The Sense of Temporal Flow: A Higher-Order Account

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We seem to experience time as flowing. Yet according to the leading metaphysical picture of time, the block-universe theory, time in fact does not flow. Block-lovers typically react to this apparent tension by unhitching the sense of flow in our temporal experience from temporal reality, holding that temporal experience must be systematically illusory. I shall develop a new block-friendly account of the sense of flow, which allows a match of temporal experience and temporal reality. According to this account, the sense of flow arises from higher-order temporal experience.

1 The problem of the sense of flow

Suppose that I look at a falling leaf. Let me describe, from the first-personal point of view, what I see. First of all, I see that the leaf moves. I do not merely see that the leaf hangs from a branch at a moment. And I do not merely see that the leaf is poised in mid-air at a moment. I rather see that the leaf hangs from a branch *before* it is poised in mid-air, and that the leaf is poised in mid-air *before* it lies on the ground. That is, I do not merely *infer* that the leaf has moved, from memories of previously experienced momentary leaf-states. I *see* that the leaf moves, by seeing that the leaf is in various different momentary locational states, and that these states are ordered by temporal priority.[1]

Compare my looking at a falling leaf with my looking at a wilting leaf. I see that the leaf moves, but I do not see that it wilts. What is the difference? It seems that my experiences as of objectual change have a certain temporal horizon.[2] I see that one object-state obtains before another one does, only if the two states are sufficiently temporally close to each other. There seems to be a maximal period of time that an individual experience can span, what is often called a *specious present*, such that the leaf goes through a series of locational states that are different enough to be visually discriminable, and that are temporally close enough to fall within a specious present, whereas no visually discriminable differences in the leaf's shape and color fall within a specious present, and hence its wilting fails to be visually perceivable (under normal

[1] Regarding talk of object-states, I shall assume that "*S* sees that the leaf is in location *l*", "*S* sees that the leaf is in the *l*-state", and "*S* sees that the leaf's *l*-state obtains" are interchangeable.
[2] I shall use the phrase 'an experience *as of x*' to indicate that while the experience represents that *x* obtains, *x* may in fact not obtain.

circumstances). Instead of perceiving the wilting of the leaf, I infer it on the basis of memories of past leaf-states of shape and color.[3]

So I see that the leaf-states are ordered by temporal priority, within the horizon of a specious present. That is not all, though. I also see that the leaf-states stand in a peculiar relationship that goes beyond their being temporally ordered. They seem to undergo a process of constant *replacement*: in the motion of the leaf, say from moment t_1 to t_3, the leaf's locational state at t_1 is replaced by the leaf's locational state at t_2, and the latter is replaced by the leaf's locational state at t_3 (ignoring the many locational states in between). I see that each momentary leaf-state is immediately replaced by another one like water flowing through a river bed, where each portion of water is immediately replaced by a new portion. In order to give this phenomenal aspect a familiar label, I shall say that my experience as of the leaf's motion, within the horizon of a specious present, is accompanied by a *sense of flow*.

We can zoom into the sense of flow and attain a better grip on it by distinguishing between an object-state's *obtaining* and its being in *the present*, or its being in *reality*, where *the present* and *reality* are intuitive, pre-theoretical notions. When looking at a falling leaf, I experience that a qualitative change occurs in the leaf: I experience that the leaf's hanging up in the tree obtains before the leaf's floating in the air, and that the latter state obtains before the leaf's lying on the ground. But I also seem to experience that a change occurs with respect to which leaf-state in the motion is in the present/reality: I experience that the present/reality is such that, the leaf's hanging up in the tree is the unique leaf-state that is in it before the leaf's floating in the air is the unique leaf-state that is in it, and so on. So I seem to see that one state disappears from the present/reality as a new state appears, which state in turn is seen to leave the present/reality as its successor-state enters. The present/reality in experience never includes non-simultaneous states. That is, the present/reality as experienced never becomes temporally extended, in the sense of accommodating a plurality of momentary object-states ordered by temporal priority. The present/reality remains temporally unextended, yet in constant flux. Figuratively speaking, the present/reality is a persisting three-dimensional container that changes constantly with respect to which object-states are in it.

Compare my spatial experience (at a moment) of the leaf in midair. I see that the components of the experienced spatial display—the leaf attended to, other leaves, branches, birds, and so on—are spatially arranged in a specific fashion. That is, I have a sense of spatial order, which may be compared to my sense of temporal order in the experience as of objectual change. But I lack a sense of difference and a sense of variation concerning which components are present/real and which are not. What seems present/real in spatial experience always includes *all* components of the experienced region. There is no spatial counterpart to our sense of temporal flow.

The sense of flow is not confined to visual experiences. It accompanies all of my experiences as of objectual change, irrespective of which sense modality is involved. An auditory experience as of a rising tone and a proprioceptive experience as of the motion of my own hands seems to come with the same impression of replacement

[3] This argument for a temporal horizon in our experiences as of change appears, *inter alia*, in Broad 1923: 351, and is discussed in detail in Hoerl 2013: section 3.

that I find in a visual experience as of a falling leaf. How does the phenomenal sense of flow arise? I call this explanatory task the *problem of the sense of flow*.

It raises the hardest philosophical challenge for the leading metaphysical picture of time, the *block-universe theory*. The challenge becomes evident in light of the following two common and plausible desiderata about experience. First, the phenomenal character of an experience as of change, and of experiences in general, is grounded in (or is even identical with) representational properties, aspects of the content, of this experience.[4] Second, our experiences as of change are veridical; they typically represent the world as it really is. In light of the first desideratum, we should expect that I seem to see that the momentary leaf-states making up an episode of locational change undergo replacement, because I have an experience whose content represents the motion of the leaf as involving replacement. In light of the second desideratum, we should expect that the content of my experience representing the motion of the leaf as involving replacement corresponds to replacement in the world.

This transition from a phenomenal aspect of my experiences as of objectual change to a metaphysical aspect of objectual change presents the block-lover with a major difficulty. In a block universe, a leaf moves in virtue of undergoing different locational states, ordered by temporal priority. This account of locational change seems to match the aspect of my visual experience that the leaf is in different momentary locational states, and that these leaf-states are temporally ordered. But my additional sense of replacement of momentary leaf-states, my apparent experience that a change occurs with respect to which leaf-state is in the present/reality, does not seem to correspond to any facts in a block universe. For there is nothing that could count as an objective replacement of momentary object-states in a block universe. There is no objective, persisting three-dimensional container, no objective present/reality, that varies in which object-states are in it, and whose variation in content is represented in our experiences. In short, there is no objective flow that matches our sense of flow. [5,6]

Block-lovers have proposed various moves in response to this challenge. Almost all responses share the concession that the sense of flow cannot be understood as grounded in experiential content that represents the world correctly. The standard view is that the block-universe theory of time rules out the veridicality of the sense of flow.

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[4] This view is known as "representationalism"; see Chalmers 2004 for an overview and references.

[5] To be sure, the block-lover can say that I experience that the leaf's hanging up in the tree is present (at a time) before the leaf's floating in the air is present, where 'is present' is given the standard block-friendly indexical treatment. On the latter account, any object-state is trivially present at the time at which it obtains. From this, however, it does not follow that I experience that replacement occurs in the leaf-case. For if, on the standard account of temporal indexicals, it is true that a leaf-state is present at one time and an incompatible leaf-state is present at another time, it does not follow that there is a persisting present that varies temporally with respect to which leaf-state is contained in it (or a property, presentness, that varies with respect to which state instantiates it). An objective persisting present is precisely what the block universe lacks.

[6] Many friends of "dynamic" theories of time have argued in this sort of way for a metaphysics of time that includes objective flow, such as presentism, the moving-spotlight theory, or the growing-block theory. See, *inter alia*, Craig 2000, 2001, Gale 1968, Hestevold 1994, Le Poidevin 2007, Maudlin 2002, 2007, Norton 2010, Prior 1968, Smith 1994, and Zimmerman 2005, 2008.

It is often held, however, that the sense of flow can be understood in another way. The most popular response seems to be to hold that an experience as of objectual change is associated with a sense of flow because the experience represents the change as involving replacement, to put it in my terms, while denying that this experience is veridical, since in fact objectual change involves no replacement. The price these block-lovers are willing to pay for their cure is to accept that our experiences as of change are *systematically illusory* with respect to the pervasive sense of flow, and hence that there is a permanent mismatch between our experiences as of change and the world.[7]

Another response is to hold that experiences as of change are veridical, while denying that these experiences are accompanied by a phenomenal sense of flow in the first place. The price these block-lovers are willing to pay for their eliminativist approach to the problem of the sense of flow is to accept that we systematically and radically misinterpret our own experiences as of change. On this view, we are all under the "cognitive illusion" that our experiences as of change are accompanied by a sense of flow, while in fact they are not.[8]

Both types of response are expected to come with an account of how the respective illusion, experiential or cognitive, arises, and this account is expected to teach us how to live with the illusion. Friends of the first response need to explain why we always experientially represent objectual change as involving replacement while there is no such thing in the world.[9] And friends of the second response need to explain why we always believe that our experiences as of change contain a sense flow while in fact there is no such sense in experience.[10]

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[7] This position is explicitly adopted in Paul 2010, and it is widely assumed in discussions of temporal experience.

[8] See Braddon-Mitchell 2013, and Hoerl 2014. Deng 2013 might also point in this direction.

[9] A popular starting point is to take motion illusions, such as motion after-effect and *phi* motion, as a guide, suggesting that just as we have experiences as of motion although there is no corresponding motion in the world, so we have experiences as of replacement although there is no corresponding phenomenon in the world. See, *inter alia*, Callender 2008 and Paul 2010. For criticism of this strategy, see Hoerl 2014.

[10] A type of response that differs from the previous two has been given by Prosser (2012, 2016: chapter 6). Prosser agrees that there is a phenomenal sense of flow—which he characterizes as the sense that change is dynamic (2016: 160)—and that it arises from an experiential content that misrepresents the world. He suggests, however, that what grounds the sense of flow in an experience as of objectual change is not an experiential representation of objectual change as flowing, or as being dynamic (2016: 165), but rather a representation of an object as enduring through change (2016: section 6.5), where the notion of endurance is intended to capture that the incompatible object-states constituting an episode of objectual change have strictly the same subject of attribution (cf. *n.* 15). Prosser holds that by virtue of objectual change being represented as having an enduring subject, this subject is represented as having incompatible attributes. He concludes from this "that the representational content associated with the experience of dynamic change is a necessary falsehood" (2016: 174). I started this essay with a phenomenological characterization of the sense of flow in an experience as of objectual change as the sense of replacement—that is, as the sense that there is a change with respect to which object-state in an episode of change is in the present/reality. I did so for the purpose of providing an initial characterization of our explanandum, which improves on unexplicated appeals to a sense of "dynamicity" so common in the literature. If

Must block-lovers pay the price of systematic illusion, experiential or cognitive, with respect to the sense of flow? My aim in this essay is to develop a novel kind of block-friendly account of the sense of flow. The account to be developed will recognize a phenomenal sense of flow accompanying our experiences as of objectual change, and it will square the two intuitively plausible desiderata introduced at the outset with the block-universe theory of time. The sense of flow, so the first desideratum, is grounded in (or is even identical with) a certain experiential representation. Moreover, the block-universe theory of time is compatible with the correctness of this representation, and hence the block-universe theory does not rule out the veridicality of the sense of flow. On the promised account, we need neither be systematically misguided by our experiences, nor by our beliefs about our experiences. The account will therefore allow for a match of temporal experience and temporal reality in a block universe. Too good to be true? I think not.

My aim is primarily constructive. I shall focus on the development of the view, not on its defense against alternative block-friendly proposals. I consider it highly worthwhile to look for an account of the sense of flow that allows temporal experience to match temporal reality, while I shall not assume or try to argue that an account that avoids systematic illusions is automatically superior to any account that is stuck with them. So I shall rest content with presenting an account that satisfies desiderata that many consider intuitively plausible, but that seem incompatible with the block-universe theory at first sight. A detailed comparison with alternatives is a task for another day.

As a final preliminary, a word of warning. The problem of the sense of flow in the metaphysical context of the block-universe theory has seemed intractable to many. To tackle the problem is to engage in a highly speculative project. That is the kind of project that I shall pursue here. I shall present a picture that will strike many as quite radical. Hard problems require extreme measures. I am not convinced that this picture is on the right track. I am convinced, however, that it merits serious consideration and that discussing it will advance our understanding of the link between the experience and the nature of time.

2 The experience as of objectual change

With the aim of explaining our phenomenal sense of flow accompanying our experiences as of objectual change, I shall begin by sketching, in broad strokes, an

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this initial characterization of the explanandum is on the right track, then the experiential representation of a single object as having incompatible attributes is insufficient to explain the sense of flow. For there seems to be no explanatory bridge from an experience as of a change in what an enduring object is like over time to the target experience as of a change in what the present/reality is like over time. In what follows, I shall develop a way of closing this explanatory gap, which even avoids the conclusion that the sense of flow must be systematically illusory in the block universe. Note, finally, that Prosser distinguishes between the sense that change is dynamic (discussed in 2016: chapter 6) and the sense that we are moving through time (discussed in 2016: chapter 7), which he views as different aspects of "the sense that time passes". My present focus is only on the former sense.

account of the nature of typical experiences as of objectual change. This account will later guide the development of my account of the sense of flow.

An object changes over time just in case it has different, incompatible attributes over time. Given that we have "immediate" experiences as of objectual change, in the scope of a specious present (see Section 1 for a familiar argument that we do), I shall make three principal assumptions about the nature of such experiences, which presuppose a background assumption about experiences as of momentary object-states.

A *perception*—in the specific sense in which I shall use this term, which is to be contrasted with my generic use of "experience"—is a momentary experience that, in normal circumstances, represents a momentary object-state, which obtains (more or less) simultaneously with the perception. My background assumption, which is widely shared, is that we have perceptions as of momentary object-states. Applied to the leaf-case: *S* has a perception, p_1, at t_1, that a leaf is in l_1, a perception, p_2, at t_2, that a leaf is in l_2, and a perception, p_3, at t_3, that a leaf is in l_3. Notice that it follows that token perceptions p_1-p_3 have the same temporal order as the leaf-states they represent, respectively.[11]

On to the nature of an experience as of objectual change. My first principal assumption is that an experience as of objectual change, in the scope of a specious present, is a temporally extended token experience that has momentary, non-simultaneous token perceptions as its temporal parts. In the leaf-case, *S* has a diachronic experience that has p_1-p_3 as temporal parts.[12]

My second principal assumption is that an experience as of objectual change represents relations of temporal priority among the momentary object-states represented by the temporally extended experience's temporal parts, where the represented temporal order of the object-states matches the temporal order of the experience's temporal parts.[13] In the leaf-case, *S* has a diachronic experience that a leaf

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[11] I am here assuming that the token perception that a certain object-state obtains is a natural experiential "unit". Such a perception represents one object or several objects as having a qualitative profile that involves no change. Whether the perception and the state it represents strictly have no temporal extension or, instead, have a short temporal extension is a further issue, on which I wish to remain neutral here. Accordingly, the characterization of a perception and its represented state as "momentary" is not meant to require a specific topology of time.

[12] The view that token experiences as of objectual change are themselves temporally extended is known as *extensionalism*. Extensionalism's main defenders are Dainton (2006) and Foster (1991). Extensionalism is not without alternatives. Instead of holding that an experience as of objectual change is itself temporally extended and made up of perceptions as temporal parts, adherents of *retentionalism* hold that an experience as of objectual change is a complex momentary state that is made up of a perception, which is directed towards a present object-state, together with simultaneous *retentions*, which are directed towards object-states in the recent past. Retentionalism goes back to Brentano (1988) and Husserl (1991). I shall formulate accounts of our experiences as objectual change and of our sense of flow in extensionalist terms. However, the key ideas of the accounts may equally be worked out in retentionalist terms. In the interest of space, I shall confine myself to the development of the simplest versions.

[13] The question as to how we manage to experience that relations of temporal priority hold between momentary object-states has given rise to a rich debate in the philosophy of temporal experience. For excellent overviews of this debate and references, see Dainton 2000/6, 2011.

is in l_1 *before* a leaf is in l_2, and that a leaf is in l_2 *before* a leaf is in l_3, where the represented temporal order of the leaf-states matches the temporal order of p_1, p_2, and p_3.[14]

My third principal assumption is that an experience as of objectual change represents the temporally ordered momentary states as having the same subject, and hence it represents this subject as persisting through the represented episode of change. In the leaf-case, *S* has a diachronic experience that a leaf is in l_1 before *it* is in l_2, and that *it* is in l_2 before *it* is in l_3.[15]

Combining the three principal assumptions:

(OC) *S* has a temporally extended experience, which has perceptions p_1, p_2, and p_3 as temporal parts, with the content that a leaf is in l_1 before it is in l_2, and that it is in l_2 before it is in l_3, where the represented temporal order of the leaf-states matches the temporal order of p_1, p_2, and p_3.

This is a case of an experience as of objectual change with respect to location—in short, of an experience as of motion. (OC) is illustrated in Figure 1.

[14] Thus I shall assume that an experience represents temporal relations as holding between object-states that are not relativized to particular moments of time, as it is implausible that we experientially represent particular moments. Accordingly, any references to specific moments in the following figures illustrating experiential contents are to be read as mere heuristic devices intended to indicate only the representation of temporal relations between states.

[15] On the representation of persistence in object perception, see, *inter alia*, Scholl (2007). Some, including Prosser (2016), draw a distinction between experiential representations of *endurance* and of *perdurance*. While they point to a relevant difference, I advise against using this terminology here. In metaphysics, where the terms have been introduced, the standard view is that an object persists just in case it exists at different times, while endurantists and perdurantists debate what grounds persistence, and whether it is grounded at all. Since this issue concerning grounding and metaphysical explanation plays no role in discussions of experiential content, the terms should be avoided in this context.

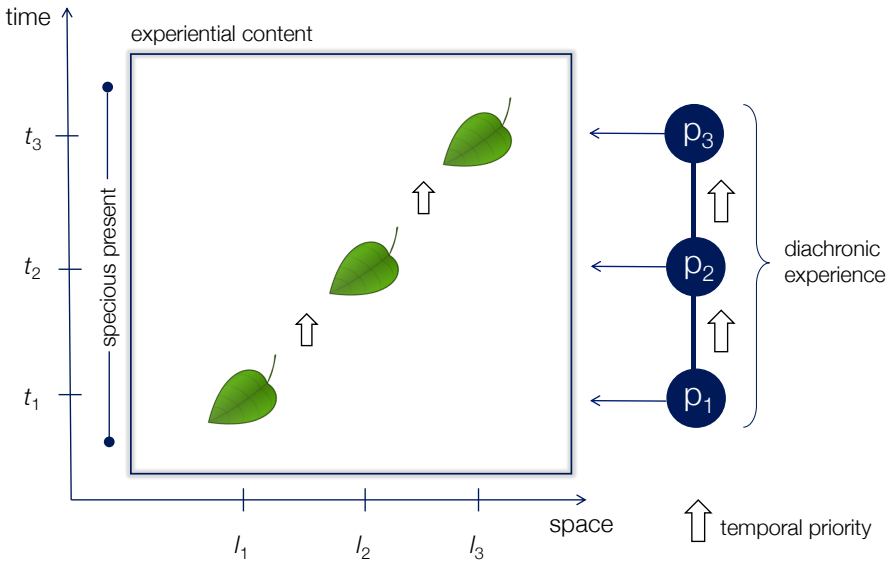

Figure 1: An experience as of objectual change

An experience as of objectual change is a *3+1-dimensional* representation of an object, in the sense that an object is represented as having, roughly speaking, different three-dimensional attributes—such as different three-dimensional locations or different three-dimensional shapes—in a certain temporal order. According to a *4-dimensional* representation of an object, by contrast, an object is represented as having a four-dimensional attribute—such as a four-dimensional location, a so-called "world volume", or a wormlike four-dimensional shape—*simpliciter*. A 4-dimensional representation is not a representation of objectual change, by the definition of objectual change given earlier.[16]

Assuming that we live in a block universe, which is standardly characterized in terms of 4-dimensional spacetime regions and their contents, why is an object-experience with an extended temporal horizon a 3+1-dimensional representation, and hence an experience as of objectual change, rather than a 4-dimensional representation? A natural (though not obligatory) answer appeals to what I shall call *temporal atomism*: the tokens and contents of diachronic experiences are generated from the tokens and contents of momentary experiences. A momentary perception represents an object as having a three-dimensional attribute—such as a three-dimensional location or shape. A temporally extended token experience derives from momentary token perceptions, such that the latter are the extended token's temporal parts. Moreover, the generated diachronic experience represents, in 3+1-fashion, a range of three-dimensional states of an object as having a certain temporal order, *R*, *because* the temporal parts of the diachronic experience represent three-dimensional

[16] It is a common view in the metaphysics of persistence and change that 3+1-dimensional facts are (partially) grounded in 4-dimensional facts. Even so, a 3+1-dimensional representation is not a 4-dimensional representation.

object-states, and because the temporal parts have temporal order *R*. So, intuitively, a diachronic temporal experience that has momentary temporal parts that represent three-dimensional object-states, and that have a certain temporal order, "projects" that order into the plurality of represented three-dimensional object-states.[17]

3 The experience as of perceptual change

In what follows, I shall develop a block-friendly account of the sense of flow as arising from a certain kind of experience as of change, which I shall call an experience as of *perceptual change*. In this section, I shall introduce the notion of an experience as of perceptual change, and I shall relate this kind of experience to experiences as of objectual change. In the next section, I shall explain the sense of flow in terms of experiences as of perceptual change.

Momentary perceptions as of object-states and diachronic experiences as of objectual change are outward-directed first-order states. I now want to suggest that these first-order experiences are typically accompanied by certain inward-directed second-order experiences. Traditionally, the main motivation for recognizing higher-order experiences has been their role in higher-order monitoring theories of phenomenal consciousness.[18] The central idea is that for an experience to be conscious is for it to be the object of a higher-order experience. Thus, my experience of a worldly state is conscious because I am aware of experiencing this state. This role of higher-order experiences is different from the role I am considering here. The question whether these roles can be connected is interesting and relevant, but trying to answer it in the confines of this essay would be far too ambitious. Accordingly, various important considerations for and against higher-order experiences that have been adduced in the complex debate about higher-order theories of consciousness will have to be set aside for now.

In typical circumstances, a momentary perception that a momentary object-state obtains is accompanied by a momentary experience that represents this perception: for any object-state, *o*, and any moment, *t*, if a typical subject, *S*, perceives, at *t*, that *o* obtains, then *S* also experiences, at *t*, that she perceives that *o* obtains. For example, when a subject has a visual perception that a certain locational leaf-state obtains, then the subject typically also has, at that moment, a second-order experience that she visually perceives that the leaf-state obtains.

Two notes of clarification. Note, first, that second-order experiences of this sort are not expected to require the effort of attentive introspection or careful self-reflection. They will rather be supposed to involve an effortless *peripheral* awareness of

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[17] According to *temporal holism*, by contrast, the tokens and contents of momentary experiences are generated from the tokens and contents of diachronic experiences. If diachronic experiences are cognitively basic, and if we live in a block-universe, then it is natural to expect that "immediate" experiences with an extended temporal horizon are 4-dimensional representations, and hence not experiences as of objectual change. So the temporal holist owes us an account of 3+1-dimensional representations. For discussion of issues surrounding what I call temporal atomism and holism, though in different terms and with a slightly different focus, see Phillips 2014a, 2014b.

[18] See, *inter alia*, Locke 1690, Armstrong 1968, 1984, and Lycan 1996, 2001.

one's own first-order experiences, which does not only accompany these experiences periodically but permanently.[19] For a simple example, I am focally aware of the glass in front of me, but only peripherally aware of the objects around it. That is, I am aware of the surrounding objects although I am not attending to them. Applied to the awareness of one's own first-order experiences, it will be assumed that when I am aware of seeing that a leaf is green while having this perception, then the awareness of the leaf's color, in the first-order content, is focal, while the awareness of my own mental state, in the second-order content, is merely peripheral.

Note, second, that the foregoing characterization of second-order experiences of first-order perceptions raises the issue of whether dependence relations hold between first-order and second-order experiences. I only said that first-order perceptions are normally accompanied by second-order momentary experiences. Are the states at different levels constitutionally independent, such that a first-order state could obtain without a second-order state, and vice versa? Or is the second-order state at least partly constituted by the first-order state, such that the former could not occur without the latter? Or is the first-order state even numerically identical with the second-order state? (In the case of identity, one might prefer to refrain from speaking of higher-order representation, and speak of same-order reflexive representation instead.) These are difficult questions, which we can, fortunately, afford to ignore for present purposes.

Consider now the phenomenally unified whole of all perceptions, p_1, p_2, …, p_m, that a subject *S* has at a moment, *t*. I shall call this whole *S*'s *perceptual window* at *t*. If an object-state, *o*, is represented by a perception of *S*, which is a part of *S*'s perceptual window at *t*, then I shall say that *S*'s perceptual window *displays o* at *t*.[20] I shall assume that for any object-state, *o*, if *S*'s perceptual window displays *o* at *t*, then *S* experiences at *t* that her perceptual window displays *o*. That is, I shall assume that a subject not only has second-order experiences of her individual first-order perceptions. She also has second-order experiences of the phenomenally unified whole composed by her perceptions.

Applying this assumption to the leaf-case, our subject *S* has, at t_1, a first-order visual perception, p_1, that the leaf's l_1-state obtains, and also a momentary second-order experience, e_1, that her perceptual window displays the leaf's l_1-state. *S* has, at t_2, a first-order visual perception, p_2, that the leaf's l_2-state obtains, and also a momentary second-order experience, e_2, that her perceptual window displays the leaf's l_2-state. Finally, *S* has, at t_3, a first-order visual perception, p_3, that the leaf's l_3-state obtains, and also a momentary second-order experience, e_3, that her perceptual window displays the leaf's l_3-state. Here e_1 obviously obtains before e_2, and e_2 before e_3.

These assumptions about momentary second-order experiences representing momentary states of a subject's perceptual window will serve as my background for the following account of experiences as of perceptual change. I shall make three

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[19] See, *inter alia*, Gurwitsch 1974 and Kriegel 2004 for the distinction between focal and peripheral self-awareness.

[20] If an object-state, *o*, is represented by a visual perception of *S*, which is a part of *S*'s perceptual window at *t*, then *S*'s perceptual window *visually* displays *o* at *t*. If *o* is represented by an auditory perception of *S*, which is a part of *S*'s perceptual window at *t*, then *S*'s perceptual window *auditorily* displays *o* at *t*. Analogously for other kinds of perception.

principal assumptions about the nature of such experiences. Their relationship is analogous to the relationship between my three principal assumptions about the nature of an experience as of objectual change, while the two kinds of change-experience have substantially different contents. The account of experiences as of objectual change sketched in Section 2 will thus be appealed to as a model for the account of experiences as of perceptual change. This structural analogy hopefully contributes to making the notion of an experience as of perceptual change intelligible.

My first principal assumption is that an experience as of perceptual change, in the scope of a specious present, is a temporally extended second-order token experience that has momentary, non-simultaneous second-order token experiences about the subject's perceptual window as its temporal parts. In the leaf-case, *S* has a diachronic experience that has e_1-e_3 as temporal parts.

My second principal assumption is that an experience as of perceptual change represents relations of temporal priority among the momentary states of the subject's perceptual window represented by the temporally extended experience's temporal parts, where the represented temporal order of the perceptual-window-states matches the temporal order of the experience's temporal parts. In the leaf-case, *S* has a diachronic experience that her perceptual window displays the leaf's l_1-state *before* her perceptual window displays the leaf's l_2-state, and that her perceptual window displays the leaf's l_2-state *before* her perceptual window displays the leaf's l_3-state, where the represented temporal order of the perceptual-window-states matches the temporal order of e_1, e_2, and e_3.

My third principal assumption is that an experience as of perceptual change represents the temporally ordered perceptual-window-states as having the same subject, and hence it represents the perceptual window as persisting through the represented episode of change concerning which object-state or object-states the perceptual window displays. In the leaf-case, *S* has a diachronic experience that her perceptual window displays the leaf's l_1-state before *it* displays the leaf's l_2-state, and that *it* displays the leaf's l_2-state before *it* displays the leaf's l_3-state.

Combining the three principal assumptions:

(PC) *S* has a temporally extended second-order experience, which has momentary second-order experiences e_1, e_2, and e_3 as temporal parts, with the content that her perceptual window displays the leaf's l_1-state before it displays the leaf's l_2-state, and that it displays the leaf's l_2-state before it displays the leaf's l_3-state, where the represented temporal order of the perceptual-window-states matches the temporal order of e_1, e_2, and e_3.

This is a case of an experience as of perceptual change. (PC) is illustrated in Figure 2.

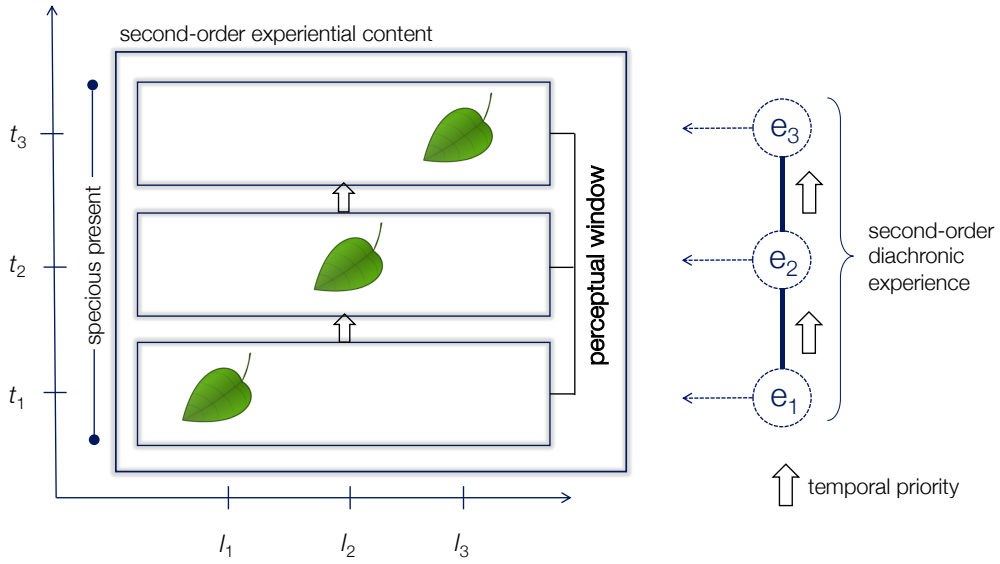

Figure 2: An experience as of perceptual change

Experiences as of perceptual change are structurally analogous to experiences as of objectual change, in that the three principal assumptions leading to (PC) parallel the three principal assumptions leading to (OC). The two kinds of experience as of change are, furthermore, related with respect to their occurrences and their contents, in the following way: when a subject, *S*, has a first-order experience as of an episode of objectual change, *eoc*, then *S* also has a contemporaneous second-order experience as of a change in which of the object-states making up *eoc* is displayed in *S*'s perceptual window. An experience as of objectual change is always accompanied in this way by an experience as of perceptual change. In the leaf-case, *S*'s experience as of the leaf's motion is accompanied by *S*'s contemporaneous experience as of a change in which of the leaf's locational states during this episode of motion is displayed in *S*'s perceptual window.

However, experiences as of perceptual change do not depend on experiences as of objectual change. Suppose that a subject experiences a "kaleidoscopic" variation in qualities over time, as she randomly turns her head. We may suppose that this is a temporally extended experience as of qualitative temporal variation without objectual change (by the definition of objectual change in Section 2), since the temporal variation does not concern qualities of a persisting object or of several persisting objects. I take it that such a first-order experience as of an episode of qualitative variation without objectual change is accompanied by a second-order experience as of a change concerning which of the object-states making up the episode of qualitative variation is displayed in the subject's perceptual window. Since there is no underlying experience as of objectual change in this case, experiences as of perceptual change do not depend on experiences as of objectual change.

In the case of experiences as of objectual change, the question arose as to why a first-order experience with an extended temporal horizon is a 3+1-dimensional

representation, rather than a 4-dimensional representation. An analogous question arises in the case of experiences as of perceptual change. Assuming that we live in a block universe, why is a second-order experience with an extended temporal horizon an experience as of a changing "three-dimensional" perceptual window—where a "three-dimensional" perceptual window is a whole of simultaneous perceptions—rather than an experience as of an unchanging "four-dimensional" perceptual window—where a "four-dimensional" perceptual window is a whole of temporally extended first-order experiences, including experiences as of objectual change?

As in my discussion of experiences as of objectual change, a natural (though not obligatory) answer appeals to temporal atomism: the tokens and contents of diachronic experiences are generated from the tokens and contents of momentary experiences. I take temporal atomism to hold for second-order experiences as well as first-order experiences. A subject's momentary second-order experience that her perceptual window displays a certain object-state is an experience about a "three-dimensional" perceptual window. A temporally extended second-order experience derives from momentary second-order experiences, such that the momentary tokens are the extended token's temporal parts. Moreover, the generated diachronic second-order experience represents various states of the subject's "three-dimensional" perceptual window as having a certain temporal order, *R*, *because* the temporal parts of the diachronic second-order experience represent a "three-dimensional" perceptual window, and because the temporal parts have temporal order *R*. Intuitively, a diachronic second-order experience that has momentary temporal parts that represent a "three-dimensional" perceptual window, and that in fact have a certain temporal order, "projects" that order into the plurality of represented states of the "three-dimensional" perceptual window.

4 From the experience as of perceptual change to the sense of flow

I am now in a position to formulate a higher-order account of the sense of flow. When I introduced the sense of flow at the outset, I characterized it as the sense of replacement. When looking at a falling leaf, I do not only experience that the leaf undergoes locational change. I also experience that constant variation occurs concerning which leaf-state is in the present/reality: the leaf's l_1-state is the unique leaf-state in the present/reality before it gets replaced by the leaf's l_2-state, which in turn gets replaced by the leaf's l_3-state. The present/reality in experience never includes non-simultaneous object-states. That is, the present/reality as experienced never becomes temporally extended, in the sense of accommodating a plurality of momentary object-states ordered by temporal priority. The present/reality in experience remains temporally unextended, yet in constant flux—it is one persisting "three-dimensional container" with varying contents. I propose to explain the sense of replacement in terms of second-order experiences as of perceptual change. Why does *S* experience that a shift occurs in the present/reality from the leaf's l_1-state to the leaf's l_2-state to its l_3-state, where one state is seemingly replaced by another one, and that one by another one, and so on? I suggest that this impression of replacement arises from *S*'s second-order experience that her perceptual window displays the leaf's l_1-state before it displays the leaf's l_2-state, and that it displays the leaf's l_2-state before

it displays the leaf's l_3-state, as stated in (PC) and illustrated in Figure 2. In general, a subject's phenomenal sense of an object-state's being in the present/reality is just the subject's awareness of the state's being displayed in her perceptual window. And a subject's sense of change with respect to which object-state is in the present/reality is just the subject's awareness of change with respect to which state is displayed in her perceptual window. We have here a higher-order account of the sense of flow.[21]

This account is expected to apply across different sense modalities. While a subject's sense of flow in a visual experience as of a falling leaf consists in her awareness of a change with respect to which locational leaf-state is visually displayed in her perceptual window, a subject's sense of flow in an auditory experience as of a rising tone consists in her awareness of a change with respect to which frequency-state of the persisting tone is auditorily displayed in her perceptual window.[22]

Let us take a step back, in order to see the bigger picture. The central aspect of the sense of flow to be explained here is that there seems to be a stable present/reality—a persisting "container"—that varies with respect to which of a range of incompatible leaf-states is in it. Since a block universe offers no objective, mind-independent present/reality in flux, there is no objective replacement that the sense of flow could be about.[23] I propose to look for replacement elsewhere. While there is no *objective* replacement to be represented in first-order experience, there is *subjective* replacement represented in second-order experience. We find the persisting present/reality that varies temporally with respect to which leaf-state it contains in the persisting subjective, mind-dependent perceptual window that changes over time with

[21] Velleman (2006) considers "the illusion of the passage of time" and suggests that it arises because we think of ourselves as "enduring": "future events draw nearer to me and past events recede. Time truly passes, in the sense that it passes *me*" (2006: 13). While he does not address the sense of flow in experience, his account may be adapted as follows. A subject, *S*, has a sense of flow in an experience as of a moving leaf, because *S* is aware of herself as persisting through the experience as of this episode of motion—that is, to put it in my terminology, because *S* is aware that *she* is the subject of the perception of the leaf's l_1-state before *she* is the subject of the leaf's l_2-state, and so on. How does this higher-order picture relate to mine? The main issue I have with it is analogous to my main concern about Prosser's approach (see *n.* 10), though the latter is a purely first-order one. If my initial phenomenal characterization of the sense of flow as a sense of replacement—that is, as a sense that there is a change with respect to which object-state is in the present/reality—is correct, then the experience as of a change in a persisting self is insufficient to explain the sense of flow. For there seems to be no explanatory bridge from an experience as of a change in what the self is like over time to the target experience as of a change in what the present/reality is like over time. In contrast, there is a well-lit explanatory bridge from an experience as of a change in what is displayed in a subject's perceptual window over time to the target experience as of a change in what the present/reality is like over time. Being present/real in experience just is being displayed in the changing window of perception.

[22] See *n.* 20 for the distinction between visually and auditorily displaying an object-state.

[23] Nor do the standard block-friendly temporal indexicals, which one might see as featuring in the contents of our experiences as of objectual change, offer any account of the impression of replacement. See *n.* 5.

respect to which leaf-state it displays. The changing perceptual window, of which each of us is aware, has all the properties that are essential to replacement.[24, 25]

Any account of the sense of flow must address the issue of why spatial experience contains no analogous phenomenal aspect. My higher-order account provides an explanation. A subject's sense of a state's being in the present/reality is tied to the experience as of the subject's perceptual window displaying that state. When experiencing that a spatial arrangement obtains among multiple objects (at a moment), a subject is aware (at that moment) that her "three-dimensional" perceptual window displays all components in the arrangement together. This is why all of these spatial components seem to be in the present/reality. When experiencing that an episode of objectual change occurs, by contrast, a subject does not have an experience as of an unchanging "four-dimensional" perceptual window. The subject rather has an experience as of a changing "three-dimensional" perceptual window. In Section 3, this claim was supported by recourse to temporal atomism. Given that the subject's perceptual window plays the role of the present/reality in her experience, it seems to the subject that one momentary object-state after another enters and leaves the temporally unextended present/reality.

I promised a block-friendly account of the problem of the sense of flow. Recall the two intuitively plausible desiderata that have traditionally been viewed as incompatible with the block-universe theory of time. First, the sense of flow is grounded in (or is even identical with) certain representational properties of our experience. Second, the sense of flow is veridical. Let me show that the proposed account of the sense of flow allows both of these desiderata to be satisfied in the context of the block-universe theory.

The account obviously allows the first desideratum to be satisfied, since it explains the sense of flow in terms of the representation of a changing perceptual window by second-order experiences. The task of providing a representationalist account of the sense of flow may have seemed enormously difficult, because we looked

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[24] I have specified all experiential contents solely in terms of temporal priority, as in "*S* experiences that her perceptual window displays the leaf's l_1-state before it displays the leaf's l_2-state." Here is an alternative specification in terms of *moments* of time: "*S* experiences that her perceptual window displays the leaf's l_1-state *at t* and it displays the leaf's l_2-state *at t'*, where *t* is earlier than *t'*." The first specification is preferable because it is implausible that we represent temporal moments in experience. That aspect aside, the second specification captures the essence of replacement as well as the first: *S*'s persisting perceptual window displays different, incompatible leaf-states at different moments, and hence it seems to *S* that different leaf-states go in and out of the present/reality. Everyone who agrees that the sense of flow is a sense of change in the present/reality is committed to a form of temporal relativization of the content of the experienced present/reality, while temporal relativization may be construed in different ways.

[25] Prosser (2016: chapter 2) argues that "experience cannot have the representational content *that time passes*" (2016: 51-2). His argument is forceful to the extent that it concerns *objective* passage, or, in my terms, *objective* replacement. But if the conclusion is meant to be that experience cannot have the representational content that time passes in any sense whatsoever, then it is mistaken, because there is also the higher-order representation of *subjective* passage, or *subjective* replacement. But do we not have a sense of objective flow, which requires the experiential representation of objective replacement? I shall address this question at the end of the paper.

in the wrong place when we focused on the contents of our first-order experiences. As I have shown, the task does not seem so daunting when the contents of our second-order experiences are taken into consideration, as well.

On, then, to the second desideratum. A subject has a sense of flow in virtue of having an experience as of perceptual change—that is, in virtue of having an experience that her perceptual window changes over time with respect to which object-states it displays. Thus, what it would take for a subject's sense of flow to be veridical is for the subject to possess a persisting and changing perceptual window. As I introduced the notion in Section 3, a subject's perceptual window at a moment, t, is the phenomenally unified whole of all perceptions, $p_1, p_2, \ldots, p_n$, that the subject has at a moment. If a subject in fact possesses a perceptual window that persists and changes with respect to its displayed states over time, then the phenomenally unified whole of a subject's perceptions is a whole that persists and changes in its parts over time. How precisely we might conceive of this persisting and changing experiential whole is a complex metaphysical issue, concerning experience, persistence, and parthood, which I shall address in detail elsewhere. What matters for present purposes is that the more general notion of a persisting and mereologically changing whole is perfectly compatible with the block-universe theory of time, unlike the notion of objective replacement (see Section 1). Accordingly, the application of the notion of a persisting and mereologically changing whole to a subject's perceptual window may reasonably be expected to be compatible with the block-universe theory. Hence, the block-universe theory does not rule out the veridicality of the sense of flow. The higher-order account thus allows the second desideratum to be satisfied, as well.[26]

I take these considerations to show that the traditional claim that our sense of flow must be systematically illusory in a block universe loses appeal once the involvement of higher-order mental states in generating the sense of flow is taken into consideration. By taking the higher-order route, we are rewarded with an account of the sense of flow, according to which we need not be systematically misguided by this sense, as it can be veridical, nor by our beliefs about it, as the sense of flow we believe there to be really exists. The account thereby draws even with anti-block theories of time that promise a match of temporal experience and temporal reality. I consider this a very good reason for taking the higher-order account of the sense of flow seriously.

Let me close by considering two worries, a worry that arises at an early stage of the development of the account, and a worry that arises at a later stage. An early worry concerns my phenomenological analysis: Is the sense of flow really captured by the notion of replacement? Primitivists about the phenomenal *whoosh* of flow will not accept this phenomenological analysis, nor will they accept any other. By their lights, the project of bridging the sense of flow in experience with conceptions of time and change in physics and metaphysics can never succeed. I have nothing more to say to convince them otherwise. Others might hold that the sense of flow can be unpacked, but that it cannot, or not entirely, be unpacked in terms of replacement. I would like to have this debate. But I have yet to encounter an alternative phenomenological description that reaches substantially beyond the usual, opaque flow-metaphors.

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[26] Setting aside familiar questions about whether we experientially represent states as standing in temporal relations, such as the relation of temporal priority, that are not recognized by relativity theory.

A later worry might be whether the sense of replacement, even if accepted as constituting the sense of flow, can be captured by the contents of second-order experiences. One might object that it is phenomenally evident that the sense of replacement is entirely experientially first-order, that it concerns only worldly aspects of object-states, without involvement of any experientially second-order aspects. We, so the objector might hold, experience an episode of objectual change as objectively, not merely subjectively, involving a variation in which object-state is in the present/reality. If so, the proposed model misses an integral aspect of the sense of replacement.

I reply that I cannot find any phenomenological evidence for the claim that the sense of replacement is entirely experientially first-order, that we have a sense that replacement happens in the world. As regards experiences as of objectual change in location, shape, and so on, I share the transparency-intuition that the experience is outward-directed. My account of objectual change (Section 2) captures this common intuition. But the sense of replacement—an experience as of perceptual change associated with any experience as of objectual change—is special. For the sense is vague with respect to whether it represents a worldly or a representational phenomenon. The intuitive description of the sense of replacement as involving a change in which momentary state of a given object is present/real is meant to respect this vagueness, by leaving open whether the present/reality is a worldly or a representational characteristic. Given this vagueness, it is perfectly permissible to characterize replacement as involving a change in which state of a given object is displayed in a subject's perceptual window. To mention an analogy, our sense that an event involves replacement is like our impression that an event involves boundary vagueness, that it is vague exactly when the event begins and ends. For this impression of vagueness is itself vague with respect to whether it is about a worldly or a representational phenomenon. Take as an example the event of crossing a street. Does it begin as I cross the sidewalk or as I cross the curb? I detect the vagueness of the event's beginning (and of its end) intuitively, but I have no immediate grasp of whether this vagueness has its source in the world or in us. Analogously for the sense of replacement. Accordingly, any claim to the effect that the sense of replacement tells us clearly that a worldly flux in the present/reality occurs seems to me to be guided by theoretical assumptions in the metaphysics of time, and hence unfaithful to the phenomenological evidence.

Needless to say, the proposed account raises many more questions than have been discussed here. How does the account compare to other block-friendly approaches in more detail?[27] What does a version of the account without the assumption of temporally extended experiences, an account that appeals to Brentanian/Husserlian retentions instead, look like? How should the account be extended to address the sense that replacement has a certain direction and occurs at a certain rate? How should the account be extended to address not only experiences during a specious present but also connected experiences constituting a continuous stream of consciousness over longer periods? Can this higher-order account of the sense of flow be integrated with a higher-order account of consciousness, so that the sense of flow can be understood as woven into the fabric of consciousness? Does the

[27] See *n.* 10 and *n.* 21 for brief comparisons with two alternative block-friendly approaches.

involvement of higher-order mental states in generating the sense of flow render this sense too sophisticated to be available to non-human animals with lesser cognitive powers? If so, might non-human animals have experiences as of objectual change without a sense of flow? Is the account supported or undermined by research on temporal experience in the cognitive sciences? These are some of the issues that need to be addressed next. As my focus has been on developing a new kind of approach, and on identifying its central strengths, concerning explanatory power and representational veridicality, I leave these issues for future discussion.[28]

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