postdictive effects, retentionalists can summon newly posited intentional entities—retentions, protentions, and primal impressions—to accommodate both the specious present and attendant phenomenology, doing justice to the Principle of Simultaneous Awareness by appeal to synchronic unity. However, in this case, it seems like retentionalism goes too far in divorcing phenomenology from the constraints of objective time, which we might think should play a larger role in consciousness if it is there to be exploited. It is also

problematic to think of the intentional entities comprising the invariant and persistent temporal structure of experience as momentary or durationless. Furthermore, an integration problem remains for the retentionalists, as they face the problem of explaining how the synchronic and diachronic unity they propose is achieved without regress to more and ever-broader representations. The extensionalist, in contrast, has at least already headed off the problem within the span specious present, which consists of one, diachronically unified experiential unit.

A further challenge for the retentionalist, though not necessarily a problem *per se*, is the question of how retentions, protentions, and primal impressions are physically implemented and how they can furnish us with the rich phenomenal character they are supposed to. Husserl's own initial thoughts were that retentions were a kind of memory (primary memory), distinct from other kinds of memory (secondary memory) (Husserl 1917),⁵⁷ similar to James' early thoughts about the fading backward-facing edge of the specious present. The difference between primary and secondary memory, at least for James is that, whereas objects of secondary memory are dredged up and brought into consciousness, objects of primary memory are "never cut off from in consciousness" (James 1981: 646-647). A claim like this sounds empirical in that there should be identifiable brain processes underpinning this "primary memory" view of the temporal structuring of consciousness. What these brain processes might be remains an open question. Extensionalists, by not positing similar entities, do not face a similar empirical challenge. Rather, an extensionalist can say that whatever brain process is responsible for experience comes pre-loaded with a temporal aspect just in virtue of itself being extended over time.

Probably the most fundamental point of disagreement between retentionalists and extensionalists concerns the role of representations in each respective scheme. As discussed earlier, there is no necessary symmetry between the properties of the contents of a representation and the properties of the vehicle of a representation. Words, for example, are representational vehicles that do not usually exhibit the same properties as their content (e.g., the word "red" is not always itself red, though it can be). Retentionalists exploit this fact in claiming that contents exhibit temporal properties, which give us a familiar temporal phenomenology consisting of things like extension, persistence, and succession, while the vehicles themselves do not exhibit such properties.

⁵⁷ Husserl's views on this subject were not stable, and his conception of retentions changed throughout his writings, none of which did he take to be definitive.

Extensionalists on the other hand see no asymmetry between the properties of vehicles and contents—the properties of the vehicles are the properties of the content. Wolfgang Köhler, as interpreted by Kiverstein and Arstila, may be an example of someone who rejects the content-vehicle distinction with his contention that “the neural correlates of temporal experience treat time as its own representation,” (Kiverstein and Arstila 2013: 447). In the color phi case, this means that “the neural events ($n_1 \dots n_n$) correlated with our experience of the red flash must occur before the neural events ($m_1 \dots m_2$) correlated with our experience of the green flash,” (ibid.). Just because content and vehicle properties are in principle separable does not necessarily mean that outcome is the most plausible scenario.

Further, an extensionalist might claim there is no distinction between vehicles and content because representations are not involved in the generation of temporal phenomenology. What an experience is of is the content of that experience (a particular percept, say), but it is only the *way that content occurs to us* that is temporal, e.g. over an interval of clock time. The content itself does not consist of represented temporal properties. So, while the retentionalist would explain the experience of succession as a succession of contents, the extensionalist explains the experience of succession as a succession of experiences.

More important perhaps than this difference with respect to content/vehicle properties, is that retentionalists and extensionalists seem to differ with respect to the relationship between phenomenal and physical properties. Retentionalists, again, see no necessary connection between an actual, physical succession (of the representational vehicle, say) and an experienced succession—we may have one without the other. Extensionalists, in contrast, at the very least, see a close connection or even mirroring between the physical temporal properties and phenomenal properties. The experience feels extended because it *is* extended, and this corresponds to an extension in real time of brain processes, which presumably correspond to some degree with the extension in time of the physical processes responsible for incoming sensory input, although some divergence between brain processes and sensed physical occurrences must be possible to account for illusions. Discrepancies between clock time and phenomenal time are after all more the norm than the exception, with subjective time dilation and contraction occurring in a variety of conditions, so the extensionalist has to avoid a precise matching with external temporal properties (though perhaps not with temporal properties of correlated brain processes).

The distinction between physical and phenomenal properties is not the same thing as what Kiverstein and Arstila call an “experience-reality distinction” (Kiverstein and Arstila

2013: 445). It is quite clear that there are many cases of temporal illusions and temporal variability, so it would be a difficult position to maintain that in all and every case temporal experience matches reality. However, it is an easier case to make that temporal experience matches temporal properties of brain processes, which themselves might not line up neatly with the temporal properties of events in the world (e.g., a brain process might take a long time, resulting in a longer experience, even though the event that experience is of occurred very quickly). There are some instances where temporal illusions are easily explained without necessarily detaching brain properties from phenomenal properties. For example, hearing thunder after seeing lightning is a non-veridical temporal illusion but results from basic physics (light travels faster than sound). Additionally, there are neural processing time considerations which can result in experiential differences, e.g. touching one's nose and toes at the same time does not result in feeling the two sensations simultaneously because of differences in processing time (ibid.).

In defense of extensionalism, we might suspect that temporal properties are profoundly different than run-of-the-mill perceptual properties, making the content/vehicle distinction much less relevant in this case. Time, to borrow Rodney Brooks' well-known phrase, is most plausibly "its own best model" on this view (Brooks 1991). Against Dennett's emphasis on the divergence between content and vehicle properties, Ian Phillips points out the uniqueness of time—that it is essentially different from properties like greenness:

Experiences which represent green trees do not themselves have to be green. Nor of course is Emily Dickenson's reference to Spring—"This whole experiment of green"—itself green! Yet it is hard to see how this bears on the case in point. Time is *uniquely* common to experience and its objects. Consequently, there is no clear analogy at all between the representation of green in experience (or poetry) and the representation of simultaneity or duration in experience. Experiences do not have colour properties; they do have temporal properties (Phillips 2010: 34–35).

If the temporal properties of experience are there to be exploited, why wouldn't they be? Why propose temporal properties of content when the vehicles have temporal properties that can already give their contents some temporal structure? There is an apparent synergy here, which retentionalism seems to ignore in favor of a more baroque approach rooted in the potentially spurious notion that time is a property like any other. It is one thing to say there is no necessary connection between the properties of a vehicle and that of its contents, but to say that *in actuality* there is no connection is a greater leap.

There are further reasons for thinking time might be special, and quite disanalogous to properties like color. Kant determined that time must be a precondition of any experience whatsoever. Our concept of time is *a priori* in that it does not derive from experience of the world. We can see this when we consider that “neither coexistence nor succession would ever come within our perception, if the representation of time were not presupposed as underlying them *a priori*,” (Kant 1781: B46). In other words, we cannot deduce coexistence and succession from worldly experience, for that worldly experience cannot be had without already being structured according to principles like coexistence and succession.

The necessity of time for the possibility of all other experiences is apparent when we consider that, “in regard to appearances in general one cannot remove time, though one can very well take the appearances away from time. In it alone is all actuality of appearances possible,” (Kant 1781: A31). According to Kant, we should think of time “not as an object [of a representation] but as the *way of representing* myself as object [emphasis added],” (Kant 1781: B54). Time is thus dissimilar to things like tones (external objects) and colors (properties, specifically secondary qualities), because temporality is common to all of consciousness, and consciousness is inconceivable without it. The notion that time should be treated like other contents, or relations between contents, and that it is not rather a structural feature of consciousness as realized by representational vehicles, is therefore open to doubt and may be considered a potential downside of the retentional view—namely that it does not treat time as adequately “special.”

Extensionalism has difficulties accounting for continuity without slipping into infinite regress. Retentionalism does not have this problem and seems better able to account for the rich phenomenology of change, succession, and continuity. However, retentionalism does face an integration problem, which is to say it is not clear how the various intentions are bound together to create a seamless unity of temporal experience. Retentionalism also faces a problem with the specious present. For extensionalists, the interval that we take to be the present is the specious present, and it is of some more or less determinate length. Retentionalism, taken on its own, does not have any cut off or definable interval, but seems like it implies retentions and protentions *ad infinitum* in either direction. This is neither phenomenologically accurate nor physically plausible. Furthermore, the notion of discrete, instantaneous representations in the form of retentions/primal impressions/protentions seems dubious when it comes to any kind of realistic physical implementation. Brain processes take time by their very nature, so it seems as though these intentional entities must have a non-zero duration.

7. Conclusion

To sum up, we can see that extensionalism has problems accounting for continuity, while retentionalism has problems coherently accounting for the specious present. Combining the two views can give us something closer to a model that accommodates the phenomenological desiderata. Experiences can have temporal properties, as extensionalists maintain, but they can *also* represent temporal properties by means of their content. The combination of these properties can give us the rich temporal phenomenology we expect, as we shall see when the advantages of a hybrid model are discussed in Chapter 6. However, before that, the next chapter will discuss in greater depth why recent proposals to rehabilitate the snapshot/cinematic model are misguided and why we should instead continue to favor the orthodox specious present view.

Chapter 5: Challenging the Dynamic Snapshot View

1. Don't Go Chasing Waterfalls

This chapter extends the defence of the specious present, begun in the previous chapter, by challenging a recent proposal that would seek to overturn that doctrine. That recent proposal is known as the “dynamic snapshot view” and is meant to upgrade the classic cinematic model to make it more plausible as an alternative to the more popular specious present views, namely retentionalism and extensionalism. However, the dynamic snapshot view is flawed for multiple reasons. The present chapter will focus in particular on how the dynamic snapshot view’s purported justification fails and actually supports a more orthodox specious present view instead.

The Waterfall Illusion is a type of motion aftereffect (MAE) known at least since the time of Aristotle.⁵⁸ It involves the apparent motion of a static object following a subject’s prolonged exposure to moving stimuli. Recently, this phenomenon has been recruited⁵⁹ in support of the dynamic snapshot view of subjective time (e.g., Prosser 2016; Prosser 2017; Arstila 2018). The dynamic snapshot view holds that temporal phenomenology can be analysed as snapshot-like experiences that encode information about change, motion, succession, etc., at an instant. The dynamic snapshot view therefore rejects the orthodox “specious present” doctrine, first popularised by William James (1890: 609), which claims the experienced present must be extended in time rather than instantaneous, as phenomena like change, persistence, continuity, and succession require intervals of time.⁶⁰ The contention here is that motion aftereffects like the Waterfall Illusion have in fact been misappropriated and do not provide evidence for the conclusions of the dynamic snapshot theorists.

⁵⁸ Aristotle describes the illusion in Part 2 of *De Insomniis* (On Dreams) in the *Parva Naturalia*.

⁵⁹ From Prosser (2017: 149): “The dynamic snapshot theory gains some plausibility from various empirical sources. Perhaps one part of the intuition that snapshot experiences can only be static is connected with the idea that for there to be an experience of change, the content of one’s experience must itself change over time. But this appears to be false; there are many examples of motion illusions in which motion is experienced despite the fact that no part of the content of the experience changes (apart from time itself). The best-known example is the waterfall illusion (Wohlgemuth 1911) ...”

⁶⁰ Two main “specious present” accounts have emerged since James, namely, extensionalism and retentionalism, which differ according to whether our experiences are themselves extended (extensionalism; see, e.g., Dainton 2006; Phillips 2014; Piper 2019) or whether we have experiences *as of* an extended interval of time (retentionalism; see, e.g., Husserl 1917; Tye 2003; Grush 2006).

The argument against the dynamic snapshot theorists' use of MAEs has two strands. First, it will be argued that the phenomenology of motion aftereffects should in fact compel us to recognise that subjective temporal properties encoded at an instant are *not* sufficient for a subjective experience of motion, contrary to the position of the dynamic snapshot theorists.⁶¹ This becomes apparent when the phenomenology of the Waterfall Illusion is appropriately interpreted. Second, it will be argued that MAEs like the Waterfall Illusion should be seen as illusions of *motion*, and therefore a result of visual processing, rather than temporal illusions *per se*. The rare condition of akinetopsia (motion blindness) helps to demonstrate that the experience of visual motion is in fact unrelated to distinctly temporal phenomenology, so drawing analogies between their mechanisms is misguided. Ultimately, the connection between subjective time and motion aftereffects is too strained for advocates of the dynamic snapshot view to effectively make a case for generalizing to temporal phenomenology.

Underlying the misappropriation of MAEs is a methodological error regarding the kind of evidence that constitutes appropriate fodder for models of temporal phenomenology. The kind of theories that seek to explain temporal phenomenology are not the kind that can be supported by evidence from any one particular sensory modality or cognitive function, such as visual motion.⁶² The dynamic snapshot theorists have therefore missed their target by focusing on a visual motion illusion. As a general constraint on models of temporal phenomenology and explanations of the cognitive mechanisms underlying such models, we should see temporality as a global precondition for subjective experiences. It is thus more plausible that temporal structure is an inherent, fundamental feature of the information processing mechanism underlying consciousness (whatever account we give of this), rather than a result of localised processes.

This chapter proceeds first by describing, in section one, the phenomenology of the Waterfall Illusion as traditionally understood, highlighting the difference between illusions of motion and distinctively temporal illusions. The third section outlines the dynamic snapshot theorists' understanding of the illusion. The fourth section gives a different interpretation—one which is more faithful to the phenomenology and which reveals the illusion is not

⁶¹ This contention goes further than a recent critique of the dynamic snapshot theory by Jack Shardlow, who, while critical of the overall theory, does not take issue with the purported phenomenology of the Waterfall Illusion (Shardlow 2019: 745).

⁶² To be clear, the dynamic snapshot theory does not seek to explain temporal phenomenology merely by appeal to mechanisms underlying visual motion perception. Rather, the theory holds that *something similar* to the mechanisms underlying visual motion could explain all of the temporal phenomenology that philosophers usually think would require an experienced interval (e.g. the feeling of succession), thus obviating the need for an extended experiential present (i.e. a specious present).

supportive of a snapshot view of any kind. On this interpretation, encoding change-like properties at an instant is insufficient for the phenomenology of motion without the perception of a change in position over time. The fifth section demonstrates the disconnect between visual motion and temporal phenomenology by considering the phenomenon of akinetopsia, or motion blindness, and also by delving into the neurophysiological underpinnings of motion perception. The sixth section develops the second strand of the argument against the effectiveness of MAEs as evidence for the dynamic snapshot theory. It is argued that MAEs are unrelated to the systems or processes responsible for the conscious experience of time generally. The connection, therefore, between visual motion-like properties of experiential objects and aspects of temporal phenomenology, like succession, is not strong enough to support inferences about the nature of the latter.

2. The Waterfall Illusion

An especially vivid early account of the Waterfall Illusion came from Robert Addams, a Scot who observed the phenomenon at the Falls of Foyers near Loch Ness in 1834. Addams reported that, “having steadfastly looked for a few seconds at a particular part of the cascade, admiring the confluence and descussion of the currents forming the liquid drapery of waters,” he then “suddenly directed [his] eyes to the left, to observe the vertical face of the sombre age-worn rocks immediately contiguous to the water-fall,” and, upon doing so, “saw the rocky face as if in motion upwards, and with apparent velocity equal to that of the descending water” (Addams 1834: 373). In other words, just a few seconds staring at a moving object (the Falls), resulted in the perceived motion of a stationary object (the cliff) in the opposite direction and at a speed apparently equal to that of the moving object from which his gaze was diverted.

The illusion does not only apply to waterfalls and cliffs, but also other forms of motion and stationary objects, e.g., spiral motion and dot patterns on a screen.⁶³ It is telling, however, that experimental researchers and early observers both thought of the Waterfall Illusion as a *visual* illusion, and not an illusion of *time* in any significant sense. In other words, on the face of it, the illusion has to do with what we *see*, which in this case does not match the state of the world (i.e., the cliff face is not in fact moving). It is not immediately obvious that the illusion concerns how we experience time, although friends of snapshot theories have insisted

⁶³ See Macpherson and Baysan (2017) for an excellent online example of a motion aftereffect.

otherwise (e.g., Robin Le Poidevin 2007: 88; Valterri Arstila 2018: 290; and Simon Prosser 2016: 123).

The contrast between MAEs and postdictive effects helps to illustrate the difference between distinctively temporal phenomenology and phenomenology that occurs over time. Visual motion, it will be argued, is an example of the latter. In contrast, phenomena like succession, continuity, and persistence are fundamental aspects of temporal phenomenology, indispensable to subjectivity in a way that motion is not. Postdictive effects are the archetypal illusions of time in the sense that they seem, *prima facie*, to affect the normal experience of succession. They are called postdictive because it seems in these situations that, paradoxically, what happens in the future is capable of dictating the present experience. Examples include the flash lag illusion (Khoei et al. 2017),⁶⁴ colour phi (Bach 2014), and the tactile illusion of the “cutaneous rabbit” (Geldard and Sherrick 1972).

For brevity’s sake we can focus on the flash lag illusion as an illustrative example of how postdictive effects concern temporality in a way that MAEs do not.⁶⁵ As mentioned previously, in the flash lag illusion, a red square moves from left to right across a screen. When the red square reaches the midpoint, a green square is presented below it at exactly the same horizontal position. However, if the red square *will* continue moving to the right, subjects perceive that the red square is to the right of the green square at the time of the latter’s presentation, rather than exactly aligned on top (as it is in fact). If the red square doesn’t continue moving right, no illusion is reported.

In the flash lag illusion, it therefore seems the perceptual system peers into the future before generating the “present” experience. Ostensibly, then, the ordering of perceived events is modulated retrospectively. We have in this case an illusion of succession, such that the perceived event corresponding to the presentation of the green square is perceived to lag that of the moving red square when in fact they are simultaneous. While postdictive illusions appear to be related to the way our brain constructs and orders experiences, MAEs do not

⁶⁴ The example described in the main text is from Khoei et al. (2017). See also Bach (2004).

⁶⁵ Postdictive effects remain poorly understood and there are many varying interpretations of what is happening in these illusions. Dennett (1993) notably contrasted “Orwellian” (post-hoc memory revision) and “Stalinesque” (modulation prior to experience) accounts of postdictive effects, while himself proposing a “multiple drafts model” of consciousness eschewing a single experiential “end point.” For present purposes, I do not mean to weigh in on the correct interpretation of postdictive effects, but only wish to draw out the contrast between illusions standardly conceived as affecting distinctively temporal phenomena (e.g. reordering the normal succession of events, as in the flash-lag illusion) and illusions that are not similarly distinctively temporal in their effects, such as MAEs.

concern such things. Rather, MAEs, along with other visual illusions of size, shape, and colour, are temporally normal experiences of things that are not the case.

Because visual motion illusions like the Waterfall Illusion do not concern mistakes related to the temporal structure of experience, and because motion is not a distinctively temporal property, we should not see MAEs as temporal illusions at all. There is nothing particularly special about a moving ball as opposed to a stationary ball in the way that we perceive them both lasting through time. We do not perceive a stationary ball as *static in time*, but rather only static in space. Perceived visual properties like colour or motion persist through time just like other perceptual phenomena and have little bearing on the temporality of experience. As Kristie Miller points out, it seems natural to say, “we have the relevant temporal phenomenology even if *nothing* perceptually changes,” (Miller, 2019). Indeed, empirical studies do not show that we feel time stops flowing in a sensory deprivation chamber, although this passage feels slower than usual (Wittmann 2017: 127; 125).

In contrast to visual properties of objects, like changes and movements, properties like succession and continuity are deeply and inextricably connected to experience itself. The latter properties are distinctively temporal because these sorts of properties are the *sine qua non* of experience through time—they are what make us think phenomena, whether stationary or moving, are lasting through time in the first place. It is not the aim here to give a definitive, exhaustive list or phenomenological description of truly temporal properties, but hopefully these considerations make it clear that, because visual motion illusions are not *distinctively* temporal phenomena in the way that illusions of succession are, we should not think MAEs are temporal illusions.

3. The Dynamic Snapshot Account of the Illusion

For proponents of the dynamic snapshot view, the Waterfall Illusion is meant to demonstrate the plausibility of a model of subjective time according to which experience can be analysed as successive instants or moments that exhibit temporal properties like succession, continuity, and persistence. We can recall that, after Addams diverted his gaze from the Falls of Foyers, he saw a static object, the neighbouring cliff face, appear to move. The dynamic snapshot theorist takes it that static moments, like static objects, can exhibit such dynamic qualities as Addams perceived. Our experiences of succession, continuity, persistence, change, and motion are not unlike the illusory motion of the cliff face in this

way: what is actually a procession of static snapshots is imbued at each step with qualities that lend a certain non-static appearance to each moment.

Before considering the dynamic snapshot proposal in more detail, it is important to understand where it comes from and why it is appealing. All snapshot views, dynamic or otherwise, maintain the temporal structure of our experience is akin to a sequence of frames in a flipbook, except in this case each frame is an instantaneous experience. According to Barry Dainton's influential formulation, the "classic" snapshot view, which he calls the cinematic model, holds that "our immediate awareness lacks any (or any significant) temporal extension, and the same applies to the contents of which we are directly aware—they are akin to static, motion-free 'snapshots' or 'stills'."⁶⁶ Our streams of consciousness are composed of continuous successions of these momentary states of consciousness" (Dainton 2017).

The perennial popularity of snapshot views⁶⁷ is perhaps attributable to the simplicity of atomic theories⁶⁸ and the intuitiveness of the analogy with film. If one thinks the mind-independent world proceeds as a series of moments, like movie frames, it seems reasonable to suppose that our experience of the world has a similarly "cinematic" temporal structure.⁶⁹ However, to account for the further *experience of* succession, appealing to a mere succession isn't enough, for we might just as easily experience each event as entirely unrelated to the others. Thomas Reid, responding to John Locke's simple snapshot view,⁷⁰ therefore claimed experiences of succession arise through the reflective comparison of experiential snapshots via memory (Reid 1785: 271). Reid, in a rare departure from his usual reverence for common

⁶⁶ The snapshot analogy is in fact somewhat misleading, as snapshots do not truly capture instants but rather the interval that the camera shutter remains open (Le Poidevin 2017: 320).

⁶⁷ For contemporary *non-dynamic* snapshot theorists, see Francis Crick and Christoph Koch (2003), Robin Le Poidevin (2007), and Philippe Chuard (2011).

⁶⁸ Hoerl (2017: 100, n. 20), discussing Chuard (2011), treats "atomism" as another name for snapshot theories, but there is a subtle distinction. Whereas atomism is concerned with the decomposition of experience into primitive units or "atoms", snapshot theories are committed to the latter *and* to experience being structured as a series of instants. One could hold an atomist view that treats the indivisible, fundamental temporal "atoms" of experience as extended in time, rather than instantaneous. See Piper (2019: 2), for a concise description and list of atomists. For these reasons, the "atomist" nomenclature, which has been at the center of a debate in the metaphysics of time consciousness (see, e.g., Lee 2014), will be avoided here.

⁶⁹ Unfortunately, the simple cinematic analogy is fraught with peril. For instance, one non-trivial difference between films and experiences is that, whereas there is someone watching a film in a cinema, in the experiential case it seems the snapshot theorist has to say something like *we are* the film, or else risk an infinite homuncular regress.

⁷⁰ As a snapshot theorist living before the invention of snapshots, John Locke thought ideas were like "images in the inside of a lantern, turned round by the heat of a candle" (Locke 1690, 2.14.9). See Hoerl (2017: 94, note 12) for an illuminating description of how Locke's lantern might have worked.

sense, thus endorses what Dainton calls phenomeno-temporal antirealism (PT-antirealism); in other words, for Reid, succession, change, and duration are not *directly* experienced (Dainton 2017). Unfortunately, Reid's view doesn't fit well with the way we usually take our experiences of succession to be, as they do not obviously require reflection or memory retrieval to occur. One way to get around this issue is to reject the snapshot view entirely and adopt a specious present view—one in which a window or interval of consciousness can take in successive events together. However, for those enamoured with the simplicity of the snapshot picture, another alternative is to tweak the theory.

With a view to preserving more common-sense notions of temporal phenomenology and account for our seemingly direct experience of change and succession, the *dynamic* snapshot theory adds that the instantaneous snapshots of experience have dynamic qualities. More precisely, Valterri Arstila, the most vociferous defender of the dynamic snapshot theory, identifies four essential theses of the dynamic snapshot view (Arstila 2018: 291). These are:

- (1) realism about temporal phenomenology (PT-realism)
- (2) punctuality of phenomenal contents
- (3) purity of temporal phenomenology
- (4) encapsulated mechanisms

As previously mentioned, Phenomeno-temporal realism (PT-realism) is the claim that, “we have immediate experiences of change, motion, and other temporal phenomena, as the majority of philosophers claim” (Arstila 2018: 291). Under PT-realism, there is a phenomenological difference between experiencing the second-hand of a clock changing position and noticing, perhaps via inference from memory, that an hour-hand *has changed positions*, with the latter not immediately part of our present experience in the same way as the former (Broad 1923: 351). The divergence between the dynamic snapshot theory and standard snapshot theories is stark here. As Hoerl (2017) argues, the standard snapshot theorist cannot draw a principled distinction between experiences of the second hand and the hour hand if both kinds of experience are based on memory, *a la* Reid. By endorsing PT-antirealism and denying the phenomenological distinction between experiences of the second hand and hour hand, standard snapshot theorists apparently ignore a basic *explanandum*. In contrast, the dynamic snapshot theorist hopes to avoid this oversight by accounting for the second hand with dynamic snapshots, while holding there is nothing dynamic about the hour hand.

Arstila's second thesis constitutes the core of any snapshot view. This is the claim that experience is ultimately composed of snapshot-like instants. Such a thesis amounts to a denial that experience is extended over time in the way non-snapshot views would have it, e.g. retentionalism and extensionalism, which see the present as consisting of an interval known as the "specious present." Formulated in an intentional way, according to dynamic snapshot theory the *contents* of experience are not extended over time, unlike retentionalism, where the contents are extended, or extensionalism, where the content/vehicle distinction collapses but the extension of the experience itself is preserved.⁷¹

The third thesis (we can call it "the purity thesis") maintains that temporal phenomenology is possible without "an associated phenomenology of things being different at different times" (Arstila 2018: 291). In other words, according to the purity thesis, we only need to experience one instant to have a phenomenology of change, motion, succession, continuity, and whatever else is thought of as belonging to temporal phenomenology. Dynamic snapshot theorists take the Waterfall Illusion to support this thesis. By challenging the dynamic snapshot theorist's use of the Waterfall Illusion, this chapter will cast doubt on the plausibility of the purity thesis.

Lastly, the fourth thesis, concerning encapsulated mechanisms, contends that, "temporal phenomenology is brought about by primitive mechanisms, each separate from the other" (ibid.). This means that temporal phenomenology is the result of many different mechanisms, perhaps different ones for each modality, as well as aspects of cognition. Such a position multiplies the complexity of any possible account of subjective time drastically, ruling out explanations that seek to ground temporal phenomenology in fundamental structural features of any single overarching mechanism responsible for consciousness. The Waterfall Illusion is meant to support the thesis of disparate primitive encapsulated mechanisms by demonstrating that motion phenomenology, as one aspect of temporal phenomenology, is produced by vector encoding occurring in the visual cortex, while other aspects of temporal phenomenology would be the result of similar mechanisms elsewhere.

Advocates of the dynamic snapshot theory use the Waterfall Illusion as evidence for the claim that features of temporal phenomenology can be experienced in isolation without

⁷¹ Although many philosophers insist on preserving a content/vehicle distinction throughout discussions of perceptual phenomena, doing so presupposes a particular view of time-consciousness, namely, what Hoerl (2013), calls "intentionalism." Assuming such a view begs the question against naïve forms of extensionalism, like that of Phillips (2014) (see also Viera (2019) for a pluralistic view, with differing accounts for different phenomena). For the moment we can remain agnostic on whether the content/vehicle distinction is meaningful and helpful in the case of time-consciousness.

requiring an extended, experiential specious present. The Waterfall Illusion supposedly demonstrates this by showing that even a static object, in the absence of a perceived change in position over time, nonetheless can appear to change or move. As Arstila puts it, "...the most significant aspect of this explanation [of the Waterfall Illusion] is that the experience of motion is explained in a framework where the contents can, subjectively speaking, be confined to an instant" (Arstila 2018: 290). Prosser likewise claims "'Moving' is a state that something can be in at an instant," (Prosser 2017: 149) before leaning on the Waterfall Illusion for empirical support. To put it in the terms of Addam's visit to the Falls of Foyers, for Arstila the cliff face would take on an immediate sensation of motion without requiring any time to elapse.

Although the purported phenomenology of "instantaneous motion" does not appear in the descriptions of Addams and others, Arstila nevertheless thinks this is what is happening in such situations based on the cognitive and neural mechanisms thought to be responsible for the illusion. Arstila's idea here is particularly indebted to Robin Le Poidevin's description of the processes underlying MAEs. Le Poidevin (2007: 89) identifies two neural mechanisms, one that detects motion "by a change in retinal stimulation" and another that "register[s] the relative position of an object and store[s] it in the short-term memory for comparison with later perceptions of its relative position," resulting in perceived change when these diverge.⁷² Le Poidevin believes the first mechanism is more "primitive," does not require any change in position, and gives rise to a sense of the change occurring "now." He thinks, following Gregory (1966), that the first mechanism results in so-called "pure motion" phenomenology in that it does not concern a relation. The second mechanism, meanwhile, "employs short-term memory, takes a series of snapshots of an object's relative positions, and compares them," (Le Poidevin 2007: 89). Le Poidevin extends this analysis to temporal phenomenology generally, such that, for instance, "the conjunction of the very recent memory of C [a musical note] with the perception of E [another musical note] gives rise to an experience of 'pure succession'" (ibid.: 91). This kind of extrapolation from the case of visual motion is a move that proponents of the dynamic snapshot view will also take up.

Le Poidevin is committed to a more traditional (non-dynamic) snapshot view. Consequently, he maintains the only difference between the illusory case and the case of veridical motion is that, while in the former only the first mechanism is engaged, i.e. we

⁷² Note the similarities between Le Poidevin's description of this second mechanism and Reid's earlier conjecture about the role of memory.

experience motion without a change in position, in the normal case both mechanisms contribute to motion phenomenology. Arstila and Le Poidevin agree that motion and change should be considered aspects of temporal phenomenology. However, whereas Le Poidevin, like Reid, sees the comparative function afforded by short-term memory as crucial, Arstila's purity thesis (3) disputes this. Instead, for Arstila, "both pure motion and pure succession are explained by appealing to a primitive mechanism specific to those experiences. For example, the second mechanism involved in the waterfall illusion is likely to be a second-order motion processing mechanism" (Arstila 2018: 291). The dynamic snapshot theorist can then avoid the snapshot theorist's somewhat counterintuitive claim that memory is involved in motion perception even though it doesn't feel this way.

Like Arstila, Simon Prosser (2016) argues the Waterfall Illusion supports the dynamic snapshot view in that it supposedly provides an instance of a static object exhibiting motion. Prosser believes one of the reasons philosophers generally don't think experience can be punctate in the way demanded by a snapshot view is because it seems that for a full-blooded temporal phenomenology, including the experience of change, succession, and the like, we must have an experience "including different states at different times" (ibid.: 123). The thinking here is that the two states must be contained within a single experience for the transition between them to be directly perceived in experience (i.e. PT-realism), and it is this thinking that motivates specious present views.

For Prosser, as with Arstila, the Waterfall Illusion challenges the specious present view by demonstrating that phenomena like motion, change, etc. do not require an extended experience, but only a snapshot. Based on the illusion, Prosser argues vector encoding of perceptual information (i.e. encoding of "both the rate and direction of motion") could be the mechanism responsible for the experience of motion (Prosser 2016: 124; Prosser 2017: 149), which allows for instantaneous states to exhibit properties like change over time.⁷³ He then generalises this mechanism, like Arstila and Le Poidevin, to offer an account of "all such continuous perceptible changes" of any sort. Prosser (2017: 149) explicitly offers the model

⁷³ See work by Alan Johnston and colleagues supporting a vector-encoding mechanism on the information processing side of visual motion perception (Johnston *et al.* 1992; 1999). Johnston contends that "motion is represented at a point and at an instant from a calculation over a spatial region and an extended period of time" (Johnston 2017: 278). Johnston also recognizes multiple "temporal channels in the human visual system," a view which is now commonplace (Johnston 2017: 276). Prosser is also influenced by work in cognitive science like that of Rensink (2002), among others, on the detection of "visual transients," which draw our attention but remain at the level of subpersonal processing, and whose absence is hypothesized to play a role in change blindness (i.e. our remarkable obliviousness to slowly occurring perceptual changes).

of “instantaneous vector rate of change” as an alternative for the phenomenology of change to the specious present view, which he views as unnecessary. Notably, however, Prosser does not think such a mechanism can accommodate discontinuous changes like the sudden change of a light from on to off.

Prosser, with his focus on the connection between temporal experience and metaphysical views of time, is more interested in establishing the mere possibility of a mechanism that eschews the specious present. Despite the spirited arguments he presents for the dynamic snapshot view, Prosser is careful not to fully commit to it. That said, Prosser does claim that, “for experiential content there is no logical entailment from the lack of temporal extension of the content to the content containing only what is ‘static’, or lacking change” (Prosser 2015, 122). The possibility of a world in which we perceive motion only in a way that is similar to the illusory case can be granted. However, it is of crucial importance to an adequate understanding of motion phenomenology, let alone subjective time, that such a world is not *our* world, as we shall see.

4. Understanding Visual Motion Phenomenology

Until the recent resurgence of snapshot theories, the Waterfall Illusion derived most of its fame in philosophy from its paradoxical character. As several philosophers have noted, the initial description of the illusion, in which the stationary object is said to exhibit *motion*, is misleading (Blakemore 1973; Frisby 1980; Crane 1988). Tim Crane, for instance, observes that, “[A]lthough the stationary object appears to move, it does not appear to move relative to the background of the scene. That is, there is a clear sense in which it also *appears to stay still*. There is a distinct appearance of lack of motion as well as motion [emphasis original]” (Crane 1988, 142). Thus, we are faced with an apparent contradiction: the cliff face next to the waterfall appears to be simultaneously in two incompatible states, i.e. moving and not moving. An illusion where we perceive objects as both moving and not moving at the same time calls out for some explanation.

The key to dissolving this paradox, it seems, is to disentangle two senses of “motion.” We do not have the impression that the cliff face is *really* moving in a full-blooded sense. We do not think that the cliff face is moving in the same way the waterfall is. Neither are we confused or unsure about this, as we might be in the case of judgments of length in the

Müller-Lyer Illusion⁷⁴. It is not merely that our beliefs about what is moving remain constant, but rather that we do not directly perceive the object *as moving* at all. It is a strange experience, both like and unlike movement, but it is not the direct perception of movement *per se*. Instead, it is more plausible to say we perceive a distortion in our perception rather than the movement of an object we perceive.⁷⁵

The “motion” detected in the illusion is easily distinguishable from its counterpart in the normal case, when an object is perceived as actually changing spatial location. Le Poidevin readily admits this in his discussion of MAEs: “ordinary perception does not seem at all like those cases of perceptual illusion where we are aware of some inconsistency” (Le Poidevin 2007: 88). At best we think of the formerly stationary object as exhibiting *motion-like* properties or having the “feel” of motion without actually being perceived as truly moving.⁷⁶

Thus, it is probably more accurate to interpret motion aftereffects as causing a motion-like distortion of a part of the visual field. In other words, instead of perceiving a change in the spatial location or extension of the objects we see, it is rather that we note a disturbance in our own vision. As we move our head, the objects *and* the surrounding context suffer the same distortion, which is not perceived as a property of the objects in themselves but instead a progressive warping of a section of the visual field, regardless of what falls within that section. The sense that the distortion is one of the visual field becomes even more salient when the gaze is shifted to a collection of objects at various distances and at various orientations, as the warping of that section of our visual field then seems quite unnatural for the objects themselves to be exhibiting individually (as it ignores relative location, distance from the viewer, or even whether or not an object is present, instead distorting the whole section in the same way).⁷⁷

We have isolated two different perceptual scenarios with differing phenomenal characters—one illusory and one veridical. Under normal circumstances motion refers to a process whereby an object changes position in space. Evidently, this occurs in cases of

⁷⁴ For an example of the Müller-Lyer Illusion, see <https://www.illusionsindex.org/ir/mueller-lyer>.

⁷⁵ Those that subscribe to the transparency thesis, which holds that we cannot perceive properties of experiences but only properties of the objects of them (Tye 2014: 40), will perhaps not like this description. There are many reasons to doubt such a doctrine, however, among them visual noise (Gert 2019; see also Kind 2003).

⁷⁶ Le Poidevin calls this the “impression of motion without any associated sense of change of relative position” (Le Poidevin 2006: 89).

⁷⁷ This can be tested by viewing the illusion on a computer screen and then, rather than shifting the gaze to a stationary part of the screen, shifting to the various objects on the desk and wall near the computer, which would be at different distances and orientations from the initial stimulus.

perceived veridical motion like looking at an actual waterfall, but, arguably, not when we perceive the illusory case. John Frisby's (1979) description of the illusory scenario is telling in this regard: "we are still aware of features remaining in their 'proper' locations even though they are seen as moving" (ibid., 101). In other words, the relations between the parts of the objects seem to remain stable relative to each other, despite the impression of movement. What we perceive, rather than objects moving from one position to another, is the apparent warping of perceptual space. However, in occupying a part of space in the visual field that is affected by the illusion, we can say that the objects, which do not appear to change location in space, nonetheless appear to exhibit motion-like properties, in the sense of being affected by this underlying distortion.

The apparent paradox of the Waterfall Illusion results from conflating two perceptual phenomena under the heading "motion": (1) cases in which objects are perceived as having motion-like properties and (2) cases where we perceive that an object has changed spatial location over time. Only cases of the second type exhibit the phenomenology of veridical motion,⁷⁸ while cases of the first might arise in both illusory and veridical cases. Although both (1) and (2) would presumably be concurrent in the case of a long exposure to the ongoing motion of an object, this is not so in the illusory case. The fact that we do *not* perceive normal motion in the same way as the illusory motion of the cliff face, and that we do not confuse the two, indicates that we cannot isolate the phenomenology of motion to the one neural mechanism to which Prosser and Arstila appeal. The mechanism responsible for the illusion is not all that is in play in the normal case, for, if it were, the illusory motion would appear normal and convincing, much the same as the actual waterfall. Some change in position must be perceived to have convincing experiences of motion, contrary to Arstila's purity thesis. Following Russell (1937), Le Poidevin (2017) calls the requisite kind of motion *displacement*, which cannot occur at any one particular instant because it necessarily involves a succession of differing positions (in contrast with the "dynamic sensation" sought by Italian futurist painters, and perhaps by the dynamic snapshot theorists). As indicated earlier,

⁷⁸ This is not to say that the converse is true, i.e., that only the phenomenology of veridical motion involves cases where we perceive that an object has changed spatial location over time. Rather, it is only to say that perceiving an object has changed spatial location over time *is* involved in veridical perception of motion. Arguably, the perception of change in position over time is also involved in non-veridical yet commonplace perceptual illusions like beta movement, a form of apparent motion that allows us to see things on screens and elsewhere as moving even though in fact there is only a sequence of frames. Apparent motion can give rise to experiences quite unlike MAEs insofar as they are much less easily distinguishable from veridical motion, if at all.

accommodating this kind of motion provides motivation for specious present views, where a conscious window can contain the successive positions of whose relations we become aware.

As far as normal motion perception goes, we are left with a more sophisticated view than the dynamic snapshot theorists can offer, involving *both* perceived motion-like properties and perceived changes in spatial location over time. Against the dynamic snapshot theorists, encoding information about motion-like properties at an instant is insufficient for a normal experience of motion. As a result, on the basis of the phenomenology of MAEs, there is no reason to suppose that temporal experiences can be explained only in virtue of information encoded at an instant, as this, too, following the analogy, would be insufficient. Vector encoding, were the analogy to hold, would not result in our normal temporal phenomenology but only an unconvincing impression of it (although even this is difficult to make sense of). Such a consequence does not speak in favour of the dynamic snapshot theory.

It seems we still need *both* information encoded at a particular time *and* information that requires perception over an interval. With just the former we end up with the unconvincing illusory case, which does not seem to us like a true case of perceived motion, while with just the latter, moving objects may be perceived in staccato fashion, or at least as failing to convey a distinctive sense of movement at any given time. Indeed, the latter scenario is one of the immediate phenomenological inconsistencies one might think of against a snapshot theory, and casts doubt on Arstila's punctuality thesis (2). In fact, such staccato experiences occur when the motion pathway of the visual cortex malfunctions, as in the rare phenomenon of akinetopsia, or motion blindness. The next section will consider this condition in order to illustrate how visual motion and temporal phenomenology are quite distinct.

5. Visual Motion and Temporal Phenomenology Come Apart

Akinetopsia, or motion blindness, is instructive concerning both the mechanisms underlying motion perception and the disconnect between motion perception and temporal phenomenology. Akinetopsia reveals that normal motion phenomenology cannot be isolated to vector encoding of motion properties, although the latter, associated with activity in areas MT/V5 and MT+ of the visual cortex⁷⁹, does play an important role in visual phenomenology

⁷⁹ MT and V5 are different names for the same area of the extrastriate visual cortex (V1, or primary visual cortex, referring to the striate cortex). MT stands for "middle temporal," an anatomical description of the area, while V5 refers to visual processing area 5, which is a cognitive functional

(Newsome and Paré 1988; Ajina et al 2015). Akinetopsia also reveals that, for all the importance attached to it by the dynamic snapshot theorists, visual motion is not especially significant to our overall temporal phenomenology. For this reason, it is misguided to use the case of motion perception to make inferences about the mechanisms underlying temporal phenomenology.

Akinetopsia is a rare condition in which a subject fails to perceive motion normally, instead perceiving a stroboscopic-like effect when confronted with visual movement. In some extremely rare cases, moving objects can seem to become “stuck” or remain frozen for some period of subjective time. The key insight about these cases regarding subjective time, however, is that *subjective time itself does not freeze* in the same way as the particular moving objects in the visual field do. Rather, the subject is able to say that the object has remained stuck for some length of time. The absence of visual motion no more affects the subject’s overall sense of time than the absence of colour vision.

The most studied subject to exhibit this rare condition is known as patient L.M. It is helpful to consider her case, a condensed version of which is provided by Heywood and Kentridge (2010):

[L.M.’s] chief complaint was that she no longer saw movement; moving objects appeared ‘restless’ or ‘jumping around’. Although she could see objects at different locations and distances, she was unable to find out what happened to them between these locations. She was severely handicapped in her daily activities, e.g. she had substantial difficulty in pouring drinks into a cup or glass, because the fluid appeared ‘frozen like a glacier’; she could not see the fluid rising and was unable to judge when to stop pouring. (ibid.: 24)

In the example above of liquid becoming frozen like a glacier, it is of crucial importance that only the liquid is apparently frozen. The static objects of visual experience (like the glass or kettle—in fact, everything that is not exhibiting observable motion) still persist through time, along with objects perceived through other sensory modalities, whether in motion or not. The subject’s cognition also continues normally through time. She does not cease to experience time; rather, certain perceptual objects do not exhibit motion as they normally would.

The fact that L.M. has trouble judging *when* to stop pouring indicates she is aware that the liquid, which should be moving, is frozen *for* some duration. In her case, though, she

description. MT+ refers to area MT *plus* nearby areas, such as MST (the medial superior temporal area).

must make a conscious calculation about how long a certain quantity of liquid would normally take to fill a cup in order to determine when to stop, instead of perceiving this unfold and acting accordingly as unaffected subjects might. That the moving object is experienced as static for some interval reveals that extinguishing the phenomenology of visual motion does not prevent us from experiencing intervals of time as normal. Vector encoding, as a potential cognitive mechanism associated with visual motion, is a red herring when we consider that knocking out this mechanism does not grossly interfere with temporal phenomenology properly understood.

As we might expect, patient L.M. was also unable to perceive motion aftereffects like the Waterfall Illusion. Zihl, Cramon, and Mai (1983) presented L.M. with a spiral-type MAE and found that she did not report experiencing the illusion at all. Nonetheless, L.M. continued to experience time, and, in fact, was able to use the timing of associated auditory cues to make inferences about visual motion, e.g. the speed and direction of vehicles nearby, to help her navigate a confusing world of staccato, yet persisting, visuals (ibid.: 315). L.M. was thus not *temporally* impaired, but *visually* impaired. Whatever mechanism is responsible for the type of visual motion experienced in MAEs, that mechanism therefore does not seem related to temporal phenomenology in any interesting sense.

Granted, the dynamic snapshot theorist is left with the logical possibility of vector encoding as the mechanism responsible for temporal phenomenology. In essence, the dynamic snapshot theorist can still say something like, “the brain appears to use vector encoding in one application, so it is possible it uses the same mechanism when it comes to other aspects of phenomenology.” However, this gives us no reason to think the brain is *actually* doing this in the domain of temporal phenomenology. In fact, temporal phenomenology, which heretofore has not been connected with any particular sensory modality or area of the brain, would seem especially resistant to such an explanation. This is because, as we see in the case of akinetopsia, it is not as easily extinguished, for example by brain trauma, transcranial magnetic stimulation, or psychopharmacological intervention, as other, less fundamental aspects of phenomenology such as visual motion. Indeed, the extinction of temporal phenomenology seems impossible without eliminating consciousness entirely.

Besides the disconnect between visual motion phenomenology and temporal phenomenology more generally, akinetopsia also makes clear that normal motion phenomenology is not generally a matter of just one mechanism, like vector encoding. This becomes clear when we consider that, even though the akinetopsic patient L.M. suffered from

the near total elimination of normal functioning in area MT/V5, motion phenomenology was *not* completely eliminated. Heywood and Kentridge elaborate: “Although L.M. has been dubbed ‘motion-blind’, she retains rudimentary movement vision, e.g. she can discriminate speed and direction of motion of high-contrast gratings at low speeds” (Heywood and Kentridge 2010: 25).

The closely related underlying neurophysiology of akinetopsia and MAEs indicates the former condition is much like a chronic inversion of motion aftereffects. Akinetopsia typically results from lesions to visual cortex area MT/V5 and can also be induced by transcranial magnetic stimulation (TMS) to this area (Beckers and Zeki, 1995). MT/V5 is active in cases of illusory motion like the Waterfall Illusion,⁸⁰ as well as in cases where subjects perceive “implied motion,” for instance in comic strips (Heywood and Kentridge 2010: 25). In addition to inducing akinetopsia, when TMS is applied to MT/V5 it is capable of eliminating motion aftereffects in normal subjects (*ibid.*). Naturally, MT/V5 is the proposed site of Prosser and Arstila’s vector encoding mechanism. In the case of the akinetopsic subject this area is essentially deactivated.

One conclusion we can draw from the neurophysiological analysis of akinetopsia is that visual motion is not the result of one simple process. Information perceived over a span of time is also relevant to our normal phenomenology of motion and is not parasitic or secondary to the operation of V5/MT, meaning the purity thesis looks increasingly dubious. This becomes even clearer when we consider that important perceptual features are retained in akinetopsic patients, including some degree of motion perception:

[...] Akinetopsia provides a clear example of *selective* loss of phenomenal consciousness for visual motion [emphasis added]. Patient L.M. [...] retained the ability to use biological motion cues which are probably processed by brain areas distinct from those concerned with processing motion of rigid bodies and global motion of a scene. (Heywood and Kentridge 2010: 25)

Progress in understanding the areas of the brain responsible for vision reveals that besides processing properties like shape and colour, the brain has a specialised “visual motion pathway.”⁸¹ According to Newsome and Paré (1988: 2201), this pathway “originates in striate cortex and terminates in higher cortical areas of the parietal lobe,” processing and

⁸⁰ The motion-like properties of static objects during MAEs is associated with false signals arising from specialised motion detection neurons that “suffer a reduction in responsiveness” as a result of sustained exposure to the moving stimuli (Anstis et al. 1998: 111).

⁸¹ See Johnston (2017) for an accessible discussion of the neurophysiology.

giving rise to experiences of the motion-like properties of objects (see Roksztin et al 2010 for a detailed neurophysiological description). As mentioned, crucial parts of this pathway, most notably processing in area MT/V5, can be severely disrupted for patients with akinetopsia and it is also this pathway that is affected in visual motion illusions, of which the Waterfall Illusion is one example. However, this pathway is more complex than the dynamic snapshot theorist appreciates, involving several stages, multiple cell types, multiple streams, and more areas than V5/MT alone (Roksztin et al 2010). More importantly, this pathway is not obviously related to general temporal phenomenology, as becomes apparent when we consider that its malfunction does not disrupt akinetopsic patients' overall sense of time continuing to flow. For these reasons we should be sceptical of claims that the alleged vector encoding mechanism of V5/MT responsible for some aspects of visual motion perception is in any way related to our experience of time.

One might think of the motion detection pathway as providing a quick and easily accessible way of encoding potentially life-threatening information, like the speed and direction of an incoming predator, which is quickly registered by these neurons without having to consider a large change in location over a span of time.⁸² A tiger, to follow this example, can be simply attributed motion and direction without having to perceptually register a substantial change in spatial location, as might be required for the full-blooded perception of motion (stripes and all) that we would normally have upon seeing a tiger run for some length of time. Arguably, the length of time necessary for the normal, fleshed out perception may not always be enough, in which case the visual motion pathway could prove highly adaptive. The neurophysiology of MAEs therefore indicates the Waterfall Illusion phenomenon and its associated physical substrate are the result of unique adaptations likely unrelated to temporal properties like succession and continuity, which would be more primitive, global features of consciousness.

As our look at akinetopsia shows, it is certainly not the case that encoding of motion-like properties in the visual cortex just *amounts to* our experience of time. We should also be wary of the claim that similar processes would be involved in experiences of all temporal properties. One reason to resist such an extrapolation is that, unlike in the motion case, there are no identifiable neural populations or brain areas picking up on fundamental features of

⁸² A TMS study by Beckers and Zeki (1995) has indicated that “perceptually effective visual motion signals reach V5 at or before 30 ms and reach VI [V1] at or before 60 ms” and they concluded on this basis that the brain employs both a fast (direct to V5) and a slow (through V1) pathway when processing motion (ibid.: 49).

temporality like succession from sensory stimuli in the same way that motion can be picked up from vision. We also do not find cases of patients that lack fundamental aspects of temporal phenomenology like the experience of succession (i.e. one thing happening after another). If it were possible for brain lesions to result in disturbances of this kind, we might think the processes underlying temporal phenomenology were localized in specific areas. These cases might convince us that temporal structure is not a global, fundamental feature of consciousness, but a bolt-on module or a series of modules. However, such cases are not forthcoming.

So long as a subject is conscious, there seems to be a basic experience of time passing. Barry Dainton (2010) aptly illustrates the ubiquity of the sense of passage through the example of lying in a deckchair looking at the sky, as well as examples from other sensory modalities:

For some moments now you have been staring at an empty region of blue sky and nothing has changed. Your inner monologue has (if only briefly) ground to a halt, you have seen no movement, your visual field is filled with an unvarying expanse of blue. But is your consciousness entirely still or frozen? Have you come to a complete stop? No. Throughout this period you remain conscious, and conscious of the blue presence *continuing on*; you have a (dim, background, passive) awareness of the blue constantly being renewed from moment to moment. This passive awareness of continuation and renewal is perhaps more vivid in the case of auditory experience. Imagine hearing a sustained but unwavering note played on a cello: you hear a continuous and continuing flow of sound. This feature—call it “immanent phenomenal flow”—is possessed by all forms of experience (think of the burning sensation on the tongue caused by biting on a chilli pepper), and is a dynamic feature of experience that is independent of changes of the ordinary qualitative sort (the chilli-induced burning is felt as *continuing on* even when its intensity and qualitative character remains constant).

This ubiquitous sense of flow is *not* dependent on movement or change. This sense of flow would not lend itself to description or encoding in the vector-like terms of trajectory or velocity and does not easily analogize to the movement of objects through space.

It is also not clear, given the ubiquity of the sense of passage, that this can or should be analysed as a consequence of disparate encapsulated mechanisms, rather than a feature of a process responsible for consciousness in general. However, Arstila’s fourth thesis posits “encapsulated mechanisms,” that is, separated, primitive mechanisms, rather than a general mechanism responsible for temporal phenomenology. For Arstila, a “second-order motion processing mechanism” is responsible for the “temporal” phenomenology in the waterfall illusion (Arstila 2018: 291). However, according to Arstila, similar mechanisms *also* exist for

every other part of our temporally structured subjective experience. For example, similar, though separate mechanisms must be found for the experience of succession in thinking and deliberating, the entertaining of beliefs and desires, interoception, proprioception, emotion and mood states, etc. Not only is there no evidence of analogous mechanisms to MAEs here, but the dynamic snapshot appeal to vectors (representing direction and velocity) just doesn't seem to coherently apply. We might also consider that different adaptive pressures would have resulted in different evolutionary paths in the development of our cognitive faculties. As visual animals, quickly registering the motion of a tiger would be of the utmost importance to survival. There is no pressure to develop a similar mechanism for encoding information about the succession of thoughts at an instant, were this even possible.

There are other compelling reasons to reject the contention that temporal phenomenology is the result of many disparate encapsulated mechanisms. Besides neurological implausibility, we might consider the principle of parsimony. Why adopt the encapsulated mechanism approach when it is simpler, more explanatory, and truer to the phenomena to locate temporality as a feature of a general mechanism responsible for consciousness, whatever that may be? A feature of a general mechanism also has the benefit of accounting for why people never seem to go “timeless” the way people go “blind”—temporality is indispensable to consciousness because it is inextricably bound up with the processes responsible for it.

6. Inescapable Temporality

A certain strand of philosophy dating back at least to Kant (1781) has contended that temporality is really a necessary precondition for conscious experience. For Kant, “Time is [...] given *a priori*. In it alone is actuality of appearances [phenomena] possible at all. Appearances may, one and all, vanish; but time (as the universal condition of their possibility) cannot itself be removed,” (Kant, 1781, A31). The necessity of time for experience can be argued by appeal to the inconceivability of experience without temporal structure. This inconceivability is not just a failure of imagination on our part. Experiences as we know them are essentially in time and occur over time—an experience that was not so would not be worthy of the name, besides being inconceivable.

Given consciousness is essentially temporal, it is plausible that temporality is an inherent feature of the widely distributed processes responsible for subjective experience generally. A recent proposal from Jakob Hohwy (2015) takes this notion to heart, placing

temporality at the heart of the predictive mechanism that Bayesian-brain-style information processing accounts see as responsible for consciousness (and much else besides). For Hohwy, it is the continuous update and replacement of our cognitive system's predictions about the hidden causes of our sensory stimuli (our models of the world) in light of new information from an ever-volatile environment that results in a feeling of rolling along through time (ibid.). Such a theory presents temporality as a deep feature, found throughout a multilevel mechanism of cognition, which is inherited by any conscious event. Isolating subjective temporality to one particular neural or cognitive mechanism, e.g. vector encoding, associated with a particular modality or phenomenon is too restrictive. Rather, it is in global processes that we may have more luck identifying the neural and cognitive correlates of temporal phenomenology in a way that illuminates why it is so fundamentally inescapable for a conscious being.

Connecting temporal phenomenology to relatively local processes like the mechanisms at work in visual motion processing is thus a deeper flaw than it appears at first. The mistake becomes clearer when we look at the implications of the view, were we to accept the dynamic snapshot theory. Suppose we grant that motion can be perceived in a robust way solely via the vector encoding mechanism that illusory motion from MAEs is meant to demonstrate. Instead of explaining temporal phenomenology, such a position only postpones explanation. This is because the phenomenology of visual motion, if determined by vector encoding at an instant, must *still* appeal to an overarching temporal phenomenology for the illusion, or indeed anything, to be experienced at all.

To elaborate, let us assume, as per the dynamic snapshot theory, that perceived motion of the illusory kind is sufficient for the phenomenology of visual motion and there is no direct perception of change in spatial location over an interval of time. Despite this, the experience of the illusory motion persists through time and must do so in order for us to have it. When faced with a static object perceived as having motion-like properties, it is not the case that our experience has stopped, is static, or is confined to an instant. The organism's overall consciousness does not become instantaneous (in other words: confined to an instant or solely about instantaneous states of affairs) just because we are experiencing an unmoving object. For the experienced illusory object (the cliff face, say) to appear static in space, but with motion-like properties, it must exhibit persistence over some length of time. This temporality is inescapable; events continue to succeed one another over time, even if the content remains the same.

Whether in the illusory or non-illusory case, while the cliff next to the waterfall is either stationary or apparently exhibiting motion, our experience of that object must continue through a window of time for us to experience that object as either static *or* moving. It doesn't give the dynamic snapshot theorists any further ammunition that the cliff-face can be seen to exhibit motion-like properties, as the perception of any properties whatsoever still requires an extended experience in the way that the competing, "specious present" models of temporal phenomenology identify (i.e. retentionalism and extensionalism). These views agree, contrary to the purity thesis, that the experiential present must be an interval of time for us to enjoy the phenomenology we are familiar with, like succession and continuity.

Against the idea of a present window, Arstila cites the frequent disagreement over lengths of the temporal interval⁸³ to suggest that no such specious present exists. However, insofar as an interval of any length is indicated at all by empirical studies it cannot be concluded that a snapshot view is more reasonable than a specious present view. Rather, it would be more reasonable to maintain there may be some inherent task-dependent flexibility in the duration of the specious present, as James (1890) long ago suggested.

7. Conclusion

Temporal phenomenology cannot be adequately explained in the way that the dynamic snapshot theorists wish. We do not have good reason to think that things like succession, continuity, and other aspects of subjective time result from or are related to similar mechanisms as the vector encoding that may occur in area V5/MT when confronted with the Waterfall Illusion. This should be a cautionary tale for theories seeking to provide explanations of temporal phenomenology. Evidence for or against models of temporal phenomenology will not be found at the level of the neural mechanisms responsible for any one specific sensory modality. Rather, models of temporal phenomenology should be intimately related to models of subjective consciousness generally, as temporal phenomenology is a precondition for having subjective experiences in the first place and not an "additional" feature of consciousness.

The Waterfall Illusion and motion aftereffects do not support the dynamic snapshot theory. The misappropriation of motion aftereffects in support of the dynamic snapshot

⁸³ E.g. Grush (2005) cites 200 ms, Dainton (2006) says half a second, Lockwood (2005) 1-1.5 seconds, Pöppel (1988) and Wittmann (2011) 3 seconds, and James (1890) around 12 seconds.

theory results from a faulty interpretation of these illusions. Furthermore, the connection between visual motion and temporal phenomenology turns out to be spurious, meaning that, despite the role of vector encoding mechanisms in the former, it is an unjustified leap from that mechanism to the assertion of a similar mechanism underlying temporal phenomenology. Consequently, motion aftereffects do not support views of subjective time consciousness that reject the specious present, while countervailing considerations remain strong in favour of the specious present.

Chapter 6: The Extensional-Retentional Analysis (ERA)

1. Introduction

According to extensional models, experiences themselves are extended in actual clock time. Retentionalist models, in contrast, posit intentions directed at different time-phases but not necessarily existing in that time-phase.⁸⁴ A *hybrid* extensional-retentional model retains both extensional and retentional features. Extensionalism and retentionalism are typically treated as opposed. This chapter will argue not only that these two ways of thinking are compatible, but that combining them results in explanatory benefits that would otherwise be shut off to us.

A hybrid extensional-retentional model could include features of both accounts. Such a model is pluralistic, appealing to different explanatory strategies for different ends. Specifically, it can hold there are intentions directed at different phases of time, but *also* that those intentions are temporally extended or “distributed” over an interval. Both features—intentionality and the temporal extension of intentions—can be seen as contributing to the phenomenal character of temporal experience. This type of extensional-retentional analysis, which I will call “ERA” for brevity and to distinguish it from other hybrid views (see Section 7), is better able to accommodate our temporal phenomenology than either retentionalism or extensionalism alone.

I will begin by arguing in Section 2 that the hybrid view escapes a potentially infinite explanatory regress associated with classical forms of retentionalism that undermines those models’ ability to offer a coherent account of the so-called “specious present”, i.e. the interval of experienced time that we take to be now. Furthermore, I will argue a hybrid view evades the unpalatable implication of the classical retentionalist picture that the specious present might have no boundary in principle and might extend indefinitely. The hybrid view can achieve both these ends by explicitly casting actual temporal extension as explanatorily relevant for experience. Following this, in Section 3 I will argue that a hybrid model can also recruit solutions from each of its components to answer potential threats to the other. Specifically, I will show how a hybrid approach can handle what Barry Dainton (2018a) has

⁸⁴ Most retentional models *also* include a stipulation that the intentional entities are always simultaneously present at a given moment and not spread out through clock time. However, it is not this property, but rather the postulation of intentions (i.e., retentions, etc.) that is the fundamental distinguishing property of retentional models.

identified as the “extensional” and “retentional simultaneity problems”, which stem from oversimplifications made by each account when considered as sole explanations for temporal phenomena. Finally, I will argue that a hybrid model strikes the right balance between parsimony and phenomenal accuracy while still accommodating temporal illusions through appeal to intentional explanations. Ultimately, I conclude that a pluralistic explanatory approach endorsing a hybrid model of time-consciousness can provide a more satisfactory understanding of the experienced present, experiential succession, and temporal variability than the standard accounts can offer on their own.

2. The Extended Present

Consider the weirdness of temporal experience. On the one hand, it can seem to us like we are directly plugged into some kind of “real” or “objective” flow of time. On the other, we know our experience of time is highly variable. While the slowing and speeding up of experiential time is a well-documented everyday occurrence⁸⁵, there are also illusions that further highlight the complexities inherent in our temporal experience. An example is the flash-lag illusion, already discussed in Chapters 4 and 5 at some length.⁸⁶ We might see this as an illusion of event order: the presentation of the green square is inaccurately experienced as occurring before it really does, namely before the red square hits the midpoint. A further wrinkle is that, like similar temporal illusions⁸⁷, this one is timeframe dependent—it does not occur when the events take place over a long enough interval (i.e., when the squares are moving sufficiently slowly). How do we account for such an unusual phenomenon? One answer might be that our experience of the order of events is independent of, and perhaps wholly detachable from, the actual event order or span of time the events occupy, with the overall experience determined by the (fallible) content of intentions.⁸⁸ Such an answer

⁸⁵ See Wittmann (2018) for a wide-ranging tour of temporal variability.

⁸⁶ See McKenna (2020) for an example: <https://www.illusionsindex.org/i/flash-lag-illusion>.

⁸⁷ See Section 6 for further discussion of relevant temporal illusions.

⁸⁸ For a detailed empirical investigation of the flash-lag effect that explicitly appeals to representations (in the form of predictions), see Khoei, Masson, and Perrinet (2017). According to the authors of that study: “...the explicit, probabilistic representation of velocity information is crucial in explaining position coding, and therefore the flash-lag effect,” (ibid. 1). Interestingly for present purposes, this account, like most others of the phenomenon, also explicitly appeals to delays in physical processing times, which, according to the authors, are (in this case poorly) compensated for by predictive representations (ibid. 2-3).

naturally favors a retentionalist view.⁸⁹ However, while this is a decent story, it is also not the whole story.

One of the main issues with the retentional story is that it neglects to give a plausible account of the duration of the interval within which experiences, illusory or otherwise, occur. Here I will consider a pair of problems related to this general worry. One of the problems for retentionalism is a potentially endless retentional regress, while another problem concerns the apparent arbitrariness of the span of the specious present. These two problems can be avoided by incorporating an extensional approach and recognizing the explanatory relevance of a real interval of time for experience, rather than leaning on intentional content exclusively. Once we do this, we not only have a decent explanation for the cases, like the flash-lag illusion, where things go wrong, but also can appeal to real features of experience in explaining the overall temporal frame or “temporal goggles” we wear in all cases.

2.1. Specious Present Problems

Of all the classic models, extensionalism seems best-suited to straightforwardly explain the duration of the specious present. The specious present, on the extensional view, is just the duration, in actual time, of present experience. On standard forms of this view our temporal experience is not mediated by intentional content. Retentionalism on the other hand is committed to intentionality. To motivate the incorporation of extensionalism into a hybrid picture, I will focus here on two problems for retentionalism: first there is a potentially endless intentional recursion leading to a problematic regress and secondly there is the potentially absurd consequence that the specious present itself, barring *ad hoc* explanations to the contrary, might extend to infinity (perhaps over the subject’s whole lifetime). Ultimately, these two problems are serious enough to strongly motivate extensionalism as an account of the duration of the specious present.

According to the classical Husserlian form of retentionalism, experience is composed of retentions, retentions of retentions, as well as retentions of these, and so on, in a process of modification that continues “*ad infinitum*” (Husserl 1917: 130).⁹⁰ However, on such a view, it

⁸⁹ Examples like these, popularized by Dennett (1991) have indeed been deployed as counterexamples against extensionalism (e.g., by Grush 2007). Phillips (2014b) offers a response defending extensionalism with specific reference to the “cutaneous rabbit” illusion, a tactile postdictive effect.

⁹⁰ This description simplifies Husserl’s view by leaving out other kinds of intentions in his tripartite scheme, but the details are unimportant for current purposes.

is unclear why there should be any boundary, however dynamic, flexible, or fuzzy, confining retentional content to an experiential present lasting any particular amount of time. There's no immediately obvious reason why the intentions posited by retentionalism would not extend forever outwards from the specious present in both directions. In fact, Husserl himself recognized this problem (in a footnote to his diagram of the retentional model) but did not seem to think it was cause for concern: "no notice is taken in the diagram of the limitation of the temporal field. No end to retention is provided for therein, and, ideally at least, a form of consciousness is possible in which everything is retentionally retained," (Husserl 1917: 52-53, n. 8). Nonetheless, Husserl thinks that "the same complex [of intentions] continuously undergoes a modification until it disappears, for hand in hand with the modification goes a diminution which finally ends in imperceptibility," (Husserl 1917: 52). He then claims that "the temporal field always has the same extension," (ibid.) and is analogous to space in this way. Why such a diminution would occur and why the field would remain finitely bounded to a particular extent, despite the worry expressed in Husserl's footnote, is not clear.

Besides the potential problem of coherently grounding our experience in infinitely *iterated* content, we are also left with the looming threat of an infinite *expanse* of temporal content constituting our present experience. We can call this the "Problem of the Infinite Present" (PIP). Retentionalists seemingly must grapple with the expansive temporal scope of experience implied by the classical model despite introspection indicating a very limited interval. PIP thus points to an apparent inconsistency between retentionalism and what we know with some confidence about human experience—namely, that it is *not* "God-like" in its temporal expanse.

Of course, there are physiological limitations on brain activity and it therefore may seem appealing for a retentionalist to lean on these physical constraints to account for the manifest finitude of the specious present. This would mean endorsing the view that physiological processes occupying a certain duration result in experiences that either occupy that interval or whose durations are in some way indirectly determined by that interval. Crucially, however, this appeal to the extension in clock time of the realizers of the intentions betrays the intentionalist conviction that only the contents of intentions are relevant to temporal experience. A response like this, which already admits a kind of hybrid view, allows a fundamentally retentional model to maintain the intuitive (but not necessarily direct) connection between brain process duration and experiential duration, whereas denying any such connection leaves us without an explanation for the particular finite duration of the specious present.

As a pioneer of the Phenomenological Method, which brackets ordinary scientific investigation, Husserl himself cannot appeal to brain processes to solve PIP. Physicalists on the other hand, as well as others that think what the brain is doing matters quite a bit to the character of our experience, might well be sympathetic to such an appeal. Indeed, merging retentionalism with empirical cognitive science and neurophysiology has recently become a minor cottage industry under the banner of what Francisco Varela (1996) has called “neurophenomenology.”⁹¹ Such projects appear to be compatible with the hybrid view I am defending here and, in some cases, may even be committed to something like it already. This is perhaps most obvious in the case of Varela (1999; 2000), who privileges the timescale of “transient neural assemblies” in determining the temporal window of experience, while also committing to retentionalism in principle. More recently, Wanja Wiese (2017), building on Rick Grush’s computationalist “trajectory estimation model” (2005), maintains that “the content of the specious present is not best conceived as a linear stream of events, but rather as a hierarchy of temporal wholes,” (2017: 3). Wiese thinks that his account is “compatible with all models that embrace the view that the content of momentary conscious experience comprises an interval (which is common ground between retentional and extensional models,” (ibid.: 4). Wiese’s view, which adapts the predictive processing framework⁹² to the temporal domain, represents a promising direction that appeals to the intentionalism of Husserl while maintaining the potential explanatory relevance of the structure of information processing and the neurophysiological underpinnings of that structure (for more on Wiese’s and Grush’s models and how they compare to the current proposal see Chapter 7, Section 5).

2.2. Extensional Solutions

For their part, extensionalists do not face PIP because they can collapse the content/vehicle distinction for the domain of temporal experience.⁹³ Because on their view intentional content is *not* responsible for the duration of the specious present, there is no infinite regress of intentions associated with extensionalism. Instead, what might be called

⁹¹ A summary of some of these accounts can be found in Dainton (2018b), which includes overviews of diverse work by Varela (1999), Van Gelder (1996), Lloyd (2004), and Grush (2005). See also Thompson (2007: Ch. 11).

⁹² See Hohwy (2013) for a wide-ranging overview of predictive processing and Hohwy, Paton, and Palmer (2016) for a predictive processing inspired account of temporal experience, in this case specifically with regards to experienced “flow.”

⁹³ See Hoerl (2013), esp. section 2 (p. 383 in particular), for a fair-handed discussion of the debate between extensionalists and retentionalists and what it consists in.

the “representational vehicles”, were we to maintain a content/vehicle distinction, just *are* of a certain duration and this duration is that of the specious present. For an extensionalist there is no hypocrisy in endorsing the importance of what intentional theorists would call “vehicles” because this is their *modus operandi*—extensionalists argue against temporal experience being explicated as *just more content*. For the extensionalist however, a new question arises: why and how should the properties of the bearer of content (i.e., the vehicle) have any explanatory purchase on the phenomenal character of our experience?

One response for the extensionalist could be that such properties just fall out of the form of the content bearers such that those properties are inherited⁹⁴ by the experience. We can call this the “resemblance” view of extensionalism (after Hoerl 2013: 381). In fact, there are many instances where the properties of a representational vehicle appear to have a *prima facie* obvious bearing on the properties of the content of the representation. While in principle representations can represent their content in any arbitrary way (they can be strings of arbitrary symbols like these, for instance), nonetheless in some cases the connection is apparently non-arbitrary. In pictorial representations, for example, certain properties of the vehicles—their colors, their shapes, perhaps their texture—might have direct relevance to the content represented. So, while the word “green” does not need to be green to represent the color green, a pictorial representation of something green, like a pine tree, *can* represent the color properties of its content in virtue of itself being green; similarly, we might consider a hieroglyphic representing a bird in virtue of having a broadly similar shape to a bird. Though contingent, the connection in the latter instance is non-arbitrary—the reason the bird-shaped hieroglyph represents bird-content is, at least to some extent, the isomorphism between the representational vehicle (the symbol) and its content.

Could not something similar occur with temporal properties? Tree rings, for instance, can be considered representations of temporal content, and it so happens that the quantity and arrangement of successive rings (a property of the vehicle) determines the temporal content that can be read off the representation, i.e., the number of years the tree has existed. Couldn’t such representations be the simplest solution to our problem with experience? Now, this dendrochronological example is not perfectly analogous to experience because in the tree

⁹⁴ See Phillips (2014a; 2014b) for naïve realist extensionalist defenses of what Phillips calls the “inheritance principle,” which holds that “for any temporal property apparently presented in perceptual experience, experience itself has that same temporal property,” (Phillips 2014a: 131). Phillips also notes that adherence to the principle is not “obligatory” for the extensionalist (Phillips 2014a: 133).

ring case non-temporal properties (e.g., the spatial arrangement and number of the rings) represent temporal properties. However, there remains a significant relationship between the (temporal) properties of the content and the (spatial) properties of the vehicle. In the experiential case, we might think temporal properties like duration are represented by temporal properties of the same kind. More bluntly, the actual duration of the unfolding experience might simply *be* the duration felt. On a physicalist account, the duration of this unfolding would ultimately be determined by the duration of a corresponding physical process. We might therefore say the temporal “structure” of the vehicle would determine (at least some of the) character of experience.

It is of course highly unlikely that there is any experience associated with tree rings, so it would be rather absurd to claim that the mere fact of *there being a representation* provides any explanation for why experience is as it is. In the case of experience the situation is significantly different because we assume that whatever sort of representation is involved is the kind where the content is *experiential* content. How and why exactly that content becomes experiential remains an open question. Nonetheless, we might see the above examples as providing an opening for the possibility that vehicle properties can have explanatory relevance.

2.3. Vehicles

Claiming vehicle properties have an “impact” on content is not going far enough for the classical extensionalist, however. Extensionalists would typically take the claim further by arguing that, when it comes to the duration of the specious present, there is nothing to say about *content* at all, because the temporal “shape” or “structure” of the vehicle just *is* the duration of present experience. That duration is potentially a span that *includes* content but is *not itself* content. Such thinking would abandon the previous analogies, in that it does away with representations entirely, at least insofar as these are meant to be explanatory with respect to temporal phenomenology.

Before continuing, it is worth pausing to fully defuse the common complaint that content/vehicle confusions are infecting our thinking, as so often happens in discussions about the relationship between brain and experience. As Rick Grush puts it: “one cannot just assume without argument, or without even addressing the issue, either that (i) properties of contents carried by vehicles can be read off any of the physical properties of the vehicles; or that (ii) relations between contents carried by sets of vehicles can be read off relations

between physical properties of the vehicles,” (Grush 2006: 440).⁹⁵ Thus, we might think the amount of time a given brain process takes is completely unrelated to the amount of *experiential* time elapsed. It remains logically possible that an instantaneous brain/informational state could represent a felt experience as a temporally extended process in the manner classical retentionalists have proposed. The same goes for the ordering of brain processes, which need not correlate to the order of events in experience. As we have seen, the latter helps retentionalists deal with illusions of event order such as postdictive effects in ways that extensionalism cannot.

However, as much as it might be a mistake to think that vehicle properties necessarily correlate with content properties, it is just as much a mistake to think they necessarily *don't* correlate with content properties. Our previous examples of hieroglyphics and trees help to demonstrate situations where it would be naive to ignore the vehicle properties and insist on an arbitrary connection between the representations and their contents, with the properties of the former irrelevant to the latter. Sometimes, the properties of the vehicles *are* relevant to the properties of the content. As Grush goes on to say:

The fact that content/vehicle confusions are confusions does not entail that *all* properties of the vehicles of a representation are irrelevant for explaining the content carried by that representation. [...] Some properties of the vehicle can be explanatorily relevant to the content they carry. Indeed, it would be hard to imagine a case where *all* vehicle properties were irrelevant. (Grush 2006: 441)

Whether or not there is a strong connection between vehicle and content properties in the temporal case might then seem to be an empirical question, not an *a priori* one. In fact, Grush says that, while he agrees “to a first approximation” with Husserl’s phenomenological analysis, he also thinks that “features of the neural information processing machinery in the central nervous system *are* relevant to those representation structures that underwrite the temporal aspects of our conscious experience,” (ibid.). The important thing to note here is just that, in fact, vehicle properties can and often are relevant to content properties, whether directly (as with the isomorphism of hieroglyphics) or indirectly, through a yet-to-be

⁹⁵ Here Grush is specifically targeting Varela’s (1999; 2000) attempts to naturalize Husserl’s retentionalism by way of neural oscillation patterns (which Varela takes to be the neural correlates of time-consciousness) along with other similar attempts by Lloyd (2002; 2004) and Van Gelder (1996), rather than attacking extensionalism, which Grush disputes but is not directly concerned with in this passage. Nonetheless, the point is generally instructive.

specified relationship that the model must flesh out in a way that makes it clear why we should think such a connection would hold.

However, an extensionalist might want to say that those alleging content/vehicle confusions in the temporal case have a bigger problem than erroneously thinking a lack of necessary correlation implies a necessary lack of correlation. An extensionalist, as indicated earlier, might want to argue that the entire content/vehicle framework is misguided because temporal experience at its most minimal (e.g., as pure succession) cannot consist in the contents of representations when temporal experience is a precondition for subjectivity (as discussed in Chapter 3) and, *a fortiori*, representational content, in the first place. We can see this when we consider that apprehension of content cannot take place in a single instant, but is a process that unfolds over time, necessitating a subjective succession. We therefore have the cart before the horse when using representational language to explain succession.

From this perspective, intentionality presupposes the thing it all-too-often is recruited to explain, which is to say, subjective experience. In other words, consciousness, extended in time, provides the grounds for intentionality, not vice versa. We need some sort of prior conditions (what I have called structure) which can be recapitulated in an ongoing fashion while an organism is conscious for intentionality to get off the ground at all.⁹⁶ So, while intentionality remains important, the demand for some basic enabling scaffolding provides a further motivation for the extensionalist component of the hybrid theory that will be advocated here.

One might respond that representational content does not actually require a subject, and the explanatory potency of the content/vehicle distinction can be maintained in the absence of subjectivity. I think this is mistaken. A representation should be capable in principle of representing its contents to a subject. Without successive experience there would be no subject because having a point of view on the world is essentially an activity, rather than an instantaneous state. Without successive of experience there would be no point of view from which contents can be experienced. Contents in the absence of subjectivity would not be meaningful to speak of and thus lack explanatory purchase on subjectivity. Thinking of succession *fundamentally* in terms of contents will therefore not help us to understand succession (note however, this is not to say representations will not help us understand anything!). The assumption on the part of those looking to explicate succession in terms of

⁹⁶ John Searle, with similar antipathy to representational explanations, called such preconditions “capacities” and has claimed that “representation presupposes a nonrepresentational Background of capacities” (Searle 1992: 178; see Ch. 8 for arguments to this effect).

content and vehicles seems to be that a representational perspective will aid in this explication. However, conceptual analyses of the latter type bottom out attempting to explain minimal features of subjectivity like succession. We end up in a circular attempt to ground experienced succession in concepts that are incoherent without the prior existence of experienced succession.

Thus, the structure of experience, is really *the only place* to look for the fundamental properties determining our minimal temporal experience, such as the duration of the specious present or the succession of experiential contents. The preceding may seem to speak strongly (perhaps even too strongly) in favor of some form of extensionalism. However, separate problems stemming from the naivete of that view will shortly (in Sections 4 and 5) lead us to consider adding content back into the picture to account for certain temporal phenomena.

3. The Jamesian Doctrine: Successive Experiences and the Experience of Succession

Notwithstanding the benefits so far attributed to the extensional perspective, it is sometimes alleged that extensionalism is at a disadvantage relative to retentionalism if it claims that *successive experiences furnish us with experiences of succession*. I will argue here that, while extensionalism *is* insufficient to account for the richness of our temporal phenomenology, this insufficiency is *not* a consequence of the falsity of the claim that successive experiences furnish us with experiences of succession. Indeed, the hybrid proposal advocated here leans on extensionalism specifically to account for minimal features of temporal phenomenology such as succession and the duration of the specious present. In part this is because extensionalism provides a much more straightforward explanation of these aspects of experience. Nonetheless, it is often alleged that extensionalism is *too naïve*. Before pursuing the advantages of a hybrid view further then, we must first answer this common complaint against extensionalism, which looks far less significant upon inspection, especially when we recognize that *both* the unfolding of experience over time and intentional content can play an explanatory role for temporal phenomenology.

Since the time of William James, it has been commonplace in the literature to invoke the slogan that “a succession of feelings, in and of itself, is not a feeling of succession,” (James 1890: 629). For brevity’s sake, we can call this the “Jamesian Doctrine” (JD). JD is often seen as self-evident. However, in considering some of the examples of the last section, it might now not seem so obvious that there needs to be a disconnect between properties of contents and vehicles in the way demanded by retentionalists. We might think not only that

vehicle properties are relevant, but *crucially* relevant, in that they can determine the temporal character of the resultant experience.

Christoph Hoerl (2013) has notably challenged the received dogma encapsulated in James' slogan. Hoerl finds the slogan repeated throughout the history of philosophy following James (e.g., Strong 1896: 153; Husserl 1917: 12; Paton 1929: 318; Sellars 1968: 232; Miller 1984: 109; Dainton 2008: 623) with widespread uncritical acceptance, particularly as grounds for accepting intentionalism⁹⁷ (with retentionalism being the preeminent form of intentionalism about temporal experience) and rejecting extensionalism. Hoerl notes however that, "it is not even clear why extensionalism and intentionalism should necessarily be seen as two distinct views of temporal experience, since an intentionalist might also maintain, as part of her theory, that episodes of perceptual experience must, as a matter of fact, be extended through a period of clock time," (Hoerl 2013: 375-376, n. 3). Indeed, something like the latter view would be sensible for a naturalistic retentionalist that understands the brain does not process and integrate information instantaneously.⁹⁸

The real bone of contention between extensionalism and retentionalism seems to be about what is doing the work of *explaining* the phenomenology. More specifically, Hoerl sees the conflict as between a "representational view" of experience to which retentionalism is committed, and a "relational view" of experience to which extensionalism is committed (Hoerl 2013: 375). For an extensionalist adopting a relational view of experience, we should jettison talk of representations, which is why it can be misleading to say that extensionalists think vehicle properties determine content properties (if they reject the distinction in the first place). Rather, a relational view holds that experience consists only of "the actual items experienced and an entirely generic relation in which the subject stands to [that which is experienced]" (Hoerl 2013: 379). Objects of experience are therefore, at least on the latter view, *not represented*, but rather mere objects to which we stand in a particular *experiential* kind of relation.⁹⁹ To paraphrase Charles Travis, an advocate of a relational view of experience, we do not take the objects of our experience to be anything (i.e., they are not represented as being any particular way) before we have the experience; rather, we simply

⁹⁷ Hoerl uses the term "intentionalist" to emphasize a commitment to the idea that intentional content determines phenomenal character, which is the default view among retentionalists. Intentionalism is a much broader thesis than retentionalism, however, and frequently appears in other domains of the philosophy of perception as well. See also note 45 on this topic.

⁹⁸ Such retentionalists may include the "neurophenomenologists" mentioned in Section 2.

⁹⁹ See, e.g., Campbell (2002; 2009), Martin (2002), Brewer (2004), Travis (2004), and Soteriou (2010), for examples and further discussion of the relational view in general.

have the experience and *then* we are able take the experiential objects to be such-and-such a way (Travis 2004: 65). Likewise, the relational extensionalist, “conceive[s] of the perceptual relation as something that itself unfolds over time” and it is this fact that results in experiential succession (Hoerl 2013: 400). We should therefore not think we experience things *as* successive first and foremost; rather, we simply experience things successively.

Hoerl’s contention that extensionalism really ought to be construed as “relational” is particularly significant in that it takes issue with how extensionalism has frequently been portrayed by intentionalists, namely, as a “resemblance” view. A resemblance view of extensionalism is one that holds “experience represents temporal features of the world by itself possessing those features,” (Hoerl 2013: 381). The previous section offered some initial reasons for why we might think vehicle properties could be relevant to the content of experience, but it also presupposes that some kind of representational structure is maintained in experience. For a relational view of extensionalism, unlike a resemblance view, the previously discussed hieroglyphic and tree ring analogies are unapt. In those examples there is no relation of the right sort between a subject and the object of experience, despite there being a resemblance between properties of the representational vehicles and the content. The right sort of relation only comes about when an experiencing subject like us enters the picture.

Thus, on the relational view, talk of “vehicle properties” influencing “content” would be misleading because on such a view there are no representations and therefore neither vehicles nor contents. Instead, on the relational view there is just a subject and objects to which the subject is related. It is only when we think of extensionalism as offering a resemblance-based view that we fall into a representationalist mode of speaking and insist upon vehicles and contents and a resemblance between the two. However, extensionalism need not insist upon this at all if extensionalism is understood relationally instead of as committed to the idea that the experience of time *resembles* the actual structure of clock time.

One of the main reasons a relational view might be preferred in the case of time is that representation/intentionality cannot be *fundamentally* explanatory of temporal phenomenology because mental representation presupposes subjectivity, which should already be temporally structured. It may be better to think of the temporal point of view as consisting of successive relations between a subject and the objects of experience rather than thinking a series of representations enable a temporal point of view to arise. Nonetheless, this is not to say that experience *cannot* involve intentionality or that intentions have no explanatory value. Leaving intentionality entirely out of our description would seem to

overlook the fact that some of our thoughts are *about* temporally indexed events. However, the fact that experiences are *about* things is insufficient by itself to explain how they come to be the experiences that they are. A hybrid view can thus escape worries about the fundamental inadequacy of intentionalism as an explanation for temporal phenomenology and at the same time can provide a non-circular grounding for experienced succession and the specious present by endorsing extensionalism. A hybrid view also does not need to adopt either the relational or representational view *tout court*, but can be pluralistic, endorsing relational extensionalism to account for succession while not abandoning the content/vehicle distinction entirely. A resemblance view might be more appropriate, as indicated previously, in accounting for the duration of the specious present.

Given the above analysis of the conflict between extensionalism and intentionalism, it should now be clearer that the Jamesian Doctrine is less threatening to extensionalism than is usually imagined. JD assumes an intentionalist perspective on experience, arguably begging the question against the extensionalist. Specifically, JD begs the question by asserting there is no significant relationship between how experience is structured and what is experienced, thereby rejecting a resemblance-based extensionalism out of hand. The doctrine also dismisses the possibility that the feeling of succession simply *is* the successively changing relations in which we stand to various objects of experience. In this way JD also begs the question against the relational view of extensionalism. As we have just seen, these questions are precisely what is at stake between extensionalists and intentionalists, so we cannot uncritically accept JD, which would be tantamount to assuming some form of intentionalism. Refusing to accept the Jamesian Doctrine, as I have suggested, removes a commonly emphasized obstacle to serious consideration of extensionalism and opens the door to incorporate extensional features in our hybrid analysis of temporal phenomenology.

4. More Explanatory Resources, Fewer Problems

To their further credit, hybrid extensional-retentional models can also help to overcome two problems facing the individual models they combine. The first is a problem for extensionalism that Dainton has called the “Extensional Simultaneity Problem,” or ESP (Dainton 2018a). The second is an analogous problem for retentionalism: the “Retentional Simultaneity Problem” or RSP (*ibid.*). Both problems, as their names suggest, are concerned with difficulties accounting for how there can be a specious present (as explicated by each view respectively) without the events experienced within it being experienced

simultaneously. As we shall see, while the simultaneity problems present serious challenges to both extensionalism and retentionalism individually, a hybrid model can help us escape these worries by addressing the problem for each with solutions from the other.

4.1. The Extensional Simultaneity Problem

The Extensional Simultaneity Problem refers to the question of how events that are “(i) experienced together, and (ii) experienced as present” can be “experienced as anything other than simultaneous,” (Dainton 2018a). In other words, because extensionalism holds that experiences are spread over time, it is unclear how they could be unified in experience (i.e., co-conscious), yet *not* be experienced as simultaneous. In more technical parlance, this is the question of how so-called “diachronic” unity, or unity across or over time, is possible without collapsing into simultaneous experience. By endorsing diachronic unity in this way, extensionalists thus reject what Izchak Miller has called the “Principle of Simultaneous Awareness,” (Miller 1984: 109), which is the contention that in order for us to have a unified experience, all the contents of experience must be co-conscious at the same time (they must be simultaneous), otherwise we would not be able to access them in our present experience. Retentionalists for their part tend to embrace this principle.

To illustrate ESP more vividly, we can consider an example of ordinary auditory perception. According to extensionalism, the experience of hearing the lyrics “Never Gonna Give You Up... [etc.]” in sequential order is an experience that is extended in time (by my reckoning about half a second). Part of this duration will comprise the specious present, the span that we take to be “now,” perhaps roughly 200 ms. For the sake of this example let’s say this involves the experience of the words “Never Gonna”. Within the specious present that includes these auditory phenomena, “Never” and “Gonna” are both supposed to be experienced as if they are happening now and are thus in some way “co-conscious” to us in the sense of both being present experiences. However, it is indisputable that the two words occur in sequence, not simultaneously. If we grant that “Never” and “Gonna” are both present to us and the specious present is defined as a duration of actual experience, it looks like we are forced to conclude the two words would be heard as simultaneous. However, because it seems plain the two words are *not* experienced simultaneously, extensionalism looks as if it must be false, and there must be some other way of accounting for the specious present.

A hybrid model can appeal to retentionalism to solve ESP: the intentions in the hybrid model allow for the contents of the diachronically unified experience to be experienced as not simultaneous but instead to be experienced however the intention specifies. Protentions and retentions allow for events to be felt as if they were fading into the past or arriving from the future. These protentions or retentions *themselves* do not necessarily have to be simultaneous in order to have the intentional character they do but could be distributed over an interval of time.

Why should these intentions be distributed over an extended interval of real time? One answer is that the extension makes better sense of the specious present, as indicated earlier. We can solve the infinite regress problem facing retentionalism by maintaining the duration of the specious present depends on the temporal extension of the set of intentions. This is an explanatory appeal that is not open to a classical retentionalist, as it grounds the duration of the specious present in non-intentional properties. Strict intentionalists/retentionalists, in contrast, seemingly must commit to an arbitrary stopping point to the nested intentions to avoid the regress. A further reason to distribute intentions over time is to avoid a similar problem to the one just discussed concerning extensionalism, but that faces retentionalism, and which concerns succession.

4.2. The Retentional Simultaneity Problem

The Retentional Simultaneity Problem refers to the question of how the contents of intentions can seem *successive* when they are actually simultaneous. As Dainton asks: “How is it possible for experienced succession to be generated by contents that exist only in the momentary present?” (Dainton 2018a). To illuminate the problem further we can return to the auditory experience considered previously. For a retentionalist, unlike an extensionalist, the intentions whose contents define our specious present are not necessarily extended over time (or if they happen to be, the extension is explanatorily irrelevant). This means the “Never” and “Gonna” of “Never Gonna Give You Up” may be *represented* in the mind at the same time, but the contents of the representations are temporally indexed in relation to each other. The question is, how can simultaneous intentions come to have content that is experienced as if it is not simultaneous at all (barring mere stipulation that this is the case).

Retentionalists generally appeal to intentional content to solve RSP. The intentional content of retentions is meant to bestow upon them a unique phenomenal character, which, when combined with other intentions, results in a feeling of succession and not simultaneity.

Yes, the intentions might all occur at the same clock time, but their contents are all *about* different times, hence they are not experienced as simultaneous but rather as successive.

While tidy, the move here comes worryingly close to solving the problem by decree. We may still ask why appealing to “aboutness” leaves us any more enlightened than the original pre-theoretic intuition that we simply experience “never” and “gonna” as non-simultaneous.

Extensionalism, which does not posit intentions and embraces our pre-theoretic intuitions, does not arouse similar suspicions. On an extensional model experience is spread through time and, supposedly, can simply *be* successive and immediately perceived as such. The extensionalist typically enlists diachronic unity to do what intentionality was meant to do for the retentionalist. This is to say, the extensionalist claims there is a unification of events over time within one span of consciousness, which seems to be necessary for us to experience things as successive. However, invoking diachronic unity runs back into ESP, while by invoking intentions, retentionalism runs into RSP. Neither appears more promising than the other in relation to its respective problem. We seem to have reached an impasse.

Now we might think successive *content*, in contrast to a succession “in and of itself,” is somehow better placed to explain our experience of succession just in virtue of it being content. Even so, it seems the skeptically inclined could reiterate the problem of succession for contents in the following way: “successive *content*, in and of itself, does not an experience of succession make [emphasis added]” (Dainton 2010: 107-108). Where the Jamesian Doctrine questioned the relevance of an actual succession to experience, here the problem is shifted one level of abstraction up, questioning the purported explanatory purchase of successive content on experiences of succession. In a similar consequence to that of the original formulation of JD, it seems that, while we cannot *rule out* that successive content can make an experience of succession, we also cannot just assume that it does.

To answer the skeptic, perhaps the retentionalist can claim that content just *is* the stuff of experience, so there is no problem. However, such an answer amounts to relabeling the assertion that we have successive experience as the claim that we have successive experiential contents, providing no better explanation of how or why we come to have such a successive experience than extensionalism provides. Another reply might be for the retentionalist to claim that experience of succession is due to *further* content, i.e., higher-order content. However, the skeptic’s reformulation of the Jamesian Doctrine can now be repeated for the higher-order content as well, and so on *ad infinitum*. Retentionalism then seems left without advantages over extensionalism in its treatment of succession.

4.3. A Hybrid Solution

Extensionalism avoids the Retentional Simultaneity Problem by maintaining experience is itself temporally extended but runs into the Extensional Simultaneity Problem, namely that it is unclear why the temporal extension should not be experienced all at once if it is diachronically unified. I propose adopting intentions to bypass ESP, accounting for diachronic unity without collapsing into simultaneous experience. I further propose adopting *temporally distributed* intentions to bypass RSP and account for succession.

On the view I advocate, intentions themselves succeed one another.¹⁰⁰ These intentions also exhibit what could be described as temporal content, in that they can be forward-directed and backward-directed, as in Husserl's scheme, meaning the intentions differ qualitatively, though it is not this content that accounts for the experience of succession. Now there may be higher-order representations with content to the effect that our experience is successive, for instance the content of the belief that experience is successive. However, I will claim that fundamentally experience just *is* successive in that intentional contents themselves are successively replaced by new contents *and* this successive replacement is highly relevant to temporal phenomenology. This is not to say that the doctrine that "succession, in and of itself, is not an experience of succession" is mistaken. A succession of numbers, for instance, is not an experience of succession. But in this case—the case of our minds—successively generated experiences are a succession of experiences and can thereby be felt as such. Provocatively stated, a succession of experiences, in contrast to a mere succession, *does* an experience of succession make.

What I am claiming is that a structural feature, namely succession, of what a retentionalist calls the "vehicles" of experiential contents, is crucially relevant to our experience being experienced as successive. This feature is not necessarily *all* that is relevant to a full-blooded experience of succession however and a hybrid view can fill its boots with higher-order content as well. I also claim that experienced succession is fundamentally *not content* and should be further explicated with reference to structural features of the mechanisms underlying experience.

¹⁰⁰ This is not to suggest a strictly serial processing system operating on these intentions at a constant rate. As Wiese (2017) has suggested, there might instead be a complex, massively parallel, nested hierarchy of intentions together responsible for the salient aspects of the sensorium. The exact properties of this computational or other kind of architecture should be largely an empirical question.

ERA cuts against the orthodoxy in two distinct ways. First, I am claiming what have been called “vehicle” properties, but which may be better termed “structural features” matter to experience. Secondly, I am claiming that a succession, in the particular case of experiential vehicles, does result in an experience of succession (bearing in mind the subtle point that whether this is an experience *as of* succession might be a further matter). The first claim is apparently vulnerable to a charge of content/vehicle confusion from intentional theorists, but, as discussed earlier, whether vehicle properties are explanatorily relevant is a contingent matter that not only cannot be ruled out, but, in the case of certain temporal properties like succession, seems quite plausible. The second claim is apparently vulnerable to that oft-repeated refrain about succession not giving rise to a feeling of succession. However, here too we can admit that, while it is true a succession by itself does not *necessarily* give rise to a feeling of succession, in the case of experience it seems plausible that a succession of experiences contingently would. This is not to rule out the possibility of a conjunction of higher-order representations of succession as well, but for the moment the focus is on what may be termed minimal time-consciousness, consisting of succession and the specious present.

What’s more, a hybrid view can head off an objection sometimes made against specious present views, namely, the Problem of Repeated Contents (Mabbott 1951). The problem is that, if we posit overlapping specious presents to account for continuity, we should expect to experience a repetition of equally vivid contents for the span of the diachronically unified specious present. This is a consequence of overlapping “acts of awareness” that each take in a certain interval but must overlap for them to be experienced continuously and connectedly (Dainton 2010: 108). The repetition involved in this picture is not faithful to our phenomenology, which does not see an over-proliferation of contents persisting and overlapping through the span of the present. We do not see, for instance, a plethora of equally vivid baseballs arcing through the air when we are passed a ball. Instead, we only see one baseball, and that baseball occupies different positions over time and is also seen *as* moving throughout the timeframe.¹⁰¹

A hybrid model has a more straightforward response to the Problem of Repeated Contents. The hybrid theorist can say we do not face the problem of repeated contents because we are dealing with qualitatively differing intentional content. In keeping with Husserl and the retentionalists’ primary contention, these contents are never given in the

¹⁰¹ See Phillips (2010), Pelczar (2010a), and Pelczar (2010b) for further discussion.

same way, i.e., retentions differ qualitatively in relation to each other as they slip further and further back. The hybrid theorist only further claims that experiential succession and the duration of the specious present are explained by structural properties of the way those intentions are temporally organized, rather than (exclusively) by their contents. Nowhere in the hybrid theorist's model do we need to posit diachronically unified, temporally extended contents; rather, we only need posit intentions spread over time, which *themselves* have perceptual contents. These contents may qualitatively differ owing to the kind of intention they are, i.e., retention or protention, but we will not face the problem of having the exact same kind of intentional contents repeated.¹⁰²

So, besides helping us with the Problem of Repeated Contents, maintaining intentional content also prevents the span of diachronically unified experience from being experienced as a simultaneity, avoiding the Extensional Simultaneity Problem. The content is what gives each part of the diachronically unified span its character. The real (rather than represented) flux of these contents, which rapidly succeed one another and are not simultaneous at any given time, allows for an experience of succession. In fact, a phrase like “the experience of *succession*” is somewhat of a misnomer in that it implies succession is experiential content. Instead, on the view sketched here, we should rather say that experiences *are* successive, but we do not have experiences *of* succession at all, except perhaps in some higher-order sense. Taking the relationalist stance, we could say that as subjects we stand in successively differing relations to experiential objects, and this what is meant by saying experiences are successive. Besides this critically important successive structure of experience, we also have experiences of events in temporal relations with each other as determined by intentional content and a specious present whose boundaries are ultimately defined by the temporal extension of the processes realizing the intentions.

5. Temporal Illusions

A hybrid view exhibits certain advantages over its components in accounting for temporal phenomenology as well. Specifically, the incorporation of retentionalism can offset disadvantages faced by classical extensionalism, which tends to endorse a naïve realism that struggles with cases of temporal illusion and temporal variability. While extensionalism has

¹⁰² For further discussion of this problem, specifically as it relates to Broad's sense-data theory, see Dainton (2000: 145) and Gallagher (2003).

the virtue of parsimony here, it does not apparently have the virtue of doing justice to our occasionally bizarre experience. A hybrid can lay claim to both virtues.

At first glance it may seem that, if we think features of temporal phenomenology (e.g., experiences of change, succession, etc.) are real features of experience,¹⁰³ then extensionalism seems to have the advantage of accounting for these features in a more straightforward, intuitive way. Change, for instance, would be experienced immediately, simply in virtue of there being changes over the course of the extended interval of experience. Likewise for succession and continuity.

Retentionalists, meanwhile, appeal to intentionality to account for features of temporal phenomenology, e.g., the second hand of a clock is represented *as* changing and thus it is experienced as such. For the retentionalists, this appears to have the unfortunate effect of changes not necessarily being felt directly, as they happen. We do not, on the retentionalist view, experience the changing position of the second hand *per se* but only experience the second hand *as* changing at a particular moment. Although this may seem like a disadvantage for retentionalism, we should also remember that extensionalism struggles to account for why real changes like the changing position of a second hand should have the additional felt quality of “changing” rather than just being experienced as occupying different positions in space as with the hour hand (a problem identified by C.D. Broad 1923: 351). A naïve form of extensionalism might claim that such an additional representational quality is just unnecessary when the property of changing is there to be picked up, in the object and its relation to its past and future states, all of which the subject directly perceives over an interval of clock time. If this view is correct, then extensionalism provides a more parsimonious explanation of the phenomena than does retentionalism.

Unfortunately, the naïve extensional view encounters a difficulty when it comes to the myriad temporal illusions that together indicate a less direct correspondence between the felt duration of experience and the actual duration of the events that are perceived.

Retentionalism, by contrast, handles such discrepancies rather well. Intentions, by their nature, are also capable of *misdirecting* or *misrepresenting*, and this provides an intentional theory like retentionalism a ready-made solution to the problems of temporal illusions such as the flash-lag illusion encountered earlier. Experiential time dilation and contraction (that is, lengthening and shortening of experienced intervals in comparison to measured clock time)

¹⁰³ Dainton (2018a) has called the view that such features are real in the sense that they are perceived directly “phenomeno-temporal realism” or “PT-realism.” It is a view that is shared across both retentional and extensional models.

can also be explained by contents represented *as* occurring slower or faster or *as* occupying smaller or greater intervals of time. Extensionalists, so long as they insist upon a naïve, direct correspondence between felt intervals of time and actual intervals of time, lack this straightforward accounting of temporal illusions.

An extensionalist *can* claim that the lag between the stimuli and our eventual illusory experience is great enough that whatever kind of strangeness results in the illusion occurs in this buffer zone or “pre-processing” (Dainton 2018a). However, this implies we are at more of a temporal distance from the things we perceive than it appears we really are, especially considering the speed with which we are capable of perceiving and acting. Barring epiphenomenalism (the view that conscious perception is causally inert), it is difficult to see how we could participate in fast-moving ball games or video games if we were systematically handicapped by the 80-100 ms lag that Dainton (2018a) suggests extensionalists might endorse. Also, as some psychologists have suggested, long-lasting postdictive effects can extend over “several hundreds of milliseconds or longer” and would therefore require an unrealistically long lag on the extensional view (Herzog, Drissi-Daoudi, and Doerig 2020). Indeed, even Dainton’s original figure seems questionable when we consider that, in esports, controllers with input lags of only 10 ms are desirable while over 50 ms of lag is potentially noticeable and uncompetitive. For a wireless controller to be perceived as smoothly tracking gameplay, “data must be refreshed 30 times or more each second,” i.e., every 33 ms or so (Torvmark and Schweber 2002). For these reasons and others, the “appeal to lag” does not seem like an elegant solution.

In contrast, as we have seen with the flash-lag illusion, postdictive effects offer illustrative examples of how retentionalism *can* elegantly accommodate temporal illusions. A further example of such an accommodation is in handling the “phi phenomenon,” also encountered earlier. In one version of this illusion, a subject is first presented with a flash (usually a colored circle) at the top left of a screen and subsequently presented with a second flash of light at the bottom right. Although this object hasn’t moved, the subject nevertheless reports continuous motion of the circle from the top left to the bottom right. If the flashed circles are different colors, the effect is even stranger, as there appears to be a point halfway along the path of the motion of the circle where the circle changes color (known as “color phi”; Kolers and von Grünau 1976). Of course, no such event has taken place—yet nonetheless it is perceived.¹⁰⁴

¹⁰⁴ See Bach (2019) for an interactive example: <https://michaelbach.de/ot/col-colorPhi/index.html>.

The retentionalist has more than one interpretation of the phi phenomenon available to them, but here is one: the retentionalist can claim that the initial experiential content might have included just the first flash, while later events (the subsequent flash) change the contents of (a new) specious present to include motion across the screen, which is the experience that is remembered when the subject is asked to report the experience. Extensionalists do not have such an easy time offering explanations for these illusions. This is because, as Dainton points out, for the extensionalist, “there is just *one* token experience corresponding to the A-flash,” which leaves us unable to account for the phenomenology of motion encountered subsequent to the presentation of the second flash (Dainton 2018a). If extensionalism were correct, we should expect subjects to report seeing either a stationary flash and *then* motion or to report seeing the situation accurately, but instead subjects report the illusory phenomenology as described.

With a hybrid view, new possibilities emerge. We might think that, not only are things represented to us *as*, for instance, changing, but *also* that this change is experienced directly. Including both of these features results in a richer and potentially more accurate phenomenological picture. In the case of the Phi Phenomenon, the illusion might involve an abnormal representation of event order, but the temporal extension of the present experience remains stable as a result of the actual duration of the experience over time.

Besides a richer accounting of phenomenology, why else might we endorse this more complex hybrid approach? In postdictive effects, events apparently in the future (or not-yet-perceived) apparently affect our perception of present events. More precisely, we can say that in such cases, subsequent events appear to affect earlier events, counterintuitively suggesting that reverse causation is at work. Some of these include the already mentioned color phi effect and flash-lag illusion, as well as the cutaneous rabbit illusion (a kind of tactile phi phenomenon) and apparent motion (the illusion that makes films and flipbooks possible). If these illusions do involve misrepresentations or post-hoc alterations of event order, it is difficult to see how a direct, naïve form of extensionalism could convincingly handle such cases¹⁰⁵, while a retentionalist could say the events are represented *as being* in a non-veridical order.

¹⁰⁵ An extensionalist might try to give a disjunctive explanation of postdictive effects where the illusory cases tamper with something like our memory of the event (and are thus categorically unlike our ordinary “veridical” experiences), but arguably this way of handling the illusions appears ad-hoc and apparently empirically refutable as it would claim the illusions are not actually perceptual but derived from failed recollection (see Dennett 1991: 115-126 for further critical discussion of memory-based explanations; see Soteriou 2020 for a general overview of disjunctive explanations).

A hybrid theorist could follow the retentionalist explanation, but also has the option of contending that where the intentions stand in relation to each other might be altered (a shuffling of the order of retentions, for instance) and that the contents of these intentions might change in response to this illusory ordering. Thus, on the latter explanation, some structural features of the organization of the intentions may be relevant, as well as the content of those intentions. The hybrid view thus opens up new possibilities that were shut off to the classical views, while maintaining the explanatory resources to accommodate illusions and temporal variability. At the same time, a hybrid view retains some of the considerations of parsimony that motivate the naïve extensionalist view, while not being so naïve that illusions become inexplicable.¹⁰⁶

6. Prior Hybrid Views

Naturally, this is not the first time a hybrid view of some kind has been suggested. However, there are few explicit recommendations of an extensional-retentional hybrid in the literature. Arguably, Shadworth Hodgson (1898) and C. D. Broad (1923) were two earlier philosophers that saw the appeal of just such a hybrid view, though they each laid emphasis on different aspects, and neither are full-throated advocates. Thomas Sattig (2019) has recently cast Anton Marty (1916) as an early proponent of an extensional-retentional hybrid view, but this interpretation seems to rely on a different understanding of the essential features of extensionalism than is typical. While Marty's view is interesting in its own right, particularly in the way it connects to metaphysics, I will hesitate to class it as extensionalist, though it certainly bears strong similarities to later retentional analyses. These early views are instructive in that they demonstrate it was not always assumed, as we often find in contemporary times, that extensionalism and retentionalism are opposed.

6.1. Hodgson

¹⁰⁶ One might wonder how deeply committed we must be to a hybrid ontology, given the hybrid explanatory strategy I have outlined above. The answer, given our epistemic limitations, is that we should remain (metaphysically) commitment phobic. The intentional language deployed here can be seen as a useful explanatory strategy rather than a rigid ontology of the mind. See Chirimuuta (forthcoming: Ch. 6) for a defense of agnosticism concerning the ontology of intentionality; see also Sprevak (2013) concerning fictionalism about neural representations. Pragmatic approaches like these provide a fertile ground for more specific explanatory projects (like that undertaken here), which freely draw on intentional language without committing to the fundamental reality of intentionality *per se*.

Though perhaps he would not have described it in such terms, Shadworth Hodgson, a contemporary of William James, can be seen as promulgating an early example of a hybrid view. In *The Metaphysic of Experience*, Hodgson contends that, “[i]t is implied by the term empirical, as applied to any portion of experience, that this portion has some time-duration; and from this it follows that the least possible empirical present moment is one, in which perception and memory (in the sense of simple retention) are indistinguishable from one another,” (Hodgson 1878: 60). Hodgson here seems to be advocating a form of extensionalism when he claims that experience has an “empirical” duration and that within this duration we cannot distinguish past from present in the normal way. It is not perfectly clear what Hodgson means when he says this is an implication of the “term empirical,” but it could be that he felt the observable physical world is not divisible into instantaneous moments and because of this we cannot have truly simultaneous experiential instants either.¹⁰⁷ On this basis, then, Hodgson might have concluded that duration is an essential feature of any experience, and indeed, any physical process. If this is accurate, then on the face of it Hodgson’s position seems intuitive—if we think that experiences result from brain processes, and brain processes do not involve an instantaneous “end point” that produces experiences, then it does seem likely that both the process and the resultant experience would naturally extend over time.

In addition to the above considerations in favor of extensionalism, Hodgson is also sympathetic to the notion that more is required to account for temporal phenomenology than the experience’s extension over clock-time alone. As for James and his successors, examples of experiences whose character seems to change depending on what has gone before (e.g. musical notes) led Hodgson to the conviction that “retention of a past in a present moment, now has been shown to take its place among the ultimate facts of experience, being involved in the simplest cases of perception, for which in fact, it is but another name,” (Hodgson 1898: 78). This mention of retention has led Barry Dainton (2017) to suggest Hodgson was advocating a “hybrid model of temporal experience that incorporates elements of both Extensionalism (over short intervals) and Retentionalism (over large intervals).”

¹⁰⁷ Hodgson seems to suggest something like this in the *Philosophy of Reflection*, when he says, “Crudely and popularly we divide the course of time into past, present, and future; but, strictly speaking, there is no present; it is composed of past and future divided by an indivisible point or instant. That instant, or time-point, is the strict *present*. What we call, loosely, the present, is an empirical portion of the course of time,” (Hodgson 1878: 253).

However, the notion of retention may be more integral to Hodgson's view than it would be if it only featured in perception over large intervals. On this more robust hybrid view, there are intentional entities like retentions that needn't occur simultaneously but instead are spread over the duration of the minimum of consciousness, and the duration of their spread may influence the duration of what we take to be present (or in other words—both extensionalism and retentionalism are operative over short intervals). Although his views might have changed over time, Hodgson's *Philosophy of Reflection*, passages of which are cited by James (1890: 690), seems to support the above interpretation. In keeping with retentionalism, Hodgson states that "...we have, in any artificially isolated minimum of consciousness, the *rudiments* of the perception of former and latter in time, in the sub-feeling that grows fainter, and the sub-feeling that grows stronger, and the change between them..." (Hodgson 1878: 251). However, in keeping with extensionalism Hodgson also says that "this minimum has a duration" (Hodgson 1878: 253). Given what we have seen from Hodgson previously, it is likely this is meant as an *actual* duration as opposed to the mere appearance of duration in experience, as a non-hybrid retentionalist can consistently maintain.

Hodgson also held a similar view regarding "imagination," which can be seen as roughly corresponding to protentions in his scheme: "...it is clear that the minimum of feeling contains two portions—a sub-feeling that goes and a sub-feeling that comes. One is remembered, the other imagined. The limits of both are indefinite at the beginning and end of the minimum, and ready to melt into other minima, proceeding from other stimuli," (Hodgson 1878: 253). However, he also warns us not to take the minimum itself to be an instant, with all of its parts (i.e. retentions and protentions—what Hodgson has been calling "sub-feelings") occurring simultaneously:

...the minima of consciousness are not *data* as minima, nor does consciousness come to us in distinct minima originally; but we it is who reduce it to minima artificially. And the very distinction of a minimum, so made, cuts it off from the continuous stream which it is part of, treats it *statically*, and thereby involves the assumption that its sub-parts are simultaneous. But this simultaneity of sub-parts, being introduced by our method, must not be reckoned to the thing analysed [sic]. (Hodgson 1878: 252).

Hodgson is quite clear that we make an error when we "talk about the *present* as if it was a *datum*, as if time came to us marked into present periods like a measuring tape," calling such thinking "an instance of the separatist fallacy" rooted in misleading habits of thinking (Hodgson 1878: 254). Ultimately, Hodgson's actual view on the subject remains somewhat obscure, but at the very least it seems that his account represents an early attempt at a

plausible hybrid extensional-retentional view, and, in particular, here we can see the seeds of an attempt to show intentional entities distributed over time.

6.2. Marty

Anton Marty (1916) has been latterly interpreted, by Thomas Sattig (2019), as a defender of an extensional-retentional hybrid view. According to Sattig:

Marty's approach is extensionalist, in so far as he allows the content of an experience of change to represent a temporally extended sequence of object-states. He does not, however, join the straightforward extensionalists [...], because he denies that the token experience itself has a temporal extension that matches the extension of the sequence it represents. Instead, the token state is, according to Marty, temporally unextended. (Sattig 2019: 164)

Sattig goes on to explain the ways in which Marty's account is retentionalist, quoting the following key passage from Marty's *Raum und Zeit*:

The intuition (*Anschauung*) of constancy and change involves: 1. that a continuum of temporal positions and their fillers is presented to us; and 2. that a judging consciousness is connected with the presentation of each of those positions and their fillers, which currently judges the presented as present, and then, for a while, as past. (Marty 1916: 210)

Marty's view indeed looks retentional and is clearly very strongly committed to the explanatory value of representational content for the phenomenal character of experience, and this in the robust sense of the contents of "judgment." However, Sattig's characterization of Marty as extensionalist is somewhat suspect. Just because Marty allows "content of an experience of change to represent a temporally extended sequence of object-states" does not make him an extensionalist, at least not as extensionalism is understood here (see Chapter 4). In fact, Marty's contention that the token state is "temporally unextended" would seem to disqualify him from extensionalism entirely. Representing temporally extended experiential content is however fully compatible with retentionalism, even if it is a slightly idiosyncratic form of the latter. Marty, as a disciple of Brentano, is still keen to offload the explanation for the phenomenology of change onto intentional content.

The interesting element of Marty's view from Sattig's perspective is not that it is (or is not, as I tend to think) a hybrid theory, but rather that it is concerned with representing "actuality-status" (Sattig 2019: 166). So, for Marty, it is not just that events are represented

by retentions as, e.g., “past” (as might be standard for retentionalism), but that object-states, like past and future time-slices of a fallen leaf, are presented as “non-actual” in experience (i.e., not obtaining). Judgments of “reality status” and “temporal order” are both relevant to temporal phenomenology for Marty, and this helps his view align with his presentist metaphysics.

Unfortunately, since Marty’s account is really just a form of retentionalism (as retentionalism is characterized here), it suffers from many of the same problems. As Sattig notes, “contemporary extensionalists claim to offer the most straightforward account of the representation of temporally extended sequences by holding that token experiences are themselves temporally extended...” (Sattig 2019: 167). Marty’s view, not being a true hybrid, does not allow for this kind of account. Instead, for Marty there are instantaneous experiential moments wherein we represent temporally extended sequences of “object-states.” As Sattig puts it, “many find this sort of representational power mysterious” (ibid.). This is a general problem for retentionalism. A second problem is that the representation of a sequence of object-states does not in itself seem to provide solid grounds for the phenomenology of the sense of flow (ibid.: 168) because a mere sequence is not enough to furnish us with a “feeling” of flow, as has already been pointed out in these pages. Finally, Marty’s presentism also gets him into trouble. For Marty, there are actually no past or future object-states in existence, but rather only experiential representations of their absences, which means change, succession, continuity, and all the other phenomenological desiderata having to do with time, turn out to be part and parcel of an enormous and systematic illusion (ibid.). On such a view, perhaps nothing we experience is *non-illusory* (because what is experienced is already always non-existent at the time of experience), which would seem to be an unpalatable consequence of any perceptual theory.

6.3. Broad

C. D. Broad also advocated a hybrid model in his 1923 *Scientific Thought*, with a greater emphasis on the extensional aspect. To set up Broad’s theory we must first imagine that we have awareness at a single moment, but this awareness is *of* experiential contents that are themselves extended through time, such that we can be aware now, in one moment, of contents at a remove of, say, .1 and .2 seconds in the past. Broad does not think we can ever *really* isolate awareness to a single moment, because, strictly speaking, moments do not exist—experience is always an ongoing, continuous process, rather than confined to an

instantaneous point. Thus, Broad thinks awareness, like its contents, is always spread over an interval. For this reason, for Broad, any given specious present refers to an extended interval of awareness that is directed at extended contents. In broad strokes¹⁰⁸, there are similarities with the hybrid model here, namely, that the intentional parts (in this case content-directed awareness) of experience are themselves extended and the contents that the intentional parts are directed at are also experienced as extended.

There are some problems with Broad's account, however. Similar to how retentionalism faces the problem of surplus content, Dainton points out that Broad's view faces the problem of repeated contents (Dainton 2017). Each awareness phase is directed at an interval of contents, say, .2 ms of notes in a song. However, the next awareness phase should also be directed at *at least* a part of those contents, meaning that we are aware of some of the content of the song twice (and three times, and so on, as the awareness phases stack up). This should lead to a repeated experience of the notes in the song for at least part of the given interval, but this does not seem to be what happens in our experience.

Additionally, Broad's theory must account for how the extended intervals of awareness are connected to produce an immediate feeling of continuity (if we want to remain true to the immediacy thesis). The notion that we have a succession of intervals of awareness invites the charge that such a theory incorrectly characterizes experience as disjoint, when introspection reveals it is plainly not. One solution is to appeal to a higher-order awareness, which is to say, awareness of the different spans of awareness. Unfortunately, such a move plainly leads to a regress problem for Broad's theory. Therefore, in its unmodified form, the obstacles to Broad's hybrid view are simply too great to accept it as is.

6.4. Comparison with ERA

The kind of hybrid model on offer here is somewhat more defined than its predecessors and will become further specified as we drill down into the mechanism underpinning it at the cognitive level. However, at the level of phenomenology we can think of this hybrid view as sharing certain features with Broad and Hodgson's earlier models, though with significantly more emphasis on retentional aspects. We can start by outlining a standard conception of the retentionalist model. On such a model, there are intentional entities—in our case, retentions and protentions, with the former directed at the past and the latter directed at the future.

¹⁰⁸ No pun intended (but appreciated).

Given such a model, the problem of constraining the model to a plausible specious present and resisting an infinitude of intentions and intentions of intentions motivates a turn to extensionalism for aid.

Under this hybrid model, the intentional entities themselves *do not* exhibit infinite recursion but are confined to the first-order level. However, there are many of them distributed over clock time; a real temporal spread that does the work previously performed by higher-order intentionality. There is thus a certain priority to the extension—the ultimate fact that there is an extension of intentional entities is the most fundamental temporal property of the system. Contrary to the position of strong representationalists, this actual extension over time has a direct impact upon phenomenology in constraining the extension of our experience to the particular span the intentional entities are spread over. Given that, in this scheme, retentions and protentions are only operating on the first order and only giving content temporal qualities like “earlier than”, “later than”, and “simultaneous with” (i.e., B-ish properties), there is no danger here of the problem of infinitude or *totum simul*. Rather we are left with a picture that accords with a finite and measurable specious present. This is not to say that the specious present would not vary—indeed, for different tasks and different modalities there may be variance, as ultimately the extension of the intentional entities is underpinned by an extension of relevant physical processes in the brain over clock time, which itself varies. The contention here, therefore, is that the details of the extended processes underlying our experience are directly relevant to the experience itself.

7. Conclusion

A pluralistic explanatory strategy that combines aspects of retentionalism *and* extensionalism in accounting for time-consciousness is not only a viable option, but a sensible one. We might envision a hybrid model where intentions are spread out over time not just incidentally, but in a way that is explanatorily relevant to the felt duration of the experienced present. Thinking in this explicitly *extensional* way helps to avoid the problems retentionalism faces in accounting for the Specious Present as well as the retentional simultaneity problem, while also providing a straightforward account of succession. A hybrid model would also still preserve the commitment to temporally indexed content and its relevance to temporal phenomenology. Thinking in this explicitly *retentional* way helps to avoid the extensional simultaneity problem while also providing a plausible accounting of temporal illusions. The ultimate upshot is that, if we avoid treating retentionalism and

extensionalism as necessarily opposed, we can begin to develop a less problematic, richer, and more fruitful understanding of experience.

Chapter 7: Temporality as Iterative Expectation Revision (TIER)

1. Introduction

The previous chapter argued for a hybrid analysis of the phenomenology of temporal experience. This chapter will spell out how such an account might be implemented on the information processing level. Specifically, this chapter will explore how the advent¹⁰⁹ of predictive processing (or predictive coding¹¹⁰) approaches in the mind sciences provides a way to answer the question of how the brain might pull off the trick of temporal experience. Predictive approaches of the kind championed by Jakob Hohwy (2013) and Andy Clark (2016) bring with them certain features, namely an in-built temporal structure and dynamic, environmentally sensitive model update system, that make them ideal bedfellows with the phenomenological perspective outlined earlier, while also representing a notable advancement in their specificity and modeling power in comparison to competing theories.¹¹¹ I will argue that seeing the mind as a predictive engine helps us understand how experience is made, and in doing so, shows us why and how experience comes to be temporal. In particular, I will argue that the process of expectation revision—the core of the predictive engine—is responsible for minimal temporal phenomenology, that is, experiential succession and the privileged extended dynamic present. According to this proposal, the temporality of experience at its most basic is not itself a product of a mechanism but instead a feature of the

¹⁰⁹ While Hermann von Helmholtz (1860) introduced the notion that perception is dependent on a mechanism of unconscious inference, more recently sophisticated variants of the general predictive paradigm have been championed by Karl Friston (2003; 2010), Jakob Hohwy (2013), Andy Clark (2016), Anil Seth (2021), Mark Solms (2021), Thomas Parr, Giovanni Pezzulo, and Karl Friston (2022), along with very many others. See Hatfield (2002) and Swanson (2016) for more on the historical roots of Predictive Processing in Helmholtz.

¹¹⁰ Attempts to understand the operation of the nervous system through the lens of probabilistic data compression go by the name “Predictive Coding” (Rao and Ballard 1999). The broad notion that the brain is “Bayesian” or can be usefully described as such (Doya et al. 2007), the notion, known specifically as “predictive processing”, that cognitive systems like ourselves seek to minimize prediction error (Clark 2016), and the far-reaching research program of Active Inference and the Free Energy Principle which embeds predictive cognition in more general physical principles (Parr, Pezzulo, and Friston 2022), can all be described as “predictive approaches” and share many commitments. Sometimes these labels are treated as equivalent despite subtle differences.

¹¹¹ Other theories of consciousness such as higher-order theories (HOTs) or integrated information theories (IIT) arguably leave the fine-grained details of information processing underspecified. It is not within the scope of the current investigation to provide a full-throated defense of predictive approaches *per se*, but rather to demonstrate how these can be fruitfully combined with a hybrid account of the phenomenology of temporal experience to arrive at a more sophisticated understanding of how this experience arises.

mechanism's ongoing operation. For brevity's sake we can call this proposal, which sees *temporality as iterative expectation revision*, "TIER".

For supporters like Jakob Hohwy, the predictive framework is supposed to "explain[]" not just what we perceive, but *how* we perceive: the idea applies directly to key aspects of the phenomenology of perception," (Hohwy 2013: 1). Beyond simply *influencing* subjective phenomenology, by Hohwy's lights, "it is *only* this idea [PP] that is needed to explain these aspects of perception," (ibid). One of the great virtues and challenges of predictive processing is that it is supposed to provide an account of how and why our subjective experience is the way it is, and even, according to some of its proponents, why there is anything it is like to be conscious at all.¹¹² Thus we ought to expect that predictive processing absolutely *must* have something to say about why our subjective temporal experience is the way it is. Fortunately, predictive processing not only can provide an account of temporal experience, but also is uniquely well positioned to do so.¹¹³

This chapter's goal is to answer the question of how experience acquires its temporal dimension by isolating the most significant aspects of the predictive mechanism for the minimal phenomenology of time-consciousness. These minimal features prominently include experiential succession and a privileged, dynamic, extended present for the experiencing subject. The proposal here is relatively straightforward: the predictive mind's ongoing construction of our experienced reality is responsible for minimal temporal experience. The main argument for the proposal is also straightforward: if we grant the basic tenets of the predictive approach and grant that the mechanism has a purchase on phenomenal consciousness, then iterative expectation revision should provide the structural foundation for temporal phenomenology because within this framework expectations are ultimately responsible for the character of phenomenal consciousness (i.e., what things are like to us as subjects). No further explanatory appeals (e.g., to higher-level priors, meta-cognition, etc.) need be made beyond the basic predictive mechanism to account for the aspects of time-

¹¹² Not every advocate of the framework agrees that predictive processing can satisfactorily answer the so-called "Hard Problem of Consciousness"—i.e., the problem of why there is anything it is like to be conscious (Chalmers 1995)—but Andy Clark, for one, has voiced cautious optimism (Clark 2016: 239; 324 n. 26).

¹¹³ Of late, more and more attention has been directed to the unique explanatory upshots of the predictive approach for time-consciousness as such. A non-exhaustive list of work to this effect would include Kiebel, Daunizeau, and Friston 2008; Hohwy, Paton, and Palmer 2016; Friston and Buzsáki 2016; Wiese 2017; Salti, Harel, and Marti 2019; Montemayor and Wittmann 2021; and Kent and Wittmann 2021, but the topic remains relatively understudied within the rather large and ever-growing interdisciplinary literature on the predictive mind.

consciousness that are most characteristic of subjectivity *per se*. These minimal features can be accounted for by appeal to structural features of an operating predictive mechanism rather than by appeal to the content of predictions themselves. Notably, these minimal features *do not* include higher-level awareness of the fact that we are experiencing things successively or the fact that we experience a privileged dynamic present.¹¹⁴

At a minimum, predictive processing accounts must be engaged in a constant process of updating predictions about the world. It is the content of the models that result from the updating of these predictions that constitute the perceptual world (when the entire multilevel process is considered). Updating these predictions can therefore generate a continual replacement of experiential contents such that we experience time flowing. If this is right, we do not experience time *itself* (whatever that would mean), but rather our perceptions are structured temporally and constantly updated by the perceptual system, in conformity with the hybrid phenomenological analysis offered in the previous chapter.¹¹⁵ It would thus be more accurate to say that we perceive or experience things *temporally* rather than that we perceive time. In this sense, the overarching perspective here is a kind of adverbialism about temporal experience—time is not something we experience but instead *how* we experience.

This chapter will start by describing the predictive approach in greater detail. It will then specify how the hybrid phenomenological analysis might be grounded in the information processing picture promoted by the predictive approach. Following this, related proposals, specifically those from Rick Grush and Wanja Wiese, will be assessed and TIER proposed as a way of solving some of the formers' problems. This chapter is meant to be suggestive but should at the very least provide reasons for thinking the predictive approach is a particularly fruitful research paradigm through which to investigate the cognitive implementation of the phenomenology of subjective time.

¹¹⁴ In this vein, some recent predictive proposals (e.g., Hohwy, Paton, and Palmer 2016; Montemayor and Wittmann 2021) seem to exhibit a common thread which is captured in simpler terms by Hoerl and McCormack's (2019) proposed "temporal updating system", which is meant to be "phylogenetically and ontogenetically" primitive and responsible for an organism's most basic temporal phenomenology (as opposed to the more sophisticated temporal reasoning that adult humans can engage in). To account for the existence of temporality as a feature of experience *at all*, we need to look at the simpler system, and the predictive approach provides an opportunity to flesh out the idea that updating our models of the world is ultimately the origin of time-consciousness.

¹¹⁵ From the point of view of relationism about temporal succession (mentioned in the previous chapter), we might see the constant revision and replacement of our expectations as a succession of ever-varying experiential relations to the objects of experience, with these relations and their objects being defined by the content and kinds of expectations the system generates concerning the causes of incoming stimuli.

2. Predictive Processing: An Overview

Predictive processing (or “PP”) is ultimately a theoretical framework that derives specific explanations for myriad mental phenomena from one overriding principle. That principle, in its most minimal form, is that the brain is an “ever-active prediction engine,” (Clark 2016: 52). Our perception results from the working of this predictive engine. Jakob Hohwy calls this, “the organizing principle for brain function as such,”¹¹⁶ and believes that, as such, “it should then encompass and illuminate all aspects of perception and action...” (Hohwy 2013: 101).

More precisely, the claim is that brains like ours make Bayesian predictions that take into account sensory input to adjust the expected probabilities of the causes of stimuli in an iterative fashion, all with a view to adaptively guiding behavior (behavior which, in turn, furnishes us with yet more information with which to update the probabilities of our predictions). To make the best predictions, the brain must always be updating its predictions in a way that takes into account and adjusts for the discrepancy (“error”) between those predictions and the sensory signal coming in, through a process known as “prediction error minimization” (PEM).

On this account, brains are not passively engaged in the absorption of environmental data but actively participating in the two-way street of perception by generating and adjusting predictions in light of incoming information. As Hohwy explains, it is crucial to prediction error minimization that the brain has, “access to not only the incoming sensory data but to a comparison between this data and expectations about what the data should be, under a model of the world. The difference between these two is prediction error, which in turn is then a measurable quantity for the brain, and something that can act as a feedback signal on the way its models of the world are chosen and their parameters revised” (Hohwy 2013: 75). What we have in predictive processing is therefore a theory about the function of the brain and how that function is carried out on a mechanistic level. What we still do not have (yet) is a theory of the physical implementation of this functional mechanism, nor a theory about phenomenology.

Although not strictly targeting these other levels of analysis, there are nonetheless inferable connections between them such that predictive processing appears to lead in the direction of a unified multilevel framework, even to the extent of providing something like

¹¹⁶ Hohwy is speaking specifically about the ongoing process of prediction error minimization here.

“bridge laws” between levels of analysis. If predictive processing is correct, for instance, it should be the case that our subjective experiences are directly determined by the operation of this systematic computational mechanism—there could be no change in the phenomenology without a corresponding change at the computational level.¹¹⁷ As Wiese and Metzinger explain:

[Predictive processing] is not directly a theory about the underlying neural processes (it is computational, not neurophysiological), but there are more or less specific proposals of how predictive processing can be implemented in the brain (see, e.g., Engel et al., 2001; Friston, 2005; Wacogne et al., 2011; Bastos et al., 2012; Brodski et al., 2015). Moreover, it seems that at least some of the principles which can be applied to descriptions on subpersonal (e.g., computational or neurobiological) levels of analysis can also be applied to descriptions on the personal level (e.g., to agential phenomena, the structure of reasoning, or phenomenological reports which describe the contents of consciousness). (Wiese and Metzinger 2017: 2)

The predictive processing framework, to its proponents, thus seems to promise theoretical unity, parsimony, elegance, interconnectedness, and so forth, which in part explains its recent rise to prominence, especially when few competitors can offer such fine-grained descriptions of disparate mental phenomena at various levels of analysis in such a conceptually consistent way. As Hohwy puts it, “the framework is extremely parsimonious, with a simple mechanism at its heart, replicated throughout the hierarchy and yet able to fulfill a number of computational functions,” (Hohwy 2013: 75). This is an attractive feature for a biologically instantiated information processing system to exhibit.

2.1. The Core Predictive Mechanism

Beyond the basic claim that the brain is a Bayesian prediction-making machine, predictive processing accounts almost always include several more specific features. The most essential features are the following, as identified by Wiese and Metzinger (2017):

¹¹⁷ In other words, the phenomenology supervenes on a computational level predictive mechanism, which in turn supervenes on the neurobiological processes occurring at the physical level. Although not usually made explicit, proponents of predictive processing generally assume a physicalist, realist metaphysics (i.e. all the facts of the universe are physical facts and there is a mind-independent reality) along with a functionalist theory of mind allowing for multiple realizability (i.e., it is the predictive function of the brain that matters for consciousness and this function could in principle be realized by other physical material and still be conscious in the same way).

1. Top-down processing
2. Statistical estimation
3. Hierarchical processing
4. Prediction
5. Prediction error minimization
6. Bayesian inference
7. Predictive control

Top-down processing (1) refers to how, unlike a more traditional functionalist view of mind, where sensory data only flows up from sense organs to a passive “seat of consciousness,” in PP expectations of bottom-up signals also flow downwards. Top-down signals affect the performance of the lower levels and bottom-up signals (ultimately deriving from environmental and bodily stimuli) affect the higher levels. At every level there are **statistical estimations (2)** of the probability of signals occurring at the lower levels of a **multilevel hierarchy (3)**, with the higher levels responsible for increasingly complex signals and the very top levels underpinning conscious experiences. Each level can affect and be affected by all other levels to some degree, either directly (in the case of those immediately above, below, or adjacent) or indirectly (in the case of more distant levels).¹¹⁸ The information generated by statistical estimations is used to **predict (4)** the incoming sensory signal, and the error between the predicted signal and the incoming signal is sent up the hierarchy to influence the higher-level model, which then adjusts to **minimize prediction error (5)**. This process of prediction error minimization (PEM) is supposed to “approximate exact **Bayesian inference**” **(6)** (Wiese and Metzinger 2017: 8)(more on this in the next section). Finally, **predictive control (7)** maintains that an organism acts to change its sensory input to fit its predictions—which is to say behavior, at least some of the time, is a symptom of the general goal to reduce prediction error. Although the proximal target of any given prediction is only lower-level activity, the distal target is ultimately the causal structure of the world itself. In the end, if perception is to adaptively guide an organism’s behavior through a potentially hostile environment, the target of those predictions must be the dynamic world it inhabits.

¹¹⁸ There is a vexed question here concerning so-called “cognitive penetrability,” i.e. the ability of high-level cognition (e.g. beliefs) to affect perception, but it is generally held that no level or set of levels is functionally isolated from the others (cf. Hohwy 2013: 117–139).

Predictive Processing

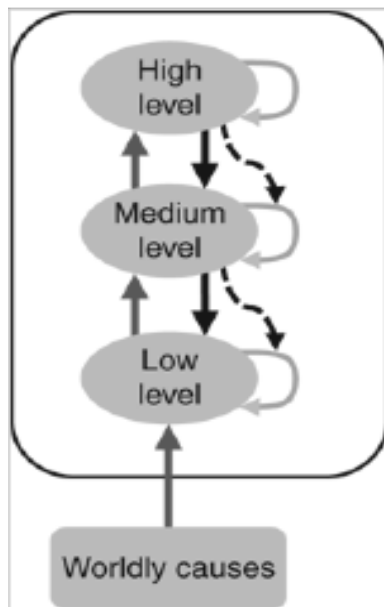


Figure 2: Hohwy's predictive processing hierarchy.

Predictions flow from the top down while error signals flow from the bottom up, with each adjusting the model at the level it feeds into. Additionally, each level exhibits self-inhibition given the expected precision of its model (circular grey arrows), and each level also feeds back predictions about expected precision. On the physical implementation level, Hohwy believes superficial pyramidal cells of the cortex may be responsible for feeding forward while deep pyramidal cells feed back (Hohwy 2013: 68).

2.2. Bayesian Inference

We may now wonder what it means for a predictive system like our brain to approximate exact Bayesian inference. Bayes' theorem is a mathematical rule determining the probability of a hypothesis given certain prior information. Bayes' rule, though mathematically simple, can be fruitfully interpreted as a “perfect guessing engine” whose inferences, while not *always* perfect, are at least “provably less fallible than any other,” (Stone 2014: 9). In Bayesian inference the goal is to compute the posterior probability of a certain hypothesis (i.e., a truth-evaluable statement about the world). It is called the *posterior* probability because we want to know the probability of the hypothesis *given* some previously ascertained data. A hypothesis is “a (simple) model of the data, and we wish to select the most probable model,” (Stone 2014: 14). Model selection is vital whether we are public health officials doing statistical analysis of disease prevalence or Bayesian brains making perceptual inferences about states of the world. According to the predictive approach, brains are essentially future-oriented prediction machines, honed by evolution to guide action adaptively in light of an incessant barrage of environmental and bodily stimuli.

The posterior probability can be formalized as $p(\text{hypothesis}|\text{data})$, where “|” means “given.” It is computed using the following equation, known as Bayes' rule:

$$p(\text{hypothesis}|\text{data}) = \frac{p(\text{data}|\text{hypothesis}) \times p(\text{hypothesis})}{p(\text{data})}$$

In plain English, this means the probability of the truth of a hypothesis given some known data is equal to the probability of that data given the truth of the hypothesis (called the “likelihood”) multiplied by the probability of the truth of the hypothesis on its own (called the “prior probability”) all divided by the probability of the data occurring on its own (called “marginal likelihood,” i.e., the probability of the “evidence”). In speaking of the mind, the entire numerator or just the specific likelihood $p(\text{signal}|\text{hidden causes})$ is often called the “generative model” (Wiese and Metzinger 2017: 14).

Predictive Processing holds that each level of the hierarchy implements Bayes' rule to adjust predictions based on incoming sensory information and increase precision in future predictions. To formalize Bayes' rule in terms familiar to perception, we can say that, “the posterior probability $P(X|Y)$ of the world state X given sensory input Y is proportional to the product of the likelihood $P(Y|X)$ and the prior probability $P(X)$,” (Doya and Shin 2007: 9).

This formulation ignores the denominator, $P(Y)$, which in this case means the probability of the incoming sensory input. This is because in the process of model selection any change in the probability of the evidence, “would change all of the posterior probabilities by the same proportion, and therefore has no effect on their *relative* magnitudes,” (Stone 2014: 4).

Beyond a single point estimate for the most probable state of the world given the sensory input, a more durable kind of estimate is the “full probability distribution or density of the posterior $P(X|Y)$,” (Doya and Shin 2007: 9). The shape of the posterior probability distribution describes how likely such an estimate of the state of the world might be. Considering an entire probability *distribution* can be a better approach for guiding action and perception in a risk-averse way as it is not usually overwhelmingly clear that one state predominates probabilistically. What’s more, posterior probabilities from e.g. time $t-1$ can be reused iteratively as prior probabilities at time t , $t+1$, etc., to increase accuracy (ibid). In a dynamically changing world, posterior probabilities can be multiplied by a state transition probability if the system has information about expected changes to arrive at a new prior for the next iteration.

2.3. Predictive Processing and Temporal Structure

The most important feature of the predictive framework for temporal phenomenology is the constant Bayesian model updating, as described above, occurring at each level in the hierarchy. When we consider how the predictive approach understands the relationship between the mechanism and consciousness, the connection to temporal phenomenology becomes clearer. Hohwy, Paton, and Palmer (2016) explain where they see experience entering the picture:

In creatures like us, it is natural to assume that perceptual inference maps on to *conscious* experience (Hohwy et al. 2008; Hohwy 2013). If this assumption is granted, conscious experience at any time would be determined by the set of predictions, distributed over the hierarchy and mixing, or convolving, hidden causes in a certain way, that at that time is best at minimizing the current prediction error. This yields an overall *hypothesis* with the highest posterior about the current sensory causes, which is therefore used to generate predictions for the ensuing sensory input. Because this hypothesis encompasses multiple levels of the hierarchy it seems a good candidate for delivering the richness of conscious perceptual experience. (Hohwy, Paton, and Palmer 2016: 319)

If the best overall hypothesis or expectation about the causes of sensory stimuli is responsible for the phenomenal character of experience, then it must be that as the expectations are revised, the phenomenal character of experience is replaced by something else, even if that something else is nearly identical because the degree of revision was minimal. Hohwy, Paton, and Palmer recognize this consequence of the predictive engine when they say that “...as soon as one hypothesis wins and thereby determines perceptual experience, it will begin to fade away and another hypothesis takes its place,” (Hohwy, Paton, and Palmer 2016: 323).

As described in the previous section, according to predictive approaches there are expectations generated by a model (the “generative model”), incoming sensory signals, and errors produced by the interplay between signals and expectations at each level of the hierarchy. The posterior probability of a certain cause given certain signals is constantly updated based on new sensory information in what Andy Clark calls “a continuous process of sensory prediction in which the target is a kind of rolling present,” (Clark 2016: 18).

However, rather than targeting the “present” *as such*, I contend it is this process that *creates* the present, understood as a privileged subjective temporal perspective. The predictive target is really just whatever causes the input. The common notion of the present, i.e., the so-called “A-series” notion of “present” which is related to a “past” and a “future” which lie behind and in front of the present along a linear dimension (McTaggart 1908), does not feature here, as the system has not created the conditions for the spatialization of the concept of time at this early stage. In other words, the conceptual present requires further processing but that which we will eventually come to think of as present is already created at this early stage.

Because the system implements Bayes’ rule to arrive at posterior probabilities of the hidden causes of sensory data, the predictive view entails that the mechanism responsible for our perception has a built-in temporally indexed informational structure. As Clark further explains, “the percept itself [is] a prediction-driven construct that is always rooted in the past (systemic knowledge) and anticipating, at multiple temporal and spatial scales, the future,” (Clark 2016: 18). Aspects of the created present thus include information about the system-relative “past” and “future”. This incorporation of prior and potentially later information into the subjective present provides a basis for the widely popular “specious present” accounts of temporal phenomenology that claim the experiential present is spread out over time in some way. According to predictive processing, however, such a temporal structure occurs at both sub-personal and personal levels of the hierarchy, remaining a feature of the system even in the absence of consciousness.

Our predictions are constantly updated in response to the incessant flow of sensory information so even if the percept and the prediction remain practically the same, a computation exploiting incoming information is still occurring. In such a scenario, despite the apparently changeless world, nonetheless a duration elapses from the perspective of the system because an ongoing series of updates still takes place, although this is not to say the system is “conscious” of any duration at this stage. It is this constant Bayesian update, even when the predicted causes of stimuli remain practically identical, that gives us our experience of time passing whenever we are experiencing anything. As we have seen, in predictive processing, posterior probabilities concerning the hidden causes of incoming sensory information are the necessary prerequisites for a percept to occur.

The proposal here is just that the update of this posterior probability enables, but does not guarantee, the experience of time passing. The experience of the passage of time is thus not a percept itself but falls out of the way that all percepts are dynamically created. This is the core of the view advanced here (i.e., Temporality as Iterative Expectation Revision) according to which temporality is understood as an intrinsic feature of the operation of the cognitive mechanism.

2.4. Additional Commitments

[T]he mind is at every stage a theatre of simultaneous possibilities. Consciousness consists in the comparison of these with each other, the selection of some, and the suppression of the rest by the reinforcing and inhibiting agency of attention (James 1890: 288).

In addition to the core claims of predictive processing outlined above, there are several further features found in most prominent predictive processing accounts. These include the notion that attention is really the result of precision weighting of predictions, the notion that we can describe what the brain is doing in predictive processing as testing hypotheses, the notion that the ultimate goal of the system is to minimize “free energy,” and the so-called “ideomotor principle,” which maintains that action and perception are inextricably linked in such a way that perception is rooted in predictions about how the organism’s actions affect the environment in ways that result in structural regularities that can act as perceptual feedback (Wiese and Metzinger 2017). Furthermore, two camps have formed on either side of a debate about whether predictive processing entails “environmental seclusion,” that is, whether the environment is merely inferred (a position known as

internalism; see Hohwy 2013) or whether the boundaries of the system extend out into the body and the world itself (a position known as externalism; see Clark 2016).

For our purposes, we can remain neutral on most of these additional features. However, the notion of “precision estimates” is less controversial within the context of the predictive processing framework and may well play a role in modulating the temporal experience. While the system is ultimately engaged in inferring worldly causes of sensory input, it is also engaged in determining the level of perceptual noise generated by a given state of the world. Certain conditions are far “noisier” than others, that is, there are conditions that inherently involve much greater uncertainty than others, and it is useful to know about these states. A dimly lit room for instance provides less reliable information about the objects within it than a brightly lit one—in the latter scenario it is quite possible to mistake a coat rack for a person because of the indeterminacy of the incoming data. To deal with this problem and allow the perceptual system to exhibit context-sensitivity, predictive processing accounts invoke self-inhibiting reflexive connections at each level of the hierarchy. Hohwy describes this structure in greater detail:

[...] Lateral connections within the same hierarchical level serve to decorrelate prediction units such that when a particular hypothesis begins to emerge as having the highest posterior probability other units are progressively prevented from influencing inference (Friston 2002a; Friston 2002b). In an uncertain situation, such as when there is ambiguous context or noise, a number of different hypotheses can concurrently seek to predict the input.... However, when one hypothesis is deemed good enough the activities of other hypotheses should begin to recede because whatever they can successfully predict is most likely just noise—those hypotheses are *explained away*.... an evolving prediction error signal that can continually be explained away well by a particular hypothesis can be assumed to be reliable and should thus be weighted more in the message-passing economy.... This notion of weighting prediction error according to their [sic] reliability is central to how the system deals with noise and uncertainty, and in turn, to the nature of attention. (Hohwy 2013: 61)

The system makes predictions about expected precisions, so besides just inferring causes of incoming sensory data, the brain is also constantly making predictions about the reliability of that data. This can be thought of as a “second-order perceptual inference,” (Hohwy 2013: 65). Perception is concerned with making the best hypotheses for the available data, so reliability is important. When incoming data is assigned more reliability, there is greater precision, that is, less variance in the data. The brain thus wants to maximize precision, at least in scenarios where it is very important to do so, and predictive processing contends that attention is the means by which this is done. We generate predictions about

expected precision and then adjust the amount of weight given to predictions about hidden causes based on the expected precision of the conditions encountered by the organism. An increase of precision weighting is quite literally the act of attending according to this framework.

What does precision weighting have to do with temporal experience? We imagine attention increasing visual acuity, auditory acuity, etc., as when you attend more closely to the lyrics of a song on the radio or the text on a street sign while driving. But attention has also been shown to modulate the experienced speed of temporal passage. Specifically, attention to a task has been shown to result in time dilation (Frey 1990; Mattes and Ulrich 1998). It could be the case that attention, through increasing precision weighting, allows the brain to make more and finer-grained Bayesian updates, which translates into finer temporal resolution. This increase in temporal resolution could be experienced as a slowing down of the passage of time for the percept because a greater amount of detail is being processed at a finer grain than normal.

3. Putting It Together: Combining the Predictive Mind with ERA

It remains to explain how the basic principle of temporality understood as iterative expectation revision (TIER) corresponds to the extensional retentional phenomenological analysis (ERA) proposed earlier. To put a fine point on what has previously discussed we can isolate the claims involved in TIER to the following:

1. The phenomenology of succession results from continual revision of expectations at all levels of a multilevel hierarchy engaged in predicting the causes of incoming stimuli.
2. The operation of the predictive system occurs in real time and its actual temporal extension bounds the interval of the present (the specious present), albeit not necessarily directly.
3. The hybrid extensional-retentional character of temporal phenomenology (ERA) is determined by specific aspects of the information processing architecture involved in the continual revision of expectations.

Temporality as Iterative Expectation Revision (TIER)

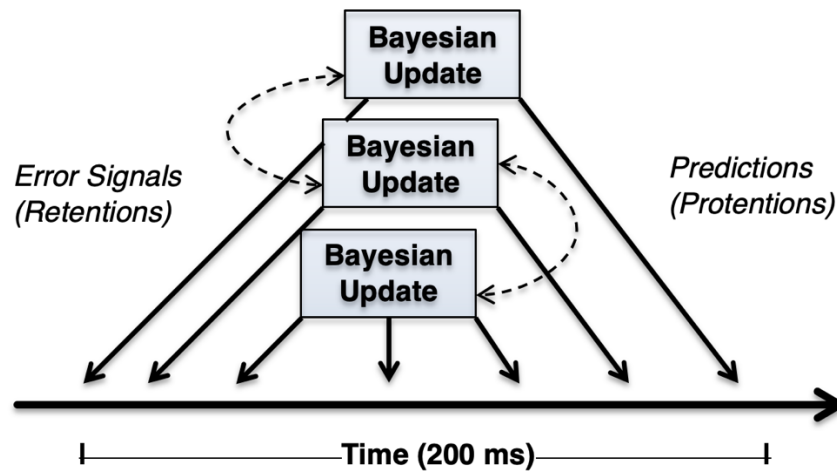


Figure 3: Illustration of the current proposal (TIER) for implementation of the hybrid phenomenological analysis according to a predictive approach. Continuous Bayesian updates, distributed over real time, provide indexical now-phases *for each level*, which together constitute the window of the specious present for the system as whole. No particular level or single update is “conscious” or solely responsible for an organism’s consciousness but rather just one part of a more massive information processing mechanism. Where and why experience comes into the picture remains a “hard” question that need not concern us here. Error signals may be the basis for Husserl’s phenomenological retentions with predictions as protentions. Only three levels of the multilevel hierarchy are shown, but distant levels of the hierarchy would be further offset in time with the total offset of variable but finite temporal extension. The dotted arrows represent the two-way interaction between levels common to hierarchical predictive approaches (see Section 2).

Under the predictive processing scheme, residual error signals used to influence future updates can be seen as analogous to retentions, while top-down predictions about what will happen next satisfy the future-directedness criterion for protentions. Husserl named the unity of “primal impression-retention-protention” that we experience the “living present” (Husserl 1917: 434): the present of our experience, whose invariant structure, as Evan Thompson puts it, “does not move in or through time” and yet also “underlies any appearance of flow whatsoever, including the appearance of consciousness to itself as flow,” (Thompson 2010: 326). Such an invariant temporal structure was necessary to give time its dynamic quality, rather than a series of static moments, even if those moments are extended in time. TIER captures this “living present” by appealing to the functional components of the predictive mechanism underpinning subjective experience. A few caveats to this match-up with Husserl’s view are in order, however.

On the view presented here, there isn't really a primal impression or *absolute now* for the subject, but rather continuous Bayesian updates that occur throughout the hierarchy that include elements (error and predictions) that can be usefully interpreted as retentional and protentional. There is no privileged "now-point" *for the whole system* within the interval of the specious present: there are only errors and predictions, which contribute to the overall updates. In this way, there are some affinities to Dennett and Kinsbourne's influential Multiple Drafts Model¹¹⁹ (Dennett and Kinsbourne: 1992). The greatest divergence between TIER and other predictive models (e.g., those considered in Section 5) is that the contents of the update (and error and predictions), i.e., what they are estimating, are not time intervals, but probabilities of occurrences within time. The updates themselves, which occur at various levels of the hierarchy, both personal and sub-personal, rather than their contents (probability distributions), generate the phenomenology of a "living present."

In accordance with retentionalism, at each level of the hierarchy, updates are made possible by appeal to information about the past and predictions about the future. As Wiese and Metzinger put it, "the prior codes the information the agent already has; the likelihood codes how the domain about which the agent already has information is related to the domain of the new information obtained," (Wiese and Metzinger 2017: 6). These are features of updates at a single level. Throughout the system, more robust traces of the past are present in the form of the error signals passed up the hierarchy. There is therefore not one single analogue for retentions in the model proposed here, but several.

The hybrid proposal is a quasi-retentional model, albeit not necessarily a strongly representational one. Although there is almost as much disagreement over what representations are as whether and how they play a role in perception, it is generally accepted that representations must be about distal events and separable from the distal events they are about. Paweł Gładziejewski (Gładziejewski 2015; 2016) claims predictive processing is representational because "PP's generative models perform a representational function by acting as detachable information bearing structures which stand-in for the features of the environment," (helpfully paraphrased by Krzysztof Dolega 2017: 2). On the other hand, in PP, predictions and errors need not represent but merely covary with proximal causal

¹¹⁹ Roughly, this is the idea that there are multiple competing models (drafts) entertained at any given time in experience and it is only upon introspection that one is selected as "the" experience we think we have had. In this context, we can think of there being "multiple nows" for the subject, rather than a single instant that is identifiably "now" for the whole system (see Dennett 1991: Ch. 5 for a defense of the multiple drafts view).

mediators, i.e., the immediate level below or above (see Section 2). Even if the generative model *is* representational (admissible here), on the proposed account the *contents of that representation are not “time” or “times”*, but only *objects* (broadly construed) already structured *temporally*. The experience of time is a process found closer to the bone, so to speak, than a purely representational view allows for. Even with a commitment to representational content, we can still see time not as a kind of content in itself but as a consequence of the way that perceptual content comes to be.

If not really “about” times *per se*, retentional models may still be *intentional* in the most basic sense of having direction towards an object. Indeed, Husserl defines retentions, primal impressions, and protentions as each being “directed towards” different phases of time. This is to say there is a distinction in the temporal orientation of say, a retention of events past and a protention of future expected events. That said, maintaining intentionality is a relatively minimal ontological commitment compared to taking time to be a represented object. The idea is just that certain elements of the predictive system are directed towards the past or future, which doesn’t amount to saying anything more than we already knew about error signals and predictions. So, according to this proposal, the insights of both Kant and Husserl are taken seriously. As Kant would have it, time is not an object of representations but rather a *way* of representing and, as Husserl would have it, the specious present retains an internal temporal structure.

In Husserlian terms, priors and error signals can be seen as “traces” of the past, while predictions about the future are evidently “traces” of the future—both of which are necessary to ensure that succession is felt *as* succession, rather than disconnected percepts with no temporal relation to each other that happen to occur one after the other. While the system is of course still making estimates, these estimates do not take intervals of time as their objects. Instead, such estimates ultimately only take worldly causes as objects. The passage of time, enabled by the invariant temporal structure of the mechanism is, in a sense, already taken care of by the updating of these estimates about worldly causes, becoming an inherent feature of the system at each level. When updates at all levels engaged in the generation of conscious percepts are considered together (more provocatively, when *we are the whole system*), we are left with a full-blooded phenomenology of temporal passage, including the notion of a specious present or window corresponding to what we consider to be “now” as well as past and future-directed information present throughout the system enabling a feeling of succession.

Ultimately however, it must be remembered the brain is not doing two things here. The brain is not making predictions about worldly causes that generate familiar percepts like trees and chairs AND making predictions about lengths of intervals, speed of passage, existence of passage, etc. This information is instead “built in” to the process of Bayesian updating itself, such that the system can’t help but be temporally structured. This accords with the Kantian notion that experience cannot be had without *already being* temporal. While one can fail to perceive a percept or go blind and lose a source of sensory input, altering or perhaps ending predictions about the causes of that sensory input, the same does not hold with temporal experience. One cannot go “timeless” without ceasing to exist as a subject and agent. We should expect that time is a fundamental part of the mechanism responsible for any perception, and indeed any experience, whatsoever—a *sine qua non* of consciousness and therefore of an entirely different character and provenance from the everyday objects of consciousness (as discussed in Chapter 3).

Besides the retentional aspects outlined above, TIER is also extensional in that the constant Bayesian updates grounding minimal temporal experience occur at different clock times over the course of a measurable interval and that fact is relevant to the resultant experience. All the updates that concern current experience are integrated such that they form a finite but variable specious present. Within this window no particular processing level dominates in the sense of entirely constituting our perception, but rather they are all together implicated. The span of time through which the most relevant updates to perceptual expectations really take place determines the span of time we take to be now. There is therefore no crucial singular update for the perceiving subject, but instead a flexible window of time, consisting of all relevant updates about current stimuli. Within this window percepts are perceived as present, but the span of the experiential window is not itself the result of any explicit mental representation but rather a consequence of the actual operation of the mechanisms of consciousness in real time.

The “nesting doll” character of TIER mirrors temporal phenomenology as it is given. Henri Bergson, writing prior to Husserl, likewise emphasized a more complex temporal phenomenology than was commonly assumed. Bergson invites his reader to imagine a succession of musical notes. He then asks, “Could we not say that, if these notes succeed one another, we still perceive them as if they were inside one another [les unes dans les autres] and their ensemble were like a living being whose parts, though distinct, interpenetrate through the very effect of their solidarity?” (Bergson 1889/2001: 75 [101]). He goes on: “One could thus conceive succession without distinction as a mutual penetration, a solidarity, an

intimate organization of elements of which each would be representative of the whole, indistinguishable from it, and would not isolate itself from the whole except for abstract thought,” (Bergson 1889/2001: 75 [101]). Thus no one note is “now” but depends on the others for its temporal character. The system, though essentially complex, has to be understood as a unity for its parts to make sense. Bergson’s complexification of temporal experience as a heterogenous unity anticipates Husserl’s tripartite scheme and later Merleau-Ponty’s networks of retentions and protentions comprising the “field of presence,” with “each present reassert[ing] the presence of the whole past which it supplants, and anticipat[ing] that of all that is to come...” (Merleau-Ponty 1945: 488). Though the Phenomenologists would vehemently object to theorizing beyond what is given in experience, their general view of experience is perhaps best accommodated by a cognitive system that also exhibits complexity in the form of a recursive, multilevel hierarchy with feedforward and feedback connections between levels.

4. Minimal Temporal Phenomenology as Systemic Structural Feature

While the distinctiveness of temporal phenomenology is commonly recognized, it is common to stray from specific concern with minimal temporal phenomenology (understood as bare experiential succession and the temporal extension of the subjective present) and locate the relevant mechanisms at an implausibly high level of processing. This section will argue higher-order mechanisms are implausible as accounts of temporal phenomenology because such phenomenology is a ubiquitous feature in experience. On the flip side, TIER has the advantage of locating the most relevant features of the information processing for temporal phenomenology at the lowest functional level, i.e., in the way that expectations are formed and updated.

Anil Seth points out the distinctiveness of temporal experience vis-à-vis the other senses when it comes to giving neurologically informed explanations:

For vision, we have photoreceptors in the retina; for hearing, there are ‘hair cells’ in the ear; but there is no dedicated sensory system for time. What’s more, setting aside the circadian rhythm, which provides us with jet lag among other things, there is no evidence for any ‘neuronal clock’ inside the head which measures out our experiences in time – and which would in any case be a prime example of what Daniel Dennett called a double transduction, in which a property of the world is re-instantiated in the brain for the benefit of an assumed internal observer. (Seth 2021: 134)

Because there is no evidence for a dedicated “sense of time” as there is for vision, as well as *a priori* reasons for thinking there cannot be, there is strong motivation for looking at the workings of the overall cognitive mechanism in accounting for temporal phenomenology. Seth goes on to assert, citing the work of Warrick Roseboom, that rather than “sense” time “we instead infer time based not on the ticking of an internal clock, but on the rate of change of perceptual contents in other modalities,” (Seth 2021: 134). Like Dayan, Hinton, and Neal (1995), Roseboom et al.’s study involved an “artificial” Helmholtz Machine: in this case a “feed-forward image classification network” designed to functionally simulate the human visual system (Roseboom et al. 2019). By analogy with this successful AI system, Roseboom et al. hypothesize that inferences play a role in human duration estimation.

However, it would not be right to say that “inferring time” explains minimal temporal phenomenology, as the latter should properly be seen as a precondition for higher-order temporal reasoning *about* that minimal phenomenology. It is only after there is perceptual change that a rate of change can be inferred from information about that rate. In other words, there must be experience over time—we must experience a duration—before we can estimate the duration of that experience. Thus, minimal temporal phenomenology is not the result of any specific inference(s), but rather a *consequence of the ongoing inferential processes* of the Helmholtz Machine. The structure of the mechanism rather than the informational content is paramount.

Hohwy, Paton, and Palmer (2016) endorse a similar but different higher-order thesis concerning experiential flow. They claim that “the sense of temporal flow in conscious perception stems from the probabilistic inference that the present cannot be trusted,” (Hohwy, Paton, and Palmer 2016: 315). The thesis is higher order because “for any level of perceptual inference, which proceeds according to its own learning rate, a higher level belief about precisions (i.e. a hyperprior) is needed to modulate that learning rate according to how volatile the context is expected to be (Mathys et al. 2012),” (Hohwy, Paton, and Palmer 2016: 318). It is this (variable) hyperprior about precision of prediction errors that is meant to determine our perceived rate of temporal flow. On their view, it is ultimately expected precisions that determine the level of distrust there will be regarding the current sensory input. However, this higher order view of flow is indebted to the structural features and ongoing operation of the predictive mechanism for its raw materials:

We argue that the sense of flow arises as the system gives up one hypothesis and settles on a new one due to its propensity for distrusting the present. The current prior decreases

and this makes it seem like we are inexorably pushed forward. The window of the specious present moves forward because the system expects change and therefore down-regulates the current input. The sense of flow thereby occurs as a property of the internal workings of the hierarchical generative model. This goes beyond just predicting what will happen, which could happen in a non-hierarchical Bayesian perceiver with no sense of flow, and it does not rely on being entrained by the actual changes in the world's hidden causes. (Hohwy, Paton, and Palmer 2016: 330)

Hohwy, Paton, and Palmer's proposal bears similarities to TIER, but also differs in significant ways, especially concerning theoretical commitments and explanatory focus. TIER is specifically concerned with a different explanatory target: minimal temporal phenomenology understood as the specious present and succession. As may now be clear, the suggestion is that "flow", understood as replacement, or if you like, bare experiential succession, "arises as the system gives up one hypothesis and settles on a new one," (ibid.). Importantly however, the "sense of flow" mentioned by Hohwy, Paton, and Palmer, and "experienced flow" are not necessarily the same thing. This has been remarked upon on countless occasions in the literature on temporal phenomenology, most famously encapsulated by the slogan "a succession of feelings, in and of itself, is not an experience of succession," (Hoerl 2013), or stated another way, "*perception of change* is not the same as *change of perception*" (Seth 2021: 133). It's important to note that what we get out of the model revision—the giving up of hypotheses for new ones—is *mere* experiential succession. Whether or not a subject is aware of this mere experiential succession *as such* may well be a question that requires appeal to metacognitive or higher-order hypotheses *about* what the system is doing. This question, which many authors like those discussed above seek to address, already goes beyond the basic question of how we come to have temporal experience in the first place.

Another important difference is that TIER makes no commitments to the content of high-level priors. *Why* one hypothesis is replaced by another is less important to this explanation than *that* it does. Hohwy, Paton, and Palmer may be right about the higher-level expectation a subject has to "distrust the present." However, we might worry this claim smuggles temporal language into a system that doesn't yet have a "present" until it is generated in the operation of the predictive engine. While the claim might seem to invoke an objective metaphysical present, such a commitment seems unnecessary if we reframe the claim as the notion that the system has a higher-level expectation of volatile input. This idea is compatible with everything I suggest here.

Lastly, and most importantly, according to TIER the specious present does not “move forward” because the system expects change and therefore downregulates the current input, even if that is in fact something that happens. The specious present moves forward just because the hypotheses are updated. The contents can even remain the same. Perceptions can last some amount of time for the subject even when not changing. Were it not for the updating of the hypotheses, there would be no specious present. Suppose the current input is not downregulated, but instead hypotheses are continually generated on the basis of that current input (assuming it is somehow retained by the system indefinitely). In this case, from the subject’s perspective, there would be an unchanging experience of a certain duration. But here already is temporal experience.

Of course, in answering why the hypotheses should change at all rather than leave us in a static non-experiential state where only one situation is ever inferred and thus only one situation exists for the subject, we could appeal to a higher-level expectation that the world changes and hypotheses must be updated. However, we could also dispense with the higher-level expectations of change and remain minimally committed to the idea that hypotheses simply change, perhaps because that’s what being a biological organism in constant physical flux requires. Indeed, as Hohwy, Paton, and Palmer recognize, in the context of dynamical systems theory, transitions driven by dynamical instabilities can lead to a tendency to switch between states in any case (Hohwy 2016: 323, n. 2).

The differences in emphasis between the current view and that of Hohwy, Paton, and Palmer can best be seen in the way the latter undertake to explain the phenomenon of binocular rivalry. Binocular rivalry is the phenomenon that occurs when different visual stimuli are presented individually to each eye (Wolfe 1983). Rather than blend them together as one percept, the visual system appears to switch between the stimuli over time. One explanation for this phenomenon is that the combination of the stimuli as one percept is inferred to have much lower probability than their independent existence. Thus, only one percept at a time can be perceived. However, each hypothesis is equally good concerning the causes of the sensory stimuli, so there must be some further explanation about what pushes the system to switch between them. Hohwy, Paton, and Palmer point to the hyperprior we have about the untrustworthy present as the reason why we switch between percepts rather than settling on one (Hohwy, Paton, and Palmer 2016: 325).

However, it seems that the more significant claim for the overall temporal character of consciousness, embedded as an assumption within the claim about the hyperprior, is that the revision of the expectation is the operative force behind the percept switching, whatever it

may be that drives the expectation to be revised. This seems to be the heart of Hohwy, Paton, and Palmer's position, although it is underemphasized in comparison to their commitment to the importance of hyperpriors about precision. The central appeal to expectation revision should be how any predictive approach ultimately explains the phenomenon of binocular rivalry. As it is with binocular rivalry, so it goes with all successive experiences, even if the change of content is less immediately jarring.

Hohwy, Paton, and Palmer are quite right to point out that the "internal workings of the hierarchical generative model" are critical for understanding flow. I would argue these structural features of the mechanism are also critical for other aspects of temporal phenomenology, like the character and duration of the specious present. Recognizing this sets up an important contrast to traditional ways of thinking about these issues: temporal phenomenology is *not* mere representational content (or not *entirely*) but instead has to do with the way this content is structured by the operation of an ongoing cognitive mechanism.

5. Related Accounts

Rick Grush has proposed a related though, as we shall see, quite distinct model of the information processing mechanism responsible for temporal experience. He calls this the Trajectory Estimation of Model or TEM. This model can be seen as a way of grounding retentionalism in its computational implementation. Such a model is meant to show us how the basic phenomenological picture, following retentionalism, could arise from a predictive mechanism physically instantiated in the brain. The important thing that Grush demonstrates for our purposes is that the details of this implementation can inform our understanding of the phenomenology or higher-level model, while also explaining temporal experience in a more sophisticated way than the broad strokes of higher-level models¹²⁰ allow.

TEM is meant to model temporal windows of approximately 200 ms ("a lag and reach of on the order of 100 ms each, for a total temporal magnitude on the order of 200 ms,"; Grush 2006: 444), which we can think of as comprising the specious present.¹²¹ Grush identifies a window of this length for two reasons: it seems likely that such a timeframe would be that within which there is no "well-defined finish-line for information being propagated through

¹²⁰ The classic models discussed in Chapter 4.

¹²¹ Within such windows Grush thinks that events exhibit a "B-ish" temporal character, which is to say, they are not experienced as "now," "past," or "future," but only in relation to each other as "earlier than," "later than," and "simultaneous with," (Grush 2016).

the processing mechanisms of the brain” (Grush 2016: 8), in keeping with Dennett and Kinsbourne’s multiple drafts approach (Dennett and Kinsbourne 1992), and because of data from studies on the timeframes of temporal illusions, especially the postdictive effects (Grush 2005).

Grush attempts to ground phenomenological features of our experience in features of the brain’s information processing system. In TEM, we are to think of perception at any given time as consisting of a trajectory estimate¹²², which is to say, not just the perception of an event but a perception of where that event came from and where it is going. More specifically, Grush appeals to what he calls “smoothed estimates” which correspond to future events and “predicted estimates” which correspond to past events, and these are meant to be the information processing underpinnings of protentions and retentions. Furthermore, so-called “filtered estimates” combine prior knowledge with incoming data to arrive at an estimate of what is going on. Perception as a whole is supposed to be “embodied in the state of the model, which is the perceptual representation of the environment,” (Grush 2008: 152), including all of the kinds of estimates listed above.

The nature of these estimates can be fleshed out in greater detail. In the case of filtered estimates, “the perceptual system’s knowledge about the represented domain, in particular how the domain typically behaves and other statistical regularities” combines with “sensory information about the domain picked up by the sense organs,” (Grush 2008: 152). Both factors, i.e., prior knowledge and incoming sensory information, are capable of overriding the other depending on circumstances. The filtered estimates form the core “data” of the percept, specifying what is represented as likely to be happening now and act as the basis for projections into the future and past. Filtered estimates differ from what Husserl called primal impressions in that they are not raw incoming sensory information, but rather employ a complex of prior knowledge in combination with incoming sensory information to make an estimate. Because of this, information from the past is already implicated in the construction of such estimates, although the estimates are directed at the current environmental (or internal) situation.

For Grush, the technical term “predicted estimate” refers to a specific, iterative process. Predicted estimates are not about what is currently going on but about what will happen later. The system takes “knowledge about how the domain typically behaves” and combines this

¹²² This trajectory estimate is described by an ordered tuple of events, which is to say, a sequence where the order of the elements matters, so that succession is represented (Grush 2006).

with “a representation of the current state,” which is to say the original filtered estimate, and then “project[s] ahead in time,” (ibid.). Insofar as predicted estimates involve predictions about the future, they can be seen as computational-level analogues to Husserl’s protentions with their future-directed intentionality.

On the other hand, smoothed estimates, rather than being directed towards the future as is the case with predicted estimates, are directed towards the past. Here the filtered estimate (“representation of the current state”) and knowledge “about how the domain behaves over time” combine to form an estimate of what was happening at some previous time (Grush 2008: 153). Grush claims that this “smoothing” process can actually produce better estimates than the original filtered estimates by appealing to “back-tracked versions of later estimates,” (ibid.). In other words, this process can iterate backwards in a similar way to how predicted estimates iterate forwards, projecting the state of the system into the past based on its current state and making estimates based on that backward-projected state. Smoothed estimates, insofar as they are past directed, can be seen as the computational-level analogues of retentions.

The upshot of these three processes is the heart of Grush’s Trajectory Estimation Model: “By combining filtering, smoothing and prediction, these mechanisms are able to produce, at any time t , an estimate of the behavior of the represented domain over any interval, [although] as the times involved in the predicted or smoothed estimates get farther from the present time, their accuracy becomes less and less reliable, so any useful interval will often be a brief one centered on the present time,” (ibid.). Presumably, beyond this window of reliability the experience would no longer be considered a part of the specious present, which Grush has indicated is probably something on the order of 100 ms in either direction, based upon postdictive effect studies. Notice, however, notwithstanding the increasing levels of inaccuracy, there is still the uncomfortable sense that, as with retentional models generally, there is nothing in principle preventing the system from extending indefinitely in both past and future directions (see Chapter 6).

Supposing there is a boundary surrounding what we take to be present, what happens beyond that? When TEM is run online, i.e., concurrent with and directed at the temporally immediate environment, the model is supposed to result in the phenomenology of perception as we know it. However, Grush also maintains the model can be run *offline*, i.e. not concurrently, “in order to produce expectations of what the modeled domain might do in this or that circumstance (or if this or that action were taken by the agent),” (Grush 2006: 441–442). Thus, Grush is claiming that this model is also at work during imagining and

remembering, but in a slightly different way, with different kinds of representations (what he calls “conceptual representations,” (Grush 2006: 447). These conceptual representations get their name from “involving concepts of processes that span potentially large intervals [beyond 200 ms],” (ibid.). Conceptual representations are contrasted with “perceptual representations” that are confined to the space of the specious present, i.e., the approximately 200 ms temporal interval that constitutes our “now.” According to Grush, this difference is also supposed to explain the stark phenomenological difference between perceptions of, e.g., music playing now and music we expect to hear in five seconds or that we did hear five seconds ago (ibid.).

The estimates at work in TEM can be seen as representations, and the particular characteristics of each accord with the features of a more or less retentional model of the phenomenology of temporal experience. TEM has affinities with Husserl’s tripartite structure of the specious present but is not completely analogous. One important difference is that, in TEM, “perceptions don’t ‘sink back’ into retention, as Husserl put it. Rather, “the entire interval estimate is constructed anew each time,” (Wiese 2017: 6). Another difference is that, whereas Husserl seemed to think his analysis applied to larger timescales, Grush restricts his to a 200 ms interval. Grush invokes two different representations for different timescales: “perceptual representations” for sub-200 ms and “conceptual representations” for larger intervals (Grush 2006: 447). Furthermore, Grush objects to the way Husserl “privileges a now-point and gives it the name *primal impression*. The trajectory estimation model does not privilege any of the phases within the temporal interval,” (ibid.: 448). Grush worries admitting primal impressions means, “temporal illusions should not be possible,” because the primal impression is invariant (ibid.). Due to filtering in TEM, “as time progresses, the *entire trajectory* is re-estimated, with the consequence that some parts of the estimate can be changed,” thus solving the problem of illusions (ibid.).

Grush favors such a representation-heavy retentional model in order to overcome the problem of temporal illusions (Grush 2005: S210). As we have seen, some of the most paradoxical temporal illusions are the postdictive effects, in which later events seem to alter the subjects’ perception of events that took place earlier. These illusions seem to require that time is an object of representations, because we seem to *misrepresent* time when they occur. As Grush puts it, “something has to be *represented* for it be *misrepresented*,” (Grush 2005: S217). For representational views of time, an illusion is just a representing of time *as* being a different way than it “actually” is. In TEM-style models, an illusion is just a statistical irregularity in the signals coming from the environment that does not match up with

expectations, resulting in inaccurate event estimations (ibid.). These inaccurate estimations alter our experience of *now* because they are constitutive of it. Grush maintains that the model retains “openness to revision for, say, 100 ms,” (ibid.: S216), which is why postdictive effects are not observed outside this timeframe.

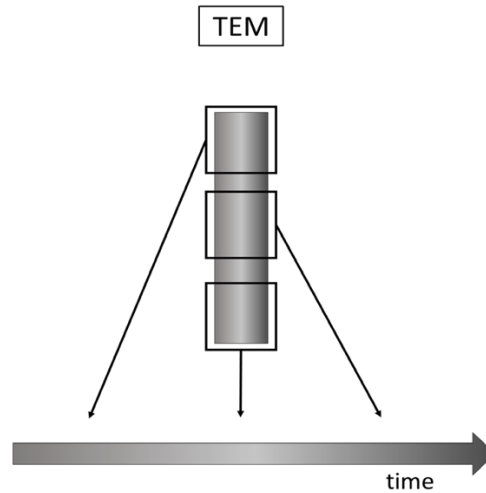


Figure 4: Grush’s trajectory estimation model, with simultaneous estimates (represented by arrows) of the probability of events at different time-phases. Together these estimates constitute the specious present (the vertical column), i.e. the roughly 200 ms interval we consider to be “now,” (Wiese 2017: 5).

5.1. The Hierarchical Extension to the Trajectory Estimation Model (HiTEM)

TEM is not a hybrid view. Instead, it is supposed to ground a phenomenology that accords with something like Husserl’s retentionalism, albeit with modifications (for example, the removal of primal impressions). Wanja Wiese’s Hierarchical Extension of the Trajectory Estimation Model, or HiTEM, is also not explicitly a hybrid view. Rather, Wiese’s model is meant to be a modification of TEM that accommodates Grush’s model within the predictive processing framework.

Wiese found Grush’s trajectory estimation model unable to answer what he calls the “interface question,” and sees his “hierarchical extension” as the remedy. TEM’s large interval conceptual representations are structured according to the tensed A-series (i.e., they are past, present, or future), while perceptual representations are structured according to the tenseless B-series (earlier than, simultaneous with, later than). We are thus left with two different kinds of representations at two different timescales. From a phenomenological standpoint, however, we seem to have a continuous and enduring experience of time with no discrete boundaries or distinctions between timescales. The interface question is therefore:

“How are perceptual representations of sequences integrated with conceptual representations of sequences” or, more simply, “How can I experience recent events as being seamlessly connected to present events?” (Wiese 2017: 7).

Building on Grush and TEM to answer the interface question, Wiese appeals to hierarchical predictive processing. Rather than two kinds of representations for different timescales, Wiese’s hierarchical extension of the trajectory estimation model takes it that “there is a hierarchy of temporal wholes” with each responsible for a different timescale (ibid.). Rather than a difference in kind between conceptual (long-interval) and perceptual (short-interval) temporal representations, in Wiese’s model these timescales are just represented at different levels of the hierarchy, because each level is responsible for a different timescale.

Wiese also introduces the concept of mediating representations, which are responsible for “represent[ing] features as being instantiated during an interval which is longer than that identified by Grush [200 ms]: it represents features as having been present in the recent past, as being present now, and as continuing into the near future,” (ibid.: 15). Our ability to perceive timbre and rhythm is supposedly dependent on such mediating representations, which allow us to experience an event as having been present before just now and expected to continue afterwards.

Our holistic conscious perception of time, according to HiTEM, is composed of all of the predictions of events made at each level in the hierarchy. If the subject detects “an increase in prediction error, an event boundary is inferred, and the event model is updated,” (ibid.: 19). This way of inferring event boundaries is essentially identical to that proposed by Zacks’ Event Segmentation Theory (EST), although EST operates on a timescale of seconds, rather than a fraction of a second (Zacks et al.: 2011).

Beyond predicting singular events, the hierarchy also allows that each level is predictive of the levels above and below, such that, e.g. a higher-level representation of rhythm can predict “the *timing* of individual notes” and “emotional responses can be predictive of the *key* in which a melody is played, and the key can be predictive of intervals in the melody,” (Wiese 2017:19). Reciprocal predictive power between levels is a feature of PP more generally, which Wiese here exploits to explain our perception of the interconnectedness of temporal scales. This attractive feature and EST are both compatible with TIER.

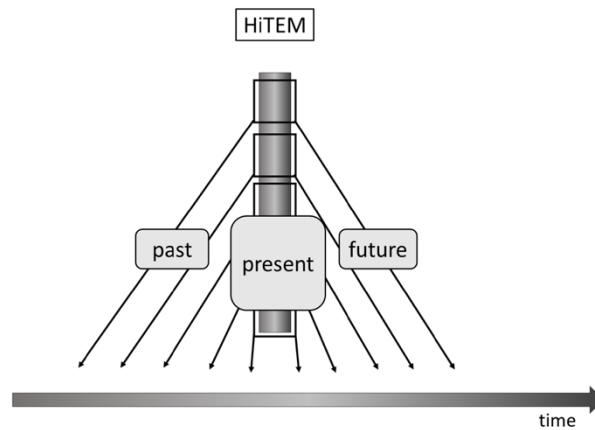


Figure 5: Wiese’s hierarchical extension of Grush’s trajectory estimation model, with representations for various timescales at each level in a reciprocally predictive hierarchy. As with TEM, the arrows represent estimations (Wiese 2017: 12).

5.2. Problems with TEM/HiTEM

TEM and HiTEM share significant conceptual shortcomings. The first of these is a failure to answer the interface question, at least in its jargon-free formulation: “How can I experience recent events as being seamlessly connected to present events?” (Wiese 2017: 12). HiTEM’s mediating representations shift the problem one step further away but the problem remains. Whereas Grush had the problem of integrating conceptual and perceptual representations, Wiese now has the problem of integrating conceptual, perceptual, and mediating representations. What mechanism is there for seamlessly connecting mediating representations at different timescales to each other or to perceptual and conceptual representations? Adding more representations is a “tortoises all the way down” kind of solution, implying an untenable regress we should avoid.

A much bigger (but simpler) problem with TEM and HiTEM is that these models see time as the object of representations. In this context, and as Grush has defined it, “object” means “*something conceived by or presented to/in a conscious mind*” and therefore need not be concrete or real (Grush 2006: 419). Grush and Wiese are committed to a view of time as an object that is represented more or less like any other: TEM (and HiTEM) “explicitly represents the temporal aspects of the modeled domain just as typical schemes represent the nontemporal aspects,” (Grush 2005: S210). This representationalism about time is in line with other internal modeling approaches, wherein, “the system has an internal model of the perceived entity (typically the environment and entities in it, but perhaps also the body), and

at each time t , the state of the internal model embodies an estimate of the state of the perceived domain,” (Grush 2006: 441–442). The problem is that the very possibility of conceiving or presenting or representing an object at all is necessarily predicated on the preexisting temporal structure of experience.

It may be that objects are represented as having certain temporal features, for example they might be represented *as* changing. However, insofar as temporality is a prerequisite for experience at all, there should also be a more fundamental level where representations themselves have an inherent temporal structure. This is where the model should become a hybrid one—the representations (in this case, the intentional entities of retentions and protentions) inherit the temporal structure of the physical system they are instantiated by.

6. Advantages of TIER

Rick Grush objects to the widespread tendency to take time as, “its own best model, indeed its only model,” (Grush 2005: S210). By this he means that, “the representation of succession is accomplished by a succession of representations,” (ibid.). However, there is an important intuition motivating such claims that Grush overlooks, which makes them even more compelling than the roboticist Rodney Brooks’ more famous general claim that the world is its own best model (Brooks 1991: 139–159). Besides the idea that it seems evolutionarily superfluous (i.e., inefficient and maladaptive) and theoretically unparsimonious (i.e., contrary to Ockham’s razor¹²³) to construct a representation for something that’s already in the world, there is the deep Kantian intuition that time, like space, is very different from other things and in fact not a thing at all. Viewing time as an object of representation trivializes the role time plays as the necessary structure or field of all other subjective experiences.

TIER also accommodates a phenomenology that is temporal at all grains. There is no scale or kind of experience that lacks temporal structure, nor could there be. Representational models are in the uncomfortable position of claiming that time and other objects of perception are represented in the same way and then somehow combined in a way that the latter are subsumed by the former. If the levels of the hierarchy in predictive processing are the building blocks of consciousness, we should expect each level to exhibit the temporality

¹²³ As Russell formulated it: “Whenever possible, substitute constructions out of known entities for inferences to unknown entities,” (Russell 1927: 160).

that conscious experiences depend upon—a temporality that is already present at the subpersonal level and is carried through to the personal. Conveniently, predictive processing already comes with such features.

Kant thought time must be a precondition of any experience whatsoever. Our concept of time is *a priori* in that it does not derive from experience of the world. In the current proposal, Kant’s argument is taken to heart. Time, or the flow of time and the experience of the present moment, cannot be the result of the same process that gives rise to appearances, i.e., objects of experience, in general. Whereas in the latter case predictive processing appeals to predictions of hidden causes in the world, we cannot admit that time results from predictions of causes of input impinging on a “time sense apparatus,” or something similar, for this would allow that experiences can be had apart from time, which is impossible. Instead, TIER sees time as an inherent feature of the processes responsible for perception, and it is inseparable from those processes. The flow of time falls out of the Bayesian inference mechanism in virtue of its constant updating of predictions, but time is not itself an object of those predictions.

TIER also avoids the so-called “interface question” by eschewing representations altogether. There is no question of how representations are seamlessly integrated when representations are not the vehicles of the relevant information for time perception. Instead, the predictions and error signals provide temporal cues at each and every level which are incorporated into updates that integrate seamlessly because that is all there is to provide the relevant information about temporality. This is analogous to perceiving a seamless integration of information despite blinking. No “extra” representations are required to fill in the space—the extant input does so automatically because the absence of information is simply not experienced. As Cyriel Pennartz explains in the case of blinking, “the lack of sensory input during an eye blink need not be actively represented in the visual system. In fact, the lack of such a representation may be the very cause of not noticing this gap, thus accounting for a feeling (or illusion) of continuity,” (Pennartz 2015: 51). Similarly, no extra temporal information or representations are necessary to integrate the information, because “...in the short run, spatial or temporal continuity in our experience may come about because of a lack of information on discontinuity,” (ibid.).

On timescales much beyond the specious present, we might observe that, in fact, the *explanandum* of the interface problem is much less compelling than Wiese had indicated, for there actually *isn’t* seamless phenomenological integration between sub-200 ms timescales and beyond. Times on either side of the subjective “now” do not feel as if they are now and

do indeed feel quite disconnected. The phenomenology of memory and anticipation are distinctly different than the phenomenology of perceiving the present. However, within the specious present the suggestion that different levels handle different timescales is taken to heart. However, contrary to Wiese's view, TIER maintains this occurs because different levels update over time, in so doing targeting different timescales.

7. Biological Origins

So far, this thesis has been primarily concerned with the way time-consciousness is for us as we find it now. In other words, the discussion has taken place on a *synchronic* level. This section will consider time-consciousness *diachronically* to demonstrate that a plausible story leading to the emergence of TIER as an evolutionarily adaptive information-processing strategy can be told.

It is sometimes said that “Time Flies Like an Arrow; Fruit Flies Like a Banana.”¹²⁴ Not only is this a good joke, but it also helpfully connects the apparent arrow of time, understood here primarily as a thermodynamic gradient (Callendar 2017: 132-133), and the evolution of life, in particular the self-sustaining impulse that leads flies to bananas. I will argue this connection is important to cognition and consciousness, particularly time-consciousness, because the pressures of our local environmental conditions, which include an apparent arrow of time, favor systems that are able to exploit these conditions appropriately in order to persist. The best way they can do this is through ongoing prediction enabled by local synchronic and diachronic variations in entropic conditions. These predictions themselves exhibit inherent temporal structure and must be revised repeatedly in complex environments.

The early universe was highly ordered in the sense of being extremely dense. In technical terms, everything began in a state of extremely low entropy, where entropy is understood as the measure of disorder in a physical system. According to the second law of

¹²⁴ This quote came to my attention as the epigraph of the preface of Huw Price's *Time's Arrow & Archimedes' Point* (Price 1996: vii), attributed to Groucho Marx. According to the *Yale Book of Quotations*, “there is no reason to believe Groucho actually said this” (Shapiro and Henderson 2006: 498). The quote may have originated with Anthony Oettinger, who discussed its grammatical ambiguity extensively in a *Scientific American* article about computational syntactic analysis, in which he argues “no computer known can deal effectively with semantic problems of this kind,” (Oettinger 1966: 169). That piece contains other entertaining tidbits such as this: “It is after all, only an accident of nature, or for that matter merely of nomenclature, that there is no species of flies called ‘time flies’,” (Oettinger 1966: 168).

thermodynamics, systems generally increase in entropy (disorder) until reaching an equilibrium. Though rare, pockets of relatively lower entropy are an inevitable consequence of our position somewhere along a larger trajectory from low to high entropy. There are thus still remnants everywhere of our low entropy (highly ordered) origins available for us to exploit. The existence of these remnants is a critical enabler of our continued existence, whether on the scale of the galaxy, the solar system, or the planet, which still contains abundant heavier elements and complex organic materials that can be used to build living systems. At some point, perhaps, all these physical systems, at every scale, will devolve into disorder, but for the moment they provide the ingredients for the temporary sustainment of relatively well-ordered systems like ourselves. Indeed, one way of *defining* what it means to be alive is as the active maintenance of an improbably low entropy state against a higher entropy background that tends towards disorder (Seth 2022: 198; Corcoran, Pezzulo, and Hohwy 2020: 3; Parr, Pezzulo, and Friston 2021).

The notion of a cosmic origin in a singularity and a universal thermodynamic gradient are standard theoretical posits. The next step in the story is the recognition that the thermodynamic gradient is responsible for conditions that guarantee an informational environment exists that allows for adaptive exploitation of the pockets of relative order left over from the early universe's low entropy origins (Ismael 2021: 76). These leftovers can be understood as exploitable informational *records*. Wherever there are records there is the possibility to use them to make inferences, either predicting or retrodicting.

A universe in equilibrium has no records—no way to determine its evolution over the dimension of time. A record could be a clump of matter hurtling through space, whose own origin can be inferred by its present velocity. Or it could be a compound emitted from an undersea vent or secreted by an organism. The entities that exploit these records are *themselves* records on multiple levels, most obviously as encoded by genetic material, but also in the way their bodies and behavior conforms to the ecological niche they have developed in.

The example of the compounds emitted from undersea vents highlights two points. The first is that such compounds can literally be *food* in the sense that these bits of relative low entropy against their relatively higher entropy background help to sustain an even lower entropy pocket which consumes them (e.g., chemosynthetic bacteria). The second point is that it would be very beneficial for an entity to treat certain chemical substances as informationally loaded signals to predict the location of the source. In so doing, the entity can perhaps obtain more of the resource. Here is one answer to why fruit flies like bananas—the

thermodynamic arrow of time has made it so. Fruit flies are drawn to bananas because they provide a chemical signal (e.g., fermenting sugar) that indicates the presence of life-sustaining compounds that are expected to aid homeostasis, which can be understood as the resistance to dissipation into the environment.

Not long after the emergence of life, there would have been an explosion of organisms in competition, each benefiting from literally consuming the others for the maintenance of themselves.¹²⁵ In this environment potential “records” multiply. It becomes important to sense and operate on records over multiple timescales, interpret them appropriately, and generate longer-term expectations. Though fallible, extrapolation to the future from records works better than any alternative to ensure continued existence, which is all that is required for its widespread adoption as an informational strategy. As Craig Callendar observes, “[what we commonly call] time is that direction on the manifold of events in which we can tell the strongest or most informative stories,” (Callendar 2017: 142). It is this informational direction, itself determined by the thermodynamic gradient, that then goes on to determine our subjective arrow of time.

So far, we have been charting a broadly “biogenic” story of the origin of cognition (Lyon 2006). As Matt Sims puts it, biogenic approaches think of “cognition as a process that underwrites an organism’s ability to remain in thermodynamically improbable non-equilibrium steady states despite the tendency for all systems to move towards thermodynamic equilibrium” (Sims 2021: 5). These approaches place a strong emphasis on how homeostasis is achieved by complex self-organizing systems that can actively change certain parameters to resist destruction by a hostile environment and see cognition as continuous with such activities (*ibid.*).

From the biogenic perspective, the facts of cognition and consciousness today are inextricable from their biological and ultimately physical origins in a world with very specific conditions. For organisms that inhabit such a world, their activities are performed embedded in positions along the thermodynamic gradient that are not time-invariant, as in idealized cases of physical systems, but exhibit a strong organism-relevant time asymmetry. It is not

¹²⁵ Peter Godfrey-Smith (2020), in his exploration of the origins of cognition, assigns great weight to the evolutionary arms race that occurred during the Cambrian explosion, a period starting roughly 540 million years ago when there was more oxygen available. The fossil record from this time indicates a proliferation of diverse bodily formats resulting from the transition to widespread predation from simple scavenging. These new pressures encouraged rapid evolution and ever more sophisticated possibilities for perception and action, which he sees as the beginning of something resembling minimal consciousness in animals like crustaceans with spatialized sensory systems, high mobility, and a need for self-recognition (Godfrey-Smith 2020: 86-88).

surprising then that this temporal asymmetry is recapitulated in the information processing architecture of a cognitive system that originates in this way. If this information processing is at all relevant to consciousness, then we should expect temporal asymmetry there as well, regardless of whether the universe is in fact an invariant block of space-time, as current physics may tell us (in metaphysical parlance: an eternalist universe). From this we have an answer to why the notion that only a dynamic, privileged present exists (in metaphysical parlance: presentism) might be a natural intuition for an organism like us to have.¹²⁶

However, when we remember the world as presented to us is not presented *truthfully* but rather *adaptively* and according to our needs, the intuition becomes less indicative of the properties of reality and more indicative of properties of ourselves and the way we navigate the world.

Besides explaining perceived temporal asymmetry, the biogenic story can also address perceived dynamism. If we live in a “static” four-dimensional block universe, as relativity suggests, then why does the world seem anything but static? The answer connects the consequences of standard physics just discussed to more recent developments in the sciences of mind. The fundamental dynamism of experience is grounded in the continuous adaptive revision of expectations in light of incoming sensory signals (records) from the environment we are embedded in. It should now not seem accidental that we ended up at this particular informational strategy. Instead, this strategy should be what we *expect*, given the way the world is and has been.

8. Conclusion

The current proposal for the mechanism underlying the experienced present stands out in several ways. The first is that seeing temporality as iterative expectation revision means appealing to the workings of the engine, so to speak, rather than the engine’s product (content), to explain a systematic structural feature of consciousness. TIER also coheres well with an explanatorily powerful larger framework, without bolting on additional theoretical commitments or new mechanisms. Finally, TIER helps to account for the phenomenology in

¹²⁶ Huw Price summarizes the intuition well in an interview for the PBS show *Closer to the Truth*: “In the case of time we can be so wrong [about what time really is] because we are highly temporally asymmetric creatures or structures in a region of the universe in which there is a striking temporal asymmetry of the thermodynamic kind. As in the case of up and down, it would simply be a matter of recognition that something we took to be a general feature of the universe is actually just a local feature of our environment” (Price 2014).

a more elegant and compelling way than has previously been available to naturalistic theories of consciousness.

In adopting TIER, there are other upshots for our understanding of experience as well. One is an accounting of the subjective arrow of time that can locate the predictive brain within a broader biogenic context, where cognition is dependent upon and conditioned by the physical structure and regularities of the ecological niche we inhabit. There is also a more natural accounting of the extended experiential present than pure content views can offer. This accounting is inclusive of the actual extension of the present experience and the complex content of the present, which seems to include information concerning the organism-relative past and future within the experience.

Chapter 8: Conclusion

1. Looking Back¹²⁷

This thesis has proposed a new way of thinking about the time of our experience that cuts across multiple levels of analysis to provide a coherent and plausible understanding of our temporal phenomenology. This view involves several distinctive contentions or “stances” regarding subjective time. The first stance is the idea that time, for the subject, should be reconceptualized as something quite different and apart from both objective time or any individual sensory capacity we might have. Rather, this thesis contends that time-consciousness is *special* in the following ways: 1) it is the precondition for subjective, agentive experience as we know it; 2) it is not something we “sense” but rather something we construct through the ongoing activity that creates conscious experience; and 3) because it is constructed, subjective time should properly be thought of as the *way* or *manner* by which we experience (including perception but also, imagination, memory, etc.). This third point, which I am calling adverbialism about subjective time, represents the overall orientation of the present work but is not something I am arguing for directly. I think that upon reflection the adverbialist stance should turn out not to be very controversial and its primary competitor, viz. the notion that we—and the brain—sense objective time directly, is really just symptomatic of insufficient introspection and seductive analogies with more studied aspects of sensory perception.

Moving beyond these general stances towards subjective time, this thesis has defended the “doctrine of the specious present”, which contends the experienced present occupies an interval, from attack by snapshot theories of various sorts, and argued that this specious present should be taken as an explanandum. I then argued in favor of a hybrid extensional-retentional analysis (ERA) of temporal phenomenology that considers the real temporal extension of cognitive and physiological processes to be explanatorily relevant to the character of our current experience, while at the same time suggesting that which can be fruitfully interpreted as intentional content is also critical to the richness of time-consciousness. More precisely, I have argued we must make an appeal to real temporal extension in order to ground the phenomenology of the specious present and the fundamental

¹²⁷ For the chapter-by-chapter breakdown of the thesis, see Chapter 1. This section is a high-level summary.

fact of temporal passage, while it would make more sense to appeal to content when explicating some of the more distinctive elements of our phenomenology mentioned in the chapter on *desiderata* including feelings of continuity, the higher-order sense that we are experiencing change and succession, and the unique temporal character of events that are imminent vs those that have just occurred among other more loaded and complex temporal phenomena (e.g., variability and illusions). I have argued this hybrid perspective not only better accommodates a variety of phenomena than its rivals, but also lines up nicely with the predictive approach to the mind, providing greater specificity and empirical tractability, and allowing for a synthesis of levels of analysis such that we can see a plausible way for this phenomenological analysis to be implemented cognitively and physiologically through the framework of temporality as iterative expectation revision (TIER).

2. Looking Forward

The study of time-consciousness remains in its infancy, both philosophically and empirically. As such, there is a low chance that any specific proposition endorsed by this thesis or endorsed by any others on this subject is exactly right. However, the various ideas I have argued for here may prove to be more useful, more explanatory, and just possibly more accurate than the historical positions upon which this edifice is built. Naturally, more philosophical and empirical work remains to be done to establish whether this is the case.

Whatever our best theory or theories of consciousness turn out to be, these should determine more than anything the sort of theory of time-consciousness we should endorse, both by creating constraints on those theories and by indicating in the structure of the theory the role that time must play in consciousness. The predictive approach to the mind might well turn out to be misguided. However, if it is not, then looking to the workings of the mechanism proposed should help to illuminate the place of time-consciousness in the overall system.

It is also important to know more about the brain than we currently do. Philosophers can exercise themselves to their hearts' content about what is logically possible and what is not for our experience, but it should be obvious that what the brain is actually capable of and especially what it is *actually doing* is where the rubber meets the road. Introspection, as we know, can be fallible: it may not seem to the layperson, for instance, that they experience anything other than a single momentary slice of time and yet the consensus view among researchers holds that is just simply not how the mind works in practice. The advent and

continual corroboration of the specious present represents a great advancement in the field. Other advancements like this are possible and may provide greater insight into the fine-grained character of our own temporal phenomenology. For example, we could certainly benefit from knowing more about what is happening during postdictive effects on the neurological level. A greater understanding of this topic could lead to a revision of our interpretation of these strange phenomena but also to further insights about time-consciousness under normal conditions.

One area of further research that has captured a limited but growing amount of attention lately concerns the neural correlates of time-consciousness. So far, accounts of these neural correlates have been highly speculative. There have been a wide variety of scientific attempts to locate the neural correlates of time-consciousness, all of which are inconclusive. In general, mainstream psychology has attempted to address the question of the neural correlates of time-consciousness in a different way than theories arising from a cognitive science perspective (Lloyd 2012). For instance, while it remains common to speak of physiologically instantiated “internal clocks” in the psychological literature (Wearden 2016; Allman et al. 2014), cognitive (neuro)scientists like Anil Seth (2021) are confident there is “no dedicated sensory system for time” and “there is no evidence for any ‘neuronal clock’ inside the head which measures out our experiences in time” (Seth 2021: 134; see also Wittmann and Montemayor 2022: 362). Instead, Seth endorses recent work by Roseboom et al. (2019) that temporal experience, understood as “duration perception” is the result of inferences about the rate of perceptual change—a process which has been modelled in an artificial neural network (ibid.).

There is thus a division in the scientific literature between those that search for a particular physiological mechanism underlying time-consciousness and those that appeal to particular mechanisms within some overarching information-processing framework. As we have seen, examples of the latter strategy besides Seth and Roseboom notably include Rick Grush’s “Trajectory Estimation Estimation Model” (2005; 2006) and Wanja Wiese’s (2017) “hierarchical extension” of Grush’s theory, which situates that computational model within the “predictive processing” framework. Others, such as Hohwy, Paton, and Palmer (2016), have attempted to give predictive accounts of the “flow of time” that appeal to the cognitive system’s higher-order expectations of change.

A further sort of endeavor attempts to ground temporal phenomenology in neurophysiological processes, with less emphasis on the computational-level information processing. For example, Francisco Varela (1999; 2000; Varela et al. 2001) sees time-

consciousness as a globally emergent phenomenon, locating its NCCs in large-scale patterns of neural oscillations. Similarly, Dan Lloyd directly addresses the “neural correlates of temporality” by advancing the idea that the default mode network (a global brain state) plays a key role. Lloyd rightly recognizes that, unlike the “timing” paradigm common to psychological studies, the more important subject of investigation is temporality as “a structural feature of consciousness” and “a fundamental dimension of all percepts and all behavior” (Lloyd 2011: 695). For Lloyd, the default mode network is meant to underpin the phenomenology of time as it is characterized by James and Husserl. Lloyd justifies his conclusion by appealing to an apparent mapping between the temporal characteristics of the default mode network and the temporal structure experience. However, as Grush (2006), referring to an earlier version of Lloyd’s view, and Lee (2011) have argued, these proposals remain conceptually and methodologically problematic, even if the background assumptions are correct.

Varela and Lloyd’s suggestions for the neural correlates of time-consciousness, though not without issue, are most in the spirit of the current project because they contend that structural features of more general neural correlates of consciousness are responsible for the temporal character of experience, rather than the temporal character of experience resulting from *additional* physiological or computation processes. Likewise, Montemayor and Wittmann have recently suggested an NCC for “time passage” at the information processing level which is not separate from the general model updating procedure that a conscious system engages in to be conscious in the first place (Wittmann and Montemayor 2021). These perspectives are more promising than either the classical approach, which searches for specific physiological timing mechanisms, or approaches from cognitive science that explain time-consciousness through “bolt-on” computational modules to some favored information processing mechanism.

It is my hypothesis that any attempt to identify a specific “location” or single network responsible for experienced time will continue to fail. However, with a promising overall theoretical framework, it may be that important aspects of relevant brain processes might be identified, and possibly even intervened upon to corroborate what I have suggested about the paramount importance of time-consciousness to subjectivity as a whole. As is well known, there is a vast array of conditions that act as temporal modulators, and while psychology has done a great job identifying what these are (seemingly anything you can think of), we are still very much in the dark about *why* such conditions act as temporal modulators, or why some have the effects they do while others have the opposite effect. Greater insight into the

processing underlying the effects of these conditions (e.g., pharmacological intervention, boredom, attention, and so forth) might point us further in the right direction concerning the specific mechanisms underlying time-consciousness.

Another potential avenue for further progress is to approach time-consciousness *biogenically*. From the biogenic perspective, consciousness and cognition form a continuum with life, and thus, looking towards deep evolutionary history may be one place to gather further clues about the character and genesis of human time-consciousness. While the penultimate chapter gives a hint of how a biogenic story can inform these kinds of accounts, there is certainly more that can be learned about time-consciousness from studying the origins of life and cognition in a variety of living systems. In combination with empirical work on neural correlates of time-consciousness, there may be synergies that lead us to a different understanding of the adaptive import of time-consciousness and the possible permutations of temporal experience in non-human animals, which may, in turn, shed further light on our circumstances.

3. Where Are We Now?

Over the course of this dissertation, I have advanced a novel view of time-consciousness from multiple perspectives and at various levels of abstraction and analysis. This view provides a coherent alternative to current theories treating this subject. In a nutshell the proposal is this: time-consciousness is not simply an aspect of consciousness but rather a precondition. This thought motivates a more detailed phenomenological analysis that sees the actual extension of experience in time and the contents thereof as both explanatorily relevant to the temporal character of experience. This thought has also motivated the corresponding information-processing picture of temporality as iterative expectation revision, which was initially inspired by the advent of the predictive approach to the mind. On this view, our subjective time is a consequence of the ongoing construction of experience—the very activity of being conscious. It therefore turns out that time, as traditionally understood, is not an object of experience at all but rather the way that we experience the world.

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