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Can We Perceive the Past?

Abstract: A prominent view holds that perception and memory are distinguished at least partly by their temporal orientation: Perception functions to represent the present, while memory functions to represent the past. Call this view *perceptual presentism*. This chapter critically examines perceptual presentism in light of contemporary perception science. I adduce evidence for three forms of perceptual sensitivity to the past: (i) shaping perception by past stimulus exposure, (ii) recruitment of mnemonic representations in perceptual processing, and (iii) perceptual representation of present objects as possessing past properties. I argue that forms (i) and (ii) are consistent with perceptual presentism, while form (iii) poses a genuine threat to the view. While the empirical case for form (iii) remains inconclusive, I suggest that the most serious challenges to perceptual presentism derive from representations that integrate mnemonic and present-tensed elements in the performance of canonical perceptual functions, such as perceiving object continuity over time.

Keywords: Perception, Working Memory, Temporal Perception, Adaptation, Serial Dependence, Object Files, Shape Perception, Temporal Representation, Perception-Cognition Border

1. Introduction

What distinguishes perception from memory? A natural answer is that perception tells us about the present, while memory tells us about the past. When you see a red tomato on your kitchen table, your perceptual state represents that there is *now* a red tomato on the table. Conversely, your perceptually-based memory of the tomato represents that there *was* a red tomato on the table.

By *perceptual presentism*, I will mean, very roughly, the view that perception is restricted to representing present conditions. Perceptual presentism has a long intellectual history. In the *Confessions*, Augustine writes: "When time is passing, it may be perceived and measured; but when it is past, it cannot, because it is not" (Gale 1968, 42). And Thomas Reid writes:

> The object of memory, or thing remembered, must be something that is past; as the object of perception and of consciousness must be something which is present: What now is, cannot be an object of memory; neither can that which is past and gone be an object of perception or of consciousness. (Reid 1785/2011, essay III, ch. I)[1]

[1] Contemporary theorists expressing sympathy with perceptual presentism include Peacocke (1999, 280), Carey (2009, 9), Kriegel (2015), Gross (2017), Beck (2018), Byrne (2018, ch. 8), Hoerl (2018), Connor and Smith (2019), and Block (2023, 20, 119).

Perceptual presentism also has important implications. For example, it is often held that perception is epistemically distinctive insofar as having a perceptual experience that represents that p provides immediate, non-inferential justification for believing that p (Pryor 2000; Silins 2021). But if perception is restricted to representing present conditions, then this route to non-inferential justification only covers beliefs about the present. Past- or future-oriented beliefs must be justified via inference, or non-inferentially via some other route.

Moreover, several have suggested that a fundamental function of perception is to deliver "news" to the rest of the mind, while cognition functions to draw inferences from that news (Beck 2018; Block 2023). This view may seem to support perceptual presentism. Intuitively, events occurring *now* are news, while past events aren't. As Block (2023) writes: "Perception functions to provide us with information about what is happening in the nearby environment now, whereas cognition functions in reasoning about the news provided by perception so as to decide what to do and to plan for the future" (20). (I'll return to this idea in section 5.1., however, where I'll argue that the news-propagating function of perception does not provide strong support for perceptual presentism.)

Furthermore, some have held that what differentiates higher cognitive faculties distinctive of human thought from "lower" faculties, like perception, shared with non-human animals is the ability to "mentally time travel" to contemplate scenarios in the past or future (Suddendorf & Corballis 2007). This hypothesis comports with the view that perceptual representations are locked to the present, while higher cognition is more temporally flexible. However, if representation of the past or future occurs even in perception, this would challenge proponents of the hypothesis to explain how (or whether) the temporal flexibility of perception differs from the temporal flexibility of thought.

While perceptual presentism is widely assumed, a substantial body of evidence indicates that perception is sensitive to the past in intricate ways. An object's appearance is determined not only by

present sensory stimulation, but by stimulation in the recent and distant past. Theorists moved by such evidence occasionally venture claims that seem to conflict with perceptual presentism. Thus, Munton (2021) claims that "representations from memory are intimately woven into perceptual representations" (2), and that "far from living in the present, an entwinement with the past is inherent in the most basic of perceptual capacities, our perception of objects" (18). Similarly, Pascucci et al. (2019) write that "the content of visual perception is strongly permeated by information lingering from the past" (20). But what is the nature of this "entwinement" or "permeation" between perception and the past? And does it threaten perceptual presentism?

This chapter critically examines perceptual presentism in light of perception science. I don't aim to conclusively establish or refute the view. Rather, I aim to pinpoint the sort of discovery that would imperil perceptual presentism, and to filter out forms of evidence that do not. I distinguish three forms of perceptual sensitivity to the past: (i) shaping perception by past stimulus exposure, (ii) recruitment of mnemonic representations in perceptual processing, and (iii) perceptual representation of present objects as possessing past properties. I'll adduce evidence for each. I'll argue that forms (i) and (ii) are likely consistent with perceptual presentism, while form (iii) poses a genuine threat to the view. While the case for this form of sensitivity remains inconclusive, I suggest that the most compelling challenges to perceptual presentism likely derive from representations that seamlessly integrate mnemonic and present-tensed elements in the performance of canonical perceptual functions, such as apprehending object continuity over time.

Two caveats. First, due to space limitations, I will only discuss perceptual sensitivity to the *past*. Certain kinds of perceptual sensitivity to the *future*—e.g., prediction or motion extrapolation (Clark 2015; Hogendoorn 2020)—might be construed as involving future-tensed perceptual representation. Such cases are obviously also relevant to evaluating perceptual presentism. However, they raise further issues that must be considered independently (White 2018). Second, my discussion

will be regrettably limited to vision. Non-visual capacities clearly also matter for evaluating perceptual presentism, and some such capacities (say, hearing a melody as extending over a long interval) might be thought to put serious pressure on presentism (e.g., Viera 2022, 639). Note, for present purposes, that if perceptual presentism fails for non-visual modalities, supporters of the view might retreat to a vision-restricted version of the thesis.

2. Formulating Perceptual Presentism

Taken literally, Reid's claim that the "object of perception and of consciousness must be something which is present" faces obvious counterexamples. Arguably, when we see a distant star that has ceased to exist, *what* we perceive—the *object* of perception—is something past, not present. Ergo, not all objects of perception are present.

However, one can accommodate these classic "time-lag" cases while preserving the spirit of perceptual presentism. Rather than imposing a presentist restriction on the *things* (objects or events) we perceive, perceptual presentism can be understood as a view about how perception *represents* the things we perceive: When an object, event, or state of affairs is represented in perception, it is always represented *as present*—i.e., as presently located or instantiated in one's surroundings—even if it turns out not to be present.[2] Thus, perception is, or at least purports to be, wholly about what's going on now.

There are various forms that that this presentist restriction on perceptual representation might take (Skow 2011; Kriegel 2015; Connor & Smith 2019). However, here I'll focus on a version of the view that builds the presentist restriction into the *content* of perception. Specifically, for any individual O and property F, if a perceptual state S attributes F to O, then S represents that O is F

[2] Barkasi (2021, 7) likewise argues that memory introduces past properties into perception, but denies that these properties are perceptually represented *as* past.

now, where "now" denotes either the time of S's occurrence or a brief interval containing that time (Peacocke 1999, 280).[3] When your perceptual state attributes brownness to a table, it represents that the table is brown *now*.

Some philosophers might be uncomfortable with the idea that perception has genuinely tensed content. For example, those who claim that perception is wholly iconic or image-like (e.g., Block 2023) might argue that perceptual representations lack the sort of syntactic complexity required for explicit tense markers like tensed copula. Two points on this. First, it is an empirical question whether perception is fully iconic, and the proposal has faced significant pushback. Just as perceptual representations arguably possess discrete, non-iconic singular constituents (Green 2023), they may also possess discrete, non-iconic tense markers. Second, proponents of iconicity might grant that perceptual representation is tensed without conceding that perceptual representations contain discrete tense markers. Instead, they might possess tensed content in virtue of their functional role (cp. Block 2023, ch. 5). If consuming processes are reliably disposed to *treat* a perceptual representation as if its content is present-tensed, this might simply make it the case that it has present-tensed content. (A parallel story could perhaps apply to past-tensed perceptual representations, if there are any—see section 5.2.)

I am construing perceptual presentism as a thesis about perceptual representation in general. Some might wish to restrict the thesis to *conscious perceptual experience*. Indeed, some might think that we can establish presentism about perceptual experience through introspection alone: When we

[3] Alternatively, one might pack presentness into the *attitude* that perceptual states bear to their contents: Roughly, whenever a perceptual state S attributes a property F to an individual O, S *represents-as-present* that O is F, and is accurate only if O is F at the time of S (see Kriegel 2015). I believe that most of my points could be adjusted to apply to attitude-based versions of perceptual presentism, but I won't attempt the needed adjustments here. See also Connor and Smith (2019) for further ways of developing perceptual presentism, and Hoerl (2018) for an attempt to characterize the relation between perception and the present without invoking any "temporal mode of presentation" within perception (129).

reflect on perceptual experience, it always *seems to us* that the experience simply makes us aware of how the environment is presently.

This issue deserves more attention than I can give it here. For now, I simply register my doubts about any quick introspective argument for perceptual presentism. These doubts primarily stem from examples of the sort to be considered in section 5.1. When you see a bitten cookie (figure 1 below), there *does* seem to be an immediate, conscious impression of a "past" aspect of the object—that it *was* circular, but no longer is. It's possible that this impression is wholly post-perceptual, but I submit that it is not *obvious*, introspectively, that this is so.

Moreover, while it could conceivably turn out that perceptual presentism is true of conscious perception but false of perception more generally, we would then like to know what prevents the non-present-tensed elements of perceptual representation from *becoming* conscious. Thus, those who are mainly concerned with conscious perception should still find value in examining presentism about perception more generally.

Perceptual presentism claims that perceptual states purport to be wholly about the present. But what, more precisely, do we mean by the "present"? A familiar debate concerns whether the perceived present is a durationless instant or an extended interval—a *specious* present (James 1890; Phillips 2011, 2014; Dainton 2022). Specious-present theorists hold that perceptual awareness of dynamic phenomena like motion, persistence, and change shows that the fundamental "units" of perceptual experience represent extended intervals. The intervals must be long enough for perceptible instances of motion or change to unfold—commonly estimated at 100-500 ms in length (Phillips 2011, 398; White 2020; Herzog et al. 2020). Opponents of specious-present theory have argued that motion, change, etc. are not genuinely perceived, only cognized (Chuard 2011).

While I cannot defend it here, I agree with specious-present theorists that the perceived present is extended.[4] I suggest that when you perceptually represent <there is *now* a red tomato thereabouts>, the indexical "now" denotes an interval roughly simultaneous with the perceptual state, but potentially including moments shortly before or after the state's onset. As White (2020) observes, the perceived present plausibly comprises an interval longer than the minimum threshold for discriminating the temporal order of events (roughly 20 ms (White 2020, 587)). One event might be perceived as preceding another, even though both are marked "present" (2020, 587-588).

Summing up: Perceptual presentism claims that when a perceptual state attributes a property F to an object O, its accuracy depends entirely on whether O has F presently. However, the "present" can be taken to encompass an interval rather than a durationless instant. Thus, perceptual presentism is compatible with basic perceptual awareness of motion and change.

3. Shaping Perception by Past Stimulus Exposure

The first kind of perceptual sensitivity to the past involves shaping perceptual processing by past stimulus exposure. It is well-established that perceptual processing at a time is causally influenced by stimuli encountered seconds, minutes, or even months prior. I mention three examples.

First, in *perceptual learning*, training in a perceptual task modifies perceptual processing to facilitate performance of the task (Goldstone 1998). Studies have documented learning-induced changes in responses at early stages of sensory processing (Schoups et al. 2001). Thus, Yan et al. (2014) found that after extended training in a contour detection task, neurons in macaque primary visual cortex began to fire more vigorously when an edge in their receptive field fell along an

[4] Among specious-present theorists, there is a further distinction between *retentional* models, on which experiences are instantaneous (or very brief) events that *represent* a longer interval (Herzog et al. 2020), and *extensional* models, on which experiences, or at least the "metaphysically fundamental units" of experience (Phillips 2011, 398), are temporally extended events lasting as long as a specious present (Phillips 2011; Dainton 2022). I will remain neutral on this issue.

extended contour. The magnitude of this physiological change correlated with improvements in behavioral performance. Further evidence from fMRI (Furmanski et al. 2004; Jehee et al. 2012) and EEG (Pourtois et al. 2008; Bao et al. 2010) suggests that perceptual learning modifies early visual cortical responses in humans too.[5]

Second, in *adaptation*, exposure to a stimulus biases perception of a subsequent stimulus "away" from the first. If you view an upward-moving pattern for 30 seconds, a stationary pattern immediately afterward appears to move downward (Anstis et al. 1998). Adaptation aftereffects occur not only for low-level properties (motion, color, etc.), but for high-level properties like facial expressions (Butler et al. 2008), causation (Rolfs et al. 2013; Kominsky & Scholl 2021), and numerosity (Burr & Ross 2008). While most aftereffects are short-lived, some can persist for months after stimulus exposure (Jones & Holding 1975; Thompson & Burr 2009, R13).

The third example is *serial dependence*. While adaptation effects are typically *repulsive*—they bias perception away from a recently perceived feature—serial dependence (SD) involves *attractive* effects of past stimuli on perception. Fischer and Whitney (2014) found that when subjects were repeatedly shown Gabor patches and asked to indicate their orientation, responses were biased toward the orientations of patches seen within the past 2-3 trials (roughly ten seconds). SD is partially spatially tuned—attraction is stronger between stimuli presented in the same location (Collins 2019). While adaptation and SD may seem like conflicting phenomena, adaptation seems to require longer stimulus exposure than SD (Fischer & Whitney 2014), and SD requires attention while adaptation does not (Fritsche & de Lange 2019).

[5] There is controversy about whether these changes reflect feedback from higher areas, and whether they involve signal enhancement or internal noise reduction (Dosher & Lu 2017). Moreover, some studies fail to find an impact of perceptual learning on early sensory areas (Law & Gold 2008). Still, the dominant view seems to be that perceptual learning alters perceptual processing, "tuning" our perceptual systems for certain sorts of detection or discrimination (Connolly 2019, ch. 2).

I should flag that it is controversial whether SD arises in perception or post-perceptual decision processes (Fritsche et al. 2017; Pascucci et al. 2019; Ceylan et al. 2021). Some suggest that SD *originates* at post-perceptual levels (i.e., in high-level decisions about stimuli) but *affects* perceptual representation of later stimuli (Pascucci et al. 2019, 22; Ceylan et al. 2021; cp. Phillips & Firestone forthcoming). If SD is purely post-perceptual in both its origin and effects, then it obviously poses no challenge to perceptual presentism. For present purposes, I'll assume that at least some instances of SD are perceptual, since I don't believe it significantly threatens perceptual presentism either way.

Perceptual learning, adaptation, and SD demonstrate rich influences of past stimuli on perception. However, these phenomena do not yet put serious pressure on perceptual presentism. The problem is that while they involve *effects* of past stimuli on perceptual representation, they do not require those past stimuli to be *explicitly represented* when their effects materialize.

When perceptual processing is sensitive to a piece of information, there are two ways this sensitivity could be achieved. First, the information might be explicitly represented in the perceptual system and retrieved while computing distal features from proximal stimuli. Second, the information might be "implicitly embodied" in the system's dispositions to transition between information-carrying or representational states (Pylyshyn 2003; Shea 2015). To take a familiar example, the visual system's assumption that light comes from above might be explicitly represented, or it might be implicit in a disposition to transition from encodings of luminance patterns on the retina to representations of surface convexity.

The distinction between explicitly represented and implicitly embodied information is not entirely clear-cut. However, one prototypical difference is that explicit representations are made available to a variety of consuming processes, while a disposition to transition between information-carrying or representational states is not (Shea 2015; Clark 1992). If the assumption that light comes from above is implicitly embodied in a disposition to transition from registrations of luminance

patterns to representations of surface convexity, then the assumption is only "available" to the process of computing convexity. It cannot be freely accessed by other computations.

Perceptual learning, adaptation, and SD showcase perception's exquisite sensitivity to past stimuli, but do not obviously require explicit representations of those past stimuli. Recall Yan et al.'s (2014) finding that training in a contour detection task led neurons with receptive fields along an extended contour to fire more vigorously. Arguably, past training trials affected the visual system's disposition to transition from states encoding local edge elements to states encoding (crudely) that an edge element at some retinotopic location lies along an extended contour. But we needn't posit an explicit representation of these past trials, since (*inter alia*) there is no evidence that information about them is available to processes outside contour detection.

Likewise, classic examples of adaptation don't seem to require explicit representation of the past stimuli inducing the aftereffect. Adaptation generally occurs when the perceptual system codes for a dimension, such as motion or color, via ratios of activity in multiple channels. Extended exposure to a stimulus reduces the sensitivity of certain channels more than others, shifting the activity ratio elicited by a subsequent stimulus away from what it would normally be (Anstis et al. 1998; Webster 2011; Block 2023, ch. 2). This is a shift in state-transition dispositions. For example, the visual system has dispositions to transition from motion energy signals at the retina to representations of motion. These dispositions are grounded in the sensitivities of various motion-coding channels. Tweaking these sensitivities through adaptation lowers the threshold for representing either upward or downward motion. However, at the time of the aftereffect, there need be no explicit representation of the adaptation stimulus.

The case of SD is more complicated because it is less understood. However, there is evidence that at least some cases of SD do not require explicit mnemonic representation of the earlier stimulus exerting an attractive effect. (Other cases of SD may be mediated by explicit short-

term memory representations (Czoschke et al. 2019). Such cases would fall under the second form of perceptual sensitivity to the past, discussed in section 4.)

In one experiment, Fischer and Whitney (2014) asked participants to report both the orientation of a currently perceived Gabor patch, and whether the stimulus shown two trials earlier was oriented clockwise or counterclockwise from vertical. They found that subjects were virtually at chance in reporting the orientation of the earlier stimulus. However, that stimulus still had an attractive influence on reports about the later stimulus. Moreover, when orientation was remembered inaccurately, attraction tended toward the *actually displayed* orientation, not the *inaccurately remembered* orientation. Arguably, then, SD can occur without explicit mnemonic representation. In such cases, SD may depend on modifications to state-transition dispositions.

Suppose, then, that perceptual learning, adaptation, and certain cases of serial dependence are wholly explained by changes to state-transition dispositions within our perceptual systems. Do these phenomena threaten perceptual presentism? I think the answer is no.

First, while some are happy to speak of information embodied in a system's state-transition dispositions as "implicitly represented" (Shea 2015), others argue that there is no reason to hold that such information is represented at all (Ramsey 2007, ch. 5). Suffice it to say that *if* implicitly embodied information is not represented in *any* sense, then implicit embodiment of information about the past within our perceptual systems poses no threat to perceptual presentism.

Suppose, however, that it is reasonable to speak of implicit representation in these cases. Still, perceptual presentism is naturally understood as a view about what perception *explicitly* represents. It is a view (*inter alia*) about the content that perception *makes available* to other mental processes, such as belief fixation and planning. Perceptual presentists hold that all contents "given" to us in perception concern the present. But information embodied in state-transition dispositions is not given to us in this sense. It is available only to certain subpersonal processes within our

perceptual systems. Phenomenological reflection bolsters this point. When we undergo aftereffects, such as afterimages, the afterimage *seems like* it is out there in the present environment—it doesn't strike us as past. Thus, even if information about the past is implicitly represented by state-transition dispositions within perceptual systems, perceptual presentists can reasonably reply that their view is restricted to explicit perceptual representation.

4. Mnemonic Representations in Perceptual Processing

I've considered cases in which perception is influenced by past factors but there is no good reason to accept that those past factors are explicitly represented. I now turn to cases where there *is* evidence that past factors are explicitly represented and recruited in perceptual processing. Unlike adaptation and perceptual learning, these cases arguably support the presence of explicit past-tensed representations within our perceptual systems.

Visual working memory (VWM) is a limited-capacity information store that can retain representations of past stimuli for several seconds after they disappear (Brady et al. 2011; Suchow et al. 2014). Importantly, there is evidence that representations retained in VWM can coherently affect perceptual processing.

First, VWM recruits some of the same brain areas as perception. Physiological studies indicate that when an item is retained in VWM, information about the item can be decoded from population-level activity in early visual cortex (Harrison & Tong 2009; Serences et al. 2009). However, while such evidence is suggestive, it doesn't establish that VWM representations are accessed during perceptual processing. VWM might use some of the same brain areas as perception without playing a computational role in perception. Nonetheless, behavioral evidence supports an active role for VWM representations in perceptual processing.

Kang et al. (2011) found that VWM coherently affects motion perception. The *motion repulsion effect* occurs when subjects are shown superimposed sets of dots moving in different directions, and the perceived angular separation between their directions of motion is exaggerated relative to their true separation. Kang et al. found that simply retaining a motion stimulus in VWM can produce a motion repulsion effect. Participants saw two 500-ms dot motion displays separated by a 2-second interval. After the second display's offset, they indicated whether its direction of motion was clockwise or counterclockwise relative to a reference bar. Critically, when the first display was retained in VWM, the second display elicited a repulsion effect: subjects' reports indicated that perceived direction of the second stimulus was repelled from the direction of the first. Conversely, when subjects made immediate reports about both stimuli without a recall task, no repulsion effect emerged. Assuming that these reports reflected participants' perceptual experiences, we can conclude that retaining the first stimulus in memory affected perception of the second stimulus. There is also evidence that VWM influences perception of ambiguous motion stimuli (Scocchia et al. 2013; Hein et al. 2021), orientation, and color (Teng & Kravitz 2019).

There are many other proposed effects of memory on perception. Munton (2021) appeals to the role of long-term memory in perception, including the recruitment of Bayesian priors (Weiss et al. 2002; Kersten et al. 2004). She also cites the phenomenon of *boundary extension*, where the representation of a scene depicted in a picture extends beyond the boundaries of the picture (Intraub & Dickinson 2008; Hubbard et al. 2010). However, these cases face certain interpretive difficulties. It is controversial whether Bayesian priors are explicitly encoded in perception, or are merely implicit in the visual system's state-transition dispositions (Orlandi 2016; Sanborn & Chater 2016; Icard 2016; Block 2018; Rescorla 2020). And as Munton observes, it is unclear whether boundary extension is genuinely an effect on perceptual representation, or arises while encoding

perceptually represented information into memory (or perhaps involves perceptually-based imagery—Nanay 2018).[6]

I focus on VWM because I believe it offers the strongest argument for the use of *explicit past-tensed representations* in perceptual processing. When information is retained in VWM, it is made accessible for retrieval and report in recall tasks. Such wide accessibility is a hallmark of explicit representation. Furthermore, it's at least plausible that when a representation of an object is retained in VWM, the object is represented or "tagged" *as* past. Such tagging would allow VWM and perceptual representations to be integrated in reasoning without creating confusion about which things are currently there and which disappeared several seconds ago (White 2020, 594). By contrast, higher-capacity sensory memory stores (e.g., iconic or fragile short-term memory—Sperling 1960; Landman et al. 2003) are more short-lived than VWM, making temporal tagging less critical.

Suppose, then, that perceptual processing is sometimes guided by mnemonic representations with past-tensed content. Does this immediately threaten perceptual presentism? I believe the answer is no.

Recall Munton's (2021) claim that "an entwinement with the past is inherent in the most basic of perceptual capacities" (18). It is important to distinguish *causal* from *constitutive* versions of this claim. On one view, perception is entwined with the past just insofar as mnemonic representations causally influence the production of perceptual representations. On another view, perception is entwined with the past insofar as some perceptual representations are either partially or fully constituted by mnemonic representations (i.e., have such representations as constituents).[7] The foregoing evidence only directly supports the causal claim: representations retained in VWM

[6] Or perhaps boundary extension emerges only when *reporting* remembered scene boundaries, not in either perception or memory encoding.

[7] However, even if perceptual representations are partially constituted by mnemonic representations, then it is still a further question whether the latter representations are genuinely *past-tensed* (see section 5.2).

influence the production of perceptual representations (e.g., of motion).[8] However, the constitutive claim is the relevant one for evaluating perceptual presentism.

Does the fact that mnemonic representations are computed over in perceptual processing suffice to show that they are perceptual representations? If so, then there would be less distance between the causal and constitutive claims than it first appears, since the right sort of causal involvement in perceptual processing would suffice to make a mnemonic representation perceptual, establishing the constitutive claim.

The answer depends on what we mean by a "perceptual representation." Perceptual presentism claims that perceptual representations have entirely present-tensed content. But what *makes* a mental representation "perceptual," as opposed to doxastic or something else?

On one view, perceptual representations are simply representations "in" one's perceptual system. They are representations within the database to which the perceptual system has access during computation. Call this the *system view* of perceptual representation—so called because it distinguishes perceptual from non-perceptual representations by appeal to the systems that use them. The view needn't claim that being a perceptual representation *excludes* being a representation of another type. If a state is accessed by systems of both perception and action, then it might count as both a perceptual representation and a motor representation.

If the system view were right, then the foregoing evidence arguably would refute perceptual presentism. For it demonstrates that VWM representations are within the database of representations that our perceptual systems can access when computing representations of distal

[8] Munton is primarily concerned to argue that mnemonic information informs the perceptual representation of objects while they are occluded, and thus allows us to "see" invisible objects. Note that one could grant that memory affects perception in this way without granting that mnemonic representations partially constitute perceptual representations.

conditions. If VWM representations are genuinely past-tensed, then we must conclude that there are perceptual states with past-tensed content, and so perceptual presentism is false.

However, perceptual presentists should reject the system view, since it provides a too permissive criterion of perceptual representation. It is highly implausible that *any* mental state within the stock of representations accessed during perceptual processing is thereby a perceptual representation. Consider cognitive penetration. It has been argued that desires can influence distance perception, whereby desired objects appear closer than non-desired objects (Balcetis & Dunning 2010). While there are reasons to doubt this claim (Durgin et al. 2011; Firestone & Scholl 2016), suppose for the moment that it is true, *and* that the effect involves direct, unmediated access to desires during perceptual processing (cf. Macpherson 2012). Then desires would be within the database to which perceptual processes have access. Still, it would seem wrong to conclude that *desires* are therefore *perceptual representations*.

So, there are reasons to regard system view as too permissive.[9] But this does not yet constitute an argument *against* treating offline VWM representations as perceptual representations when they are accessed during perceptual processing. I now consider a more restrictive criterion that may serve this purpose.

Various authors have suggested that perceptual states are *stimulus-dependent* in a way that cognitive states are not (Beck 2018; Phillips 2019; cp. Rock 1982; Carey 2009, 9). Roughly, perceptual states function to be produced by proximal stimulation of the sense organs, and to be updated in response to changes in proximal stimulation. If a state is completely untethered from

[9] Gross (2017) likewise claims that there can be representational states within perceptual systems—viz., attentional commands—that are not perceptual representations. However, his basis for denying that attentional commands are perceptual representations seems to assume perceptual presentism: "Consider the…attentional command. Though it is perhaps (if we deny it cognitive status) a representational state *in* perception, it is not itself a perceptual state, at least in the sense of a state whose function is to represent the here and now" (6).

proximal stimulation, then it must either be non-perceptual or it must involve some malfunction of the sensory system (e.g., in certain cases of hallucination).

Beck (2018) endorses the stronger claim that, necessarily, *all constituents* of perceptual states function to be stimulus-dependent. Roughly, any perceptual attributive—any element of a perceptual state that indicates a property—functions to be causally sustained by some relevant aspect of proximal stimulation—i.e., a "cue" to the property it represents. However, this claim has faced pushback (Quilty-Dunn 2020a). Moreover, cases of perceptual tracking through full occlusion raise *prima facie* difficulties for strong stimulus-dependence. Perceptual object representations are plausibly sustained through periods of occlusion where no proximal cues are received from the object (Scholl & Pylyshyn 1999; Flombaum et al. 2008; Munton 2021). Here, a perceptual representation of the object, and arguably attributives for at least some of its features, e.g. shape or size, are sustained not by proximal cues supplied by the object or its features, but (if anything) by proximal stimulation supplied by the occluder.

I espouse only *modest* stimulus-dependence criterion as a signature mark of perception. Canonically, perceptual representations (i) function to be produced by proximal stimulation, and (ii) function to be updated in response to changes in proximal stimulation.[10] When your perceptual system is functioning normally, a perceptual representation of a red apple is generated in response to proximal stimulation received from the apple, and the representation is disposed to be updated in response to changes in proximal stimulation. Notice that object and feature representations retained through occlusion meet this modest stimulus-dependence criterion. The representations are generated in response to proximal stimulation, and are disposed to be updated in response to relevant proximal changes (e.g., if the object emerges from occlusion and has changed color).

[10] I do not offer this as a strictly necessary or sufficient condition for perception, or as a general theory of the perception-cognition border (for my views on the latter, see Green (2020)).

Importantly, many VWM representations do not meet even this modest stimulus-dependence criterion. VWM representations can be retained "offline," where they function to remain unchanged regardless of changes in proximal stimulation. VWM representations *may* be altered by incoming proximal stimulation due to interference from perceptual processes in overlapping brain areas (Teng & Kravitz 2019; Adam et al. 2021), but plausibly they do not *function* to be altered this way. Their being so altered does not produce any reliable adaptive benefit for the organism. This offers a principled reason to withhold perceptual status from them.[11, 12]

One might argue that appealing to stimulus-dependence is question-begging in this context. For, if perceptual presentism trivially *follows* from stimulus-dependence, then anyone skeptical of perceptual presentism would simply reject the stimulus-dependence criterion. However, perceptual presentism does not trivially follow from stimulus-dependence, so this concern is misplaced. There is no inconsistency in the idea that representations of past properties, states, or events might function to be produced and updated in response to proximal stimulation. In fact, I'll argue in the next section that some of the most interesting challenges to perceptual presentism are cases of just this sort.

Summing up: There is evidence that mnemonic representations are recruited during perceptual processing. However, assuming modest stimulus-dependence as a signature marker of perception, we can exclude "offline" mnemonic representations from the realm of perceptual states, even when they causally influence perceptual processing.

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[11] My point is not that mnemonic representations can *never* be perceptual representations. Rather, it is that *some* mnemonic representations—those that lack even a modest form of stimulus-dependence—are plausibly not perceptual. I return to this issue in section 5.2.

[12] While modest stimulus-dependence provides *one* way of denying perceptual status to offline VWM representations, it may not be the only way. Theorists have proffered various empirically necessary conditions on perception, such as iconic format (Block 2023), modularity (Mandelbaum 2018; Quilty-Dunn 2020b), or dimension-restriction (Green 2020, 2023). Perhaps offline VWM representations lack one or more of these features. I emphasize stimulus-dependence because I think it offers the most straightforward rationale against treating offline VWM representations as perceptual, and most theorists would agree that it is at least a reliable signature of perception.

5. Past Properties of Present Objects

I turn to the cases I take to pose the most serious challenge to perceptual presentism—the perception of present *objects* as having past *properties*. Past-tensed representations may feature as constituents of more complex perceptual representations that also possess present-tensed content: e.g., <O *is* F, but *was* G>. Various cases might be thought to work this way. I'll suggest a general strategy on behalf of perceptual presentists for handling them, which I call the *complexity gambit*. I'll consider an example where the complexity gambit is viable, and then an example where it is not.

5.1. Causal History from Shape

Consider the bitten cookie in figure 1. You probably have an irresistible impression that the cookie *used to be* roughly circular before it had a portion removed. That is, you have an impression of its "causal history." Some have suggested that an object's causal history might be extracted during perceptual processing on the basis of cues in the proximal stimulus (Leyton 1989, 1992; Spröte et al. 2016; Chen & Scholl 2016). If so, a natural interpretation is that you enjoy a perceptual representation with partly past-tensed content. Call the cookie's precise bitten shape "B." Then the representation is something like: <That object is *now* B, but *was* circular>.

Figure 1. A bitten cookie. *Source:* Spröte & Fleming (2016).

If this is the correct account, then it poses a more difficult problem for perceptual presentism than the mere recruitment of mnemonic representations in perceptual processing. For, the representation of the cookie as formerly circular might be just as stimulus-dependent as the representation of its current shape. The representation of circularity is not like a VWM representation retained offline while the cookie is absent. Rather, like the representation of the cookie's current shape, the representation is formed on the basis of shape-relevant cues in the proximal stimulation received from the cookie. It might also be updated in response to proximal changes. For example, if the cookie were further distorted (e.g., crumbled) to remove any hint of its past circularity, the representation of circularity might be discarded.

Earlier, I mentioned the idea that a fundamental purpose of perception is to deliver "news" to the rest of the mind on the basis of sensory stimulation. While that idea might appear to support perceptual presentism (as Block (2023, 20) seems to suggest), we can now see why this is not quite right. For perception to provide "news," it only needs to deliver information about the environment that is new *for the perceiver*. But past-tensed content can surely qualify as news in this sense. If I enter my kitchen and see a bitten cookie, then it is news to me that the kitchen contains a formerly circular cookie. For certain purposes, such as monitoring my daughter's sugar consumption, this news might be rather important.

Roland Fleming's group has performed numerous studies of the recovery of causal history from shape. These studies probe our ability to judge which shape something had before undergoing some distortion, and to classify shapes by the particular kind of distortion they have undergone (Schmidt & Fleming 2016; Spröte & Fleming 2016; Schmidt & Fleming 2018; Schmidt et al. 2019). In many cases, the relative contributions of perception and post-perceptual cognition in generating subjects' responses are unclear (as the authors acknowledge—Schmidt et al. (2019, 168)). However,

I'll highlight the study that I think bears most directly on the issue of whether recovery of causal history is genuinely perceptual.[13]

Spröte, Schmidt, and Fleming (2016) created shapes that appeared either "complete" or "bitten" and asked participants to mark the perceived axis of symmetry of the shape by placing dots along that axis. For complete shapes, subjects' responses clustered around the real symmetry axis, while for bitten shapes, responses instead clustered around the axis of symmetry of its *unbitten counterpart* (figure 2). Parallel results emerged for judgments about the front, back, and center of the shapes. Spröte et al. take these results to suggest that the visual system constructs representations of both the present and past shapes of a bitten object. But presumably we do not perceptually represent these objects as *currently* possessing their past shapes—we are not confused about whether the cookie in figure 1 is presently circular or bitten. The obvious alternative is that pre-bite shapes are attributed in the past tense, while post-bite shapes are attributed in the present tense.

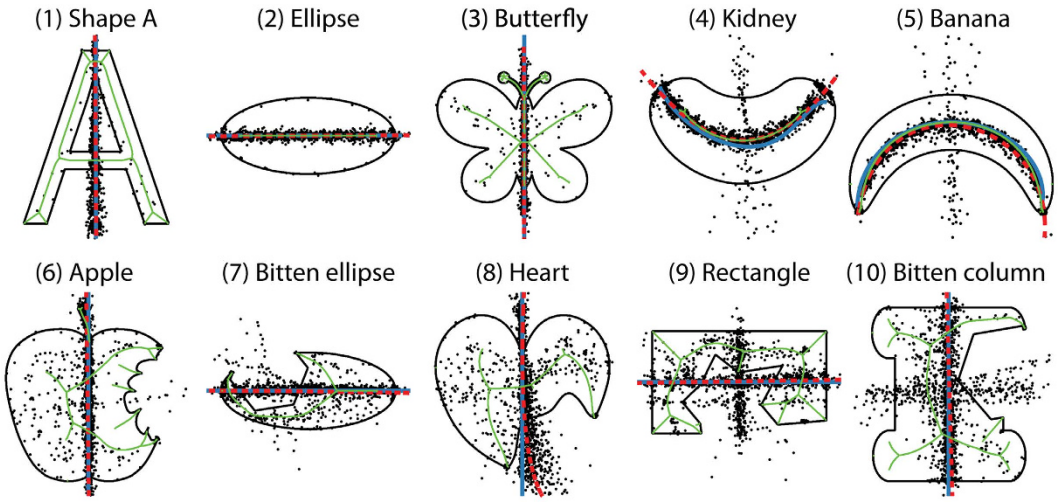

Figure 2. Stimuli used by Spröte et al. (2016). *Source:* Spröte et al. (2016).

[13] Chen and Scholl (2016) performed another study sometimes taken to demonstrate that causal history is genuinely perceived. However, this study probed the perception of dynamic transformations (viz., intrusions) within a brief apparent motion sequence—i.e., *very recent* causal history. In this case, it is plausible that causal transformations were represented wholly within the bounds of a single specious present. Given the qualification in section 2, this would be consistent with perceptual presentism.

One might suggest that representation of the completed shape did not occur in perception but only in cognition, and these cognitive judgments guided performance on the dot placement task. However, if completed shapes affect the representation of symmetry axes, then this is some evidence that they are represented perceptually. There is evidence that the perceptual system recovers axes of global symmetry and elongation and uses them in constructing visual shape representations (Humphreys & Quinlan 1988; Quinlan & Humphreys 1993; Chaisilprungraung et al. 2019). If the processes that recover completed shapes causally influence the processes responsible for recovering symmetry axes, this lends defeasible support to the view that the former processes are perceptual too (cp. Chen & Scholl 2016).

Rather than dwell on the perception-cognition issue, I will assume for the sake of argument that completed, pre-bite shapes *are* perceptually represented. My question is whether, granting this, we must conclude that completed shapes of bitten objects are perceptually attributed in the *past tense*. I think the answer is no: Perceptual presentists can accept that completed shapes are perceptually represented while denying that they are attributed in the past tense.

The most flatfooted strategy would be to hold that perception of bitten shapes involves a familiar kind of perceptual completion. Perceptual completion comes in two familiar varieties: *modal* completion (figure 3a) and *amodal* completion (figure 3b). In modal completion, one experiences an illusory border between the completed shape and its surroundings—the square appears brighter than its background. In amodal completion, one has a perceptual impression of the completed shape, but no illusory border is experienced (Murray et al. 2004). In both cases, one perceptually represents the relevant object as *presently possessing* the completed shape. If we perceptually complete the missing portions of bitten shapes in either of these ways, the result would presumably be a perceptual representation of the bitten object as presently possessing its completed shape. The bitten cookie would be perceived as presently circular.

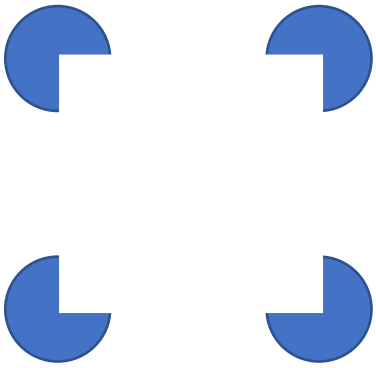

Figure 3a. Modally completed square

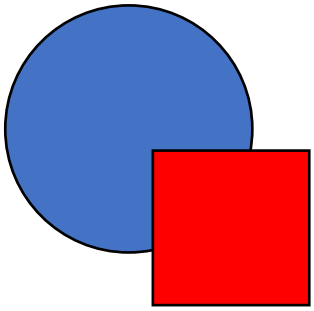

Figure 3b. Amodally completed circle.

However, the "completion" of bitten shapes differs markedly from both modal and amodal completion. Regarding the former, there seems to be no phenomenal impression of an illusory contrast border surrounding the missing portion of a bitten shape (Spröte & Fleming 2013). Regarding the latter, evidence suggests that bitten shapes are treated differently by the visual system from amodally completed shapes. Visual search data suggest that amodal completion of partially occluded objects takes place early and "preattentively," while completion of bitten objects does not (Brenner et al. 2021). Thus, the "completion" of bitten shapes probably is not reducible to ordinary modal or amodal completion.

I recommend a different strategy. It is possible that perception might represent a past property of an object without attributing the property in the past tense *and* without representing it as a present property of the object. Instead, the property may feature as part of a complex perceptual description of a distinct present property. Call this the *complexity gambit*. In the current case, the perceptual presentist might suggest that the completed "past" shape of the object serves as a means to representing the more complex present shape of the object, but without any explicit representation of its pastness.

Consider the object in figure 4. If asked to describe its shape, it would be natural to reply: "ellipse, save for a rectangular notch on the left." When you answer this way, you do not commit to

the claim that the object ever *was* elliptical. The appeal to ellipticality serves only as a convenient means to describing the real, complex shape of the object.

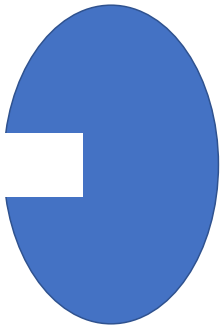

Figure 4. Ellipse with a notch.

There is a useful analogy to the perception of holes. Studies suggest that when we see an object with a hole, we visually represent not only the shape of the object, but also the shape of the hole it encloses (Palmer et al. 2008; Nelson et al. 2009). When asked which among several alternatives matches a target shape, participants are equally fast and accurate whether the target shape is a material surface or an immaterial hole (Nelson et al. 2014). More recently, Kim (2020) found that when participants performed the well-known "bouba/kiki" correspondence on objects with holes, correspondence decisions were driven by the intrinsic shape of the hole, rather than the shape of its exterior.[14]

Palmer et al. (2008) propose that the visual system employs a two-part scheme to represent objects with holes. It generates one representation of the shape of the outer boundary of the surface, and another representation of the shape of the hole, with the latter marked as enclosing an empty region. Together, such representations describe the overall shape: the shape of the surface bounded by the outer contour "minus" the shape of the hole—a "negative part." Because the intrinsic shape

[14] See, however, Bertamini and Helmy (2012) for evidence that holes are not perceived like material objects in all respects.

of the hole is encoded by a constituent of this representation, it is made accessible to shape recognition processes.

A similar scheme might be employed for bitten objects. Perception might complete the bitten shape by filling in the portion that has been removed, then produce a representation of the shape of the indentation caused by the bite, marked as enclosing empty space. Together, these representations would describe the overall shape: the shape of the completed counterpart minus the shape of the indentation. Critically, however, the completed shape is not represented as a *past* property of the object. The representation is silent on whether the object ever *had* the completed shape by which its present shape is described.

This story assumes that the visual system represents the intrinsic shapes of indentations caused by bites. I already mentioned such evidence in the case of holes, but there is also evidence that the shapes of other negative parts like notches or bites are perceptually represented, provided they are sufficiently salient. Mary Peterson and colleagues have shown that when we see a figure-ground display, the shape of the region seen as background, perceived as an "intrusion" into the figural region, can be processed to the level of semantic categorization (Peterson & Skow 2008; Cacciamani et al. 2014). Cacciamani et al. (2014) showed participants figure-ground displays in which a familiar shape was suggested on the side of the contour typically seen as background (fig. 5). The shapes defined by these contours nonetheless exerted semantic priming effects (faster categorization of words naming objects belonging to the same superordinate category). Thus, salient negative parts can plausibly have their shapes perceptually encoded, even when the negative part is (unlike a hole) not bounded by a closed contour.[15]

[15] Note that this story only applies to *salient* negative parts. Spröte et al. (2016) found that participants plotted the symmetry axis of a completed shape, rather than the bitten shape actually shown, only when the concavity was plausibly interpreted as a bite—not when the concavities were smoothed. As Spröte et al. note, the apparently bitten concavities were more salient than the smoothed concavities due to the presence of sharp discontinuities at the opening of the concavity (Kim & Feldman 2009) and completion cues linking the contours on opposite sides of the concavity.

Figure 5. Stimuli from Cacciamani et al. (2014). *Source:* Cacciamani et al. (2014).

I've argued that perceptual presentists might accommodate the perception of causal history from shape through the complexity gambit. Even if we perceptually represent the "past" shape of a distorted object, it is questionable whether we represent this shape in the past tense. Rather, it may feature as a constituent in a complex representation of the object's present shape.

At this point, one might wonder what *would* constitute good evidence for past-tensed content in perception. If the complexity gambit allows us to finesse any possible evidence against perceptual presentism, then one might worry that it is too powerful. However, I do not think this is true. In the causal history case, the complexity gambit is available only because certain present properties of the object are *naturally describable in terms of* the relevant past properties—viz., due to a close geometrical relationship between them. I suggest that progress might be made by instead investigating the representation of past properties bearing *no non-arbitrary relation* to the object's present properties. I close with a potential example of this sort.

5.2. Object Files

I argued earlier that when mnemonic representations are retained wholly offline, we can deny them perceptual status because they violate even a modest stimulus-dependence criterion. These cases involved "pure" VWM representations completely untethered from current proximal stimulation.

However, the visual system also forms complex representations containing mnemonic elements *alongside* present-tensed elements, and these representations *do* seem to satisfy stimulus-dependence.

An *object file* is a representation that sustains reference to an individual over time while storing information about that individual's current and recent features (Kahneman et al. 1992; Noles et al. 2005; Green & Quilty-Dunn 2021). Evidence for object files derives from many sources. In the object-reviewing paradigm, two wireframe objects appear on a computer screen, and features (letters or shapes) appear within them before vanishing. Next, the objects move to new locations, and a new feature appears in one of them. Participants are asked whether the new feature matches either of those seen previously. Responses are faster when there is a match, but faster still when a feature reappears in the same object it appeared in initially, even though the object has shifted location. This is called an *object-specific preview benefit* (OSPB). Object files are held to underlie the OSPB. When features appear in objects at the beginning of a trial, representations of those features are entered into files dedicated to the relevant objects; these representations are retained in the files after the features vanish. Later, when a feature reappears, responses to it are facilitated if it matches information already in the relevant file.

Object files are plausibly perceptual representations. First, they subserve the vital perceptual function of apprehending *object continuity over time* (see also Munton 2021; Green 2023). Suppose that multiple objects are perceived at time T1 and time T2. The visual system faces a problem of determining, for each object at T1, which object (if any) at T2 is a continuation of it (Dawson 1991). Object-file theory claims that an object at T2 is treated as a continuation of one at T1 when a single object file targets both of them. There is evidence that the perception of object continuity in apparent motion corresponds well with object-file maintenance as indexed by the OSPB (Odic et al. 2012; although see Mitroff et al. 2005).

Object files also seem to meet the modest stimulus-dependence criterion. They are initiated in response to proximal stimulation and function to be updated in response to changes in proximal stimulation. Perhaps most obviously, an object file deployed when perceptually tracking an object must maintain a record of the object's current location, and update this record in response to signals received from the object as it moves.

Here is the threat to perceptual presentism: If (i) the mnemonic constituents of object files attribute features in the past tense, and (ii) object files—including all of their constituents—are fully perceptual, then there are some past-tensed perceptual representations, and perceptual presentism is false.

The complexity gambit does not seem applicable here because the relationship between past and present features encoded within an object file can be wholly arbitrary. If an A appears on an object and vanishes, the object need have no property afterward that is naturally describable in terms of the A. So, if object files fail to undermine perceptual presentism, it is not because they succumb to the complexity gambit.

Still, perceptual presentists might raise doubts about (i) or (ii) above.

Start with (i). I said earlier that representations in VWM plausibly mark their contents in the past tense, since this would reduce the chance of confusing objects currently before you from objects that have now vanished. But an alternative view would be that VWM representations do not *explicitly mark* their contents as past—they do not contain syntactic elements that explicitly encode this information. Instead, their functional role disposes them to be treated *as if* their contents were past rather than present. A similar possibility arises for object files. The mnemonic constituents of an object file might play a different functional role from other constituents, disposing them to be treated *as if* they attributed properties in the past tense, but without actually doing so.

One challenge for this proposal is to explain what underpins the functional-role difference between attributives for present properties and attributives for past properties, if tense is not syntactically marked. How do consuming processes "know" to treat a given attributive in an object file as if its content were past, if this information is not explicitly encoded? Setting this question aside, however, note that functional-role properties might contribute to grounding temporal content in the absence of syntactic tense markers. If consuming processes treat a given constituent of an object file *as if* it represents the content *x was red*, this might simply *make it the case* that the constituent represents this past-tensed content, even without any discrete constituent akin to a past-tensed copula.[16]

Turning to (ii), one might suggest that object files are not *fully* perceptual representations, but *hybrid* representations with both perceptual and non-perceptual constituents. The non-mnemonic constituents are perceptual, while the mnemonic constituents are not. Thus, while object files do have past-tensed constituents, none of them are perceptual representations.

This reply prompts the question of *why* the mnemonic constituents should be dismissed as non-perceptual. I said that a vital perceptual function of object files is the apprehension of object continuity over time. One way to argue that mnemonic constituents of object files are non-perceptual would be to claim that only the non-mnemonic constituents contribute to performing this function. However, this claim is incorrect. The mnemonic constituents of object files play a key role in determining object continuity through saccades. Perception can use the information that object O *was red*, say, to determine which object visible after a saccade marks a continuation of O (Hollingworth et al. 2008; Richard et al. 2008; Schut et al. 2017).

[16] Compare Block's proposal that object files possess singular content in virtue of their functional role rather than through the possession of a discrete syntactic constituent with singular content (Block 2023, ch. 5). See Green (2023) for objections to Block's model.

Thus, perceptual presentists cannot withhold perceptual status from object files' mnemonic constituents on the grounds that they are not used in the performance of perceptual functions. They need another reason for doing so.

One might appeal again to stimulus-dependence. While I argued above that object files satisfy modest stimulus-dependence, perhaps not every *constituent* of an object file meets this condition. In particular, the mnemonic constituents of object files may not function to be updated in response to new sensory input.

I regard this as an empirical question. It could turn out that newly received cues to an object's past properties *are* used to update object-file representations of its past properties. If so, these representations would be stimulus-dependent after all. Note also that others have objected to the view that all constituents of perceptual representations must function to be stimulus-dependent (Quilty-Dunn 2020a). So, the current strategy requires a controversially strong version of the stimulus-dependence criterion.

In any case, the current strategy raises an important, more general question. Suppose we grant that a *whole* object file is perceptual because, *inter alia*, it satisfies modest stimulus-dependence and subserves canonical perceptual functions. Then the question arises whether any *constituent* of a perceptual representation automatically qualifies as perceptual, "inheriting" perceptual status from the complex of which it is a part. One view would say *yes*: the property of being a perceptual representation is like the property of being located in Massachusetts—if it is possessed by the whole, it is also possessed by the parts. Another view would say *no*: the property of being a perceptual representation is like the property of weighing ten pounds—it can be possessed by a whole but not its parts. More generally, is the property of being a perceptual representation *preserved under syntactic*

decomposition?[17] If so, then object files pose a significant threat to perceptual presentism. If not, then the perceptual presentist may have an escape route.

I mention two further fallback positions for the perceptual presentist.

First, perceptual presentists might restrict their view to conscious perception, and attempt to show that the mnemonic constituents of object files—or perhaps even object files as a whole (Mitroff et al. 2005)—are always unconscious. For those primarily interested in conscious perception, I suggest that the perception of causal history from shape offers a more pressing challenge to presentism than object files.

Second, even if we grant that object files are thoroughly perceptual representations with past-tensed constituents, one could argue that there is still a *functional asymmetry* between present-tensed and past-tensed representation in perception: Whenever past-tensed representation occurs in perception, it occurs *for the purpose* of guiding production of present-tensed perceptual representations, but the converse is not true. Thus, in the case of object files, perhaps past-tensed constituents are retained solely for the purpose of guiding present-tensed representation of object continuity and persistence. If so, then perceptual presentism, strictly speaking, would be incorrect; but something would remain of the intuition that the basic function of perception is to represent present conditions. Past-tensed perception occurs only when it aids in performing this function.

I conclude that object files offer a crucial case study for perceptual presentism. They straddle the boundary between present and past. They fulfill paradigmatic perceptual functions and are modestly stimulus-dependent. However, they also possess mnemonic constituents that are vital in performing their perceptual functions.

[17] *Decomposition* is the key direction here. One might hold that a non-perceptual representation could have a perceptual representation as a constituent, but that no perceptual representation could have a non-perceptual representation as a constituent.

6. Conclusion

Perceptual presentists hold that perception is restricted to representing present conditions. While perceptual presentism is commonly assumed, it is rarely defended. Moreover, various strands of evidence suggest that perception is attuned to the past in lawlike ways. This chapter has distinguished three forms of perceptual sensitivity to the past and considered their bearing on perceptual presentism. I argued that only the third form constitutes a genuine threat to the view. While the case for this form of sensitivity remains inconclusive, I suggest the most compelling challenges to perceptual presentism derive from complex representations that integrate mnemonic and present-tensed elements in performing canonical perceptual functions.[18]

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