

ABSTRACT

Title of Dissertation: MEMORY, TIME, AND TEMPORAL EXPERIENCE

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This dissertation puts forth a series of empirically-grounded theoretical proposals about memory and temporal awareness.

After an introductory chapter setting up the stage, Chapter 2 concerns episodic memory. According to the standard view, episodic memory is both distinctively metarepresentational and, relatively, uniquely human. I argue that the standard view conflates two closely connected yet distinct senses of ‘episodic memory’. More specifically, I argue that even if the phenomenally conscious contents of episodic recollective *experience* are metarepresentational, that does not require that the episodic memory *system* have a metarepresentational structure. After arguing for a first-order account of the memory system, I show how the system-experience distinction helps to render the task of demonstrating episodic memory in non-human animals empirically tractable.

Chapter 3 concerns altered temporal phenomenology in life-threatening danger. I argue that the phenomenon colloquially known as ‘time slowing down’ turns out to consist of three distinct elements — subjective time expansion, slowing down of perceptual motion, and timelessness. Drawing on em-

pirical findings from a range of related fields, I explore how each element departs from ordinary, ‘normal’ temporal experience. Collectively, these individual accounts in turn further our understanding of passage phenomenology and temporal consciousness in general.

Chapter 4 investigates the cognitive underpinnings of our intuitive belief that time passes. On my account, while this belief is less metaphysically weighty than sometimes assumed, it is still of significant theoretical interest not only because it is linked to a rich phenomenology, but also because time’s dynamic character is a *psychologically compelling* phenomenon. Both of these features, I argue, are best accounted for by taking seriously the idea that we have something akin to an intuitive theory in the domain of time, with the belief that time passes serving as an inference-guiding principle shaping our ‘manifest image’ of time.

MEMORY, TIME, AND TEMPORAL EXPERIENCE

by

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Dedication

For Ma, from where it all began.

Acknowledgments

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Chapter 1: Context and background

Memory and time are among the most fundamental aspects of cognition and consciousness. Our perception of the world and our understanding of ourselves are deeply shaped by our capacity to store, maintain, and retrieve information, as well as our capacity to represent and think about time. Unsurprisingly, these two capacities also interact with each other in profound ways. Consider the following three passages from William James (1890):

Memory proper, or secondary memory as it might be styled, is the knowledge of a former state of mind after it has already once dropped from consciousness; or rather *it is the knowledge of an event, or fact, of which meantime we have not been thinking, with the additional consciousness that we have thought or experienced it before.* [...] Memory requires more than mere dating of a fact in the past. It must be dated in *my* past. In other words, I must think that I directly experienced its occurrence. (pp. 650–651)

In general, a time filled with varied and interesting experiences seems short in passing, but long as we look back. On the other hand, a tract of time empty of experiences seems long in passing, but in retrospect short. A week of travel and sight-seeing may subtend an angle more like three weeks in the memory; and a month of sickness hardly yields more memories than a day. The length in retrospect depends obviously on the multitudinousness of

the memories which the time affords. Many objects, events, changes, many subdivisions, immediately widen the view as we look back. Emptiness, monotony, familiarity, make it shrivel up. (p. 624)

In short, the practically cognized present is no knife-edge, but a saddle-back, with a certain breadth of its own on which we sit perched, and from which we look in two directions into time. 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. 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. (pp. 609–610)

In the first passage, James observes that episodic memory (what he simply calls ‘memory’) must involve ‘the additional consciousness’ of one’s subjective past. On a natural interpretation, the latter is not only about representing the past as such, but also about representing oneself as having existed in the past. In the second passage, James distinguishes between subjective experience of time ‘in passing’ and ‘in retrospect’, proposing that remembered duration is modulated by the information richness of memory content. Finally, in the third and most poetic passage of the three, James seems to be suggesting that perception presents us with a temporally-extended window of events, in a way that perhaps requires contributions of what we today know as working and short-term memory. This is, of course, the influential doctrine of the specious present.

In addition to illustrating the intimate and numerous ways in which memory and time are in-

terconnected in the mind, these three passages from James are also noteworthy in that they highlight the *richness* of memory and temporal phenomenology. This richness presents as much a challenge as an opportunity for studying the mind. Characterizing phenomenology is no easy matter, and even a proper characterization achieves only half of the task. For it takes much further work to account for the rich phenomenology in question in naturalistic terms. Nevertheless, this dissertation comprises three projects conducted in precisely such a spirit. These projects are fully independent of one another, and can be read in any order. Taken together, however, these targeted investigations contribute to a broader goal of advancing our philosophical understanding of memory, time, and especially their connections, in an empirically-informed manner.

In this introductory chapter, I begin by briefly describing the context and background out of which the central questions for each project arise. Not everything discussed here will be explicitly presented in the individual chapters, at least not in the same way. Likewise, I refrain from repeating the argumentative details provided later on. The primary goal of the introduction is rather to motivate the projects themselves and my approach towards them.

Episodic memory as self-knowledge

When people ordinarily use the term ‘memory’, they often mean *episodic memory*. Episodic memories are memories of experiential episodes — specific events from one’s personal past. Episodic memories are standardly contrasted with semantic memories, consisting of general knowledge about the world, including concepts, generalizations, particular facts, among others. In bringing to mind the sensorily-rich details of how I took public transit from Oslo airport to my downtown hotel a few years back, I *episodically* remember an event which happened in the past. In this case, the content of my memory reflects information pertaining to the learning episode itself. In comparison, my knowledge of Oslo

being the capital city of Norway is stored in semantic memory, and by now I have no idea how this piece of information was first acquired.

Owing partly to the psychologist Endel Tulving's work, in contemporary theorizing episodic memory is widely regarded as both conceptually and phenomenologically rich. [Tulving \(1985\)](#) proposes that episodic memory is characterized by 'autonoetic consciousness', meaning experience of self-knowing. In autonoetic consciousness, the rememberer re-experiences one's own past, and this is supposed to account for the observation that in episodic recollection one does not merely *know* that such-and-such happened but further knows the remembered event *as* part of his or her past. This is, of course, the same point emphasized by James ([1890](#), p. 651) when he writes that an episodic memory 'must be dated in *my* past', which he further relates to the 'warmth and intimacy' of episodic memory. In addition, modern philosophers (e.g., John Locke, Thomas Reid) have spilled much ink on the relationship between self and (episodic) memory. There is no denial that episodic memory affords a unique kind of cognitive contact with one's past self.

Episodic memory thus constitutes an important repository of self-knowledge. This is not just knowledge *about* oneself. Rather, its importance is sometimes cashed out by the thought that episodic memory is essentially self-referential (see, e.g., [Fernández, 2019](#); [Mahr & Csibra, 2018](#); [Perner, 2000](#)). One may wonder: does this mean that episodic memory presupposes a conceptual representation of the self? If episodic memory is autonoetic in character, then the answer seems to be 'yes'. This seems to in turn entail that non-human animals and young children do not possess episodic memory due to their lack of the relevant conceptual apparatus. To be sure, whether or not human adults are uniquely in possession of episodic memory is an empirical question; this is something about which there is — or ought to be — a fact of the matter. There is, however, an unfortunate stalemate on this issue, particularly concerning non-human animals.

The dominant autonoetic conception of episodic memory in the literature has an intrinsic phenomenological dimension. The phenomenological contrast between episodic and semantic memory is thought to be straightforward. In human research, subjects can simply be asked to report either that they *remember* an episode or that they merely *know* so-and-so to be true (Gardiner, 1988). This paradigm is plainly not applicable when studying non-verbal non-human animals. Indeed, it is unclear what non-linguistic evidence *could* tap into their phenomenology. Comparative psychologists have thus coined the term ‘episodic-like memory’ in order to separate the phenomenological and behavioral dimensions of episodic memory (Clayton & Dickinson, 1998). The idea is that if non-human animals can be shown to remember the *what*, *where*, and *when* elements of a specific event, they can be said to possess episodic-like memory. However, because what-where-when information can be encoded semantically as well, for non-human animals to possess episodic-like memory is not even a good *indication* that they possess episodic memory. This calls into question just how *episodic-like* is episodic-like memory.

Chapter 2 is motivated in part to provide a way out of this stalemate. I claim that the autonoetic conception of episodic memory admits a pair of subtly different theses, depending on whether the claim is made about episodic recollective *experience* or the episodic memory *system*. Part of what contributes to this ambiguity is the fact that the term ‘episodic memory’ can be used to refer to either the conscious act of remembering or the underlying neurocognitive system. But since episodic recollection is accompanied by a rich phenomenology, it is quite possible that the contents stored in the episodic memory system contribute only partly to the overall phenomenology. This in turn allows for the possibility that whereas autonoetic episodic recollection is uniquely human, the episodic memory system is widespread across species. While this is not the same as arguing that the latter *is* the case, the system-experience distinction calls for a reconsideration of division of labor in episodic memory research.¹

¹This chapter was first published as ‘What is so special about episodic memory: lessons from the system-experience

Experiencing the slowing down of time

Survivors of life-threatening danger often report having experienced time to slow down during the accident. On a natural interpretation, these reports describe alterations in one's sense of the speed by which time passes. As such, they reflect striking distortions in temporal experience that call out for explanation. Yet whereas our experience of the passage of time is a central topic in contemporary philosophy of time, virtually all of the existing discussions are concerned with passage phenomenology under normal conditions where the speed of felt passage receives little attention. By contrast, in abnormal conditions — including conditions of life-threatening danger but also psychedelic states, psychiatric disorders, and meditative states — altered passage phenomenology is often reported. There is thus a rich body of evidence that should be of interest to philosophers working on temporal experience.

It is worth observing that paying attention to altered temporal phenomenology is theoretically valuable for the same reason that studying (static) visual illusions is theoretically valuable. By gaining an understanding of when and how 'errors' occur, we thereby gain insights into how the human cognitive system works in general. In particular, altered temporality in life-threatening danger offers three distinct opportunities. First, many survivors report elapsed time to be greatly expanded, meaning that what they knew to be, say, a several seconds long event felt to have lasted much longer. Second, even more strikingly, survivors often describe the frightening encounter as unfolding in slow motion, the phenomenology of which is arguably analogous to the visual representation of the iconic 'bullet-time' scene in *The Matrix*. Third, at the most extreme, survivors report experiencing 'being in no time', time being 'at a standstill', or having 'no realization of time passing'.

Such alterations to temporal phenomenology are as rich as they are striking. Chapter 3 aims to distinction', *Synthese* **200**, 5 (2022). Reproduced with permission from Springer Nature.

understand mechanistically how subjective time expansion, the slow-motion effect, and timelessness depart from ordinary temporal experience. The individual accounts developed are independent of one another; collectively, they make the case that the colloquial expression ‘time slowing down’ denotes a thematic category rather than a proper explanatory target on its own. I thus propose several hypotheses, making use of interval timing, event segmentation, discrete perception, and so on. In each case, some form of memory turns out to play a crucial role in accounting for the temporal phenomenology in question. This project thus demonstrates that the opportunities afforded by altered temporality in life-threatening danger consist partly in separating the different ways in which ordinary passage experience ‘breaks down’, which in turn reflect the different neurocognitive processes that contribute to the appearance of the unity of temporal experience. Temporal phenomenology is thus not only rich but also thoroughly multi-faceted.

Manifest time, intuitive time

It is part of our commonsense picture of the world that time passes. This seemingly innocuous statement has proved to be a source of controversy, however. In particular, some philosophers take our manifest image of time to reveal a deep metaphysical feature of reality that science fails to capture, namely that *time really passes* (e.g., [Norton, 2010](#)). Just what is it to include time’s passage as part of our commonsense picture of the world, however? Answering this prior question is important for a couple of reasons. One has to do with the fact that many a philosopher and physicist accept the passage of time as an utterly obvious intuitive datum. The strongest reason in favor of a dynamic theory of time, it is sometimes claimed, is that the passage of time is simply ‘given’ in experience (e.g., [Craig, 2000](#); [Davies, 1995](#); [Schlesinger, 1991](#)). Yet despite the strong argumentative role it is supposed to play, relatively little has been said to systematically characterize what this powerful phenomenology is supposed to consist

in, at least not in sufficiently clear, naturalistic terms. Gaining clarity here would thus be of tremendous value.

Second, perhaps even more tellingly, there is a broad consensus across the field that time, at the very least, does *seem* to pass. Since this is a broad consensus, we may be ecumenical about how this ‘seeming’ is supposed to be cashed out, allowing a variety of candidates such as perceptual experience, agential experience, intuitive judgment, and so on. But in any event, there is something psychologically compelling about the idea that time passes. For example, even though he considers the passage of time a ‘myth’, Williams (1951, p. 466) nevertheless concedes that ‘we [simply] *find* passage’ and that ‘we are immediately and poignantly involved in the jerk and whoosh of process, the felt flow of one moment into the next’. Sentiments like these are not at all uncommon in the literature, and they seem to suggest a psychologically robust element of our cognitive apparatus vis-à-vis time’s dynamic character.

Chapter 4 makes the case that our manifest image of time indeed represents time as passing in a substantive way, but also that it turns out to fall short of constituting the phenomenological ‘oomph’ that some have assumed it to be. However, the psychological compellingness of our passage experience without the phenomenological ‘oomph’ makes the phenomenon all the more interesting. I explore the proposal that our grasp of time’s dynamic character constitutes intuitive knowledge.

Chapter 2: What is so special about episodic memory: Lessons from the system-experience distinction

2.1 Introduction

When the psychologist Endel [Tulving \(1972\)](#) first introduced the term ‘episodic memory’, he had in mind a form of declarative memory specialized in storing information about temporally-dated events and their spatio-temporal relations.¹ As such, episodic memory was intended to contrast with semantic memory, then conceived of as a mental thesaurus for general factual knowledge. But such a *content*-based distinction turned out to be inadequate. For what-where-when information can certainly be represented in a purely semantic format. It makes sense to say, for example, that information pertaining to where and when one was born is encoded in semantic memory.

Later on, [Tulving \(1983, 1985\)](#) proposed a *consciousness*-based distinction instead, according to which episodic memory is to be characterized in light of its distinctive self-related phenomenology. In terminology now standardly employed in the literature, episodic memory involves *autonoetic* (self-knowing) consciousness, for it affords an awareness of re-experiencing one’s own past. Thus, in episodic recollection, one does not merely know that such-and-such happened, but is further aware of the event remembered *as* part of his or her life. As we shall see, this is an intuitive idea, but one that carries subtle consequences. By contrast, retrieving semantic information is accompanied by Tulving’s *noetic* (know-

¹This is now commonly referred to as ‘what-where-when’ information.

ing) consciousness, without implicating any phenomenologically salient subjectivity. Notably, this is so even when the information retrieved is explicitly about oneself. In remembering *that* I spent my second birthday at the hospital, I remember something true of myself. Still, in this case my memory consists solely of impersonal what-where-when information, and its phenomenology differs from that of autoeotically remembering *how* I spent my tenth birthday at home (Gardiner & Richardson-Klavehn, 2000).²

It bears emphasis that in characterizing episodic memory in terms of autonoesis Tulving was not merely making a phenomenological observation. Rather, it was an attempt, under the memory systems framework (Squire, 1992), to characterize a neurocognitive system which underlies subjective experience of a distinctive sort and, relatedly, which subserves behavior with a particular function. To be sure, a phenomenological *approach* to memory was not exactly novel. Prefiguring Tulving, William James (1890, p. 239) regarded episodic memory as ‘suffused with a warmth and intimacy to which no object of mere conception ever attains’. The crucial contribution of Tulving’s work lies rather in placing the rememberer’s experiential self-awareness to the front and center of an empirical inquiry.³ Consequently, possession of episodic memory has been experimentally operationalized as a matter of possessing a certain experiential state of awareness, standardly measured via the remember/know paradigm (Gardiner, 1988; Tulving, 1985).

²Autonoesis is more generally associated with mental time travel, which includes event constructions in both the past and future directions. As Tulving (1985, p. 1) puts it, autonoesis ‘mediates an individual’s awareness of his or her existence and identity in subjective time extending from the personal past through the present to the personal future’. My concern in this chapter is with episodic memory only, and for our purposes, of most relevance is the unique sense of self rather than the temporality of autonoetic consciousness. For general discussions of autonoesis and mental time travel, see Perrin (2016), Perrin and Rousset (2014), and Vandekerckhove and Panksepp (2009).

³Some recent phenomenological characterizations do not *explicitly* put the emphasis on experiential self-awareness as Tulving does. Thus, Dokic (2014) characterizes the phenomenology in terms of what he calls an ‘episodic feeling of knowing’. Likewise, Fernández (2019) and Perrin, Michaelian, and Sant’Anna (2020) propose that central to episodic remembering is a certain ‘feeling of pastness’. Note that these characterizations are nevertheless Tulvingian, in the sense that they share a commitment to the unique sense of self as characteristic of episodic remembering. For instance, the notion of the feeling of pastness in recent literature is grounded in the rememberer’s own subjective past, not the past in general (cf. B. Russell, 1921).

Tulving’s seminal work has proved fruitful for subsequent empirical research on memory and beyond.⁴ But, in this paper, I shall take up two theoretical positions that have risen to prominence under Tulving’s influence in both the philosophical and empirical literature. The first is what I call the *metarepresentation thesis*, or the claim that episodic memory has a metarepresentational structure (Mahr & Csibra, 2018; Owens, 1996; Perner, 2000, 2001; Redshaw, 2014; Wheeler, Stuss, & Tulving, 1997). In the second place, the *human uniqueness thesis* contends that episodic memory is a uniquely human phenomenon (Keven, 2016; Klein, 2014; Suddendorf & Corballis, 2007; Tulving, 2002, 2005). Both theses, I shall argue, are more problematic than have been realized. For both their advocates and opponents have under-appreciated the question of how the episodic memory *system* should be characterized in light of the celebrated autonoetic character of episodic recollective *experience*. As I will argue in the following pages, if construed as claims about episodic remembering qua experience, both the metarepresentation thesis and the human uniqueness thesis are well-motivated but are of lesser theoretical interest than they have been granted; yet if construed as claims about the memory system, they are substantive and interesting positions but are less motivated than standardly assumed.⁵

An overarching goal of this paper is thus to make the case that real progress on exploring whether episodic memory is metarepresentational and uniquely human requires first disambiguating the questions themselves. Specifically, in §2.2, I will argue that advocates of the metarepresentation thesis do not carefully distinguish the claim that the phenomenally conscious contents of episodic remember-

⁴See, e.g., Irish, Lawlor, O’Mara, and Coen (2011), Lind and Bowler (2008), Markowitsch and Staniloiu (2011), Perner and Ruffman (1995), Piolino et al. (2006).

⁵The system-experience distinction advocated here is not a controversial one, even though I will say a bit more in §2.2 to bring out its significance for our purposes. In her assessment of the (dis)continuism debate, Robins (2020) calls attention to what is essentially the same distinction between episodic remembering, as an occurrent mental state, and the episodic memory system. Why has this distinction been largely overlooked, however? My suggestion is that the two uses of the term ‘episodic memory’ — one designating a conscious state with a distinctive phenomenology, the other designating a neurocognitive system — are both perfectly natural and closely connected. Notwithstanding their connection, they sit at different levels of theorizing, and so *how* they are connected is an open and empirical question.

ing have a metarepresentational structure, from the claim that the contents stored within the episodic memory system are metarepresentational.⁶ After these two claims are distinguished, though, it may still be natural to suppose that if the phenomenology of episodic recollection is best characterized in metarepresentational terms, then the underlying memory system must be specialized to store metarepresentational contents as well. But this is by no means mandatory. Quite the contrary, I will argue that there is good reason to characterize the episodic memory system in purely first-order terms.⁷ Attention will then be given in §2.3 to develop a non-metarepresentational account of the episodic memory system. With an eye to the phenomenology in particular, my goal is to show how the celebrated *autonoetic* character of episodic recollection can be plausibly explained when we look *outside* the episodic memory system—specifically, via the system’s interaction with other neurocognitive components of the brain.

I will then, in §2.4 apply the lessons from the previous two sections to the human uniqueness thesis. The extant case against ascribing episodic memory to nonhuman species, I will argue, is likewise predicated on a failure to carefully distinguish the challenge of identifying markers of episodic recollective *experience* from that of identifying markers of the episodic memory *system*. This matters not just because, by itself, absence of evidence for a certain phenomenology of remembering does not constitute absence of evidence for the memory system. More importantly, the system-experience distinction re-

⁶Note that while both claims can be understood as a metarepresentation thesis about episodic memory, only the latter is strictly about the episodic memory *system*. Here the notion of metarepresentation is that of a representation *of* a representation *as* a representation (Perner, 1991), and Tulving himself is ultimately concerned with whether the episodic memory system is metarepresentational in this sense. In proposing an explanation for childhood amnesia, for example, Tulving and colleagues argue for a subtle but what they consider crucial distinction between encoding personally experienced events and encoding events *as personally experienced*: “[to] episodically remember a prior happening, the episode must have been originally encoded *as a subjective experience* and *integrated into the personal perspective* of the rememberer (Wheeler et al., 1997, p. 346; emphasis added).

⁷I take the representational structure of the memory system to be specified by the contents the system is *specialized* to store. The ‘specialized’ qualification is important, since, after all, everyone should allow that *some* contents stored within the episodic memory system can be metarepresentational. Some experiences have a metarepresentational structure to begin with (e.g., seeing oneself as dancing, assessing one’s subjective certainty) and will be remembered as such. Moreover, remembering is itself an experience which may be recursively embedded in future remembering states (e.g., remembering oneself remembering). Occasionally storing such metarepresentational contents is compatible with a memory system specialized to store first-order contents.

quires that we open ourselves to the possibility that what may *indeed* be uniquely human about episodic recollection may not have much to do with the episodic memory system we possess. If this is right, then we will need to reconsider the role played by phenomenology in our conception of episodic memory more generally. More to the point, it may be that phenomenology is not, as many have thought, the insurmountable challenge to comparative psychology research on memory. This last point calls for a revision of how we should view memory research overall: there are, it turns out, two neighboring but distinct research programs — one concerning episodic recollection, the other concerning the memory system — and they should be kept apart not despite but because of their close connection.

2.2 Episodic memory: system versus experience

Our first order of business is to motivate the system–experience distinction. We do so in part by putting the distinction to work: I will argue that the metarepresentational structure of episodic recollective *experience* does not presuppose a metarepresentational structure of the episodic memory *system*.⁸ I shall begin, however, by clarifying two important assumptions I make throughout what follows. The first is reductive representationalism about consciousness, the view that the phenomenal characters of experiences can be reductively explained by their representational contents (Dretske, 1995; Lycan, 1996; Tye, 1995). This is a widely-held, albeit seldom articulated, methodological assumption both for a naturalistic approach to the phenomenology of episodic recollection and for any phenomenologically-informed inquiry into the episodic memory system (see, however, Fernández, 2006, 2019). One reason to state it explicitly here is that it will help us to see clearly the two different senses of the term ‘episodic con-

⁸For the sake of the argument, I take for granted that auto-noetic episodic remembering does have a metarepresentational structure, effectively accepting the metarepresentation thesis construed as a claim about episodic recollective experience. To be sure, this is an assumption that some have called into question (see, e.g., Carruthers, 2018; Conway, 2001; Ganeri, 2017). But my goal here is to make the case that even accepting it does not lead to the conclusion that the episodic memory system is metarepresentational.

tents', namely the representational contents of the phenomenology on the one hand and the contents stored within the episodic memory system on the other. Under reductive representationalism, the phenomenology is fully explained by episodic contents in the first sense, but not necessarily the second.⁹

Secondly, I will also assume that the episodic memory system is a natural kind, by which I mean that there is a psychologically real division between episodic memory and other forms of memory, corresponding to discrete neurocognitive systems. While not without dissenting voices, sympathies towards and tacit endorsements of the natural-kind assumption are rather common in the literature (for further discussions, see [Cheng & Werning, 2016](#); [Michaelian, 2011](#)). For our purposes, though, there is a further, dialectical reason for taking the system to be a natural kind. It is that doing so resists operationalizing 'the episodic memory system' as a placeholder for *whatever* gives rise to the distinctive phenomenology of episodic recollection. To be clear, it may well turn out to be the case that what we have independent reason to view as the episodic memory system *is* wholly responsible for the distinctive what-it-is-likeness of episodic recollection. But such an outcome, as natural as it may seem, should be something to be established empirically, not via stipulation. Otherwise, it would trivialize not only the system-experience distinction, but possibly the whole memory systems framework.

Notice, then, that to draw the system–experience distinction is to observe the different levels at which a mental phenomenon can be studied. As such, the distinction is already recognized in much of cognitive science research, and can seem hardly worth emphasizing. In vision science, for example, the point of experimentally manipulating subjects' visual *experience* is precisely to tap into the inner work-

⁹While not specifically focusing on episodic memory, [Kriegel \(2015\)](#) suggests that the phenomenology may be better explained under *non*reductive representationalism. His idea is that when we episodically remember an event and experience it as past, this pastness is not part of *what* is represented (i.e., a conceptual ingredient of the content), but rather an aspect of *how* the remembering represents what it does (i.e., an irreducible mode of presentation). Additionally, another option would be to consider how the phenomenology might be explained in a non-representationalist approach to consciousness altogether. In what follows, I will have to set these suggestions aside. The literature by and large assumes a reductive representationalist approach. Therefore, I will not circumvent a methodological commitment shared by my interlocutors.

ings of the visual *system*. However, attentional influences on visual information processing and cross-modal interference have also been known and investigated for decades now (Maunsell, 2015; Spence, 2011). Hence one should not assume that a phenomenological difference between two visual experiences, even in a controlled experimental setting, is always due to differences in the operations of the visual system alone. Conversely, it is also a familiar point by now that conscious experience of a specific cognitive capacity may not always be the most helpful guide to, and certainly not the ultimate arbiter of, determining the inner workings of the underlying system. This is the general lesson to draw from, inter alia, masked priming (Bachmann & Francis, 2013) and the ventral-dorsal split of the visual system (Goodale & Milner, 1992; Sheth & Young, 2016). All this is to say that the system-experience distinction, while intuitive, is by no means trivial.¹⁰

Further, when it comes to episodic memory in particular, there is good reason to pay extra attention to the system-experience distinction. It is that by all accounts, episodic recollection is phenomenologically rich and multi-faceted. This *prima facie* requires that we open ourselves up to the possibility that contributing to the overall experience may by default be more than one distinct neurocognitive system. As a concrete and relevant example, recall the unique sense of self characteristic of episodic remembering. In Tulving's (2005, p. 14) words, this reflects a conceptual truth vindicated by the phenomenology of *autonoetic* remembering, namely that 'there can be no [mental time] travel without a

¹⁰Here I choose two general findings from vision primarily because vision science is arguably one of the more 'mature' branches of cognitive psychology, the lessons of which may be reasonably expected to generalize. Masked priming occurs when certain target stimuli are presented for short durations and then masked by other stimuli, such that participants will report not having seen the target stimuli, even though the influence of the target stimuli can be observed in downstream behavior. Initial findings in support of the ventral-dorsal split come from blindsight patients, who, despite their lack of conscious experience within an area of their visual field, were able to appropriately control their motor actions. The phenomenon has since been investigated in neurological and neural network-based studies as well (Fang & He, 2005; Goodale, 2014; Milner & Goodale, 1995; Weiskrantz, 1999). Notably, the ventral-dorsal split fits a general pattern that many cognitive tasks can be performed in the absence of conscious awareness (for a review and discussion, see Shea & Frith, 2016). As a relevant further example, recent evidence shows that individuals with *aphantasia* (who self-reportedly lack voluntary visual imagery) can perform just as well as typical individuals on imagery-related memory tasks, likewise suggesting a dissociation between conscious experience and cognitive function (Keogh, Wicken, & Pearson, 2021; Pounder et al., 2022).

[mental time] traveler’. But while a phenomenologically salient self manifests in experience, whether some self-representation needs to be stored within the episodic memory system — and if so, how — is yet an open question. Indeed, we can frame this as an overarching question to guide our inquiry from now on:

Overarching Question: Is the distinctive phenomenology of episodic recollection — most notably, its auto-noetic character, the unique sense of self — fully explainable by the episodic memory system?

The Overarching Question serves to clearly separate the sense in which episodic recollective experience may be metarepresentational, from that in which the episodic memory system has a metarepresentational structure. Now, there are theorists who do not take auto-noesis as a phenomenological feature, and for them the Overarching Question may not seem as pressing. [Mahr and Csibra \(2018\)](#), for example, characterize auto-noesis in terms of a metarepresentational *epistemic attitude* that grounds the epistemic generativity of episodic memory.¹¹ But, still, a similar question can be raised: is this epistemic generativity fully explainable by the stored contents within the episodic memory system? It is quite possible that it is. Yet epistemic generativity is first and foremost a feature of the consciously-experienced remembering states, and for that reason does not strictly *require* that the episodic memory system store metarepresentational contents to begin with. Therefore, even though the Overarching Question is formulated vis-à-vis phenomenology, its basic format has general applicability. This highlights an important payoff of drawing the system-experience distinction, namely a framework to explore how, and the extent to

¹¹Epistemic generativity is a technical notion first introduced in epistemology ([Lackey, 2005](#)). For our purposes, the basic idea behind it can be illustrated by the observation that in remembering something episodically one does not merely know that such-and-such happened, but also knows *why one knows*, viz. on the basis of remembering (see also [Dokic, 2001](#); [Fernández, 2016](#)). On the account offered by [Mahr and Csibra \(2018\)](#), this is because episodic recollection comes with a representation of its own origin.

which, features of episodic remembering can be mechanistically implemented in the underlying memory system.

It is also worth noting that the Overarching Question can be seen as a natural extension of the constructive character of episodic memory in psychology ([Alba & Hasher, 1983](#)), and, relatedly, the increasingly popular generationism in philosophy of memory ([Michaelian, 2016b](#)). According to these perspectives, episodic remembering is reconstructed in use. Yet if, as Schacter and Addis ([2007](#), p. 773) put it, episodic remembering is a matter generating a representation via ‘a [re]constructive process in which bits and pieces of information from various sources are pulled together’, it will then make sense — indeed, it will be of urgency — to ask from whence the phenomenologically salient autonoetic component (which will be referred to as ‘ME content’ henceforth) is generated. There are importantly different theoretical positions to explore, which lead to different conceptions of the episodic memory system. One natural thought is that the ME content is part of what is stored within the episodic memory system. Alternatively, the ME content may be stored outside the memory system proper, but still somewhere to which the system has procedural access — perhaps analogous to how semantic information is accessed and utilized in the reconstruction process. Yet a different possibility is that the ME content is an ‘add-on’ to the memory representation well after it is reconstructed to completion, in which case further questions are invited regarding the nature and mechanism of such a post hoc operation. These are all real possibilities that follow from the fact that an episodic remembering state is itself an experiential state *of* a previous experience. It is, then, an open and empirical question as to whether, and if so how, the ME content characteristic of the remembering state inherits what is included in the original experiential state.¹²

¹²It is somewhat surprising that theorists working in the generative framework have not said more to flesh out these different and potentially other possibilities. But there are two exceptions. [McCarroll \(2018\)](#) proposes that observer memory involves an *implicit* representation of the self via a particular mode of presentation of the past event. [Cheng, Werning, and](#)

With that being said, in what follows I will not proceed from a strictly generative framework. For not only does the Overarching Question not require that we approach it that way, my goal in this section is also more modest. It is to explore, in fairly high-level and non-partisan terms, what *sorts* of answers to the Overarching Question are available. Given the system-experience distinction and the phenomenological richness of episodic recollection, neither a ‘yes’ nor a ‘no’ answer is obviously to be preferred. Each, therefore, must be developed and motivated on a principled basis, and then the logical next step will be to compare their relative strengths.

Suppose first that we answer ‘yes’ to the Overarching Question. Effectively, this amounts to supposing that, in addition to what-where-when information, the episodic memory system stores some sort of ME content directly, which can be retrieved as such and become phenomenologically salient. In more concrete terms, given reductive representationalism, whereas the stored what-where-when information, comprised of sensory-perceptual event details, contributes to the quasi-perceptual character of episodic recollection (*replaying* a prior experience), the stored ME content is responsible for the distinctive autonoetic character (*reliving* a prior experience). Thus the phenomenology is fully accounted for by the contents stored within the memory system. Note that we have not said anything about what the ME content consists in, beyond what explanatory role it is supposed to play. Even so, this already begins to constrain the representational structure of the episodic memory system. More to the point, it requires that the system be metarepresentational in character.

To see why, note first that for the proposed explanation to work, the postulated ME content must not be equated with a specific kind of self-representation already contained in sensory-perceptual event information. Some argue that the phenomenal character of perceptual experience constitutively

Suddendorf (2016) suggest that autonoesis may be grounded in either the perspectival character or the phenomenological transparency of the constructed scenario. I have some reservations about these proposals, which will become clear shortly.

involves what can be called the ‘egocentric sensitivity’ or ‘first-personal givenness’ of experience (Burge, 1998; Zahavi, 2005). The basic idea is that the what-it-is-likeness of experience is strictly speaking a kind of what-it-is-like-*for-me*-ness, where the ‘for me’ component corresponds to some minimal, nonconceptual form of self-representation.¹³ Note that for the stored what-where-when information to contain self-representation in this sense, it only *implicitly* represents the self in the perspectival and sensory-specific contents of the original experience. Indeed, self-representation of this sort is arguably better referred to as ‘self-related information’, for which no conceptual repertoire is required (Musholt, 2013). Plainly, self-related information is not the relevant kind of ME content that we are looking for. For the autonoetic character of episodic recollection involves a more robust, conceptual understanding of the self, one that allows us ‘to mentally represent and to become aware of [our] protracted existence across subjective time’ (Wheeler et al., 1997, p. 335). This highlights the fact that episodic recollection is not only phenomenologically but also conceptually rich, involving explicit self-awareness of one’s past experiences and one’s participation in them.

So the ME content must be conceptual in nature, it seems. But it might be replied that this is too hasty, and that the episodic memory system can do fine with storing only nonconceptual ME content, insofar as we allow an additional process which functions to insert some suitable *conceptual* ME representation post retrieval. This is an intriguing suggestion, and we may grant that it is capable of doing justice to the autonoetic character of episodic recollection (see, for a proposal broadly along the lines of this suggestion, Klein, 2013). The problem, however, is that in the current context it would mean giving up the original ‘yes’ answer to the Overarching Question. After all, this suggestion commits one to the idea that an additional process external to the episodic memory system would *also* contribute to

¹³Consider, for example, how in *seeing something as being a certain distance away in that direction*, the organism’s internal representation of the object constitutively involves information associated with the organism’s egocentric perspective. It is relative to this perspective that the location of the object is specified, but the perspective itself need not be represented as such. This is the sense in which perceptual experience involves minimal self-representation.

the distinctive phenomenology. In fact, it would arguably make *the* contribution. For this reason, this is not a viable suggestion at the moment.

But if the episodic memory system stores the ME content in terms of some conceptual, explicit self-representation, important work is then needed to explicate how such ME content relates to the stored what-where-when information. It is not enough to simply postulate that the system stores conceptual ME content *alongside* the relevant what-where-when information. For in episodic recollection, the sense of self and the event in which the self is remembered to engage are integrated into a single, coherent mental episode. Herein too lies the ‘warmth and intimacy’ of remembering rightly observed by [James \(1890\)](#). The sense of self, in less metaphorical terms, is not a *separate* mental state that happens to co-occur with the remembered event. Rather, it is *part of* the phenomenology that the sense of self manifests in an unmediated, non-inferential manner. When I recall what it was like having dinner at my parents’ last Christmas, I am readily aware that it was *my* experience. As [Klein \(2014\)](#) vividly puts it, such an awareness requires ‘no additional mental gymnastics’. This, then, sets a further constraint on the episodic memory system: as far as stored contents go, the remembered event and my participation in it must stand in some appropriate logical connection, such that when retrieved what I episodically remember is felt as immediately and meaningfully *mine*.

These considerations imply that the contents stored within the episodic memory system must be metarepresentational: specifically, with the ME content being a metarepresentation, having the what-where-when event information as its first-order content. No other logical relations between the two seem adequate in explaining why episodic remembering is autonoetic in the relevant sense. This is, of course, quite often how advocates of the metarepresentation thesis motivate their view. Thus Tulving and colleagues emphasize that the remembered event ‘must have been encoded as a subjective experience and integrated into the personal perspective of the rememberer’ ([Wheeler et al., 1997](#), p. 346). Likewise

for Perner (2000, p. 300), who contends that the stored contents have an explicitly self-referential format: ‘I have information (that “pear” was on the list and that I have *this information* because I have seen “pear” in the list)’.

So our original supposition that the episodic memory system is wholly responsible for the distinctive phenomenology of episodic recollection has led us to conclude that the system has a metarepresentational structure. Yet this conclusion too might be resisted by the suggestion that the episodic memory system could do fine with merely first-order ME content, insofar as we allow an additional process combining the simultaneously retrieved (first-order) ME content and what-where-when information into an integrated whole via some metarepresentational embedding. In response, as before, the problem is that such a suggestion gives up the original ‘yes’ answer to the Overarching Question. For, once again, an additional process external to the memory system would make the main contribution to the auto-noetic character of episodic recollection. For this reason, this suggestion is not viable either.¹⁴

Taking a step back, it is important to clarify that the preceding considerations are put forth *not* as an attempt to develop a genuinely explanatory metarepresentational account of the episodic memory system. Such work has already been done by some of the authors quoted above. What I mean to highlight here is rather the fact we arrived at a metarepresentational conception of the memory system as a result of eliminating unviable hypotheses under the supposition of a specific answer to the Overarching Question. It is not, in other words, so much of an obviously straightforward position. It would

¹⁴What if we locate metarepresentational embedding strictly at the stage of retrieval, thus within the bounds of the episodic memory system? In this case, the contents stored within the episodic memory system can be purely first-order — including both the what-where-when information and self-representation. But they are not merely retrieved *alongside* each other; rather, when retrieved they are *combined* into metarepresentations before becoming available to downstream ‘consumer’ systems. This, then, may be another way for a first-order memory system to give rise to auto-noetic episodic remembering. While such an organization of the episodic memory system is certainly possible, it seems rather mysterious as to why the retrieved-as-metarepresentational contents are not instead encoded as metarepresentational and stored as such in the first place. There is certainly more to be said here, but fleshing out the proposal and its implications would go beyond the scope of this paper.

appear obviously straightforward, perhaps, only if one were already committed to answering ‘yes’ to the Overarching Question, or if one failed to recognize that there was such a question admitting of different answers in the first place.

But now suppose instead that we attempt a ‘no’ answer to the Overarching Question. We are, in other words, working towards an account to the effect that the autonoetic character of episodic recollection is *not* exhausted by the episodic memory system. This is already a promising path to pursue for two reasons. First, as indicated earlier, given the system-experience distinction and the phenomenological richness of episodic recollection, what explains the distinctive phenomenology may well lie outside the memory system proper. Additionally and more specifically, what we are also able to see now is that, for our goal of explaining the phenomenology, there turns out to be an abundance of theoretical resources at our disposal for postulating separate processes external to the episodic memory system. This is because the reason to resist postulating these processes dismissed earlier no longer applies now, since we are no longer under the supposition that the episodic memory system is wholly responsible for the distinctive phenomenology. As a result, we now have significantly fewer constraints on the structure of the episodic memory system, and furthermore are not under any pressure to postulate a metarepresentational memory system to begin with.

It is important to be clear about the scope of this conclusion. What we have established is the unnecessary of the metarepresentation thesis about the episodic memory system. Its alternative, a non-metarepresentational account, is not yet developed in any detail; to do so will be the task of the next section. But there are two general lessons that are starting to emerge. The first is that features at the content level of episodic recollection do not, by themselves, necessitate features of the episodic memory system. Upon reflection, this follows from a more general point, namely that functional specialization of the brain by no means entails that discrete neurocognitive systems work in isolation. Features of a

cognitive capacity that show up in conscious experience, then, may or may not be due to operations of the corresponding neurocognitive system alone.

To further illustrate with a nearby example, note that in virtually all instances, the contents of episodic recollection will involve a certain amount of information stored in the semantic memory system (Irish & Piguet, 2013). Indeed, it is widely accepted that episodic recollection can be semantically scaffolded, and that semantic retrieval can be episodically enriched (Renoult, Irish, Moscovitch, & Rugg, 2019). Yet no one thinks — nor should anyone think — that on this basis we ought to incorporate the semantic memory system within the episodic memory system, or vice versa. By parity of reasoning, then, we are not forced to postulate a metarepresentational structure to the episodic memory system either, simply on the basis that the consciously-accessed contents of episodic recollection are metarepresentational.¹⁵

In the second place, we can now see that there is a sense in which the metarepresentation thesis when construed as a claim about the episodic memory system is in fact a rather unmotivated view. For it postulates sophisticated representational abilities and conceptual resources *within the memory system* in order to account for a distinctive phenomenology. As I have argued, however, to account for this phenomenology, it is not obviously preferable to appeal to a sophisticated, possibly over-intellectualized memory system alone, when we can utilize appropriate capacities already existing in other neurocognitive systems. To be more specific, we know that for human beings there are other systems capable of metarepresentational embedding, most notably the mindreading system. A possibility is thus that the mindreading system can be recruited to interact with what can be purely first-order outputs of the episodic memory system. If this idea pans out, then with regard to the distinctive phenomenol-

¹⁵We may call such temptations to conflate features of the representational contents of conscious experiences and features of discrete neurocognitive systems ‘feature internalizing’. This is analogous to what Millikan (1991) calls ‘content internalizing’, a mistake that projects representational content to the vehicles of representations.

ogy of episodic recollection, a metarepresentational memory system will fare no better than a non-metarepresentational one. Other things being equal, then, we ought to favor the latter over the former.

2.3 Towards a first-order account of the episodic memory system

I have argued that it is promising to explain the distinctive phenomenology of episodic recollection by taking into account the ways in which the episodic memory system interacts with other neurocognitive systems, without presupposing that the memory system itself has a metarepresentational structure. The goal of this section is to turn this broad idea into a concrete and genuinely explanatory proposal. There is, however, an immediate worry that must be dealt with before progress can be made. Recall that the auto-noetic character of episodic recollection manifests in experience in an unmediated, non-inferential manner. But wouldn't the appeal to something — or, rather, anything — external to the episodic memory system with which it interacts introduce further inferential processes, hence failing to do justice to the auto-noetic character thus characterized? And if so, wouldn't that mean a metarepresentational episodic memory system is necessary after all?

This worry can be dealt with easily enough. It is certainly true that postulating an additional component external to the episodic memory system in our explanation will entail additional inferential processes. But, once again, we need to keep in mind the system-experience distinction. After all, the unmediated, non-inferential character of auto-noesis is a phenomenological feature of the experience. Hence, the relevant question is whether there will be additional inferential processes that make a difference in *undermining this phenomenological feature*. I think not. For all else being equal, in most cognitive domains including perception, language comprehension, motor control, and certainly memory, most of the system-level computations and inferential processes leading up to a conscious experi-

ence are not themselves consciously experienced. Absent independent reason to think otherwise, then, we should expect the current case to be not any different. Of course, often times all else is *not* equal. Hence a satisfactory response to the present worry will depend on the details of exactly what additional inferential processes are postulated. It is to this issue that we now turn.

Let's begin by stipulating that the episodic memory system is not metarepresentational in character and that it stores first-order contents only. We can be more specific. Let's say that the contents stored within the episodic memory system comprise representations which are spatio-temporal, perspectival, modality-specific, and sensory-perceptual in nature. As discussed above, these representations already contain some minimal, nonconceptual form of self-representation. More speculatively, there may also be some sort of nonconceptual content encoding the events' pastness or temporal distance in an analogue magnitude, 'unit free' format (Peacocke, 1986). But the important point to keep in mind is that these representations are not metarepresentationally embedded whatsoever. We are, that is, committing ourselves to the idea that there is no metarepresentational ME content within the episodic memory system: or, equivalently, the stored contents are not metarepresented *as belonging to me, as experienced by me, as having resulted from my past, as having obtained in my past*, or anything of the sort. This is strictly speaking an unrealistic stipulation, since, as suggested above, any memory system will at least occasionally have to deal with contents that are metarepresentational. Nevertheless, including this strong stipulation and exploring how far we can go will prove helpful for the sake of an intellectual exercise.

With this setup, what we are looking for is a mechanism that is suitably responsive to the operations of the episodic memory system and one that reliably labels its outputs under the conceptual embedding of I REMEMBER (recall that episodic remembering is both conceptually and phenomenologically rich). It bears emphasis that *some* sensitivity to either the outputs of the episodic memory system or the manner in which the outputs are generated is an uncontroversial part of our cognitive ar-

chitecture, irrespective of what the episodic memory system is like. This is the insight from the memory monitoring framework (Koriat & Goldsmith, 1996; Koriat, Goldsmith, & Pansky, 2000), and the need for memory monitoring within the cognitive architecture is motivated by perfectly general considerations having to do with, *inter alia*, memory accuracy and distinguishing episodic remembering from other forms of episodic thinking (Dokic, 2014; Michaelian, 2016a). For our purposes, suffice it to say that memory monitoring is standardly understood to involve automatic, implicit, and heuristics-based metacognitive processes. For example, processing fluency as a sensory cue is known to have an impact on the subjective experience of remembering, through unconscious inferential processes (Kurilla & Westerman, 2008).

Will memory monitoring together with the heuristic cues it relies on be what we need in order to account for the distinctive phenomenology of episodic recollection? I believe so, but not without borrowing additional theoretical resources. For to satisfactorily account for this distinctive phenomenology, the relevant monitoring mechanism must be involved in making a phenomenologically *and* conceptually rich contribution in its interaction with the episodic memory system. One worry, then, is that since memory monitoring is implicit and heuristics-based, by itself it appears to be a poor candidate for generating the needed conceptually-rich outcome.

This worry too can be dealt with. While it is true that some familiar cases of heuristics-based metacognitive monitoring — such as the tip-of-the-tongue phenomenon, *déjà vu* experiences — do have a certain *je ne sais quoi* to them, and while metacognitive feelings themselves may be affective states (Arango-Muñoz, 2019), in principle there is no reason why as a category heuristics-based metacognition cannot give rise to or become associated with conceptually rich experiences.¹⁶ The question is how to

¹⁶Indeed, Perrin et al. (2020) develop a metacognitive account of the phenomenology of episodic recollection according to which the feeling of pastness is developmentally enriched by other acquired concepts such as SELF and CAUSALITY.

make a positive case that they do. The hard work in what follows will thus be developing an account that plausibly connects memory monitoring with conceptual richness suitable for explaining the auto-noetic character of episodic recollection. For this, we turn to Carruthers' (2011) interpretive sensory-access theory of self-knowledge, and I will argue that it is an inferential rule of the mindreading system, with the help of memory monitoring, that embeds appropriate first-order contents supplied by the episodic memory system under I REMEMBER.

The interpretive sensory-access theory will take some unpacking, as will the utilization of the mindreading system, which can seem surprising. For mindreading is often conceived of as a capacity for gaining knowledge about other individuals. But one central claim of Carruthers' theory — the sensory-access part — is that the mindreading system automatically utilizes many of the same sensory cues for other-knowledge in gaining self-knowledge. Another central claim — the interpretive part — is that both self- and other-knowledge in the form of propositional attitudes are inherently interpretive on the basis of sensory-perceptual information. Thus, Carruthers (2011) proposes that self-knowledge comes from our turning our mindreading capacities on ourselves. Specifically, we routinely interpret the relevant sensory-perceptual evidence available in working memory so as to attribute mental states to ourselves, in exactly the same way that we do when it comes to attributing mental states to others.¹⁷

Crucially, this interpretive nature of self- as well as other-knowledge entails that the mindreading system has access to more than just sensory-perceptual information, even though the interpretive processes only utilize sensory-perceptual cues. This is as it should be. For, in general, the appropriate

¹⁷A consequence is that, in the same way that we do not have direct, privileged access to others' minds, the interpretive sensory-access theory contends that we do not have direct, privileged access to our own minds either. In my view, the interpretive sensory-access theory is well-supported by behavioral, imaging, and neuropsychological evidence (see also Carruthers, 2013; Cassam, 2014; Rimkevičius, 2020). But a full defense is beyond the scope of what can be accomplished in the space available. Hence, I will instead motivate utilizing this theory with the uncontroversial idea that memory is, after all, a form of knowledge and that episodic memory in particular is viewed as a form of self-knowledge. Developed to explicate the nature of self-knowledge, the interpretive sensory-access theory is thus well-suited for our purposes.

conceptual information, once acquired and stabilized, is bound into the sensory-perceptual states with which it is associated. Thus in perception we do not simply see shapes and colors; we see *a tomato*. And instead of only hearing phonemes and syllables, one hears someone *calling one's name*. Furthermore, the outputs of the mindreading system themselves are bound into the contents of consciously-experienced sensory-perceptual states. It is for this reason that we do not merely hear someone asking about the address of the courthouse; we automatically hear them *as wanting to know the way to the courthouse*. Herein lies the needed link, I submit, between memory monitoring and the conceptual richness required by autonoetic episodic recollection.

To see how, it is instructive to begin by considering the question of what episodic remembering is most useful for. We will do this in several steps. Suppose first that after a deliberate memory search, I gather that I had Italian food for my birthday dinner last year. In this case, certain spatio-temporal, perspectival, modality-specific, and sensory-perceptual details may come to mind in an integrated manner, with a past temporal orientation. Or, I may simply have the relevant bits of information about the event stored in semantic memory, allowing swift and easy access (perhaps because it was a particularly memorable dinner). Through either way of having obtained the answer, I quickly move on to decide that I will have something different for my birthday this year. This is because, as it turns out, the memory search conducted was for the purpose of helping me with dinner decision for tonight. Note that, *for this purpose*, it does not seem to matter whether the information retrieved — either imagery-based or purely semantic — is consciously experienced with an autonoetic character (i.e., represented *as my own*, *as having obtained first-hand*, etc.). For in this case the mental state that should conclude the memory search simply has first-order information about a specific dinner last year. The underlying processes, including memory monitoring processes, giving rise to the end state are doubtless complex, and they are known to be fallible. But in a non-reflective, non-critical context such as this one, it is reasonable

enough to go along with the first-order information that one swiftly settles on.

Now consider a slightly different case, in which I am about to engage in a similar memory search but this time in response to my partner's inquiry about what we had for dinner for our anniversary last year. Suppose further that I too gather that we had Italian food. But there are two crucial differences between this case and the previous one that call for something additional in conducting the memory search. The first difference is that there are some important interpersonal goods at stake. I thus readily find myself conducting the memory search in a more reflective, critical context, which should raise the evidential threshold for what it takes to settle on an answer. Second, more importantly, there is now a sense in which it is explicitly my *knowledge* of the event in particular that is being inquired into, not least because my partner's question is directed at *me* and by extension *what I remember*. Through the mindreading system, I hear my partner *as wanting to know if I remember what we had for dinner for our anniversary last year*, even though the utterance may contain nothing metarepresentational (e.g., 'What did we have for dinner last year?').

Note, then, that in this second case the mental state that should conclude the memory search is no longer purely first-order information, but instead *what I remember*, represented as such. Furthermore, due to the interpersonal goods at stake, I am motivated to act more carefully and double-check the accuracy of the information retrieved before answering my partner's question regardless. One way to do this is by checking whether I can *really* see myself, through the mind's eye, enjoying an Italian dinner with my partner last year. Less metaphorically, if what *swiftly* comes to mind is a *vivid, sensory-rich* experience filled with *affectively salient* details, that will add to the evidence and lead me to judge that I did have Italian with my partner for dinner for our anniversary last year. By contrast, if I only seem to have some vague impression that we did, and if no corresponding mental imagery is forthcoming, then that will lead me to question the accuracy of my vague impression. These are, of course, among

the very sensory cues that are utilized by implicit, heuristic-based memory monitoring in general.¹⁸ But the current suggestion is that, in this case, the interpersonal goods at stake together with the fact that it is my knowledge of the event that is being inquired into, make it so that I am consciously utilizing the indicative value of the heuristic cues and drawing explicit inferences about how the occurrent mental state relates to the target experience. In this second case, then, whether the information retrieved can be consciously experienced in a metarepresentational manner becomes crucial.

Now, as the final and most important step, suppose that I vividly remember the dinner with my partner for our anniversary last year. Having done so, I answer my partner's inquiry by reporting, in first-order terms, 'We had Italian food last year'. But because it was, once again, my knowledge of the event that was inquired into, naturally I will now be heard by my partner *as reporting remembering that we had an Italian dinner last year*. Likewise, if my partner is doubtful of the answer offered, he will be doubting the accuracy of the answer *as a representation* — in particular, *my representation* — of the event. Crucially, the interpretive sensory-access theory predicts that I should also hear myself *as remembering that we had Italian last year*, rendering my knowledge in this instance explicitly metarepresentational. This is because, once again, the mindreading system works towards ourselves as well as towards others, using the same sorts of sensory cues and following the same inferential rules.¹⁹

The general lesson to draw here is that, at least in a social context, others' inquiries into past events are routinely heard *as wanting to know what we remember*; in answering these inquiries, one's memory searches will benefit from engaging in auto-noetic mental time travel which involves making explicit use

¹⁸It is an ongoing debate as to what the types of heuristic cues are utilized by memory monitoring. For my purposes, I am not taking a stand on whether the cues are based on contents or procedural features. Hence here I include cues of both types.

¹⁹This account assumes that REMEMBER is part of the conceptual repertoire of the mindreading system. Also assumed to be part of the mindreading system are implicit inferential rules such as 'REMEMBERING entails KNOWING', 'reporting that one remembers that such-and-such entails that one remembers that such-and-such'. Whereas the development of the conceptual repertoire and inferential rules of the mindreading system is a matter of ongoing investigation, that the mindreading system in human adults is thus equipped is not in dispute.

of the heuristic cues typically utilized in implicit memory monitoring. Additionally, our answers are routinely heard by ourselves, as well as by others, not merely as reports of what happened but explicitly as reports of our knowledge of what happened. One prediction then is that this will have an impact on our cognitive architecture vis-à-vis episodic remembering in general, *even in non-social contexts*. Specifically, it predicts that all episodic memories, initially retrieved as purely first-order contents, should be experienced in a metarepresentational manner — thanks to the mindreading system, they will be routinely interpreted as representations of self-knowledge.

The interpretive sensory-access theory of self-knowledge thus provides us with an account of the distinctive phenomenology of episodic recollection, notably its conceptual richness. In motivating this account, the two contrast cases considered are of contemporary life. But that is only for ease of illustration, and it is not hard to imagine that similar social interactions might have been present in our ancestors' social environments as well. The hypothesis is then that the mindreading system has a built-in inferential rule that functions to routinely embed first-order outputs of the episodic memory system under I REMEMBER. And even though this inferential rule may have its evolutionary origin in social contexts, once established and stabilized it will apply broadly. The assumed first-order outputs of the episodic memory *system* will thus be routinely *experienced* as having a metarepresentational structure.

It bears emphasis that the results of this metarepresentational embedding are further bound into the consciously-experienced sensory-perceptual states in episodic recollection. The proposed interaction, in other words, supplies additional contents to the ones stored within the episodic memory system in producing the remembering state (recall the two different senses of 'episodic contents'). As a result, what one consciously experiences includes *both* sensory-perceptual event details *and* a metarepresentation to the effect that these details are of a past experience. On my account, then, episodic recollective experience involves both sensory and propositional contents. But the latter does not render episodic

memory a matter of propositional attitudes (Fernández, 2019; Mahr & Csibra, 2018). Rather, the idea is simply that the auto-noetic character of episodic *recollection* in particular crucially depends on the workings of the mindreading system. My account thus captures the sense in which, and indeed provides a mechanistic explanation of how, episodic memory is a form of self-knowledge with a distinctive phenomenology.²⁰

This is an admittedly speculative account. It should be stressed, however, that my primary goal here is to show *that* a rabbit can be pulled out of a hat, so to speak, rather than a detailed demonstration of *how*. The rabbit is of course the distinctive phenomenology of episodic recollection, especially vis-à-vis its conceptual richness, and the hat is a purely first-order episodic memory system. I suspect that, for some time now, the metarepresentation thesis has remained dominant in part because of an inability to appreciate that the presumed ‘trick’ would not involve any magic whatsoever.²¹ I should also add that, even though memory monitoring plays an important role in this account, by itself it is insufficient to explain the auto-noetic character of episodic recollection. Rather, it must work in combination with the conceptual enrichment and metarepresentational embedding of the mindreading system.

It is instructive to contrast my account with some of the proposals in the literature that draw on similar considerations. First, Mahr and Csibra (2018) likewise emphasize the adaptive value of episodic memory as well as the importance of memory monitoring through the lens of social cognition. They contend that episodic memory is metarepresentational insofar as it involves a distinctive epistemic attitude taken towards what-where-when event information, (meta)represented as having been obtained firsthand. They explicitly pitch their position as a functional account of episodic memory *capacity*, however, and shy away from taking a definitive stance on the operations of the memory system involved.

²⁰I thank an anonymous referee for *Synthese* for inviting me to further clarify my thinking on these issues.

²¹It is telling, in this regard, that the so-called minimalist approach to episodic memory and its development is motivated precisely by deference to the conceptual richness of auto-noetic remembering (J. Russell, 2014; J. Russell & Hanna, 2012). If what I have been arguing is on the right track, however, this deference is not really necessary.

Hence it is not exactly clear whether their account should be read as making any definitive claims about episodic recollective experience or the episodic memory system in particular. They do speculatively suggest, however, that ‘the main achievements in episodic memory development occur as a consequence of the development of retrieval mechanisms’ (Mahr & Csibra, 2018, p. 15). This indicates that their functional account is friendly to the possibility that the contents stored within the episodic memory system are not themselves metarepresentational.

In the second place, McCormack and Hoerl (2001) compare what they call the ‘constitutive view’ versus ‘causal view’ about the role played by metarepresentation with regard to episodic memory. These authors suggest that episodic recollection may either *constitutively* involve representing oneself as the subject of certain experiences, or, alternatively, the development of episodic memory capacity may *causally* depend on the ability to represent oneself in certain ways. Opting for the causal view, McCormack and Hoerl’s position seems to me compatible with a first-order account of the episodic memory system as well. But their position is motivated in part by denying that episodic recollection is autonotic in the relevant sense. This is unnecessary. For there is not a forced choice, as McCormack and Hoerl seem to think, between the constitutive view and the causal view once we draw the system-experience distinction. Assuming that episodic recollection is metarepresentational (accepting the constitutive view), its developmental origin is still a question left entirely open. My argument in this section can be read as making the case that the mindreading system plays a causal role vis-à-vis the conceptual richness of episodic recollection (accepting the causal view). This is as it should be, as the constitutive view is concerned with representational content and the causal view with neurocognitive systems.

In summary, even if the outputs of the episodic memory system are purely first-order, they can nevertheless be recruited and utilized by our sophisticated cognitive machinery so as to give rise to phenomenologically and conceptually rich episodic recollective experience. Importantly, to recognize and

then flesh out this possibility requires that we separate in our theorizing features of episodic recollection from those of the underlying memory system in the first place.

2.4 Episodic memory: uniquely human?

So far, I have been primarily concerned with the question of how to understand the episodic memory system, specifically its representational structure, in light of the distinctive phenomenology of episodic remembering. I have also been making the case that the system-experience distinction and the Overarching Question are useful albeit under-appreciated tools when it comes to generating novel theoretical hypotheses and clarifying extant theoretical positions regarding the memory system. But the system-experience distinction has far-reaching implications for comparative psychology as well, so now I shift my attention to the hotly contested issue of demonstrating episodic memory in nonhuman species.

At the core of the issue is whether comparative psychologists are warranted to ascribe episodic memory to nonhuman animals based on evidence suggestive of what is now commonly called ‘episodic-like’ memory ([Clayton & Dickinson, 1998](#)). The dominant view, namely the human uniqueness thesis, is motivated twofold.²² First, as we have seen, episodic memory presupposes sophisticated (meta)representational abilities and conceptual resources. Many thus understandably exercise extra caution when interpreting the animal data, taking as the default position that nonhuman animals are not thus endowed. Notably, to disprove this default position involves inferring conceptual thought in nonhuman animals from non-linguistic behavioral evidence, a task that is by no means easy and straightforward ([Beck, 2012](#)). In the second place, the nonlinguistic nature of animal data also makes it particularly tricky to establish any-

²²Charitably understood, the human uniqueness thesis is purely negative: extant evidence does not substantiate the proposition that nonhuman animals have episodic memory. In this sense, the human uniqueness thesis serves as a null hypothesis. But devising an apt null hypothesis in comparative cognition research is not as straightforward as it may seem ([Andrews & Huss, 2014](#); [Mikhalevich, 2015](#)), and as I shall argue, the logical strength of the human uniqueness thesis is particularly strong even as a null hypothesis, especially when the system-experience distinction is not drawn.

thing conclusive on the phenomenological dimension of the kind of memory that nonhuman animals possess.²³ Indeed, when the notion of episodic-like memory was first introduced, it was intended by comparative psychologists to acknowledge the seemingly insurmountable challenge involved in demonstrating in nonhuman animals a phenomenologically rich remembering experience.

Methodologically, this separation of the phenomenological and behavioral dimensions of episodic memory was somewhat of a necessary strategic concession, in order to initiate a research program focused on a similar, if not the same, phenomenon that *can* be inferred by nonlinguistic evidence. A more recent strand in the literature, however, has begun to propose that the hallmark of episodic memory should be behaviorally defined anyway, focusing on the qualities that can be objectively assessed in humans and nonhuman animals alike ([Eichenbaum, Fortin, Ergorul, Wright, & Agster, 2005](#)). This stands in sharp contrast with Tulving's phenomenology-based conception, but it is motivated by an inference to the best explanation. Setting aside subjective experience for the moment, there has been an impressive accumulation of evidence for the similarities between recollective behavior in nonhuman animals and that of human beings (for a review, see [Salwiczek, Watanabe, & Clayton, 2010](#)). What to my mind appears to be the strongest evidence comes from studies done with Western scrub-jays, whose natural propensity to cache and recover perishable food items is experimentally exploited to measure their episodic-like recall. In [Clayton and Dickinson \(1998\)](#), scrub jays were shown to flexibly adjust their strategies for retrieving cached foods. After caching events, scrub jays were more likely to return to where mealworms — their preferred choice — had been cached, but only *before* they perished. A reasonable interpretation is that the birds' memory contained a representation of *what* they cached, *where* they cached it, and *when* they cached it — that is, they were not merely utilizing cues of familiarity

²³Recall that for human beings, episodic memory is standardly assessed by the remember/know paradigm, wherein the subjects verbally report either remembering or merely knowing something. This paradigm plainly is not applicable to non-human animals.

or acting instinctively. In later studies, Clayton and colleagues found that the jays integrated what-where-when information with prior experiences to issue in strategic behaviors in novel contexts as well (Clayton, Emery, & Dickinson, 2006; Dally, Emery, & Clayton, 2006). Such evidence suggests that certain nonhuman species can make use of what-where-when information in a way that is not only extremely flexible but also highly generalizable (see also Eacott & Norman, 2004; Hamilton et al., 2016; Kouwenberg, Walsh, Morgan, & Martin, 2009). Furthermore, as it turns out, there is also a strong case for homology across various species of the underlying brain networks and neuronal populations implicated in human episodic memory (Allen & Fortin, 2013; Murray, Wise, & Graham, 2018; Pastalkova, Itskov, Amarasingham, & Buzsáki, 2008; Umbach et al., 2020). It can thus be argued that one would need a strong, principled reason to maintain that the same memory system is *not* present in nonhuman animals.

As impressive as the existing evidence is, to insist solely on that basis a behavioral conception of episodic memory is bound to be dialectically ineffective, for the simple reason that the other side of the debate *does* have a strong, principled reason for thinking otherwise. Earlier we set considerations of subjective experience aside. But it is reasonable for advocates of the human uniqueness thesis to reply that these considerations should *not* be set aside. For we already know that it is possible to store and retrieve what-where-when information about a past event without subjectively re-experiencing it in the relevant sense. Indeed, this is precisely what has led Tulving to consider autonoesis a defining feature of episodic remembering, and this empirically validated insight should not be set aside simply because it is inconvenient for comparative studies.

There is a sense in which this back-and-forth consists merely of a terminological dispute, however. By this I do not mean that the dispute is empty; rather, it is just that the dispute is concerned with *how to fix the phenomenon of interest* by different groups of researchers with different interests to

begin with. After all, there are no disagreements of an empirical sort at stake: advocates of the human uniqueness thesis do not deny that some nonhuman animal species make use of what-where-when information in a flexible and generalizable manner; comparative psychologists likewise generally accept that nonlinguistic behavioral evidence does not bear directly on the issue of animal phenomenology.

In order to make progress, we would do well to bring in the system-experience distinction again.²⁴ That is, regarding the human uniqueness thesis, we ought to first distinguish the claim that episodic recollective experience is uniquely human from the claim that the episodic memory system is uniquely human, and then evaluate the cases for and against each in turn. The considerations in support of the human uniqueness thesis reviewed above — that episodic recollection is conceptually and phenomenologically rich — characterize first and foremost features of the consciously-accessed contents of the remembering experience. And as we have seen in §2.2, considerations at this level by themselves do not determine what the underlying memory system must be like. Therefore, even if we grant that autonoetic episodic *recollection* is uniquely human, it does not follow that the episodic memory *system* is likewise unique to human beings. More to the point, the case made by advocates of the human uniqueness thesis is restricted to one about episodic recollective *experience*, so it takes further argument to extend their conclusion to the episodic memory *system*.²⁵

Note that this changes not only the dialectic of the debate but also what the debate is *about*. For the system-experience distinction allows comparative psychologists to maintain that the aforementioned behavioral and neurological similarities between human beings and nonhuman animals con-

²⁴Tulving's (2005) own suggestion to comparative psychologists is to look for evidence of future-directed mental time travel in nonhuman animals. But this likely only pushes the question one step back. For the same considerations that count against attributing episodic memory to nonhuman animals on the basis of non-linguistic behavioral evidence will likely count against attributing future-directed mental time travel to nonhuman animals as well (Suddendorf, 2013).

²⁵This point applies to cases involving neuropsychological patients and young children as well (see, e.g., Klein & Nichols, 2012; J. Russell, 2014), where the disputes in my view are not about different theoretical possibilities, but are instead due to different opinions regarding what the equivocal term 'episodic memory' denotes.

stitute a strong abductive case for taking as the default position that the episodic memory system is widespread in the animal kingdom, while acknowledging the challenge to assess the phenomenology of remembering in nonhuman animals. This separation of theoretical focus is not just a strategic concession, but what we should expect insofar as we identify and recognize the different levels at which memory can be studied. Uniquely human episodic recollective experience does not require a uniquely human episodic memory system.

Here is another way to put the point. Other recent attempts to move forward the debate on episodic vs. episodic-like memory tend to either downplay the phenomenological dimension (Buckner, 2013; van Woerkum, 2021) or contend that the phenomenological and behavioral dimensions of episodic memory are more evidentially connected than previously thought (Boyle, 2020). While these attempts are noteworthy, they assume that there is a univocal phenomenon, namely episodic memory, admitting of different dimensions to be investigated. It is, I suggest, better still to recognize at the outset that we are dealing with different albeit connected phenomena at different levels of theorizing, namely episodic recollective experience on the one hand, and the episodic memory system on the other, and then exercise caution in drawing out the implications of discoveries made at one level for those made at the other.

Furthermore, if, as suggested in §3.3, *in the human case* the auto-noetic character of episodic recollection turns out to not crucially rely on a metarepresentational memory system, comparative psychologists can further free themselves of the worries about attributing sophisticated (meta)representational abilities and conceptual resources to nonhuman animals. For it is quite possible that it is the auto-noetic character of episodic recollection in particular that is unique to human beings, due to our much more complicated social lives and, relatedly, due to our immense interest in *talking* about what we do (and do not) remember with one another. Plainly, neither of these two conditions applies to nonhuman animals. Seen through this lens, the human uniqueness thesis when construed as a claim about episodic

recollection is something that comparative psychologists can and should happily accept. As to whether or not the episodic memory system is uniquely human, that is a question for which behavioral and neurological evidence should take priority, in accordance with comparative research in other cognitive domains. Crucially, the question will now be an empirically tractable one.

But isn't this simply an ad hoc rejection of Tulving's phenomenology-based conception? Not so. To see why, consider the Overarching Question again. The Overarching Question invites us to consider, given that episodic recollection in human beings has a distinctive self-related phenomenology, the different contributions made by the episodic memory system and potentially by its interactions with other neurocognitive systems. This means that *already in the human case* there are in fact two neighboring but distinct research questions: one related to the episodic memory system, and the other related to episodic recollective experience. It is just that these two questions are so closely connected, that progress made on one of the questions not only significantly informs the other, but is sometimes viewed *as* progress made on the other. The system-experience distinction suggests, however, that this can at least occasionally be a mistake, since, once again, there are two distinct phenomena at different levels of theorizing. Separating research into episodic recollection from that into the episodic memory system is admittedly somewhat revisionary, but also it is also liberating. For it encourages us to look beyond the memory system when accounting for, inter alia, the phenomenology of remembering, and invites us to approach the topic through the broader lens of cognitive architecture.²⁶

²⁶This is related to a point recently raised by Craver (2020) regarding what he calls the 'epistemic' versus 'empirical' conception of episodic memory. While he is not concerned with the human uniqueness thesis in particular, Craver urges against assuming that the epistemic conception on which episodic remembering is an epistemic achievement can be reduced to the episodic memory system. One reason for this is that as an epistemic achievement, remembering as we know it is part of a much larger practice of communicating as well as tracking what we know about the world. It is thus likely to implicate more cognitive resources than a memory system specialized for storing and retrieving information.

2.5 Concluding remarks

In this paper, I have been concerned with the question of *how* episodic memory can be metarepresentational and uniquely human. One important conclusion is that the question itself is in need of disambiguation. Failing to do so has obscured potentially fruitful areas of research in some cases, and turned what should be empirical matters into terminological disagreements in others. It is important to be clear about the scope of this conclusion, however. The twin theses that the episodic memory system has a metarepresentational structure and is uniquely human are not hereby refuted. Indeed, it would be naïve to think that in these areas mere philosophical argumentation can be decisive. But after disambiguation, the twin theses end up being less motivated than they have initially seemed. My arguments thus invite their advocates to be more cautious and explicit about the strengths of their positions, and encourage all to think more carefully and creatively about the ways in which the auto-noetic character of episodic remembering and possibly its human uniqueness are mechanistically implemented.

Throughout this paper, I have assumed that human episodic remembering does have an auto-noetic character, implicating a unique sense of self best understood in metarepresentational terms. In closing, I want to offer a skeptical thought against this seemingly innocuous assumption. For it may be that when *theorizing* about episodic memory, we tend to consider instances of episodic remembering in which we find ourselves in already-reflective contexts (e.g., *To answer that question, I have to think about what I did this morning before leaving*). This is perhaps due to the fact that episodic remembering is more phenomenologically salient in those contexts, and therefore they are the ones that individual theorists have converged on. Or, it may be that our folk-psychological notion of remembering—as a deliberate mental action that we perform—narrows our attention to voluntary episodic recollection, even though involuntary memories are just as common (Rasmussen & Berntsen, 2011; Rasmussen, Rams-

gaard, & Berntsen, 2015). But in either case, there is then a selection bias at work, and in those biased contexts, it is also natural to *think about* and *report* what we remember in metarepresentational terms already, irrespective of what episodic remembering may be like in other contexts.

In other words, the autonoetic character may be a contingent and context-dependent feature of human episodic recollection. Indeed, given the system-experience distinction, to the extent that there is an interesting feature of the recollective experience in any particular case, there will always be a further question as to whether this reflects some design feature of the episodic memory system, results from the system's standard interactions with other neurocognitive components of the brain, or — we should now add — is contingently dependent upon the context in which the organism engages in episodic recollection. To not consider these different possibilities would be to miss out on important opportunities.

Chapter 3: Altered temporality in life-threatening danger

3.1 Introduction

Subjective time distortions are commonly reported by survivors of life-threatening danger. Elapsed time is said to feel greatly expanded, and external events seem to unfold in slow motion. Notwithstanding research showing the malleability of time perception ([Eagleman, 2008](#)), these are especially striking distortions of temporal phenomenology that cry out for explanation.

Notably, similar distortions are reported also for peak athletic performance ([Jackson, 1996](#)), depression ([Ratcliffe, 2014](#)), and certain psychedelic states ([Bayne & Carter, 2018](#)). Although in each of these contexts the exact etiology of the altered phenomenology likely differs, the wide-ranging presence of ‘time slowing down’ suggests that what survivors of life-threatening danger report is not an isolated phenomenon.¹

The proximal goal of this paper is to develop a novel account of altered temporality in life-threatening danger. I shall begin by showing existing accounts in the philosophical and psychological literature to be inadequate (§3.2). My strategy is not to take issue with the exact details of these accounts. Rather, I will motivate a new investigation by examining in detail the available phenomenological data for ‘time slowing down’ (§3.3). I will argue that their complexity has been vastly underappreciated. Specifically,

¹As the topic of this paper is temporal phenomenology, by ‘altered phenomenology’ I mean altered *temporal* phenomenology specifically. This is not to suggest that temporality is the only aspect of subjective experience that is altered in the cases of interest.

I will propose a taxonomy of three distinct elements of the altered phenomenology — *subjective time expansion*, *slowing down of perceptual motion*, and *timelessness*. I will then develop an explanation of each element in turn by drawing on empirical findings across a range of related literatures, making the case that temporality is distorted in a plurality of ways in the cases of interest (§§3.4–3.6).

Investigating altered temporality in life-threatening danger will consequently provide unique opportunities for furthering our understanding of temporal passage phenomenology (Paul, 2010; Prosser, 2013; Torrenco, 2017) and temporal consciousness (Dainton, 2010; G. Lee, 2014; Viera, 2019) in general. Making progress along these dimensions constitutes the distal goal of this paper. A valuable lesson from psychopathology is that there is much to be learned from conditions which deviate from the normal about what normality consists in.

3.2 Motivating a new investigation

Existing accounts of altered temporality in life-threatening danger fall under two opposing viewpoints. According to the memory account, the subjective slowing down of time is not an online perceptual phenomenon; rather, it is the enhanced memory encoding of the frightening encounter that leads to duration dilation in retrospect (Stetson, Fiesta, & Eagleman, 2007). The idea that time is not so much illusorily *experienced* as erroneously *remembered* to be passing more slowly is reminiscent of William James' thinking on time perception. Distinguishing between felt time 'in passing' and 'in retrospect', James (1890) proposes that the lengthening of the latter varies with the 'multitudinousness of the memories which the time affords' (p. 624).

According to the perceptual account, the survivors report bona fide perceptual distortions, conceived of as among the immediate psychological consequences of the body's fight-or-flight response

(Arstila, 2012; Phillips, 2013). Distilled to its essentials, the perceptual account emphasizes mental states with ‘manifest’ temporal features as the internal reference for subjective time. One possibility, for example, is that arousal accelerates how fast one can *think* and *shift attention*. These changes are immediately noticeable, and they in turn distort one’s sense of how fast time seems to pass. This is because the latter is presumed to be a matter of comparing the perceived duration of external events to the internal reference. In a slogan, ‘when we become faster, the world appears slower to us’ (Arstila, 2012, p. 1).

The two accounts just sketched share two serious shortcomings, one methodological and the other substantive. First, in construing the altered phenomenology as rooted *either* in memory *or* in perception, each is at odds with what should be an uncontroversial starting point: the biological significance inherent in life-threatening danger impacts *both* how one experiences the frightening encounter *and* how one remembers it. Indeed, the arousal-driven neural mechanisms modulating the perception of emotional events influence not only *what* gets encoded in memory, but also *how* the memory content is stored and retrieved (Clewett & Murty, 2019). Hence, to account for altered temporality in life-threatening danger requires recognizing the confluence of contributions from perceptual and memory processes alike.²

Notably, it is unpromising to simply combine the memory account and the perceptual account currently on offer. For the more substantive shortcoming is that they fail to adequately characterize the altered phenomenology which they seek to explain. As will be presently discussed, the complexity of ‘time slowing down’ is easily underestimated. The altered phenomenology consists of intricately intertwined elements, in part due to the fact that time is such a basic dimension of conscious experience. Fur-

²Differently put, it would be highly surprising if encountering life-threatening danger led to profound perceptual distortions but had no impact on subsequent memory processes, or vice versa. That said, in the initial examination of the survivors’ first-person reports (§2), we will proceed *as if* the distortions were perceptual in nature. This is merely for ease of discussion. It will be a matter of careful analysis to then tease out the separate contributions from perceptual and memory processes to what the survivors report.

thermore, the phenomenal character of temporal experience is notoriously difficult to capture verbally in general.³ Caution and critical attention thus become crucial when analyzing the survivors' reports, to which we now turn.

3.3 Clarifying the phenomenology

The earliest scientific evidence documenting altered temporality in life-threatening danger comes from interviews with mountain climbers who survived accidental falls (Heim, 1892). As we learn from studies in recent decades, though, falling is but one form of life-threatening danger that leads to subjective time distortions (Cardena & Spiegel, 1993; Hancock & Weaver, 2005; Terr, 1984; Ursano et al., 1999). In two systematic studies sampling survivors of various kinds of extreme danger, the so-called 'altered passage of time' is among the highest reported subjective effects, on par with feeling of unreality and increased speed of thoughts (Noyes & Kletti, 1976a, 1977).

For our purposes, the significance of Noyes & Kletti's work lies not in the statistical data, but rather in the elaborate first-person reports provided by their subjects. Inspection of these reports reveals that the so-called 'altered passage of time' comprises a cluster of three elements, each constituting a distinct explanatory target. There are, in other words, three different forms of 'time slowing down' in need of explanation.

First, many report a *subjective expansion of elapsed time*, for which the following is a representative example: '[it] seemed like five minutes before the car came to a stop when, in reality, it was only a matter of a few seconds' (Noyes & Kletti, 1977, p. 376). The semantic content of such reports motivates viewing them as concerned with 'the explicit cognition of the duration of passed time' (Arstila, 2012, p. 3). Upon

³It is telling, in this regard, that part of the debate over whether experience supports metaphysical passage concerns just what the alleged experience as of the passage of time is or could be like (Deng, 2017; Hoerl, 2014; Prosser, 2016; Skow, 2011).

reflection, however, they have to do with the *passage* of time too, if not primarily so. This is because reports that highlight how the perceived duration of an event differs from its (supposed) objective value often are reports about one's experience of time's passing in disguise (Wearden, 2015).

When one complains, for example, that what is supposed be a several-second interval before the traffic light changes feels like a minute, this is in effect reporting that time seems to pass slowly during this period — so much so that it feels as if a minute had passed. This does not mean that subjective time expansion is a matter of considered judgment, something to be inferred in thought afterwards. Rather, one *feels* that time passes more slowly while waiting, and references duration to concretely describe that *feeling*. Likewise, the previous survivor's explicit mention of duration is aimed at reporting the subjective feeling of time slowing down as well. In both cases, one's temporal phenomenology is distorted by virtue of a discrepancy between subjectively-experienced and objectively-known time. For survivors of life-threatening danger, the striking impression of time being 'strung out' or 'expanded' consists not merely of the frightening encounter lasting a certain period, but of it lasting *longer* than one implicitly knows it should. To explain subjective time expansion, therefore, is to explain the discrepancy between felt and known time.⁴ In the second place, survivors often describe the frightening encounter as unfolding in *slow motion*. This puts the emphasis on visual phenomenology. According to one survivor, '[everything] was in slow motion and it seemed to me that I was playing on a stage and could see myself

⁴Two terminological clarifications warrant emphasis. First, in the time-estimation literature, 'time's subjective expansion' refers to the overestimation of stimulus duration, such as that of an oddball embedded in a sequence of standard stimuli (Pariyadath & Eagleman, 2007). This is otherwise known as 'duration dilation', and the oddball's duration is subjectively dilated *relative to that of the standard*. As such, it is different from subjective time expansion discussed above, which has to do with the discrepancy between felt and known time *of a given event*. Second, the survivors' use of conventional time units to characterize this discrepancy is no evidence that time is represented in the brain in terms of such units. Phenomenology is one thing, and how it is to be described using public language is another. There is now compelling evidence that all creatures, including animals and human infants, represent temporal intervals using analog magnitudes (Gallistel, 1990; vanMarle & Wynn, 2006). These representations allow for more-or-less comparisons without representing units of measurement or numbers (see also Peacocke, 1986). Of course, one *can* represent a 6-second interval *as* lasting six seconds, in which case the conceptual content is bound into one's overall experience. But this is by no means mandatory, nor possible without formal education.

tumbling over and over in the car’ (Noyes & Kletti, 1976a, pp. 20–21). Experiencing such a global slowdown of environmental events is an especially striking form of ‘time slowing down’. Understandably, it has garnered much clinical and theoretical interest (Marmar, Weiss, & Metzler, 1998; Stetson et al., 2007). However, little attention has been paid to the fact that, in many cases, not only do environmental events seem to unfold slowly, they also appear discontinuous — ‘like a movie [running] slowly so the frames progress with a jerky motion’ (Noyes & Kletti, 1977, p. 377). The oft-invoked movie analogy is telling. It both underscores the global scope of the slow-motion effect and helps make sense of its occasional fragmentary character. One way to take seriously the movie analogy is to suppose that there exist chunked, discrete segments of the visual stream similar to what ensues when the frames of a film are corrupted. Thus for some survivors, what gets disrupted is the *continuity* of visual motion as well as its *speed* of progression. To explain the slow-motion effect, then, is to explain the subjective deceleration across one’s entire visual field, at times manifesting in ‘gappy’ experiential episodes.⁵

It bears clarifying, at this point, exactly how subjective time expansion and the slow-motion effect constitute distinct explanatory targets. On the one hand, the two are described by the survivors in different experiential terms, which provides *prima facie* reason to consider them different phenomena. Yet on the other, one might suspect that whether the survivors reference conventional time units or motion speeds, one and the same altered phenomenology is being reported. This suspicion is worth taking seriously. After all, motion evolves over time, and speed and duration are interdependent variables. It thus seems natural to construe the visually striking *slow-motion* effect in terms of the frightening encounter seeming to take *longer* to unfold. If so, subjective time expansion and the slow-motion effect might simply reflect different ways of describing the same rich phenomenology. More to the point, a difference in

⁵There are occasional reports of the slow-motion effect in the auditory modality — e.g., ‘I remember, like in slow motion, the sound of glass shattering’ (Noyes & Kletti, 1977, p. 377). For ease of discussion, I treat the effect as a visual phenomenon, though for reasons that will soon become clear nothing hangs on this.

descriptive focus would not warrant postulating two different *forms* of ‘time slowing down’.

Something along these lines appears to be a widespread tacit assumption. Combined with the tempting notion that subjective time is inseparable from (or reducible to) our experience of motion and change,⁶ it might be further supposed that, if anything, the slow-motion effect is the ‘real’ (explanandum) phenomenon. For example, although the extensively-used Peritraumatic Dissociative Experiences Questionnaire recognizes altered temporality as diagnostically relevant, it only asks whether ‘things seemed to be happening in slow motion’ (Marmar et al., 1998). Likewise, when describing the phenomenon of ‘durational prolongation’, Terr (1984) claims without any hesitation that ‘trauma may be experienced in slow motion’ (p. 642). And in his discussion of traumatic duration distortions, Phillips (2013) develops an account aimed to explain the slowing down of the perceptual environment, focusing on the slow-motion effect. A charitable interpretation of these claims is not that they consider subjective time expansion irrelevant, but that they do not view it as a *separate, independent* phenomenon.

Two points should be made in reply. First, we know of other contexts wherein ‘time slowing down’ in the sense of subjective time expansion is reported in the absence of the slow-motion effect. In addition to waiting, as illustrated above in the traffic light example, boredom is another frequent trigger of altered temporality (Watt, 1991). There the standard explanation, simply put, is that time seems to drag because of greater attentional focus on processing temporal rather than task-relevant information (Zakay & Block, 1996). Notably, this explanation appeals to how attention interacts with the inner workings of a dedicated timing mechanism. Although the attentional model of time perception is not entirely uncontroversial (Merino-Rajme, 2022; Phillips, 2012), it is plain that boredom-induced altered

⁶This temptation is possibly motivated by the often mentioned but rarely expounded claim that there is no dedicated sensory system for time (cf. Singhal, 2021; Viera, 2020). It is beyond the scope of this paper to demonstrate that the temptation is mistaken. For now I shall simply note that one does not lose temporal consciousness altogether by undergoing, say, sensory deprivation or meditation where there is no experience of motion to speak of. Quite the contrary, those contexts provide valuable opportunities to study temporal consciousness.

temporality is unlikely to be adequately explained at the level of visual motion regardless. This suggests an abstract, amodal form of ‘time slowing down’ that is not motion perception-dependent, and thus not equivalent (nor reducible) to the slow-motion effect.

Second, even for the cases under consideration where subjective time expansion and the slow-motion effect are reported in tandem, an inference from introspective inseparability to ontic equivalence is dubious. By the nature of the computational problem involved, motion perception is bound up with timing. It should thus be no surprise that the slow-motion effect readily admits of a characterization in terms of *temporal content*, both first- and third-personally. Relatedly, there is a certain sense in which perceiving the world in slow motion is a form of *temporal experience*, in which case subjective time expansion and the slow-motion effect are rendered experientially unified. These observations lend support to the original skepticism that what I propose as two different forms of ‘time slowing down’ differ in name only.

However, the explanatory relevance of these introspection-based observations must be evaluated in light of how time is represented in the brain. For we know that timing can be either implicit or explicit, implicating representations at different stages of processing and degrees of abstraction (Coull & Nobre, 2008). Philosophers and psychologists have also recently emphasized the distinction between temporal representation and mere temporal sensitivity (Hoerl & McCormack, 2018; Peacocke, 2017). In consequence, claims about *temporal content* need to be treated with caution. Indeed, given the fundamental role timing plays in cognition, ‘temporal content’ may be an umbrella term picking out various kinds of temporal and nontemporal representations, supported by different neurocognitive processes. Mutatis mutandis, then, for ‘temporal experience’. In principle, there is nothing to keep an introspectively unified temporal experience from being subserved by disparate underlying mechanisms.

Admittedly, a conceptual possibility does not establish anything conclusive. Meanwhile, it is im-

plausible to think that any explanatorily significant underlying differences, if existing, will be transparent to introspection. In other words, there is no reason to expect introspection to be decisive in determining whether ‘time slowing down’ is a unitary phenomenon admitting of two characterizations, or whether two subtly different forms of ‘time slowing down’ co-occur.

There is, however, a strong empirical reason in favor of the second possibility. It stems from the fact that subjective time expansion and the slow-motion effect have importantly different phenomenological profiles. They are described by the survivors in different experiential terms, highlighting different though possibly related aspects of temporality. As Noyes & Kletti (1976a, p. 23) put it, ‘[not] only did elapsed time seem drawn out, but events seemed to happen in slow motion’. One way to flesh out the distinction they have in mind is to understand the former as being amodal in nature and the latter visual-perspectival. On this view, it follows that the representations involved in the former possess a different, more abstract format than those in the latter. Such a difference in representational format arguably reflects the more general distinction between explicit time perception and perceptual temporal processing (van Wassenhove, 2009).

To drive home this point, note that there remain two distinct albeit closely-related explanatory targets even when assuming that subjective time expansion spontaneously arises *on the basis* of the slow-motion effect. Doubtless, here the overall experience is phenomenologically rich and introspectively unified. However, for explicit time perception to harness temporal information embedded in visual motion, a further cognitive process that transforms such information into a suitably usable format must be implicated. Differently put, visual motion encodes duration implicitly but not necessarily explicitly, even though the implicit content can be *made* explicit. This distinction is corroborated by the altered phenomenology of interest: the feeling that the frightening encounter lasts longer than it should has an abstract character absent in merely seeing the world unfold in slow motion. In consequence, merely

explaining the slow-motion effect is insufficient to account for the discrepancy between felt and known time.

Whereas these first two elements of altered temporality in life-threatening danger differ in a subtle way, the third element is unmistakably unique. This is the feeling of *timelessness* which Noyes & Kletti's subjects variously describe as 'being in no time', time being 'at a standstill', having no 'realization of time passing', or experiencing 'one moment which never altered'. The admittedly ineffable character of these reports makes it challenging to theorize about timelessness. Indeed, the notion of time standing still seems to defy what appears to be a precondition of conscious experience (at least in its familiar form), namely its continuous flow. However, not attempting to develop an account of timelessness would be a serious mistake. The striking degree to which timelessness deviates from normal wakeful consciousness should be leveraged as an opportunity to investigate the conditions that are implicated — and, for that matter, taken for granted — in the latter.

In this regard, two features of timelessness are particularly pertinent. The first is that it is described by the survivors as an immersive, transcendent experience often accompanied by transcendence of space and feeling of unity as well. Admittedly, the latter two are no less ineffable, which is something that the survivors themselves readily acknowledge. One way to make progress is to embrace the idea that timelessness, unlike subjective time expansion or the slow-motion effect, is not *of* anything in particular. Instead, the transcendence of time is what holistically *structures* the altered phenomenology. Put differently, individuals experiencing timelessness shift into a different *sort* of consciousness altogether. On this point, it is notable that the transcendence of time, space, and individual identity comes as a 'package deal' in other contexts as well, most notably in psychedelic states ([Shanon, 2001](#)) and meditation ([Ataria, Dor-Ziderman, & Berkovich-Ohana, 2015](#)). This both requires that timelessness be explained in a holistic manner, and further suggests the possibility of a more general phenomenon to be investi-

gated.

That a shift of consciousness occurs in timelessness is supported by the pattern that timelessness tends to occur in the third and final phase of the frightening encounter which [Noyes \(1972\)](#) fittingly calls ‘transcendence’. The first two phases are ‘resistance’ and ‘life review’, during which subjective time expansion and the slow-motion effect tend to occur. To be sure, as can be expected, no two life-threatening encounters are exactly alike. Hence this three-part sequence characterizes a typical temporal progression of the different phases, not intended as universally applicable. With this caveat in mind, an important implication follows: the order in which the distinct elements of the altered phenomenology occur is explanatorily relevant. To preview, my suggestion will be that this reflects a rapid noradrenaline-driven progression from aroused to hyper-aroused bodily states when encountering danger. Indeed, the role of arousal will be consistently emphasized in each of the following three sections, albeit in different respects.

3.4 Explaining subjective time expansion

As a point of departure, it is well-established that human time perception is malleable, influenced by affective, attentional, and cognitive factors ([Matthews & Meck, 2014](#)). A robust finding from this line of research is that aversive stimuli — especially fear-eliciting ones — are perceived as lasting longer than they objectively are and than non-aversive stimuli. This pattern holds across sensory modalities, and applies to low-level (e.g., looming objects) as well as high-level (e.g., angry faces) stimuli ([Droit-Volet & Meck, 2007](#); [Tipples, 2011](#)). Our tendency to overestimate the duration of fearful stimuli fits well with a wider set of findings suggestive of an ‘internal clock’ dedicated to interval-timing in the second-to-minute range ([Fayolle, Gil, & Droit-Volet, 2015](#); [Lake, LaBar, & Meck, 2016](#)). In its core, the internal

clock model postulates a pacemaker–accumulator system that provides the ‘raw material’ making possible representations of duration (Gibbon, 1977; Treisman, 1963). Schematically, this is done by having the pacemaker emit pulses at a certain rate, which are stored in the accumulator via a switch under attentional control. The readout of the accumulator is then supplied to downstream processes, a consequence of which is generating a perceptual sense of elapsed time.⁷

The internal clock model ascribes our tendency to overestimate the duration of fearful stimuli to an arousal-driven increase in the pulse rate of the pacemaker (Gil & Droit-Volet, 2012). For if the acceleration of the pacemaker results from an automatic physiological reaction to perceived danger (‘fight-or-flight’), more pulses accumulated in a fixed interval will result in an overestimation of elapsed time. The arousal factor and the resultant duration overestimation here both seem connected to what survivors of life-threatening danger report. Since proximity to death naturally evokes fear, a simple account of subjective time expansion might explain the reported slowing down of time as due to a pronounced, arousal-driven increase in the perceived duration of the frightening encounter as per the internal clock model.

By itself this simple account is too simple, however, for a pair of related reasons which are instructive to clarify. First, the notion of duration overestimation denotes a behavioral pattern for *time estimation*, and it is silent on the phenomenology of *time’s passage*. By way of illustration, consider someone who overestimates the duration of a fearful stimulus by 20%. In an experimental setting, this

⁷It is worth pointing out that the internal clock model is an information-processing model, with its components and processes functionally defined. The neurophysiological details of the model are a matter of ongoing research (Grondin, 2010; Matthews & Meck, 2016), which need not concern us here. There is strong evidence that, however the neural mechanism(s) will turn out, the internal clock model characterizes the formal, computational processes underlying interval timing. For example, as accumulation is a linear yet noisy process, the internal clock model predicts that errors in time estimation are proportional to how long the target intervals are, following Weber’s law. This prediction is empirically validated (Wearden & Jones, 2007). The model also predicts that when the rate of the pacemaker is altered, its effect will be multiplicative as opposed to a fixed additive amount (since rate changes are iterative over time). Empirical studies using a wide range of paradigms suggest this to be the case as well (see, for a review, Allman, Teki, Griffiths, & Meck, 2014).

might mean that the participant indicates by pressing a button that they judge 2 s to have passed roughly at the 1.7 s mark. This quantitative difference can be described in terms of the idea that the passing of external time is slower relative to the participant's internal standard. In fact, empirical researchers frequently employ such language. But this is not to be taken literally, as external time does not slow down in reality.⁸ Furthermore, from the behavioral outcome we are not warranted to infer that the participant's subjective experience is that time seems to pass at a slower rate. In fact, phenomenologically everything probably feels normal, as participants in psychophysical experiments are typically not aware that they overestimate the duration of fearful stimuli when they do. By contrast, survivors of life-threatening danger do report *feeling* the expansion of elapsed time.

This points to the second, deeper reason why the simple account is inadequate. As discussed in §3.3, subjective time expansion consists in the discrepancy between felt and known time: the altered phenomenology comes in the form of feeling the frightening encounter as lasting longer than it presumably should. Hence, an explanation to the effect that a dilated duration representation is supplied by an accelerated internal clock is necessarily incomplete. That is, the internal clock model can at most explain the *felt time* component of the discrepancy. Additionally, the source of the survivors' knowledge pertaining to how long the frightening encounter should last needs explaining too. To be sure, this knowledge is approximate in nature; there is no reason to suppose that the survivors have a precise understanding of how long, say, a car crash is supposed to last. Nevertheless, it is partly against some form of background temporal knowledge that subjective time expansion arises.

The missing piece in explaining the *known time* component of the discrepancy lies in the fact that event perception implicates a spontaneous interplay between what event segmentation theory (EST)

⁸Another way to see the point here is by noting that when external time is chosen as the standard, the participant's internal time can be said to speed up. So duration overestimation can be described in terms either of 'time slowing down' or of 'time speeding up', depending on one's reference of choice.

calls ‘event models’ and ‘event schemata’ (Zacks & Tversky, 2001). This will take some unpacking. Event models are actively-maintained working memory representations of *what is happening now*. Here an event is understood as a perceptual entity, ‘a segment of time at a given location that is conceived by an observer to have a beginning and an end’ (Zacks & Tversky, 2001, p. 17). As such, event models integrate information from the recent past and make predictions about the near future. Accordingly, they provide perceptual constancy in event perception despite changes in sensory input over time (analogous to how object files sustain reference to objects despite featural changes). The forming of event models involves an interaction of both bottom-up (sensory-driven) and top-down processes, with the latter implicating event schemata. Event schemata can be viewed as ‘cognitive scripts’ which are stored in long-term memory that encode, inter alia, the sequential-temporal patterns of previously encountered events. Consequently, according to EST, event perception results from a dynamic, constructive process integrating information from sensory input, working memory, and long-term memory.

At a general level, event models help to solve a problem for perception rooted in neural transmission delays. Simply put, the problem is that since neural processing takes time, the sensory information made available to conscious perception is bound to lag behind the objective goings-on in the environment, which requires compensation (Nijhawan, 2008). Event models are therefore predictive forward models, with their predictive power derived from event schemata. Previously-learned information about the movement sequences of an action, for example, can inform the current event model involving said action in a forward-looking fashion, generating predictions about what will happen next. Notably, perceptual predictions are not just something nice to have occasionally. Perception is nearly always action-oriented. And while it is important to quickly detect and respond to environmental changes, being able to *anticipate* what will happen next and plan accordingly provides a greater adaptive advantage (Richmond & Zacks, 2017).

Within this predictive framework, segmentation is considered a fundamental component of event perception. Segmentation is connected to the *updating* of event models. The predictive power of any actively-maintained models is bound to change over time. Thus when prediction errors exceed a certain threshold, event models will need to be updated, and failing to do so would result in ill-fitting models. According to EST, event boundaries tend to be identified at points when prediction fails and updating happens. This updating occurs in bottom-up fashion in one way, in that it is driven by sensory input, but top-down in another, since the new model will be informed by prior knowledge as well.

It is crucial to note that events qua perceptual entities are recursively and hierarchically organized. In simpler terms, events have sub-events, which may in turn have sub-events of their own. This means that event segmentation simultaneously occurs on multiple timescales. Further, the threshold of prediction error can vary for each timescale. Event segmentation is thus the process by which we spontaneously discretize the continuous flow of perceptual information into meaningful, hierarchically nested units. In this regard, there is a sense in which event segmentation is less about identifying event boundaries than understanding event structures. Yet another way to put the point is that perceptual event boundaries are themselves hierarchically structured.

For our purposes, it is important to further note that in addition to events' sequential-temporal patterns, their durations are likely encoded in event schemata as well. Events are extended in metric time. And our knowledge and perception of the temporal structure of events concern not just abstract mereological relations between meaningfully-delineated events and subevents; a crucial, indispensable aspect has to do with their hierarchical organization in terms of duration ([Figdor, 2020](#); [Khemlani, Harrison, & Trafton, 2015](#)).

To see this, it is helpful to consider an example that applies EST to everyday life. When I hit the call button on my phone, contained in the event model will be an implicit expectation of how long

it will approximately take for the call to get through. This is informed by an event schema encoding statistical information about the duration of previously-made calls. Suppose now that a few seconds later, I detect no sign of the call getting through. I begin to wonder what might have gone wrong. My initial expectation has now been violated, and the original event model is no longer predictively accurate. This then triggers an update of the event model.

For all this to happen, though, two further processes must be involved. The first is timing, the keeping track of elapsed time. Second, there exists an automatic comparison between the output of the internal clock and the call's expected duration. Notably, both of these processes occur without conscious awareness. I do not need to instruct myself to start counting time after hitting the call button. Nor do I need to consciously monitor elapsed time in comparison to event model's prediction. Rather, it is when and only when there is a mismatch between perceived and expected duration that I become consciously aware of the consequences of these underlying processes all at once — I am caught by surprise.

This example brings out two important, if somewhat surprising, lessons. The first is that event perception requires ongoing interaction and coordination between event segmentation and timing, including both interval and motor timing. This is for the simple reason that, for predictive models to be useful, the temporal *locations* of event boundaries are as important as the sequential-temporal patterns of events. Even in the simplest case, it is not enough to merely predict that *A then B*, where *A* and *B* are two discrete subevents. An event model based on such crude sequential information is necessarily uninformative about the temporal distance between *A* and *B*, and as such it has very little predictive power for guiding perceptual and motor processing relevant to *A* and *B*. More generally, *when* to expect/perform an action is just as important as *what* action to expect/perform, and part of knowing *when* involves tracking and encoding elapsed time.

Notably, the notion that event models and event schemata encode durational information accords well with the internal clock model, especially regarding the model's postulate of the so-called 'decision stage' where the output of the accumulator is compared with temporal reference memory for decision-making ([Gibbon, Church, & Meck, 1984](#)). In animal and human studies, the content of temporal reference memory is typically thought to be related to a recently learned duration (e.g., a fixed interval between trigger and reward). Yet if what I have been suggesting is right, temporal reference memory may be stored in the form of event schemata more generally, providing temporal knowledge in a wide range of domains and with different degrees of granularity. This is now starting to look a lot like what *known time* amounts to.

The second lesson to be drawn follows from the coordination between event segmentation and (interval) timing. It is that as a result of this coordination, we have an implicit sense of the 'normal' speed of time's passage associated with the rate at which events unfold following expectations. This is an implicit sense in that it is typically not part of conscious perception. Indeed, I suggest that normally it would only enter consciousness in a distorted form — that is, when event segmentation and timing are out of sync. The crucial point, however, is that unsynchronization of the two will be exceptional.

Expected duration via event schemata is statistical in nature, thus covering a range rather than a specific value. Yet even if expected duration is off by a significant margin, any transient mismatch between expected and perceived duration typically becomes an error signal that the event model needs updating. This is to say that the mismatch can be resolved by immediately adopting a model with a better fit of the input, the processes of which have been shown to be unconscious and automatic ([Speer, Swallow, & Zacks, 2003](#); [Zacks et al., 2001](#)). Returning to the example above, the new model might serve to accommodate the possibility, for instance, that I currently have poor cellular reception. In this case, despite a transient mismatch between perceived and expected duration, event segmentation and interval

timing remain in synchrony.

Encountering life-threatening danger, however, disrupts the coordinated synchrony between the two. For here a mismatch between expected and perceived duration cannot be easily resolved. To see why, consider someone whose internal clock rapidly accelerates due to intense fear of death, such that one has the impression that 6 s (perceived duration) have passed for an event that one implicitly knows to be roughly three seconds long (expected duration). *In principle*, this mismatch can be resolved in one of two ways. One possibility is to hold on to the expected duration while correcting for the acceleration of the internal clock. It is implausible to think that the output of the internal clock can be modified in such a top-down fashion, however. There is good reason to view the internal clock informationally encapsulated, in order to maximize reliability (Montemayor, 2019). As such, the internal clock produces perceptual deliverances, the contents of which cannot be modified at will.⁹

Another way to resolve the mismatch is to update the event model in order to reflect the perceptual deliverance to the effect that the frightening encounter is six seconds long. But this is equally unlikely. Whereas any event models may be mistaken given the circumstances, in the case under consideration ongoing sensory input is likely to continuously confirm that the initially-chosen event model, at a large timescale, is *not* mistaken. In other words, there is likely no prediction error strong enough to initiate an updating process. If one's event model predicts, for instance, that in one second the distance between the incoming vehicle and oneself will be cut by half, this prediction is likely to be born out by visual motion, regardless of the output of the internal clock. This means that the mismatch between expected and perceived duration cannot be easily resolved by updating the event model.

What one ends up with, then, are two conflicting duration representations — one from the inter-

⁹This needs to be distinguished from the claim that external factors can influence the internal clock. Factors such as attention and arousal exert their influence on the ongoing inner workings of the internal clock, with implications for its output. This is consistent with the notion that once the output is produced, it is not vulnerable to top-down control.

nal clock, and the other from the event model — that are both resistant to modification. Consequently, both are maintained. This in turn results in a mismatch of which one is now consciously aware. To be specific, the content of the mismatch is such that the event seems to have lasted longer than it should. Phenomenologically, one has the impression that external time seems to be passing more slowly compared to some internally-held ‘standard’. This is precisely what survivors of life-threatening danger report in subjective time expansion. Combining the internal clock model with event segmentation thus explains both the *felt time* and *known time* component of the discrepancy, respectively. We have, in other words, supplemented the original simple account with an explanation of why for encounters with life-threatening danger the arousal-driven duration overestimation can lead to the feeling of ‘time slowing down’.

There is, however, a noteworthy limitation of this explanation having to do with the *magnitude* of subjective time expansion. For although the survivors do not always mention the extent to which time seemed drawn out, based on the existing reports from survivors that do, the extent can often outstrip the acceleration of the internal clock. Recall the first survivor for whom what he knew to be a few seconds long event in actuality seemed like five minutes. Although I know of no direct evidence bearing on this matter, an acceleration of the internal clock by nearly a hundred times seems plainly unrealistic.

It might be tempting to conjecture on this basis that reports of subjective time expansion tend to be exaggerated and that therefore the striking magnitude of this form of distortion need not be of concern. While the possibility of exaggeration cannot be ruled out, this line of reasoning is too hasty. First, it question-beggingly assumes that an exaggerated effect is of no explanatory interest. Further, there is a readily available explanation for the magnitude of the distortion once we realize that moderate degrees of subjective time expansion *in perception* will be encoded by the memory system. This in turn initiates the beginning of a series of extended and complex memory processes which can result in more

extreme degrees of ‘time slowing down’ being reported.

Due to its emotional intensity, one’s experience of the frightening encounter will receive enhanced encoding. According to recent neurocognitive models of emotional memory, compared to positive and neutral events, emotionally-arousing negative events are encoded with greater volumes of sensory and affective details, and retrieving them is associated with greater cortical reinstatement (Clewett & Murty, 2019; McGaugh, 2004). When retrieved, the phenomenology of recollection will likely consist of the impression that *a lot* happened on the basis of a memory that is particularly vivid and rich in detail. This will manifest in greater time spans in retrospect, since retrospective duration judgments are modulated by event complexity (Block, 1974).

An initially puzzling finding about emotional memories is that despite enhancement in encoding, they are not remembered more accurately (Loftus, 1979). We now know that this is partly due to what is called the ‘emotional memory trade-off’. Memory encoding is enhanced for details that are central to the emotionally salient aspects of the event, at the expense of impaired processing of contextual information that binds the different spatiotemporal components into a coherent episode (Mather, 2007). One implication is that at retrieval, emotional memories tend to involve active reconstruction to a greater degree. This further constitutes a potential source of increasing event complexity which retrospective duration judgments use as a cue.

Moreover, we know that over time emotional memories are also more likely to be revisited (Berntsen, 2001). This is consequential, because with each retrieval, the memory content undergoes reconstruction and elaboration wherein additional details may be filled in, the result of which impacts subsequent retrievals (Kensinger & Ford, 2020). Taken together, these factors suggest that an originally moderate effect of subjective time expansion is likely to receive amplification in memory. It is thus plausible, indeed likely, that what survivors of life-threatening danger end up reporting exaggerates the degree of

subjective time expansion. This is not a *semantic* exaggeration, however. Rather, it is that the survivors end up retrieving a memory representation that is multiply-distorted in its temporal aspect.

3.5 Explaining the slow-motion effect

Recall that the slow-motion effect consists in a global slowdown of the perceptual environment and that this sometimes manifests in the frightening encounter taking on a fragmentary character. Curiously, reports of the slow-motion effect are striking in yet another — and, I will argue, explanatorily relevant — respect. It is that they tend to consist of recollections from an *observer* as opposed to *field* perspective. In other words, the survivors report witnessing the frightening encounter ‘from a distance’, and for Noyes & Kletti, this reflects a depersonalization syndrome. As it turns out, taking an observer perspective is a common feature of traumatic memories (Kenny & Bryant, 2007). Though some see this as evidence for an adaptive memory mechanism serving to provide an emotional distance from the traumatic event (Fernández, 2015), an observer perspective may originate in perception also. Indeed, in one study that asked the participants when they first adopted the reported observer perspective, McIsaac and Eich (2004) found that nearly half answered with ‘during the trauma’.

This result may not be so surprising or unintuitive upon reflection. Extending Nanay’s (2010) view on amodal completion that occluded parts of perceived objects can be amodally represented via mental imagery, having a visual experience which represents oneself from an observer perspective may likewise be accomplished by selectively integrating certain aspects of exteroceptive or interoceptive information with mental imagery from an external perspective. In an ordinary sense, one can already visually imagine how one looks from other perspectives. While this is admittedly not *seeing* in the familiar sense, the phenomenological distinction between imagining and seeing may be a matter of how

internally-generated and externally-supplied contents are monitored and integrated (Dijkstra, Kok, & Fleming, 2022). It is possible, then, that when monitoring fails or when the relevant contents are integrated differently, one can have a visual experience of seeing oneself from an observer perspective.¹⁰

Returning to survivors of life-threatening danger, there is of course no way to verify whether the reported observer perspective is perceptual in origin or a figment of memory. This difficulty points to an important methodological point worth repeating, however: explaining the altered phenomenology demands an openness to contributions from perceptual and memory processes alike. Just as some survivors might have adopted an observer perspective during the frightening encounter whereas others after the fact, so too we can expect some instances of the slow-motion effect to originate in perception whereas others in memory. With this recognized, a further possibility is that even for the instances that are originally perceptual, memory processes may further exaggerate the degree of the distortion, similar to what we have seen with subjective time expansion in §3.4. Accordingly, my approach in what follows in explaining the slow-motion effect is to focus on its perceptual basis, while leaving the possibility open that memory processes have a role to play later on as well.

The overlap between reports of the slow-motion effect and observer perspective is more than incidental. Here I take inspiration from Nigro and Neisser (1983), who speculate that observer experiences — wherein one adopts an observer perspective on events *as they occur* — may result from ‘instantaneous reconstruction’ (p. 468), for which they propose emotional self-awareness as a trigger. As McCarroll (2017) points out, this accords well with the fact that observer experiences are reported by patients of social anxiety disorder and victims of trauma. One explanation is that there is a fair amount of internally-generated contents already present in normal circumstances which facilitate perceptual processing but

¹⁰Note that if Nanay (2010) is right about amodal completion, perceptual processing nearly always deals with a mixture of internally-generated and externally-supplied contents.

which are rarely attended to as such. In events involving high degrees of emotional self-awareness, however, such contents may become more salient and take priority over externally-supplied contents. In this sense, Nigro & Neisser's notion of instantaneous reconstruction may refer to an operation that reorganizes and reprioritizes the different sources of information in perception. While egocentric sensory information is normally what is attended to, for instance, this need not always be the case. And just as we can attend to different aspects of the visual field, so too attention may modulate the perspective from which the visual field is adopted.

In this regard, it is telling that the survivors who report the slow-motion effect from an observer perspective do *not* report the entire frightening encounter from that perspective. Rather, there is often a spontaneous switch between field and observer perspectives, and sometimes even between *different* observer perspectives for different moments of the encounter. In a particular dramatic account, one survivor reports first 'looking down from 50 to 100 feet in the air', and then continuing to switch observer perspectives three times, while emphasizing that he was 'looking at the situation happen [which he the observer] was not actually a part of' (Noyes & Kletti, 1977, p. 377). This strongly suggests that during different moments of the encounter, different sources of information might have been selected and attended to, with different observer perspectives created ('reconstructed') in reflection of different attentionally-salient aspects of the event.¹¹

Taking a step further, Nigro & Neisser's instantaneous reconstruction can be elaborated in relation to the notion of discrete perception to issue in an explanation of the slow-motion effect. According to my preferred discrete theory, conscious perception consists of a sequence of discrete conscious percepts each preceded by continuous unconscious processing (Herzog, Drissi-Daoudi, & Doerig, 2020).

¹¹Keep in mind that it is possible for survivors to simply *imagine* the frightening encounter from observer perspectives while the event was underway. Even though this would not lead to observer experiences, the imagined contents could be encoded by the memory system as well, giving rise later on to observer memories. For an excellent discussion of observer experiences and memories, see McCarroll (2018).

On this two-stage model, what we consciously experience is the final product of a myriad of lengthy and complex unconscious processes spanning across different sources of information. This final product is a single, integrated representation about the recent past that functions as an internal model held in working memory — until the next conscious percept arrives in its substitution (whether this results in an immediate replacement or gradual degradation of the previous model is an open question). Each conscious percept is a feature vector that encodes rich event information, both temporal and nontemporal, processed during the previous unconscious window. Crucially, the lengthy unconscious stage is where sense-making occurs. Here certain features are grouped together whereas others separated; and while some are to be integrated, yet others need to be suppressed; and so on. Any forward-looking predictions are formed during the unconscious stage too, such that each conscious percept encodes immediate-future expectations. The sense in which conscious percepts serve as internal models held in working memory is suggestive of them being event models on a certain timescale. Alternatively, they might be mid-level representations serving as input to event models. To the best of my knowledge, this potential connection has not been explicitly drawn, the exploration of which may provide an avenue for future research.

It is during the unconscious processing stage that the reorganization and reprioritization of different sources of information occurs. This means that unlike imagining, adopting an observer perspective is typically not under deliberate conscious control. Rather, depending on the type of accident and the exact moment of its occurrence, processing priority may be given to certain interoceptive information (e.g., kinesthetic imagery), auditory information (which encodes spatial information differently from vision), or else. This is well-supported by the survivors' reports: during different moments of the frightening encounter, some senses were significantly enhanced whereas others attenuated.

Importantly, such selective enhancement occasionally can result in the construction of different

observer perspectives altogether. It is not so implausible to think, for example, that during a certain motor vehicle accident, kinesthetic or auditory information can provide robust cues about the trajectory of one's vehicle more so than visual information. Further, during a moment of fear and perceptual chaos, these cues may be modulated by attention in such a way that they are translated and integrated into the visual modality, providing an observer visual perspective from a distance or from above that encodes rich spatial information. While speculative, this is motivated by the idea that although it is not mandatory for spatial information to be encoded visually, abstract spatial information *can* be mapped onto the visual modality. More generally, a conscious percept involving an observer perspective may be constructed from a variety of sources of information, depending on their relevance or salience.¹²

The adoption of observer perspectives helps to make sense of the reported fragmentary character of visual motion. On the current suggestion, there is a straightforward sense in which during encounters with life-threatening danger there indeed exist chunked, discrete segments of the visual stream. These come in the form of discrete conscious percepts that seem subjectively disconnected from one another because of the different perspectives involved. In other words, the rapid switching of visual perspectives disrupts the apparent continuity of perceptual experience. To be sure, the claim is not that the switching always happens, but that when it does it is explanatorily relevant. This is, however, only one of the two reasons why visual motion can seem fragmentary when encountering life-threatening danger. The other has to do with the disruption of conscious updating in general, which goes on to explain the slow-motion effect as a whole.

Recall that according to the two-stage discrete theory of perception, whereas unconscious pro-

¹²For instance, Wells and Papageorgiou (1999) propose that the observer perspective adopted by patients of social anxiety is linked to their shifting attention inward to the self (i.e., interoceptive information), due to their intense social-evaluative concerns activating heightened processing of one's public image. Note that the reconstruction is not strictly speaking instantaneous, as initially suggested by Nigro & Neisser, since lengthy unconscious processes in the range of hundreds of milliseconds are involved. However, because those processes are unconscious, the adoption of an observer perspective is still going to *feel* instantaneous.

cessing evolves continuously over time, conscious perception consists of temporally-separated discrete conscious percepts. This theory accommodates the *subjective* continuity of conscious perception by proposing that the ‘sequence of conscious percepts is slower than the spatiotemporal resolution of their contents’ (Herzog et al., 2020, p. 8). In other words, the contents of each conscious percept are temporally rich enough to leave no gaps in between any two adjacent percepts. Here it is important to emphasize that while conscious percepts encode rich temporal information, this is not *in virtue of* conscious percepts themselves being temporally extended in an isomorphic way. Rather, conscious percepts encode temporally-extended features such as duration and motion (integrated in the previous window of unconscious processing) as quantitative labels, in exactly the same way nontemporal features such as color and location are encoded.¹³

When updating occurs, a new conscious percept substitutes the old one, and a new internal model is formed, one with informational connection to the previous model. Evidence suggests that the lengthy unconscious stage before the next update can last up to 450 ms (Drissi-Daoudi, Doerig, & Herzog, 2019). Meanwhile, there is good reason to suppose that conscious updating occurs in both a bottom-up and top-down fashion as well, flexibly adjusting the threshold for when unconscious processing is considered complete given stimuli characteristics, goals, or task demands. When encountering life-threatening danger, however, this updating is likely to be disrupted due to two interactive factors.

The first one is arousal, or rather arousal-biased competition, which enhances perceptual processing of high priority information while suppressing that of low priority information (Mather & Suther-

¹³Indeed, theories of temporal consciousness — at least those that assume a representationalist framework — that postulate temporally-extended *experiences* as mirroring their temporally-extended *contents* have been accused of involving a ‘content-vehicle confusion’ (Dennett & Kinsbourne, 1992). This is what G. Lee (2014) calls ‘representation by resemblance’ (cf. Hoerl, 2013; Phillips, 2014). In the theory under consideration, by contrast, the quantitative labels encode features of the represented object or event, as opposed to features of experience. While this is not the place for a full defense of the theory, Herzog et al.’s (2020) two-stage discrete model is most strongly supported by long-lasting postdictive effects, wherein a later stimulus modify the perception of stimuli presented a few hundred milliseconds earlier. For general discussions of discrete perception, see Freeman (2006) and VanRullen and Koch (2003).

land, 2011). Here priority is not to be predetermined, but in the cases of interest biologically significant stimuli are likely to be prioritized (via a bottom-up route), as is, where possible, means to maximize chances of survival (via a top-down route). Either way, arousal leads to selectively enhanced processing of certain aspects of the frightening encounter, with implications for the *contents* of conscious percepts. This is analogous to enhanced memory encoding considered earlier, which leads to selectively detail-rich memory representations. More speculatively, arousal may also impact the *objective duration* of unconscious processing phase. When encountering life-threatening danger, being able to detect and respond to changes quickly is often crucial. This may exert a top-down ‘demand’ to increase the rate of conscious updating, which is accomplished via a relative decrease in the duration of unconscious processing.

These changes by themselves do not yet *disrupt* conscious updating. This is when the second factor, attention, comes into play. James (1890) famously characterizes attention as ‘the taking possession by the mind, in clear and vivid form, of one out of what seem several *simultaneously* possible objects or trains of thought [... implying] withdrawal from some things in order to deal effectively with others’ (pp. 403–404; emphasis added). As it stands, this characterizes the way in which attention selectively enhances processing of task-relevant information *at a given moment*. When applied to conscious percepts *over time*, however, a possibility is that an individual conscious percept may be fixed in place by attention in working memory longer than it is normally supposed to. As before, the mechanism by which this occurs can be either bottom-up or top-down. When encountering life-threatening danger, a conscious percept may be ‘taken possession’ by attention due to the biological significance of the stimuli. It is also possible that one deliberately, intently focuses on the current conscious percept for strategic planning purposes (whether this *is* strategic is another matter). In either case, the fixing in place of a conscious percept disrupts the updating process. This may be because the *next* final product of the ongoing unconscious processing is likely to be temporarily barred from entering consciousness, or entering in a

somewhat degraded form. Yet another possibility is that there is no final product to speak of as long as the last conscious percept is still ‘taken possession’ by attention. Of course, armchair reasoning cannot tease apart these different hypotheses, and this presents an opportunity for empirical investigation.

Nevertheless, the first consequence of this disruption is that conscious perception should become temporarily fragmentary. This is because when the next conscious percept does eventually arrive, its contents are likely to be somewhat spatiotemporally disconnected from those of the previous percept. The exact degree of the disconnect depends on the length of the delay and the motion characteristics of the stimuli, an important point to which we will return later. Certainly, it is plausible that, at least in some cases of life-threatening danger, the disconnect can be significant so as to create the impression that ‘the frames progress with a jerky motion’, as one survivor from earlier puts it.

The second consequence of the disruption explains the reported global slowdown of the perceptual environment. Recall that arousal leads to enhanced processing of prioritized information, resulting in vivid and detailed conscious percepts representing the recent past in shorter segments (due to shorter unconscious processing windows). When such percepts are fixed in place in working memory for extended time, there will be abundant time, relative to the normal update rate, to closely examine the contents rendered conscious in the percepts. To be sure, the claim is not that in each conscious percept *subjective* time is dilated so as to enable replaying of events at a slower rate (recall that duration is encoded as a quantitative label). Rather, it is the interval between the formation and subsequent updating of the conscious percept that is *objectively* increased due to attention’s ‘taking possession’ thereof. The resultant outcome is that while the contents of the conscious percept may integrate information from a shorter unconscious processing window, their broadcasting lasts a longer period of time, allowing for detailed examination of different aspects of the event, perhaps in sequence or even repetition. Phenomenologically, this then gives rise to the impression of events unfolding slowly.

We have taken a long route to explain the slow-motion effect, first focusing on the reported observer perspective first and then on the fragmentary character of visual motion. The payoff, though, is that these co-occurring features are now explained in a unified framework grounded in discrete perception. Notably, the explanation is strongly supported by the fact that heightened perception and the slow-motion effect tend to co-occur in the survivors' reports as well. A plane crash survivor revealingly describes the slow-motion effect as being able to 'see everything without having to look' (Terr, 1984, p. 642). This phenomenon can be understood in terms of being intently absorbed in the present moment — that is, the current conscious percept being taken possession by attention. Here both arousal and attention play crucial and interactive roles, and I will argue next that this is how timelessness should be explained too.

3.6 Explaining timelessness

Recall that timelessness tends to occur in the last, transcendence phase of the frightening encounter. Leading up to this point, in a fairly short amount of time, the body has already been aroused and has undergone an enormous amount of physiological and mental activity. I will now extend the explanation of the slow-motion effect above and argue that timelessness reflects a state of *hyper*-focused attention on a particular moment (i.e., a conscious percept) at the expense of temporary suspension of conscious updating altogether. The phenomenological profile of timelessness is of particular importance here. Note that it is one thing to experience 'time slowing down' of varying magnitudes — both subjective time expansion and the slow-motion effect admit of degrees. Time seeming to stand still or losing its meaning, by contrast, seems to involve a more fundamental distortion of temporal phenomenology. As one survivor puts it, 'I had no realization of time passing, only of one moment which never altered'

(Noyes & Kletti, 1976a, p. 25).¹⁴

The idea that timelessness is due to a temporary suspension of conscious updating over time is apt to explain the transcendent character of timelessness, namely the sense in which timelessness holistically *structures* experience. As seen earlier, the disruption of conscious updating does not lead to the disappearance of consciousness, not even temporarily, for there will still be an internal model being fixed in place for some brief time. Temporary suspension is a more extreme form of this disruption, however. Here one is in a hyper-aroused state and hyper-focused on the current conscious percept, resulting in it being fixed in place by attention for extended time, perhaps in the range of a few of seconds. In this case, two consequences follow. The first is that when conscious updating eventually resumes, the contents delivered in the new percept will be significantly disconnected from the current one. Second, relatedly, this will result in an overall temporal disintegration. This is pointed out by Noyes and Kletti (1976b): ‘[in] an extreme instance, immediate experience might seem without antecedent [sic] or consequence, hence isolated from time or timeless’ (p. 108). According to this suggestion, the reason for time to lose its meaning in timelessness is that the current moment is no longer integrated with other moments in time. Importantly, this suggests timelessness as an immediately retrospective feeling. For it is only when the next conscious percept arrives and when one realizes how much *must have* happened in between that one experiences time as having just stood still. Again, James’ (1890) thinking on time perception turns out to be insightful, as he points out that ‘it is only as entering into the living and moving organizing of a much wider tract of time that the strict present is apprehended at all’ (p. 573).

Suppose, for the sake of the argument, that the temporal suspension of conscious updating can

¹⁴This is reminiscent of a remark that Wittgenstein (1922) makes in a different context in the *Tractatus* (6.4311): ‘[if] we take eternity to mean not infinite temporal duration but timelessness, then eternal life belongs to those who live in the moment’. In other words, time can seem to stand still for those who are ‘stuck’ in the present. Interestingly, this seems to be just how Carl Jung describes experiencing timelessness as ‘a nontemporal state in which present, past, and future are one’ (noted in Noyes, 1972, p. 176).

result in timelessness in the fashion just sketched. Is there reason to believe that when encountering life-threatening danger conscious updating will be brought to a temporary halt, however? While any considerations on this issue will be unavoidably speculative, I take the following suggestions to be plausible starting points. In particular, there may be two routes that take one from an already-aroused to a hyper-aroused state.

First, whenever one senses a slight possibility of survival in a life-threatening situation, that information itself is highly biologically relevant and therefore salient. Accordingly, there may be circumstances where whatever one determines one must do in order to maximize one's chances of survival spontaneously becomes where the *entirety* of one's attentional resources is allocated. This leads to the seemingly paradoxical consequence, however, that conscious perception 'freezes' precisely when one needs to act swiftly and strategically the most. But this is only paradoxical if it is assumed that in order to act adaptively — to the extent that doing so is possible when encountering life-threatening danger — one's course of actions must be consciously planned out based on consciously-accessed perceptual representations. This is often not the case, however. We know that in many instances of fight-or-flight response the body generates motor plans automatically and unconsciously ([Öhman & Mineka, 2001](#)). And there is positive evidence that demonstrates the adequacy of unconscious representations for adaptive or near-optimal behavior in motor control (see, for a review, [Shea & Frith, 2016](#)). In other words, behaviors that are most likely to promote survival in life-threatening danger need not come from conscious, higher-level cognitive thinking. Before an imminent helicopter crash, for example, it seems that one of the least unfortunate situations is one in which the pilot *just knows* where the eject button is.¹⁵

Another route to hyper-arousal may be the recognition — correct or incorrect — that death is

¹⁵If anything, for well-learned sensorimotor skills at least, conscious attention tends to impair as opposed to improve performance ([Beilock, Carr, MacMahon, & Starks, 2002](#)). To be sure, none of this is supposed to entail that some strategic, survival-promoting course of actions cannot be consciously planned out. The point is merely that the involvement of deliberate thinking is not necessary.

imminent and highly probable, in which case the moment at which this recognition occurs occupies the entirety of one's conscious attention. This accords well with the fact that timelessness occurs more commonly in those who believed death to be imminent. It also fits nicely with the fact that timelessness tends to occur after the phases of resistance and life review. Through either route, the overall suggestion is that the reallocation of attentional resources happens in such an extreme manner that it occurs at the expense of subsequent conscious updating. In other words, timelessness is a consequence of one's attentional system pushed to the extreme.¹⁶

3.7 Concluding remarks

I have argued in this paper that there are three distinct elements of altered temporality in life-threatening danger—subjective time expansion, the slow-motion effect, and timelessness. So, as it turns out, the colloquially familiar phrase ‘time slowing down’ denotes a thematic category, rather than a proper explanatory target in and of itself. The sense in which elapsed time is felt as slowed down in subjective time expansion has an amodal character which is absent in either the slow-motion effect or timelessness. The latter two, in turn, directly concern the continuity of perceptual experience, suggesting a form of passage phenomenology rooted in certain general features of perceptual processing (see also [Hohwy, Paton, & Palmer, 2016](#)).

¹⁶The neurophysiological plausibility of the proposed explanation warrants a brief remark. In encountering life-threatening danger, there will be a particularly pronounced surge of noradrenaline in the brain. The proposed progression from aroused to hyper-aroused bodily states is thus likely due to a noradrenaline-driven process. Notably, this progression is apt to explain several nontemporal subjective effects prior to timelessness. For we know that emotional arousal, especially in response to fear, is associated with a surge of noradrenaline in the amygdala, and that this is part of a larger process that implicates the locus coeruleus-noradrenaline system, a structure in the brain stem projecting widely to the cerebral cortex and, relatedly, implicated in a wide range of cognitive processes ([Aston-Jones & Cohen, 2005](#)). One consequence of this process is enhanced perceptual processing and emotional memory ([Talmi, 2013](#)). Another may be the increased speed of thoughts. Finally, a more speculative one is that through the amygdala, the modulatory effects of increased noradrenaline levels lead to rapidly enhanced activities in the hippocampus, which we know plays a key role in memory retrieval ([Squire, 1992](#)). This can help make sense of the life review phase for which the survivors report rapidly replaying an unusually large number of episodic memories.

Before ending, it is worth acknowledging that my overall account may not be immediately recognized by some as a philosophical *theory*, in the conventional sense, of altered temporality. For my account embraces the possibility that the distortions reported by the survivors are multifaceted in phenomenal character and heterogeneous in underlying mechanism. But this, I contend, is appropriate: the impact of an imminent threat to life alters subjective experience in extraordinary if disarrayed ways. Indeed, a unifying theme emerging from our discussion is that fear alters our perception of time through modulating arousal and attention, the effects of which are multifaceted and diverse.

This in turn suggests that ordinary temporal experience is underlain by a variety of processes as well, responsible for different aspects of a rich phenomenology that are perhaps unified only in appearance (see also [Viera, 2021](#)) and only when things do not ‘go wrong’. Doing justice to the richness of temporal experience *as such* in this sense is crucial for furthering our general understanding of temporal passage phenomenology, but that is a task for another time.

Chapter 4: Towards a multi-level account of felt passage

4.1 Introduction

The world is a dynamic place. Ice melts, flowers bloom, and trees grow. There is an influential line of thought in metaphysics that all this has to do with — indeed, depends upon — the passage of time. For there is thought to be a deep contrast between change and mere variation. An example of the latter is that it is raining *over here* and not *over there*. Genuine change, however, supposedly requires something about time itself to change, namely which moments are present, past, and future should change. Philosophers sometimes talk of *temporal becoming* when referring to this sui generis sort of change attributed to time itself, and this notion has also been discussed under the labels of ‘absolute becoming’ (Broad, 1923), ‘objective becoming’ (Skow, 2015), ‘pure becoming’ (Taylor, 1992), or ‘robust passage’ (Pooley, 2013).¹

There is some broad consensus that time does seem to have such a dynamic character, in a notable way that makes it fundamentally different from space. It is thus a powerful intuitive datum that time passes whereas space does not. Indeed, it is oftentimes claimed that the passage of time is simply *given* in experience. Thus, for example, we have Schlesinger (1991, p. 427) declaring that ‘[t]here is hardly any

¹Pooley contrasts robust passage with what he calls ‘deflationary passage’, championed by Dieks (2006) and Savitt (2009), which consists in successive event occurrences and nothing further — that is, nothing having to do with time itself changing. Whether deflationary passage is passage in name only is not something on which I need to take a stand here (cf. Callender, 2000). My interest in this paper is *felt* passage. However, later on I will draw a parallel and less controversial contrast between robust and non-robust passage *experience*.

experience that seems more persistently, or immediately given to us than the relentless flow of time'.²

There is thought to be a deep tension, however, between the so-called 'manifest image' of time grounded in experience and the image we get from physics. The notion of the passage of time presupposes that which moment is NOW is an objective matter. However, Special Relativity puts pressure on the idea of an objectively present moment.³ Further, recent work in quantum gravity suggests that time may not be admitted at the fundamental level of reality altogether.⁴ From the perspective of the scientific image, then, our manifest image of time as dynamic is deeply mistaken.

A natural reaction towards this tension is to pursue a Sellarsian project of reconciliation. Perhaps the most influential reconciliatory strategy in the recent literature consists in the development of what [Miller, Holcombe, and Latham \(2020\)](#) call *phenomenal illusionism*. According to this position, while time does seem to pass, our experience as of the passage of time is to be explained away as illusory by appealing to certain contingent design features of our perceptual systems. For instance, [Paul \(2010\)](#) argues that the animated character manifest in our experience as of change — assumed as indicative of temporal becoming — is an illusory byproduct of the way motion and change is perceived by the human brain.⁵

Phenomenal illusionism confronts two challenges, however. The first one concerns the *scope* of its explanatory power. Since phenomenal illusionism views passage phenomenology as consisting in

²Similar remarks can be found in [Davies \(1995, p. 275\)](#), [Norton \(2010, p. 24\)](#), [Schuster \(1986, p. 695\)](#), and [Taylor \(1992, p. 81\)](#), among others. Terminology-wise, in this paper I do not distinguish between the 'flow' and the 'passage' of time, and for now (till §4.5) I use 'the passage of time' interchangeably with 'temporal becoming'.

³The notion of objectivity here has to do with frame-independence. Early anti-passage arguments based on the relativity of simultaneity can be found in [Gödel \(1949\)](#) and [Putnam \(1967\)](#); [Sider \(2001\)](#) takes the challenge from relativity to be decisive. For recent critical discussions, see [Barbour \(2012\)](#), [Fine \(2006\)](#), [Maudlin \(2002\)](#), and [Peterson and Silberstein \(2010\)](#).

⁴[Barbour \(1994\)](#) proposes a timeless ontology of quantum gravity according to which the universe consists merely of three-dimensional configurations. More recently, [Huggett and Wüthrich \(2013\)](#) review several approaches to quantum gravity which treat (space)time as non-fundamental. They examine the 'empirical coherence' of these theories. Strictly speaking, this concerns how to relate these theories to the empirical, observable realm in general, not the manifest image as understood here specifically, in the sense of a commonsense picture of the world.

⁵[Benovsky \(2015\)](#), [Dainton \(2011, 2012\)](#), [Gruber and Block \(2013\)](#), [Prosser \(2012\)](#), and [Le Poidevin \(2007\)](#) also defend phenomenal illusionism.

systematic perceptual misrepresentation, it seems to make a mystery of felt passage in the absence of perceiving motion or change, or when we turn our attention inward. Furthermore, as it focuses on phenomenal animation in motion perception,⁶ the view seems ill-equipped to explain the arguably more abstract sense of the future approaching (closer) and that of the past receding (further). Though perhaps not (as) ‘animated’, the former is a salient aspect of the phenomenology of anticipation, and the latter that of relief. Taken together, these considerations suggest that our experience as of passage is richer than phenomenal illusionism assumes.⁷

The other — and to my mind more fundamental — challenge concerns the explanatory *target* of phenomenal illusionism on its own terms. For one, it seems open to the passage realist to maintain that phenomenal animation is not what felt passage really consists in. This is to contend that phenomenal illusionism falls short of identifying, let alone explaining away, the crucial phenomenological datum given in experience that is supposed to favor passage realism.⁸

Let’s put aside this version of the challenge, however, to focus on a different one in this paper. Specifically, I have in mind the passage *anti*-realist who argues that there is actually no experience as of passage that requires explaining away in the first place. Rather, to resolve the tension between the manifest and scientific images of time, (part of) what one needs is an account of why we are inclined to mistakenly *believe* that we experience time as passing. Miller et al. (2020) call this *cognitive error theory*, and from its perspective the perceptual illusionist has conceded too much in granting that experience

⁶Phenomenal animation needs to be distinguished from perceptual animacy, which in psychological research describes the human tendency to perceive inanimate objects as having goals and intentional states (see, for a review, Scholl & Tremoulet, 2000). We will revisit the point that the contents of conscious perception can often outstrip low-level sensory primitives.

⁷Additionally, Bordini and Torrenzo (2022) examine the phenomenology of fear in relation to passage phenomenology, which they argue involves a ‘feeling of imminence’.

⁸For passage realists such as Craig (2000) and Smith (1994), experience represents some non-relational, transitory temporal property. Similarly, Balashov (2005) argues that what most strongly motivates passage realism is the phenomenology of *occurring simpliciter*. The general idea is that these experiences are best explained by temporal becoming. For critical discussions of these so-called ‘arguments from experience’, see Frischhut (2015), Hestevold (1990), Hoerl and McCormack (2018), and Skow (2011).

represents time as passing.⁹

The move to deny time's *seeming* to pass appears both counter-intuitive and dialectically puzzling on initial glance (§4.2). The first goal of this paper is to argue, however, that the cognitive error theorist's critique of phenomenal illusionism is otherwise well-motivated (§4.3). To be sure, my interest lies not in a full defense of cognitive error theory. Rather, I will show that the force of the critique comes out most strongly when we distinguish experience as of *robust* from *non-robust* passage. Although this distinction does not itself aspire to originality, I will argue that it invites a novel project of elucidating the intuitive belief that time passes *in a non-robust but nevertheless substantive manner* (§4.4). The project, in other words, is to take seriously and illuminate the idea that we have an intuitive theory in the domain of time.

In particular, I will argue for two claims. First, the intuitive belief that time passes is constituted by a multi-level, hierarchically-organized representational structure (§4.5). In it three levels can be identified and distinguished: (i) a non-conceptual sense of elapsed time; (ii) a concept-laden awareness of felt passage; and (iii) a set of full-blown judgments about time's dynamic character. In defending this multi-level structure, however, I do not pretend to flesh out the details of each level in a comprehensive manner. Rather, my strategy is to show how the combination of the three levels constitutes an attractive overall framework: one that helps us capture and systematize the myriad ways in which the intuitive datum concerning time's passage has already been characterized, while at the same time explaining the persistence of this intuition. I will, however, explicate in some detail the claim that our non-conceptual sense of elapsed time has a dynamic quality built-in (§4.6). The upshot is that this is a bona fide form of passage phenomenology in part because, as I will argue, conscious duration is as much about representing the dynamics of event structure as it is about mapping the metric temporal information.

⁹Proponents of cognitive error theory include [Braddon-Mitchell \(2014\)](#), [Deng \(2013a\)](#), [Hoerl \(2014\)](#), [Huggett \(2014\)](#), and [Miller \(2019\)](#).

4.2 Cognitive error theory's error

Cognitive error theory denies that it seems as though time passes: there exists no experiential sense of time's dynamic flow. Instead, we mistakenly believe that time seems in a certain dynamic way that it does not in fact seem. This is stating the view in a rough and preliminary way, and in the next section I will argue that the position, when properly qualified, is not as revisionary as it appears at first glance. For now, however, note that by comparison no color anti-realist denies that perception represents objects *as* colorful, and that no eliminativist about consciousness denies the *appearance* of phenomenality (and, in both cases, for good reason). Similarly, while Hume rejects any sensory impression of necessary connection, he grants that we have a custom-induced, reflective impression of necessary connection nonetheless. Hume, therefore, holds no skeptical doubt about the experiential *seeming* of causality (also for good reason).¹⁰

All this is hardly surprising. It is a truism that the world as presented in experience does not invariably accord with the world as it really is. Likewise, we can certainly make mistakes in our attempts to characterize the content of our experience. In consequence, we must recognize that what seems to be the case is sometimes up for debate. Yet it would be an entirely different matter to claim, both in the contexts mentioned and in general, that experience does not *at all* present the world to us in the manifest way it seems to, and that it is a cognitive error for us to think otherwise. This type of view, I submit, is liable to invite an incredulous stare.

Might our cognitive error theorist fare better than has been suggested, however? In fairness, cog-

¹⁰Hume's views on causation are a matter of interpretive dispute. As it concerns phenomenology, though, Hume is fairly straightforward. The only complication lies in the fact that he holds that we have no *direct experience* of necessary connection in any *single cause-effect instance*. However, Hume's point is to emphasize that necessary connection exists in the mind rather than as a sensory primitive. For recall that, according to Hume, 'the mind has a great propensity to spread itself on external objects, and to conjoin with them any internal impressions, which they occasion' (T 1.3.14.25). Beebe (2006, 2007) defends a projectivist interpretation of Hume's views on causation which builds upon Hume's 'spreading of the mind'.

nitive error theory takes a positive stance on temporal experience, claiming that it is by and large veridical: it is just that, *contra* common wisdom, the overall phenomenology does not encompass the purported passage phenomenology. It is thus important to keep in mind that the cognitive error theorist objects to phenomenal illusionism not because on her view passage phenomenology is *not* illusory, but because she denies its existence altogether. One putative benefit of this denial is that temporal experience is now characterizable in passage-free terms, which is to say, exactly as the passage anti-realist would (should?) like to have it.¹¹

But even understanding cognitive error theory as principally concerned with advocating for the view that temporal experience as such is veridical fails to mitigate the injustice it does to what many consider a glaringly obvious fact about our mental life. This is the fact, as Maudlin (2007, p. 135) puts it, that ‘the world is given to us as changing, and time as passing’, something, as Maudlin further notes, that not even Descartes at his most skeptical ever questions. Once again, for comparison, notice how odd it would be if someone were to claim that our intuition of causality between the so-called ‘causes’ and ‘effects’ arises only at the level of belief, and that in experience we merely perceive the temporal conjoining of events — *but*, the skeptic emphasizes, *at least this we do veridically*. This assurance of veridicality, it seems to me, would be cold comfort. More importantly, we would find the skeptic’s offer of comfort unnecessary and utterly misguided, predicated on a false characterization of human psychology from the get go.

For decades now, psychologists have studied the conditions under which humans do and do not perceive causality by using stimuli as simple as 2-D geometric shapes. Within this line of research, following the seminal work of Michotte (1963), a distinction is drawn between causal inference or judg-

¹¹For explicit defenses of this kind of position, see Deng (2019) and Farr (2020). In her earlier work, Deng (2013b) puts the point slightly differently, arguing that the passage anti-realist can understand passage in terms of succession. On this view, to characterize passage phenomenology one needs nothing more than the experience of succession of moments in time. Note that on this clearly deflationary account, temporal experience ends up being characterized in passage-free terms as well.

ment and causal impression or perception. In an especially relevant and telling study, Schlottmann and Shanks (1992, p. 340) report that ‘factors that influence *judgments* of causality have no detectable effect on the *perception* of causality’. As it regards the skeptic’s claim above, this means that causal beliefs can be inferentially modified while perceptual impressions of causality remain unchanged. It is thus implausible to hold that causality is merely a matter of belief in our mental life, occupying no experiential reality, and this implausibility is not something that can be swayed by the theoretical comfort of veridical perception.

Returning to cognitive error theory concerning felt passage, the comparison made above is not intended as a knockdown objection. The point is rather that veridicalism, on its own, is not a view worth having if its admissible contents of experience are deemed impoverished given reasonable assumptions about human psychology. There thus remains a strong presumptive case against cognitive error theory. In this regard, it should perhaps come as no surprise that proponents of cognitive error theory often refrain from making their case directly, instead resorting to undermining the plausibility of phenomenal illusionism. The tacit dialectical assumption here seems to be that the passage anti-realist must choose between phenomenal illusionism and cognitive error theory, and so that the rejection of the former ensures the acceptance of the latter. Indeed, something along these lines seems to be part of what motivates Hoerl (2014, p. 192) to raise the *intelligibility problem*, that of requesting the phenomenal illusionist to make intelligible ‘within the context of a theory that says that there is no such thing as passage, how there can nevertheless be such a thing as an illusory phenomenology of passage’.

Additionally, a related line of critique, advanced by Balcells (2019) and Deng (2013a), questions whether the phenomenal illusionist can effectively make sense of passage phenomenology *as illusory* by way of illusory motion phenomenology, a point to which I will return briefly. For ease of discussion, however, I will focus on the intelligibility problem in what follows, and I will suggest that the

full force of the problem is best appreciated when we sharpen our focus not on the sense in which the phenomenology is illusory, but on *how it is a phenomenology as of passage* instead.

This is pretty abstract. Let's try to attain a more concrete understanding of phenomenal illusionism first. Recall that Paul's (2010) account seeks to explain phenomenal animation as illusory, thereby also explaining our experience as of the passage of time as illusory. Paul's strategy is to begin with apparent motion. In the now well-known color phi case, for example, when presented with appropriately spaced and -timed flashes of dots of different colors, a percept of a single dot continuously moving and changing color is formed. In reality, of course, no actual movement of a single dot occurs. Rather, all that really goes on is the successive flashing of distinct dots, and the brain 'fills in' the gaps, generating an illusory perception of a single dot animatedly moving and changing color. To Paul, this means that the animated character manifest in our experience as of change is something the brain constructs and projects onto the world, rather than grounded in some objective feature of the world detected by us.¹²

Or, more carefully, the reasoning goes something like this: since the phenomenon of apparent motion demonstrates that some 'filling-in' mechanism is responsible for the illusion of animation in the relevant cases, this undermines the motivation for supposing that, in general, our experience as of qualitative change involves detecting some objectively animated feature of the world. That is, this undermines the passage realist's abductive argument from experience.

As should now be clear, Paul's account primarily functions as a debunking argument aimed at the passage realist. Meanwhile, this argument also serves double duty of providing additional support to passage anti-realism by accommodating the seeming presentation of the passage of time in experience.

¹²It is worth clarifying that by 'detecting' Paul does not mean primitive sensory registration, but rather the representation of something that bears an appropriate abductive relation to temporal becoming. What both Paul and her presumed interlocutor accept is that we have experience as of change with an animated character associated with 'real' change. Her interlocutor further holds that this animated character of experience is best accounted for by the existence of temporal becoming.

In this sense, there is a natural and straightforward solution to Hoerl's request of making intelligible illusory passage phenomenology: the phenomenology to be explained away as illusory is whatever phenomenology that the passage realist claims to favor her view. But I do not think this is quite right, as I think Hoerl's worry cuts deeper.

4.3 Phenomenal illusionism's illusion

In this section, I will incorporate Hoerl's worry behind the intelligibility problem into a dilemma presented to the perceptual illusionist. This way of contextualizing the intelligibility problem, I suggest, will help us better see the problems with phenomenal illusionism in a way that will prove instructive later on. To state the dilemma, we need to first draw a distinction between *experience as of robust passage* and *experience as of non-robust passage*. Recall that the notion of the passage of time, as I am understanding it, refers to a sui generis sort of change attributed to time itself. Less abstractly, time passes if and only if there is some sort of continuous becoming PRESENT of different states of affairs in the world. Further, it is in virtue of this fundamental temporal motion that qualitative change comes about, and one way to capture this dependence relation is to say that the former figures as part of the metaphysical ground for the latter.

Now, for there to be the slightest reason to take the argument from experience for passage realism seriously, as the phenomenal illusionist does, temporal experience must represent the passage of time in the robust sense just described. We can remain ecumenical as to *how* experience represents passage this way. What matters is the recognition that it is not enough for the way time seems in experience to be merely *interpretable* in terms friendly to passage realism. For the argument from experience involves an inference from phenomenological 'oomph' to ontological 'oomph'. Correspondingly, the phenomeno-

logical datum allegedly given in experience is that time seems to pass, period. That is, to the extent that there is a substantive debate about what to make of the experiential seeming of time's passage, at issue is the experience of robust passage.¹³

This point warrants explicit articulation because time seems to pass in a non-robust manner as well, for example, as we perceive objects as having different properties or occupying different locations at different moments, or as we sense the durations of internal or external events. There is something it is like to experience time passing in these mundane cases, insofar as they represent temporal before-and-after relations or temporal magnitudes which are definable *over time*.¹⁴ Less demanding, perhaps some sort of subjective temporal flow is presupposed by the stream of consciousness.¹⁵ It is worth underscoring, though, that this is all felt passage in the non-robust sense, insofar as such admittedly dynamic experiences do not represent *temporal* becoming. Hence experience as of non-robust passage does not serve to favor passage realism over anti-realism, since it is compatible with both a dynamic temporal ontology and a static one.¹⁶

We can now state the dilemma for the phenomenal illusionist as follows. Phenomenal animation

¹³Two clarifications are in order. First, I am not contending that as a matter of fact experience does — much less that it must — represent robust passage. The point made above rather concerns, dialectically, how the argument from experience should be understood as claiming. Second, in making that point I do not mean to deny other possibilities of arguing for passage realism based on experience in less direct ways (e.g., [Markosian, 2022](#); [Prior, 1959](#)). Put differently, the phrase 'argument from experience' is a proper name, not a description.

¹⁴One might wonder why it is that perception represents spatial relations and spatial magnitudes and yet we do not seem to experience space as passing in any way. A satisfactory answer to this important question will have to wait until §4.6. To preview, my suggestion will be that temporal information is linked with our capacity to act in a way different from how spatial information is utilized, but that this difference has nothing to do with temporal becoming.

¹⁵For recent discussions of this type of felt passage, see [Hohwy et al. \(2016\)](#) and [Ismael \(2017\)](#).

¹⁶To my knowledge, Maudlin ([2007](#), pp. 120–126) is the only philosopher who suggests that consciousness simply would not arise in a world without the passage of time. So it might be thought that on this view *any* experience whatsoever favors passage realism over anti-realism. It is beyond the scope of this paper to assess this line of reasoning. But it should be noted that what Maudlin means by 'the passage of time' is some sort of intrinsic directionality in the geometry of spacetime, not temporal becoming as standardly understood and as understood here. There is a related thought that deserves mentioning. Perhaps a growing block theorist or moving spotlight theorist can argue that her conscious experience is evidence that she exists in the now, and then argue for the passage of time indirectly on the basis of her changing experiences. The problem with such an argument is well-known, however, namely that it faces the so-called 'epistemic objection'. Roughly put, one cannot know for certain based on conscious experience that one exists in the objectively present moment, since one's past selves would take themselves to occupy the objectively present moment as well (see [Braddon-Mitchell, 2004](#); [Sider, 2011](#)).

is characteristic of either experience as of non-robust passage, or that as of robust passage. The first horn of the dilemma is simply that, given the distinction just drawn, if the target of the phenomenal illusionist's explanation ends up being experience as of non-robust passage, there will exist no debunking argument to speak of. Recall that phenomenal illusionism is supposed to be a Sellarsian project aimed at reconciling the apparent tension between the manifest and scientific images of time. However, there does not *appear* to be any tension between such perceptual elements as (non-animated) change and duration, on the one hand, and an ontology without temporal becoming, on the other. To be sure, this is not to dismiss experience as of non-robust passage as philosophically uninteresting. Indeed, I will argue that non-robust passage phenomenology is poised to elicit a substantive, psychologically compelling impression of time's dynamic character. However, this move is not available to the phenomenal illusionist.

Rather, for phenomenal animation to be the proper target of debunking, it must be assumed as characteristic of experience as of robust passage. This is, of course, how Paul (2010, pp. 334–337) intends her argument to proceed. Now, the illusion of phenomenal animation in apparent motion is perfectly clear and empirically well-understood. Paul's crucial move is to argue that the sense in which this type of experience involves illusory animation generalizes to all cases of our experience as of motion and change. The idea is that there is a misrepresentation of the same — or at least very similar — sort in cases of apparent and non-apparent motion alike, due to the same — or at least very similar — cognitive mechanism(s) at work. Upon reflection, however, (and this is the second horn of the dilemma) it is far from clear that the proffered explanation of apparent motion as illusory can, as intended, explain the allegedly illusory nature of our experience as of motion and change in general vis-à-vis robust passage. This realization can be appreciated from two separate perspectives, and it is crucial that we keep them distinct because they point to importantly different albeit related difficulties of phenomenal illusionism.

First, consider the color phi phenomenon again. Our impression of a single dot changing color as it animatedly moves involves a percept which misrepresents the actual states of affairs in the world. Simply put, a phenomenally dynamic conscious output is generated from a series of well-calibrated static inputs. No reasonable passage realist should take issue with the color phi phenomenon, nor with how it is explained in cognitive science, to which Paul appeals in her account. Rather, the passage realist should take issue with Paul's attempt to *generalize* the explanation for apparent motion of one specific sort to motion experience in general. The passage realist, I submit, can make this point in a perfectly principled manner.

For just because the passage realist holds that we detect (in the relevant sense described in fn. 12) robust passage in our experience as of motion and change, she is not thereby committed to holding that we do so *perfectly* at all times. Quite reasonably, the passage realist can claim that, just as causality is sometimes perceived based on low-level sensory cues which do not result from actual causality, so too the color phi phenomenon and indeed all other cases of apparent motion are simply instances in which the relevant mechanism for detecting passage misfires. Yet occasional misfiring is consistent with the idea that when the mechanism *does* function properly it generates experiential content that favors passage realism. In this regard, there is a curious sense in which it is the phenomenon of apparent motion that is explained away.

At this point, let me put my cards on the table: I do not think that the passage realist has the correct ontology, and I do not find the argument from experience to be any good. Nevertheless, I must confess I fail to see anything wrong for the passage realist to resist Paul's attempted debunking in the way just sketched. It is Paul's contention that the animated character manifest in our experience as of motion and change *is* illusory. This position, by itself, makes sense given Paul's (2010, p. 352) background assumption that in reality 'there is no real flow or animation in changes that occur across time', *and* given

her willingness to grant the seeming presentation of robust passage (or ‘real flow’) in experience. Yet appealing to specific cases in which phenomenal animation is illusory (e.g., the color phi phenomenon) is far from beginning to explain away as illusory the ‘flowy’ phenomenal character of our experience in general. Indeed, the unique phenomenon of apparent motion offers no reason whatsoever to convince the passage realist that we suffer from a pervasive illusion of passage. Accordingly, Paul’s attempted debunking fails.¹⁷

The fact that the passage realist can, as it were, debunk the debunking simply by pointing to the general fallibility of the putative detection mechanism at issue — whatever it might be — suggests that there is something wrong with Paul’s starting point. Recall that we are presently assuming phenomenal animation to be characteristic of experience as of robust passage. As indicated earlier, this has to do with conceding to the passage realist the seeming presentation of time’s passage in the robust sense, so as to debunk this phenomenological datum. But this concession, I will now argue from a second perspective, is deeply unmotivated *for the passage anti-realist*. Indeed, I will suggest that this concession is a mistake.

To see why, let’s suppose, in agreement with Paul, that there is no temporal becoming and that real motion consists simply in the changing of locations of a persisting object, which is to say, *not* in the changing of the object’s monadic temporal properties of pastness, presentness, and futurity. This is not how real motion seems to us, however, according to Paul. For there is an additional animated character manifest in our experience which, *unless explained away*, constitutes observational evidence for passage realism. Note that this commits Paul to the following counterfactual: if there *were* real flow in changes across time, then the animated character manifest in experience *would* not be illusory but

¹⁷Cognitive error theorists often argue that there is a disconnect between the sense in which apparent motion involves illusory animation and the sense in which veridical motion is supposed to be illusory. I am inclined to agree. However, the argument made above on behalf of the passage realist does not rely on such a disconnect. Rather, the argument simply relies on the more general principle that no perceptual mechanism is error-free. This is not to imply that the passage realist has a plausible story to tell about what that perceptual mechanism is. But that is another matter.

veridical instead. The problem — that is, Hoerl’s intelligibility problem — now becomes conspicuous when we ask: what justifies the supposition that, even in a world *without* temporal becoming, our brain still generates an illusion of robust passage, the content of which would presumably be veridical in a world *with* temporal becoming?

To be clear, this supposition is crucial for Paul’s debunking argument to get off the ground. It is the phenomenological datum presumed to serve as observational evidence for passage realism that needs explaining away, after all. However, it is unclear what reason there is for conceding that we do have experience as of robust passage *other than for the purpose of launching the debunking*. I will not insist that there cannot be any such reason.¹⁸ For our purposes, it suffices to note that if the question of whether the phenomenology is illusory or not turns out to be a matter of in which possible world we find ourselves, then whether it is going to be *explained away as illusory* or *vindicated as veridical* by the tools of cognitive science also hinges on the possible world we inhabit. Dialectically, this is deeply troubling for the phenomenal illusionist.

Here is a more concrete way to understand the trouble. Note that phenomenal animation in the color phi phenomenon is not explained away as illusory merely by means of the empirical discovery of some ‘filling-in’ mechanism. It can be easy to forget that ‘filling in’ in one way or another nearly always occurs in perceptual processing, as it is the task of perception to ‘recover’ the external world from limited sensory information. Our acceptance of the color phi phenomenon as involving illusory animation rather has to do with our independent knowledge of what the actual inputs are like. The explanatory role played by the ‘filling-in’ mechanism in apparent motion is thus to describe *how* the illusion comes about, after *that* it is illusory is established. As for our experience of motion and change

¹⁸Prosser’s (2016) ‘multi-detector argument’ aims to show that under some broad assumption of physicalism experience cannot *possibly* represent robust passage. An argument similar in spirit can be found in Price (1997).

in general, by contrast, the phenomenal illusionist cannot establish the illusion claim without begging the question against the passage realist. This is why the empirically-grounded explanation of illusory animation in apparent motion does not generalize. Now, the phenomenal illusionist can *stipulate* that our experience is illusory in general in some relevant sense, and then supply a mechanistic explanation as to how that comes about. But in that case, the project is no longer one of debunking.

If all this sounds like bad news for the phenomenal illusionist, it is because it is. But note that our discussion turns out to be bad news for the passage realist just as much. For just as the phenomenal illusionist cannot non-question-beggingly assume that our passage phenomenology is illusory, so too the passage realist is not justified in claiming that experience as given carries certain phenomenological ‘oomph’ in such a way that licenses a direct inference to an ontological ‘oomph’, namely temporal becoming. As [Callender \(2017\)](#) points out, the passage realist’s argument from experience is no good because it ‘reads theory into the data’. Callender cites Schuster ([1986](#), p. 695), who claims that the passage of time is given in experience as an ‘aspect of our perception of the world as the sights and sounds that come in upon us’. To my mind, Norton ([2010](#), p. 24) is another example of reading theory into the data when he claims that felt passage ‘is our largely passive experience of a fact about the way time truly is, objectively’.

I conclude that the cognitive error theorist’s critique that the phenomenal illusionist has conceded too much in granting the seeming presentation of passage turns out to be correct. This critique needs to be more carefully worded, however. It is that there is a strategic mistake on the phenomenal illusionist’s part to grant the seeming presentation of time’s passage *in the robust sense*, when experience makes no claims about passage construed as such to begin with. It bears emphasis that this is not some peculiar feature of temporal experience, however. Quite the contrary, it is temporal experience that has been sometimes assigned a peculiar role in metaphysical theorizing. For it is one thing to acknowledge

that passage realism tends to enjoy some intuitive appeal. Yet it is quite another matter to suppose, as Deng (2019, p. 14) puts it, that ‘human beings in general walk around with tacit [passage realist] models in their heads’. Deng’s suspicion can be taken a step further, however. For now emerges the question of just what people’s commitments about time’s dynamic character in fact are. It is to this issue which we turn next.¹⁹

4.4 From robust passage to intuitive belief

Some metaphysical theories are deeply intuitive by virtue of the fact that they accord with experience (e.g., endurantism), and others are deeply not for the opposite reason (e.g., panpsychism). Yet there are other theories that are neither terribly intuitive nor counter-intuitive, perhaps because they are a distance away from ordinary experience (e.g., truthmaker maximalism). I begin this section with these observations because they help to bring out two general points. First, whereas experience can sometimes *motivate* one’s metaphysical theorizing, it will be unlikely that one can routinely turn to experience for *adjudication* between competing theories. It is certainly not often that the content or character of experience can by itself play a decisive role in settling a substantive metaphysical debate. This in turn reinforces the second point that the route from experience to metaphysics is more nuanced and subtle than sometimes assumed, because experience by itself often turns out to be neutral with respect to different metaphysical possibilities.²⁰

¹⁹I venture to suggest that Deng’s suspicion may be fairly widespread among passage anti-realists. Some of them — namely, phenomenal illusionists — nevertheless make a genuine effort to explore if anything might lie behind the alleged givenness of robust passage, despite their suspicion. It is a curious development in the literature that many detailed articulations of the argument from experience for passage realism have come from anti-realists. I will argue that this is a testament to the *psychological compellingness* of our manifest image of time, especially given that its *content* does not in fact contain experience as of robust passage.

²⁰We need to be careful so as not to overstate this point, however. It is perfectly reasonable to prefer a metaphysical theory that better accords with experience over its rival, *provided that both are equally explanatorily adequate*. Emery (2022) calls it the ‘principle of minimal divergence’. However, since there are powerful empirical arguments against passage realism, this principle does not apply here.

If what I have been arguing thus far is on the right track, then the idea that the passage of time is given in experience is dubious when construed as a claim about *experience as of robust passage*. By itself this of course does not mean that there are no experience-based considerations relevant for metaphysical theorizing about time. Rather, it is in part to emphasize the need to exercise caution in interpreting our richly contentful manifest image of time, *especially* when it arises as potentially evidentially relevant. Seen through this lens, the cognitive error theorist's denial of time's seeming to pass — now properly clarified as related to experience as of robust passage — becomes far less revisionary than previously thought. Or, at least, it is my contention that this is how cognitive error theory should be understood.

This still leaves open the question of how to understand the nature of the mistaken belief identified by cognitive error theory. The mistake — now put in my preferred terminology — consists in our taking experience to represent time as robustly passing, and here there are primarily two questions to be asked. The first one concerns *how* this belief arises (given that it cannot, *ex hypothesi*, be via the standard perception-belief route), and the second one concerns *for whom* it does arise (whether philosophers are alone in suffering from the error). Note that these two questions are not entirely independent from each other. For if the mechanism by which the belief arises is of a psychologically basic sort, then there is reason to suppose the error to be widely shared. Conversely, if evidence suggests that the error is not widespread across populations, then the mechanism responsible for its occurrence may be of an idiosyncratic or context-specific sort. Ultimately, though, these are empirical issues that need to be addressed using empirical methods.²¹

This is not to say that there is no more *philosophical* work to be done. For one thing, empirical results on people's beliefs about time and temporal experience still need to be interpreted, and drawing out their implications is likely not a straightforward matter. But that is not the sort of philosophical

²¹For recent attempts, see [Latham, Miller, and Norton \(2020, 2021\)](#), [R. Lee et al. \(2022\)](#), and [Shardlow et al. \(2021\)](#).

work to be pursued for the remainder of this paper. Instead, my starting point will be that denying the seeming presentation of the passage of time in the robust sense is consistent with accepting felt passage in some non-robust sense still. I consider the latter to be of significant philosophical interest, not only because it constitutes a rich phenomenology, but also because, in the spirit of cognitive error theory, philosophers are presumably led astray *from*, even if not *by*, experience as of non-robust passage. A more narrowly-focused question thus concerns what explains philosophers' tendency to commit the alleged cognitive error concerning robust passage.

Here is a thought which I think gets things partly right, but only partly. Perhaps philosophers are led astray due to some sort of collective *metaphysical engineering* of the manifest image that is itself void of robust passage; yet in this enterprise philosophers are liable to confuse non-robust passage with robust-passage, leading them to unwittingly give more evidential weight to the manifest image than they should.²² One piece of indirect evidence in support of the notion of metaphysical engineering comes from a recent study by [Starmans and Friedman \(2020\)](#). The researchers report data showing that philosophers differ considerably from both non-philosophy academics and laypeople in their knowledge attributions in certain Gettier-style cases. The fact that it is not just laypeople but also non-philosophy academics who have intuitions about knowledge different from philosophers' is significant. For it suggests that the divergence of intuitions is unlikely to be explained by the hypothesis that laypeople simply have insufficiently careful or sophisticated views about what knowledge consists in. An alternative hypothesis is that philosophers are outliers because of their unique professional attention paid to theorizing about knowledge *per se*, which impacts how philosophers, as a group, conceptualize knowledge.

Applying this second alternative hypothesis to aid cognitive error theory has some plausibility.

²²These two thoughts are gestured at briefly in Deng (2019, p. 14). In a similar vein, [Smart \(1980\)](#) regards our sense of the passage of time as a metaphysical confusion.

Admittedly, the difference between the metaphysically engineered outcome of the manifest image vis-à-vis passage and the image itself may not be best characterized in terms of *divergence*. In the case of knowledge, there is a genuine bifurcation of judgments in that knowledge attribution is a binary matter on which philosophers and laypeople differ. By contrast, I am supposing here that the cognitive error theorist takes philosophers as inclined to mistakenly *over*-interpret the manifest image, attributing to it the metaphysically-loaded notion of temporal becoming where it does not belong. But this contrast is a superficial one. What is supposed to do the explanatory work in both cases is the idea that prolonged philosophical theorizing about a subject causes a shift in how philosophers conceptualize that subject compared to laypeople.

This is admittedly all very speculative. But if anything in what has been suggested is on the right track, such a shift may be particularly likely in the domain of time, due to philosophers' attempts to explicate the many metaphors commonly used to characterize time's passage. Metaphors such as *time flows like a river* are deeply intuitive, and yet by nature imprecise and ambiguous. Furthermore, note that *passage* itself is a motion metaphor already. Motion in the ordinary sense consists of transitions in both space and time, and everyone agrees that time does not literally move in *that* sense. To precisify the notion of the passage of time, then, it might seem somewhat reasonable to postulate an additional, sui generis sort of motion that is neither *in* space nor *in* time — call it temporal motion instead. Thus enters the idea of temporal becoming?

I am not entirely confident in the suggestion just made about how exactly the error originates. But the details of how the metaphysical engineering comes about are in a way besides the point. For in any event, the allegedly over-interpreted manifest image itself must still contain appropriate 'source material' *against which the error is to be defined*. This invites, I submit, an entirely different explanatory project altogether. As noted at the outset, there is some broad consensus on the experiential seeming

of the passage of time in a way that suggests time as fundamentally different from space. Also noted — and more importantly for our present discussion — is the additional sentiment that this seeming constitutes first and foremost a *pre-reflective* conception of time’s dynamic character. Now, even if the cognitive error theorist replies that we are mistaken in describing what is on her account an over-interpreted image as pre-reflective, it remains the case that this allegedly mistaken description seems perfectly natural with respect to the ‘source material’. This suggests that, metaphysically engineered or not, the seeming presentation of time’s passage has a certain psychological compellingness, and by this I do mean in the literal sense that it *compels* one to believe the suggested content of the seeming.²³

One way to appreciate the psychological compellingness of our manifest image of time is to consider the psychological difficulty of giving it up. [Ismael \(2017\)](#) describes this as follows:

The apparent conflict between the familiar, flowing time of everyday experience and the static time of the Block Universe has a stubborn way of reasserting itself as a substantive and all-important metaphysical disagreement, even in my own mind. It is a reminder of the constant tension in the human between the transcendent and embedded viewpoints, which is in its turn the product of the peculiarly human form of mindedness. (p. 35)

Ismael’s remark is meant to highlight that the appearance of the conflict between the manifest and scientific images of time is *resilient*. This is something that calls out for explanation. Note that part of what gives rise to the conflict is simply the ‘familiar, flowing time of everyday experience’. This does not concern robust passage. Expressed in my preferred terminology, even experience as of non-robust passage carries a certain psychological compellingness that demands accommodation, manifested in the persistent impression that there is *something* about time’s dynamic character revealed in ordinary experience

²³For discussions of a closely related notion of seeming in epistemology, see [Moretti \(2015\)](#), [Reiland \(2015\)](#), [Teng \(2018\)](#), and [Tucker \(2010\)](#).

that is missing in the scientific image of time.

This takes us back to cognitive error theory. Whereas I think it right to correct the misconception that ordinary experience represents time as passing in the robust sense, this correction needs to be properly contextualized so as to not miss out on an equally important question. That is the question concerning what it is about experience as of non-robust passage such that it is poised to strike one as psychologically compelling evidence that time passes — even if not in the robust sense of temporal becoming, nevertheless in a substantive sense in which reality is not viewed as static, in which space and time are considered fundamentally different by us, etc.²⁴

Note that, contrastingly, if one holds that felt passage is *either* robust but a philosophical mistake, *or* non-robust but philosophically uninteresting, then the only pressing question will seem to be about the cognitive mechanism responsible for that mistake. Ismael's remark above is a reminder that this is predicated on a false dichotomy. Indeed, there is a rather mundane but psychologically compelling sense in which time as it seems to us in experience differs from time as understood in the Block Universe, and this difference still is of significant theoretical interest. Furthermore, this difference need not reflect a mistake in the sense of an anomaly. Our manifest image results from an interpretive cognitive process subserving adaptive behaviors. Consequently, it is hardly surprising that it does not always deliver deep insights into the nature of reality. But even so, there remains a broader — and, in a way, prior — question concerning the content of our intuitive thinking about time, as well as its role in the cognitive economy.

4.5 Intuitive grasp of dynamic time: a multi-level analysis

Exactly what it means to say that our manifest image of time represents time as passing, or that it is part of our commonsense picture of the world that time passes, is the central question to be addressed in

²⁴See [Callender \(2017\)](#) for an account of manifest time in this spirit.

this section. I emphasize at the outset, though, that nothing philosophically fancy is presupposed in this inquiry. That is, I will not be assuming, for example, that when Williams (1951, p. 466) describes the passage of time in terms of the ‘jerk and whoosh of process’, he is drawing attention to anything other than a perfectly mundane element of ordinary phenomenology. Similarly, the approaching of the future need not be explicated in terms of temporal becoming; perhaps the combination of temporal distance, temporal asymmetry, and temporal orientation will suffice. When ordinary people think about the passing of time, these are among the things they think about. I will henceforth speak of there being an intuitive belief that time passes.²⁵

I do need to say a few words about what I mean by ‘belief’ and what it means for a belief to be ‘intuitive’, however. There is a substantial philosophical literature on the nature of belief, which will be set to the side. Here I take beliefs to form a heterogeneous cluster of mental representations, ranging from attitudes towards propositions to implicit statistical knowledge. In doing so, I follow how the notion of belief is understood in cognitive science, broadly operationalized as *information which explains reasoning and behavior*. In this regard, it is perhaps useful to think of believing, or kinds of believing, alongside beliefs. Remembering is believing (in which case one believes what one remembers), as is interpreting the world by means of a certain assumption (in which case one believes that assumption). For a belief to be an intuitive, however, it is not enough that its content has intuitive plausibility. The notion of intuitiveness employed here is a bit more demanding. In particular, I intend the passage of time to be understood as intuitive in the specific sense employed in cognitive science too, where intuitive theories are contrasted with scientific theories, and where intuitive beliefs are contrasted with reflective

²⁵Gell (1992) provides some anthropological evidence that belief in the passage of time is universal. We also represent the *speed* by which time passes, as evidenced by the fact that statements such as ‘time flies when you are having fun’ are immediately comprehensible and part of our common discourse about time. Finally, though there are culturally-specific metaphors to describe the passage of time, Kövecses (2005) argues that their linguistic presence and acquisition occur early in development.

beliefs.²⁶

While I will not attempt a definition of intuitive beliefs in the form of necessary and sufficient conditions, there are two paradigmatic features that are relevant for our purposes. First, to obtain or activate intuitive beliefs, one need not reflect on the way one arrives at them, either epistemically or causally. Note that this makes perceptual beliefs — beliefs that are the outputs of perceptual processes — intuitive in the relevant sense, and it follows that the manifest image consists of intuitive beliefs. Additionally, beliefs resulting from spontaneous inferential processes are also intuitive ones, akin to intuitive judgments as discussed in the reasoning literature.²⁷

In connection to this first feature, the assumptions and commitments behind intuitive beliefs are often *not* explicitly articulated or immediately reportable, nor are the inferences made based upon them always conscious. Some concrete examples will help to make this point vivid. In my usage of the term, we possess an intuitive belief about ourselves as agents with free will: we simply act as if we are, without having to think so first. Furthermore, this belief automatically figures in our understanding and assessment of others' actions.²⁸ By a similar token, we intuitively take agents as disposed to maximize rewards and minimize costs, and we automatically perform computations in accordance with this principle.²⁹ Finally, as an example in a non-social domain, we have an intuitive understanding of objects according to which objects respect spatio-temporal continuity. Though rarely articulated explicitly, this intuitive belief has profound implications for such basic cognitive tasks as object tracking and event segmenta-

²⁶Classic discussions of intuitive theories can be found in Carey (2009) and Wellman and Gelman (1992). Intuitive theories are *theories* in that they are coherently interconnected systems of concepts that can be used to make psychological inferences. The sense in which they are *intuitive* partly has to do with their acquisition channel, i.e., in the absence of formal education. Sperber (1997) distinguishes intuitive beliefs from reflective beliefs, differing in whether they are automatically treated as 'data'.

²⁷Note that whereas many intuitive beliefs in this *process*-oriented sense will come out to have intuitively plausible *content*, it does not necessarily follow that they always will.

²⁸Unsurprisingly, as reported by Nahmias, Morris, Nadelhoffer, and Turner (2005), this belief is importantly linked with our notion of moral responsibility.

²⁹Jara-Ettinger, Gweon, Schulz, and Tenenbaum (2016) call this the 'naïve utility calculus'.

tion.³⁰

Note that it is in a perfectly ordinary sense to attribute beliefs in the examples just given. The fact that people do not always consciously maintain those beliefs as they go about living their everyday lives hardly matters for belief attribution; intuitive beliefs, like beliefs, can be tacitly held. Rather, what matters is that in each of the aforementioned cases the intuitive belief in question functions as a fundamental principle that constrains perceptual processing and/or decision-making. They are, in this regard, among the basic tenets by which we make sense of and interact with the world. While playing this sort of inference-guiding role is not a universal feature of intuitive beliefs — on my account there is unlikely to be any universal feature — I will suggest that it is an important feature shared by our intuitive belief about time’s dynamic character.

Thus, intuitive beliefs also form a heterogeneous cluster spanning a wide range of cognitive domains. They serve different functional roles, and are bound to admit of varying degrees of conceptual richness. Further, as already indicated, whereas some intuitive beliefs are immediately accessible, others can be deeply embedded in the cognitive architecture. Correspondingly, there are then two different ways in which intuitive beliefs contribute to the manifest image. Sometimes they explicitly and directly inform us of what the world is like. But others are better construed as domain-specific principles serving to guide learning and inference. As such, they structurally shape the formation of the manifest image, with their conceptual content implicated rather than explicitly represented in the manifest image. Thus our perception of agency does not necessarily involve representing others *as* agents with free will. Nevertheless, the concept of free will is implicitly embedded in our understanding, expectations, and attitudes of others, and this implicit content can be *made* explicit upon reflection.

³⁰A wealth of evidence from developmental psychology is reviewed in Carey (2009) and Spelke (2022) in showing that this last principle is early-developing. Scholl (2007) relates it to our intuitions about object persistence.

Intuitive beliefs of this second sort are often beliefs belonging to intuitive theories. Intuitive theories are not merely categorized aggregates of intuitive beliefs, however (just as scientific theories are not categorized aggregates of scientific beliefs). Rather, such theories are organized knowledge systems that contain explanatory principles which, when relevant, are automatically recruited to interpret and make predictions about one's current evidence. This explains why, for instance, subjects in Heider and Simmel's (1944) classic study spontaneously used mentalizing terms to describe moving inanimate geometric objects as if they had intentions and emotions.

Another example of intuitive inference-guiding principles comes from teleological thinking, the tendency to think about objects and events as having a purpose — existing or happening for a reason. Teleological beliefs are reported by young children when probed to explain, for example, why rocks are pointy ('so that animals won't sit on them'; see Kelemen, 1999). Further, teleological thinking continues throughout the lifespan, as evidenced by the fact that when under time pressure even highly-educated adults are prone to endorse teleological explanations in domains where the adults know such explanations to be false (Kelemen, Rottman, & Seston, 2013). Crucially, for young children and adults alike, it is not as if they constantly held an explicit belief that things (or most things) have a purpose and then used this belief in deliberate reasoning. Rather, teleological thinking is better construed as a default cognitive mode. There is thus a robust sense in which the belief that things have a purpose *is* part of our manifest image or naïve conception of the world. This is because the world is perceived via the lens of this belief.

Drawing on this last example, my suggestion is that the intuitive belief that time passes is constituted by a multi-level, hierarchically-organized representational knowledge structure. The suggestion is in effect that we have an intuitive theory in the domain of time just as we do in the domains of physics, psychology, and biology. As a first attempt to motivate this bold conjecture, I will distinguish three lev-

els of mental representations for our intuitive belief that time passes. These levels, in ascending order of conceptual richness, are as follows: (i) a non-conceptual sense of elapsed time; (ii) a concept-laden awareness of felt passage; and (iii) a set of full-blown judgments about time's dynamic character. Stated as such, however, there is an immediate worry that needs to be dealt with. It is that it seems strange to include full-blown judgments in an account that is supposed to elucidate the *intuitive belief* that time passes.

A couple of clarifications should be made in reply. The first one is simply that in proposing this tripartite hierarchy no claim is made about the *necessity* of all three levels for the intuitive belief to exist. Rather, it is more helpful to view the intuitive belief that time passes as an abstraction of sorts which encodes a rich body of knowledge implicated in the manifest image in a myriad of ways, and which is likely to be reported or endorsed when one is probed in appropriate ways. The content of this abstraction, then, also depends upon what it is an abstract *of*, which is of course an empirical question. Second, more importantly, one crucial signature for intuitive beliefs is that their activation or employment requires no deliberate reasoning or decision-making. This feature is connected to the ways in which intuitive beliefs are constitutively involved in the manifest image. In this regard, it helps to consider adult folk-psychology as an analogous case. While it encodes a rich body of social knowledge, and while adults can engage in complex propositional syllogisms in the interpersonal realm, whenever utilized, the activation of folk-psychology is nevertheless automatic, with many of its inferences spontaneously drawn. Therefore, folk-psychology is still an intuitive domain in the relevant sense. Much the same, I submit, can be said of the intuitive belief that time passes. There is thus, in principle, no awkwardness in including full-blown explicit judgments in an intuitive knowledge system.³¹

³¹ Furthermore, full-blown explicit judgments in intuitive domains can be viewed as culturally-enriched linguistic articulations of what might be called 'core principles' of the domain in question. To use folk-psychology as an example again, one can form an explicit judgment to the effect that people seek to maximize rewards and minimize costs, in addition to

What does it mean to view the intuitive belief that time passes as an abstraction, however? I mean it in the sense of an inference-guiding principle of an intuitive theory. On my account, our intuitive belief that time passes does not *so much* function to track any particular state of affairs in the world, as it functions to organize and interpret the sensory information to issue in specific elements of the manifest image. Less abstractly, we see the world in part through the lens of the belief that time passes, and this is the sense in which our manifest image of time represents time as passing, the world as changing, the past and the future as fundamentally different, etc. All this invites the question, of course, of how this intuitive belief is acquired. Though a full treatment of this question is well beyond the scope of this paper, progress can be made by gaining clarity on the organizational structure of the three levels involved.

Already implicit in my tripartite hierarchy is the idea that our linguistic and conceptual practice associated with the notion of the passage of time refers not to *one thing*. Such an outcome, I submit, is strongly suggested by the philosophical literature on temporal experience, albeit indirectly in its struggle to identify that *one thing* that is supposed to account for our experience as of the passage of time.³² But this singularity assumption has always been in operation and yet rarely defended. Upon reflection, this is a surprising assumption to make. For if I am right about the intuitive belief that time passes being an inference-guiding principle of an intuitive theory, then we have reason to expect its cognitive implications to be varied and complex.

Now, pitting the multi-level structure and the singularity assumption against each other may provoke the suspicion that the former is an *ad hoc* attempt to incorporate existing accounts by placing them in a hierarchical structure. As will be clear shortly, this multi-level structure is not an ‘anything goes’

intuitively believe this to be the case.

³²The literature is large and growing. We have already seen that phenomenal illusionists look to our experience as of motion and change. Prosser (2012) and Velleman (2006) defend the position that felt passage is grounded in our representation of the enduring self. Young (2022) argues that agentive experience is what is responsible for our belief that time passes.

account, although I do think being inclusive with respect to currently existing theoretical proposals is a merit of the account. More importantly, there are good reasons to think that a multi-level structure is appropriate for capturing the intuitive belief that time passes as an inference-guiding principle. I will argue for this appropriateness in three steps.

First, because time perception does not uniquely implicate a particular sensory faculty, representations of temporal properties in general, including any dynamic properties, are likely to be abstract and amodal (i.e., not limited to a specific sensory modality). This means, on the one hand, that the contents of these representations are not determined by the non-temporal sensory primitives which reliably correlate with objective (spatio-)temporal features of the environment. Instead, their contents are to be determined by the internal systems responsible for their construction. A case in point is that non-conceptual representations of durations, which are known to be phylogenetically and ontogenetically ancient, take on an analogue-magnitude — thus abstract and amodal — format regardless of the modality of the input. Likewise, perception of order and simultaneity is amodal in character, having to integrate relevant temporal information coming from different sensory channels. For the more conceptually-rich representations, their contents largely depend upon their functional-semantic roles in the cognitive system, and this strongly suggests that the concept of the passage of time exists in a rich network of interconnected concepts.

There is a general lesson here. As [Halberda \(2019\)](#) argues in the case of representations of numbers, sensory input does not determine conceptual content. The thought is that since numbers as such are not *in* the world, our mental representations of numbers then must come from the mind interpreting sensory information that is not itself numerical. This conclusion is supposed to generalize to abstract representations in general. Now, given the central importance of timing throughout cognition, there is reason to expect temporal representations to be mapped widely with representations of

other sorts and from other domains. This makes it likely that representations in the domain of time are particularly conceptually- and inferentially-rich.³³

The second step in my argument makes an indirect but general claim by pointing to the fact that cognitive domains in which representations are likewise abstract, amodal, and yet widespread throughout cognition tend to warrant a multi-level analysis. Consider representations of agency. There is evidence, as reported by [Choi, Mou, and Luo \(2018\)](#), that infants as young as 3-month-old are capable of representing (an admittedly rudimentary form of) agency non-conceptually by way of representing goal-directed actions. This is to be distinguished from how cognitive development equips children and adults with conceptually-rich representations of agency, or representations embedded in richer inferential and conceptual networks. Such representations in turn form the proper basis for explicit judgments and attributions of intentional states, and are importantly connected to representations in other domains such as causation and morality. Thus, it is hard to understand our concept of agency *not* implicitly as a causal and moral concept as well, and our reasoning about intentionality often spontaneously involves reasoning about causation and reasoning about morality at the same time.

The third and final step is that a multi-level decomposition for cognitive domains in which representations are abstract, amodal and yet widespread throughout cognition is the rule rather than the exception. The reason, as indicated by the example of the domain of agency, is twofold: these representations are abstract and amodal, making widespread mappings to representations of other sorts and from other domains convenient; these domains are also of central importance for cognition, making widespread mappings to representations of other sorts and from other domains advantageous if not necessary. Indeed, content determination for abstract concepts is achieved through such intercon-

³³Indeed, we do know this to be true in at least one particular respect, in accordance with the so-called ‘spatialization of time’, as [Boroditsky \(2000\)](#) argues that abstract conceptual representations in the domain of time are structured through spatial metaphors.

nected mappings. Further, any such individual mappings may receive continuous enrichment so as to form systematic bodies of knowledge. The exact same sort of representational structure, it stands to reason, applies to the domain of time. The case for felt passage, I suggest, is in fact particularly strong, as evidenced by the abundance of existing discussions in the literature on how rich conceptual connections between passage and other temporal (e.g., PRESENTNESS) or non-temporal concepts (e.g., CHANGE) are contained in temporal experience. What needs to be acknowledged, then, is that there is unlikely going to be a magical ingredient — namely a single, specific phenomenological datum to be introspected — that uniquely deserves the title of felt passage, or considered the origin of our intuitive belief that time passes.

It is noteworthy that within this multi-level structure there is a ready explanation as to why the passage of time tends to be characterized in overly metaphorical terms in ordinary discourse, but sometimes even in philosophy as well. Metaphors are imprecise and often subject to interpretation, and their value lies in calling our attention to certain nuances which are otherwise difficult to articulate simply and/or explicitly. Yet given that the notion of the passage of time stands in rich and varied conceptual connections to other concepts both internal and external to the domain of time, metaphors may well be the naturally-employed tools to talk about it.

More importantly, conceiving the intuitive belief that time passes as an inference-guiding principle of an intuitive theory provides an explanation for the psychological compellingness of this intuition. When the belief is activated or employed, especially salient in the manifest image is not only any particular perceptual belief at the moment, but potentially also a whole network of interconnected concepts from which the particular perceptual belief gains its accessible contentful significance. As mentioned earlier, not all relevant assumptions and commitments are explicitly articulated or immediately accessible. Nevertheless, our cognitive contact with the world is shaped by them, and their influence *can* be

made explicit by reflection or introspection.

This means that insofar as our manifest image represents time as passing in a psychologically compelling manner, it is because the manifest image becomes the way it is in part by way of the intuitive belief that time passes. This explanation thus turns the idea that the passage of time is given in experience on its head, for the latter has the order exactly backwards. In a quasi-Kantian way, it is not that the passage of time is given in experience, but rather that conscious experience becomes possible because of the structuring it receives from our intuitive grasp of time's dynamic character.

4.6 Duration, action, and passage

The multi-level analysis of the intuitive belief that time passes has two main virtues. The first is that it helps us capture and systematize the myriad ways in which the intuitive datum concerning time's passage has been characterized. Second, it offers an explanation of why this intuition is psychologically compelling. In this last section, I am going to develop the bottom level of the hierarchy — a non-conceptual sense of elapsed time — in some detail. This is to directly address the worry that duration perception is not obviously connected with felt passage.

We shall still begin with an understanding of analogue magnitude representations of duration. It is well-established that human (and animal) timing in the interval range (from seconds to minutes) is governed by the so-called internal clock. (For ease of exposition, here I will focus on interval timing, though much of what I will say about interval timing below applies to motor timing as well.) Distilled to essentials, the internal clock model postulates a pacemaker–accumulator system that provides the raw material making possible representations of duration.³⁴ This is done via the pacemaker emitting pulses

³⁴Much of our current theorizing about the internal clock model follows the scalar expectancy theory developed by [Gibbon \(1977\)](#) and [Treisman \(1984\)](#).

at a certain averaged or fixed rate, which are stored in the accumulator. In this model, the readout of the accumulator is then supplied to downstream processes, influencing behavior but also simply generating a perceptual sense of elapsed time.

The internal clock model is a powerful information-processing model, with its components and processes characterized in purely functional terms. We have good reason to think that, however the neurophysiological details will turn out, the internal clock model characterizes the formal, computational processes underlying interval timing in the brain. For example, as accumulation is a linear yet noisy process, the internal clock model predicts that errors in time estimation are proportional to how long the target intervals are, following Weber's law. This prediction is empirically validated. The model also predicts that when the rate of the pacemaker is altered, its effect will be multiplicative as opposed to a fixed amount (since rate changes are *iterative* over time). Empirical studies using a wide range of paradigms suggest this to be the case as well.³⁵

It is tempting to think, at this point, that duration perception is solely focused on mapping the *metric* temporal information in the environment — that is, temporal magnitudes. On this thought, it is indeed unclear how elapsed time can be related to felt passage or the intuitive belief that time passes. One way to motivate the worry is by noting that representing magnitudes of other sorts is not obviously connected to anything dynamic in experience. For example, given that spatial awareness by way of spatial magnitudes does not generate any dynamic phenomenology, what makes temporal awareness by way of temporal magnitudes different?

Pooley (2013) raises the question sharply, though he does so in the context of representing temporal sequence (thus in a slightly different context):

[Viewing an event relative to different events on an ordered sequence] no more corre-

³⁵For reviews of the findings mentioned above, see Allman et al. (2014) and Wearden and Jones (2007).

sponds to the real passage of time than the analogous spatial truth that, relative to a sequence of locations ordered continuously by their mutual spatial distances, the first element of the sequence is an ever greater spatial distance from each subsequent member of the sequence. (p. 335)

Pooley's point is that just as representing the relative distances between spatial locations generates nothing intrinsically dynamic, so too merely representing the relative distances between temporal locations fails to capture the dynamic character of time.

While this may be correct about representing spatial and temporal distances in the generic sense, there is a crucial difference between formal, mathematical representation (which is Pooley's topic) and perceptual-cognitive representation (which concerns us). More to the point, the latter is part of a cognitive system's interaction with a changing environment, and this means, I argue, that in any realistic cognitive system duration perception cannot be *solely* devoted to mapping the metric temporal information in the environment. The answer to the question of what makes temporal awareness by way of duration perception different from spatial awareness by way of distance perception is that duration perception consists of more than representing magnitudes.

We will illustrate this with a toy example. Suppose that an agent has learned, after repeated trial-and-error training, that there is about a 10 s gap between the initiation of an action (A) and an expected reward (R). Suppose further that where the action must be performed is spatially separated from the reward location, so that in effect an additional action of making one's way to the reward location is involved. What, exactly, has the agent learned in this case? While it is natural — and, indeed, correct — to say that the agent has learned the temporal distance (duration) between (A) and (R), this is also an incomplete characterization of the agent's internal states. For the agent has also learned that a reward is

forthcoming about 10 seconds *after* performing the required action. Note that this knowledge does not simply involve representing a temporal sequence. Nor does it suffice to combine the temporal sequence with duration information. Rather, what crucially needs representing is also the temporal location of another event, (R), *from the temporal perspective* of a given event, (A). To be able to do this is crucial for achieving the agent’s goal. This is because in order to obtain the the expected reward, actions need to be planned out and executed in a timely manner after (A), as in from the temporal perspective at (A).

This toy example illustrates that adaptive behavior in an ever-changing world requires representing the dynamics of event structure as much as temporal magnitudes. Indeed, these two types of representations must be integrated in the cognitive system in a useful way linked to our capacity to act.³⁶ To put the point simply, when to perform an action is just as important as what action to perform. Crucially, this action-oriented knowledge of *when* cannot only be a matter of representing temporal magnitudes; rather, it must involve tracking elapsed time from the temporal perspective relevant to the agent at any given time — which is to say, tracking the passage of time. Thus understood, our sense of elapsed time is already dynamic due to the representational requirements of agency. This provides, I suggest, an ever-present, though not to say always salient, feeling that time, in a non-robust but nevertheless substantive sense, passes.

It is worth clarifying that this does not necessarily involve any conceptual representation of temporal properties. The claim is not that, in the toy example, the agent’s internal states must be explicitly *tensed*. Rather, the claim is that the agent’s perceptual-motor planning and coordination is underpinned by dynamically changing temporal perspectives. In the same way that objects are perceptually represented from the organism’s own egocentric *spatial* perspective, events are represented from the organism’s own egocentric *temporal* perspective (which is not to say that they can only be egocentric,

³⁶Petter, Gershman, and Meck (2018) argue for a similar conclusion in the context of reinforcement learning.

of course). Within each temporal perspective, the temporal asymmetry between the past and future is implicitly recognized insofar as events from the past have different cognitive significance from events in the future *relative to the agent's goal state*. Put in somewhat intellectualized but more intuitive terms, our capacity to act presupposes an implicit appreciation of the fixedness of the past and openness of the future, where the past and future are both indexically comprehended. This suggests that such a temporal asymmetry may be a basic principle built into our cognitive architecture, and as a result our manifest image is imbued with the impression that time passes.

4.7 Concluding remarks

Let's return to where we started: the world is a dynamic place. The twofold overarching goal of this paper is first to properly characterize this dynamic character of reality as it manifests in experience, and second to develop an account of the dynamic phenomenology. I have urged to resist the temptation for thinking that our manifest image of time must represent time as robustly passing in the sense of temporal becoming. But the more important part of the project involves showing that experience as of non-robust passage is still ripe with opportunities for philosophical exploration. Here I have only begun to explore two specific issues, concerning why the intuition that time passes is psychologically compelling, and concerning how our non-conceptual sense of elapsed time is a genuine form of passage phenomenology. Much more work is needed, no doubt. However, my answer to each of these two questions here also serves as a demonstration for a more general approach, and it is to take seriously the idea that we have an intuitive theory in the domain of time.

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