Title

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On locational sensory individuals and spacetime

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"Space-time" — that hideous hybrid whose very hyphen looks phoney.

—Vladimir Nabokov, *Ada, or Ardor: A Family Chronicle*, p. 543

Abstract: Perception not only registers property instances, but also connects with and attributes properties to individual entities—so-called *sensory individuals*, or SIs. But what are SIs? The most-discussed answers are: (i) SIs are ordinary material objects—cohesive, temporally persistent objects extended and bounded in space, and (ii) SIs are locations or regions in spacetime. I will argue for the object view of SIs on the grounds that its rival, the locational view, faces obstacles concerning the relationship between SIs and spacetime: it makes a mystery of perception's representation of SIs as occupying locations in and moving in ordinary spacetime.

1 Introduction: Sensory individuals

On a reasonably wide consensus, perception does more than register distal property instances: in addition, in at least some modalities, at least some of the time, perception connects with and attributes properties to individual entities — so-called *sensory individuals*, or SIs. Thus, on this view, a modality like vision does not merely register *redness is happening*; rather, it has a predicational structure, representing of some SI a that the feature *redness* is exemplified by a. Theorists have called on such SIs not only as the loci of perceptual attribution, but also as targets for focal attention and perceptual demonstration, and as the distal individual *res* that ground our *de re* cognitive contact with the world.[2]

Suppose we accept these motivations and, therefore, join the consensus endorsing the reality of SIs. We then face the further question, on which there is considerably less consensus, about just what sorts of things SIs are. The answers to this question (when asked about vision in particular) that have received the most discussion from SI-realists are:[3]

the object view:
Visual sensory individuals are (at least in canonical instances) ordinary material objects—cohesive, temporally persistent objects extended and bounded in space (Marr 1982; Spelke 1990; Cohen 2004; Matthen 2005, pp. 277-282; Pylyshyn 2007; Dickie 2010; Nanay 2013, p. 51).

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[2] Beyond this, one of the most-discussed motivations for recognizing SIs and their role in the representational structure of perception comes from considerations about perceptual binding: we can account for the visual system's ability to identify the unique green triangle in an array of green circular and red triangular distractors by thinking of vision as searching for (not simply *greenness* or *triangularity*, but) the one SI in the scene that simultaneously exemplifies both *greenness* and *triangularity*. This is, of course, an instance of 's Jackson's 1977 Many Properties Problem. For discussion, see Treisman and Gelade (1980), Treisman (1998), Clark (2000), and Cohen (2004); but see Quilty-Dunn (2023).

[3] These are not the only accounts of SIs in the literature. In particular, cf. various structural and/or associational accounts of SIs, especially as directed at undestanding mutimodal feature binding, defended by Fulkerson (2011), Bayne and Spence (2014), O'Callaghan (2014, 2016, 2017), Green (2019), and Cohen (2023).

the locational view:
Visual sensory individuals are (at least in canonical instances) regions in spacetime (Treisman 1998; Clark 2000; Treisman 2003; Nanay 2022).

This paper is about the dispute between these two SI-realist conceptions of the nature of SIs. I will argue that the locational view faces a pair of obstacles concerning the relationship between SIs and spacetime, the first of which has received some attention in the literature, but the second of which (as far as I know) has not.

Some preliminaries.

First, it is worth asking why the locational view has seemed attractive to some theorists. An obvious virtue of the view is its parsimony. For those persuaded of the need for SIs within the representational repertoire of perception (perhaps for the reasons adduced above), it will seem attractively conservative to assign the latter role to locations (entities we have independent reason for thinking are represented by perceptual systems) rather than new entities that would require their own motivation. A second motivation comes from thinking about the attribution of features — say, color or contour — in early vision, at a stage where object representations have not yet been formed, but where there are already representations of retinotopic locations that could, in principle, fulfill the roles assigned to SIs (Clark 2004) . More recently, Bence Nanay has argued that the locational view offers the best account of the way in which perceptual attribution guides goal-directed action (Nanay 2013, pp. 49-62), and that it affords the best description of picture perception (Nanay 2022). In short, it is fair to say that the locational view has some powerful *prima facie* attractions, and so is worth taking seriously. This makes an open-eyed assessment of its potential difficulties all the more important.

A second preliminary remark is a methodological clarification. The problems to be discussed below concern whether the locational view allows for a coherent understanding of the way SIs are represented as moving through and occupying locations in spacetime. But note that what is at stake here is not whether the locational view is committed to an incoherent conception of *the world*; it is, rather, whether the view is committed to an incoherent conception of *the way perception represents the world*. This matters for our evaluative purpose. Presumably, demonstrating that a view has the former sort of commitment would provide sufficient reason all by itself for rejecting that view: the world can't be an incoherent way, so we have reason for rejecting views that say otherwise. On the other hand, a view entailing that perception represents the world incoherently cannot be rejected quite so abruptly: after all, there are representations with incoherent contents (e.g., the sentence *there is a barber who shaves every person who does not shave themself*), so we can't just assume immediately that perceptual representations aren't among them. That said, I think a commitment to attributing incoherent contents to ordinary perceptual episodes is reasonably regarded as a cost. Such a commitment would amount to a particularly severe error theory about ordinary perceptual content. Moreover, on some standard ways of thinking about content (Stalnaker 1984; Lewis 1986), such a commitment would collapse all ostensibly distinct perceptual contents into one. Perhaps one could learn to live with such consequences if they arose only in isolated, rare, or strange cases. But if a theory entails that they arise ubiquitously for ordinary perceptual episodes, as I shall argue is true about the locational view, then this should count against the theory in question.[4]

Two final preliminaries concern simplifying assumptions. First, to ease exposition, I'll work with unimodal cases involving vision. I don't believe that this limitation is crucial. For, while a number of authors (e.g. Martin 1992; Batty 2010; Richardson 2014; Young 2020) have held that there are significant differences in the spatiotemporal structure of perceptual experience in different modalities, the problems

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[4] A related clarification: to simplify discussion, I will remain as agnostic as possible about first order issues about the metaphysics and physics of spacetime, motion, and change themselves, apart from (mostly) retaining the assumption that that moving and occupying positions in spacetime are possible at the scales relevant for perceptual attribution. (For entrypoints to the vast philosophical literatures on these topics in metaphysics and philosophy of physics, see, e.g., Dainton (2001) and the entries in Knox and Wilson (2022).) I take it that nearly all parties are committed to explaining (or explaining away) those ostensible data, and invite readers who prefer accounts at odds with my naïve formulations below to substitute their preferred reformulations as needed.

raised for locational views in what follows don't depend on facts about the experiential spatiotemporal structure of any particular modality. As such, these worries can be raised within any modality (/system of modalities) that (i) attributes features to SIs, and (ii) represents SIs as occupying and moving through spacetime.[5]

Finally, and again for purposes of simplicity, I'll treat the object and locational views as uniform accounts of the nature of all SIs. This puts to one side hybrid views on which some SIs are understood in locational terms and others in object terms (cf. Clark 2004; Nanay 2022). That said, the problems to be raised for the locational view arise straightforwardly for any locationally construed SI that is perceptually represented as moving through or located in space. This means that any form of SI realism on which there are any locational SIs represented as moving through and occupying positions in spacetime is subject to these problems, whether or not it additionally recognizes non-locational SIs as part of a hybrid account.[6]

2 Motion and individuation

I begin with a relatively familiar problem for the locational view concerning the perceptual representation of motion.

2.1 The motion problem

Perceptual systems routinely represent sensory individuals as moving in spacetime. When you see a baseball thrown from the outfield to the catcher (or, in a more artificial context, when you track one or more moving dots in a single/multiple object tracking task in the lab), your visual system represents a single locus of feature attribution that persists through changes in represented features and location (Pylyshyn and Storm 1988; Carey 2009; Burge 2010; Green 2018; Quilty-Dunn and Green 2021). At t_1 it is represented at location l_1; at t_2 it is represented at location l_2; and at t_3 that very same sensory individual is represented as being located at l_3. Hence, if, per the locational view, feature bearers/SIs are regions of spacetime, it follows that one such spacetime region — the single moving sensory individual — is represented as moving through, hence sequentially occupying, a series of non-identical spacetime locations.

Unfortunately, as a number of authors (Siegel 2002, p. 137; Cohen 2004, p. 478; Matthen 2004, 2005, ch. 12) have noted, that does not seem to be a coherent way that the world could be. It is hard to see how *one* spacetime region could occupy a sequence of *many* locations. Spacetime regions just are, hence are individuated by, positions/positional ranges in spacetime. As such, it is difficult to combine coherently the apparent fact that sensory individuals are represented as moving, i.e., *changing* their positional ranges in spacetime, with the locationist understanding of sensory individuals as individuated by a *fixed* spacetime position/positional range. What this mismatch brings out is that, given its resources for understanding sensory individuals, the locational view is committed to attributing to perception an incoherent content in ordinary cases of perceived motion.

The same mismatch emerges in consideration of the object-specific preview benefit (OSPB) — the finding that, following recognition of a first feature F_1, recognition of a second and congruent feature F_2 is speeded relative to baseline (but recognition of a second and incongruent feature F_2 is slowed relative to baseline), when F_1 and F_2 are represented as qualifying the same bearer (Kahneman et al. 1992). In effect, the OSPB is an operational signature of SI-sharing by distinct feature attributions. Crucially for our purposes, the reason for thinking that OSPBs are *object*-specific is that these effect arise for feature attributions involving apparent motion (*inter alia*) — where the two attributions in the pair are represented as occurring at distinct spacetime locations. The presence of OSPBs in cases of apparent motion is reason for thinking the perceptual attributions involved, taken together, represent *one* SI but

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[5] For discussion of non-visual and especially intermodal SIs, cf. the works cited in note 3.

[6] This allows that one might evade the force of these problems by adopting a highly circumscribed locationism on which only SIs not represented as moving through or occupying positions in spacetime are locational.

multiple locations. This is just the mismatch we've already encountered. Again, given the locationist understanding of SIs as spacetime locations, the proponent of that view is committed to describing apparent motion in a way that attributes to perception an incoherent content.

Call this the motion problem for the locational view of SIs.[7]

2.2 Responses

How might a defender of the locational view respond to the motion problem? Here are some suggestions:

- *Deny the reality of motion.*

  One might deny the reality of motion altogether. To be sure, it seems hard to deny that things perceptually appear to move, but perhaps that's an illusion (cf. the illusion of motion in moving pictures): perhaps perception misrepresents the world as containing moving things, when, in fact, things — in particular, SIs — do not move at all.[8]

  Though denying the reality of motion strikes me as a pretty extreme response, the more significant worry for us is that it does not solve the motion problem.

  If the perception of motion is like the illusion of motion in moving pictures, then perception (erroneously) represents motion of objects in spacetime; but that means that the problem is still with us. For the motion problem does not depend on the *existence/reality* of motion; it depends only on the claim that we perceive (/perceptually represent) motion. The datum that is a challenge to the descriptive resources of the locational view is (not that objects move, but) that objects are perceptually represented as moving.[9] Hence the solution on offer won't save the locational view from the motion problem.

- *Deny the reality of motion perception.*

  Suppose then (and contrary to Parmenides, cf. note 9) that there is motion, but that there is no perceptual representation of motion of any single object in spacetime. If there is no perception of motion, there can be no problem about how to reconcile motion perception with the locational view.

  The immediate concern for this response is that we have mountains of phenomenological and psychophysical evidence attesting to the reality of the perceptual representation of motion. Motion perception is a familiar and ubiquitous aspect of our visual perception of the world, and one that has appropriately become the topic of a vast empirical literature within perceptual psychology (it is, unsurprisingly, a mainstay in canonical vision science textbooks (e.g. Palmer 1999; Frisby and Stone 2010)). On the present proposal, all this naïve and non-naïve evidence will have to be explained away, and the well-established empirical fields devoted to accounting for it dismissed.

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[7] If the motion problem arises when perception represents one SI but many spatiotemporal regions, some theorists have also challenged the locational view in the opposite way — i.e., by constructing cases in which perception seems to represent multiple SIs in a single spatiotemporal region (Valdes-Sosa et al. 1998; Blaser et al. 2000; Cohen 2004). While I find this problem potentially serious for the locational view as well, more needs to be said to close off decisively the response that the distinct SIs in such cases are assigned to different depths in space from the viewer, hence can be thought of as distinct spatiotemporal regions after all (but cf. Valdes-Sosa et al. 2000, pp. 498-500).

[8] I owe the connection to the moving pictures illusion to a referee for this journal.

[9] For what it's worth, this is a datum that even Parmenides appears to accept. On the standard reading, at any rate, he is an irrealist about motion, but an error theorist (so not an irrealist) about the perceptual representation of motion (Dorter 2012; Huggett 2019). (Thanks to Monte Johnson for discussion on this point.)

An obvious alternative story (also considered and rejected by Siegel 2002, pp. 137-138) would be that when one seems to see the single moving baseball (/a single moving object in the OSPB recognition task), the information that there's a single object comes (not from perception, but) from post-perceptual cognition. However, this putative re-explanation is implausible. There is abundant evidence of the representation of motion by cells in the visual cortex dating to at least Lettvin et al. (1959). Indeed, this point is crucial to the standard explanation of motion adaptation (as in the motion aftereffect) as arising from lateral inhibition between neighboring neurons in the visual cortex (Mather et al. 1998). Given that post-perceptual cognitive processes do not give rise to this sort of low-level inhibition, the proposed explanation of apparent motion in post-perceptual terms would leave us without an explanation for these phenomena. Finally, the proposed reconstrual of the cases in cognitive terms fails in view of the finding that verdicts about SI-sharing coming from OPSBs dissociate from (hence are not explicable in terms of) conscious judgments about object identity (Mitroff et al. 2005).[10]

It must also be said that this second response to the motion problem (like the first) seems an exorbitant piece of revisionism that has no motivation independent of its use in defending the locational view, and relative to which the object view amounts to a less revisionist alternative.

- *Attribute motion to something other than SIs.*

  One might accept that visual systems both represent motion and attribute properties to SIs, but understand the visual representation of motion in terms of the attribution of motion to something distinct from SIs.

  While perhaps coherent, this move invites many questions to which it is hard to imagine non-stipulative answers. For one, if the moving objects (and their locations in spacetime) are distinct from the locations that locationists propose to treat as visual feature bearers, it's unclear why any particular locations rather than others deserve the honor of being SIs. For another, if the extra non-SI entities bear motion properties, presumably they also have to have locations at times; but if so, why can't they bear colors, shapes, and so on, thereby doing property-bearing jobs that SIs were supposed to have done (thereby obviating the locational view entirely)?

  Once again, absent some motivation for this proposed response independent of its use in defending the locational view against the problem about motion, it will seem undermotivated.

I conclude, then, that the motion problem remains a significant challenge for the locational view of SIs. The problem arises from a mismatch in individuation: given the way in which that view is committed to individuating SIs, it predicts *many* SIs in ordinary cases of perceived motion, where the best theoretical understanding is that there is only *one*.[11]

3 Location, location, location

As noted, the individuation mismatch problem reviewed in §2 has received some attention in the literature. However, there is a distinct way in which cases of perceived motion create difficulty for the locational view, and which (to my knowledge) has received far less discussion. I want to emphasize that this second problem is distinct from the motion problem: it has nothing to do with the individuation of SIs, but instead concerns the possibility of representing spacetime regions as themselves occupying spatiotemporal locations at all. I'll call this the locations for locations problem.

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[10] Further evidence against treating the representation of motion in post-perceptual terms comes from the observation that akinetopsia (/"motion blindness") results from lesions to/TMS interruption of cortical regions generally regarded as visual areas (Zihl et al. 1983).

[11] Moreover, there remains the problem arising from the opposite individuation mismatch discussed in note 7.

3.1 The locations for locations problem

We can bring out the locations for location problem by considering, once again, an ordinary case of the perceptual representation of a feature-bearer (i.e., an SI) moving in spacetime, such as that involved in the perception of a hurled baseball traveling along its spatiotemporal trajectory. We noted in the foregoing discussion of the motion problem that there is abundant phenomenological and psychophysical evidence of such cases, and that accounting for them appears to require thinking of perception as representing SIs as occupying a series of spacetime locations. Of course, if SIs are spacetime regions, then this would commit us to the idea that perceptual systems represent spacetime regions as occupying locations in spacetime. But, even putting the motion problem about individuation mismatch entirely to one side, it is unclear whether there's a coherent understanding of that sort of content.

What would it mean to represent a spacetime region itself as occupying a spatiotemporal location? We represent an ordinary object (say, a baseball) as occupying a location in spacetime when that object is represented as having a value/position along spatial and temporal dimensions. To do the same for a spacetime region *R* would be to assign to *R* values along spatial and temporal dimensions. But which ones? Surely not those in terms of which *R* itself is defined, since this would preclude the possibility of *R*'s occupying distinct spatiotemporal locations (i.e., the possibility of *R*'s moving). This suggests that representing *R* as being located in spacetime would require assigning to it values along *further* spatiotemporal dimensions — hyperdimensions — other than those that define *R*. But positing such spatiotemporal hyperdimensions/hyperlocations is egregiously unmotivated.

It may help to appreciate the locations for locations problem by setting it against a well-known complaint Smart (1949) makes against the coherence of temporal passage (he frames the point as a objection to construing time as a "moving river"):

> We become even more worried when we ask ourselves how fast this river flows. If time is a flowing river we must think of events taking time to float down this stream, and if we say "time has flown faster to-day than it flew yesterday" we are saying that the stream flowed a greater distance to-day than it did in the same time yesterday. That is, we are postulating a second time-scale with respect to which the flow of events along the first time-dimension is measured (Smart 1949, p. 484).

Here, Smart points out that an opponent who thinks time moves in spacetime faces the problem of specifying the temporal dimension along which time moves (with the constraint that the answer to that question can't be the temporal dimension we started with). Our worry is that, because a locationist about SIs is apparently committed to saying locations are represented as moving in spacetime, she faces the analogous problem of specifying the spatial dimension along which the location is represented as moving (with the constraint that the answer to that question can't be the spatial dimension we started with). Just as in Smart's case concerning temporal passage, if we think of moving spatiotemporal regions as being represented as occupying spatiotemporal positions, we seem to be driven to (implausibly) postulating a second represented spatiotemporal scale — a set of spatiotemporal hyperdimensions — with which to index those positions.

And, indeed, we are now in a position to notice that motion is inessential to the locations for locations problem. Though consideration of motion makes the difficulty vivid, the issue arises just as forcefully in static perception. For, just as in the dynamic case, construing a static SI as a spatiotemporal region would seem to demand assigning to that region a positional value along spatiotemporal dimensions distinct from those that define it. If the unavailability of such distinct hyperdimensions makes it impossible to assign to a region the multiple locations we would need to understand it as moving, the unavailability of these hyperdimensions should also make it impossible to assign to a region even a single location. To represent even a static spatiotemporal region as occupying a spacetime location would require a represented location for that location. It would seem, then, that the problem we are confronting is independent of considerations about motion; it arises from the relationship between the locational understanding of SIs and spacetime, whether such individuals are represented as moving or not.

3.2 Responses

How might a defender of the locational view respond to the locations for locations problem? Here are some suggestions:

- *Accept hyperdimensions.*

  Might one bite the hyperdimensional bullet, adding further dimensions to one's perceptual ontology?

  The contemplated position introduces serious problems of coordinating between the standard dimensions and the new ones. For one thing, if perception represented features as distributed in hyperdimensional rather than ordinary spacetime, its deliverances would be uninformative (as they obviously are not) with respect to the guidance of action in (non-hyperdimensional) ordinary spacetime. Similarly, on the contemplated view, the hyperdimensional locations of perceptually represented SIs should be incommensurable with/uninformative about the (presumably) ordinary dimensional represented locations of objects in thought (say, in working or long term memory). Surely this is implausible.

  The acceptance of hyperdimensions (whatever their relation to SIs) to supply locations for locations also threatens regress. If spacetime regions defined by ordinary dimensions can be assigned to locations in represented hyperdimensions, this invites us to ask whether hyperdimensional regions can, similarly, be represented as occupying locations as well, this time with respect to yet further represented dimensions (hyper-hyperdimensions?). *Prima facie*, the latter question generalizes: we can then ask whether regions defined in terms of hyper-hyperdimensions can themselves be represented as occupyng locations along represented hyper-hyper-hyperdimensions, and so on into the night. Regress looms.[12] Of course, the threatened regress might, in principle, be blocked. Perhaps there are reasons why regions *can* be represented as occupying locations in a higher dimensional regime at the first level but not at the second or later levels. However, until such reasons have been provided by the proponent of hyperdimensions (I am not aware that any have been offered), it would seem that the threat of regress amounts to another motivation for rejecting the hyperdimensional inflation on offer.

- *Relativize to locations of a different SI.*

  Perhaps hyperdimensions can be avoided. In ordinary cases we represent multiple SIs at a time; perhaps we can assign a relative spatiotemporal location to a target SI by relation to that of other SIs whose location is given independently. For example, your perceptual system might describe the spatiotemporal location of the red circle relative to that of the green square (as it might be, *ten degrees of visual angle to the left*; or, in a case of motion, perhaps something like *to the left at* t_1, *occluding the square at* t_2, *to the right at* t_3…).

  Of course, the suggestion here depends on having a prior representation of the spatiotemporal location of at least one additional SI. For this reason, the strategy is clearly inapplicable to cases involving perceptual attribution to exactly one SI (say, a moving red dot on a uniform black

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[12] Once again, I am echoing Smart. The quotation above continues:

> Furthermore, just as we thought of the first time-dimension as a stream, so will we want to think of the second time-dimension as a stream also; now the speed of flow of the second stream is a rate of change with respect to a third time-dimension, and so we can go on indefinitely postulating fresh streams without being any better satisfied. Sooner or later we shall have to stop thinking of time as a stream. Our difficulty, of course, is that at present we do not see very clearly just how we are to stop (Smart 1949,p. 484).

background occupying the rest of the visual field), in which there is no additional SI whose position could ground the representation of spatiotemporal locations for the one SI perceived.[13]

But even in cases involving multiple perceived SIs, the strategy under consideration merely pushes back, rather than resolves, the problem of locating SIs in spacetime when the latter are understood as spatiotemporal regions. It trades the question how the proponent of the locational view understands the represented spatiotemporal locations of a first SI for the question how the proponent of the locational view understands the represented spatiotemporal locations of a distinct SI. There is no reason to think this second question is easier to answer than the first.

- *Construe the spacetime of perceptual representation relationally.*

  The last suggestion for avoiding hyperdimensions required having a prior, independent specification of the represented spatiotemporal location of at least one other SI, and so gave out in cases where such an independent specification was unavailable. Alternatively, we might suppose that perception represents all spacetime locations relationally. In this case it will still be impossible to provide a prior, independent specification of the represented location of a second SI as a step on the way to fixing the represented location of a first, but this need not be seen as an obstacle to our strategy for avoiding hyperdimensions. We can understand the represented locations of the two SIs as mutually interdefined in a holistic/relationalist spatiotemporal framework — i.e., we can construe the represented location of the second in terms of that of the first even if we lack an independent specification of the represented location of the first.

  This suggestion is problematic as well. One difficulty is that, like the proposal just discussed above, the current proposal is inapplicable to cases involving perceptual attribution to just a single SI, in which there are no other available SIs to be enlisted.[14] Hence, it would leave us unable to account for less than the full range of attributions made by our perceptual systems.

  A second difficulty is that, because it imports a relational metaphysics of spacetime into the content of perceptual representation, the current proposal brings with it significant demands on the psychology of perceptual representation: it entails that perceptually representing the spacetime location of even a single SI will require representing all of the other SIs in terms of which the location of the former is interdefined. Of course, this means that updating the represented location of each moving SI will require revising the specification of the location of every other. Consequently, on this proposal, we would expect to see that the psychological resources required for tracking N moving SIs should increase exponentially with N. That prediction is not borne out: though there is evidence that performance on multiple object tracking falls off as the number of tracked items increases (together with additional factors including the speed of items and/or their spatial density), this performance dropoff does not appear to be exponential in the way predicted by the current proposal (Pylyshyn and Storm 1988; Cavanagh and Alvarez 2005; Alvarez and Franconeri 2007; Franconeri et al. 2010; Holcombe 2023).

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[13] Objection (due to an anonymous referee): Perhaps perceiving a single SI is impossible. The locationist will redescribe tracking one single red dot on a uniform background as a series of attributions to multiple locational SIs, each of whose spatiotemporal location is given by relativizing to the others. If so, the problem posed to the proposal by cases of attribution to a single SI can be sidestepped.

Response: The locationist's reconstrual of the problematic case is inadequate. First, if the proposed series of attributions has a first member, then the reanalysis fails to avoid the difficulty: given that other items in the series and their locations would not yet be available, perception would need to specify the location of this first member without adverting to the locations of others — i.e., not relative to any other SIs. Second, as discussed in §2, OSPBs and other psychophysical measures provide reason for thinking that perceptual tracking (such as the case offered in the main text) cannot be described in terms of attributions to *multiple* SIs, as proposed, but, rather, requires maintaining a *single* locus that persists through changes in represented features and location.

[14] Cf. note 13.

> Similarly, the proposal under consideration predicts that the psychological resources required to track the motion of a single SI among N stationary distractors should increase linearly with N: updating the position of the moving SI will require adjustments to (not just the position of that moving SI, but) the representations of the positions of the distractors as well. Again, there is no evidence of such an increase in resource demands as the number of stationary distractors grows. The apparent failure of these predictions gives us further reason to reject the proposal at hand.

I conclude, then, that the locations for locations problem remains unanswered, and so poses a significant challenge for the locational view of SIs.

4 Conclusion

Because we are used to thinking about baseballs and other ordinary objects as occupying locations in and moving in ordinary spacetime, the apparent fact that perception represents SIs as occupying locations in and moving in ordinary spacetime poses no special challenge for the object view, on which SIs just are (more or less) ordinary objects of exactly this sort. It is much less clear how to make sense of spacetime regions as themselves occupying locations in and moving in ordinary spacetime. Therefore, the apparent fact that SIs are perceptually represented as doing these things is potentially troublesome for the locational view.

Perhaps there is more sense to be made of these possibilities than I have allowed; or perhaps there is not, and ordinary perception represents the world incoherently as a matter of course. I submit that the case for these conclusions, and therefore for the locational view of SIs, remains to be made.[15]

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