Temporal Perception, Magnitudes, and Phenomenal Externalism

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What are temporal magnitudes? What is it to perceive them? And what are the consequences of plausible answers to these two questions? These three questions set my agenda.

1. Durations Treated Realistically

Consider truths about the length of a wall, or the velocity of a planet, or the mass of a rock. Under a general realism about the ontology of magnitudes, such truths about the possession of particular magnitudes by particular objects and events cannot be reduced to truths not involving an ontology of magnitudes. Such truths about the magnitudes of objects and events are not reducible to facts about the results of the application of measuring procedures. Nor are they reducible to truths about systems of magnitude-free relations to some chosen entities as units. The fact that an entity, or an n-tuple of entities, has a particular magnitude of a certain type can causally explain other facts. It can itself potentially be explained by other facts. For the purposes of this paper, I will take for granted a background realism about magnitudes that endorses all these claims. For the positive case for this kind of realism about magnitudes, see Peacocke 2015.

Under this realistic conception, particular magnitudes of a given kind - particular distances, masses, accelerations, areas - are in themselves unit-free. They can be assigned numerical measures once a unit has been selected. But these numerical measures are a means of picking out a magnitude whose nature does not involve numbers at all.

I propose that all these claims flowing from a realistic conception of magnitudes apply equally to duration and to other temporal magnitudes. My starting point in this paper is that duration and other temporal magnitudes should be regarded as on a par with other physical magnitudes in accordance with this realistic treatment.

These claims of realism and irreducibility of the ontology of magnitudes do not imply absolutism about magnitudes. For a huge range of magnitude-types, real and irreducible magnitudes of those types are relative to a frame of reference. We know from the special theory of relativity that this applies to durations. Such relativity is entirely consistent with the fact that two events' being separated by a certain duration, in a given frame, is causally explanatory of other events and states of affairs. Nor does this realism about magnitudes mean that they exist in splendid isolation from other magnitudes. Magnitudes of a given type can be real and irreducible, even if they have fundamental and even individuative connections with magnitudes of other types.

One of the things that can be explained by two events' being separated by a certain duration, in a given frame of reference, is the perception, by a person at rest in that frame, that they are separated by that duration, relative to that frame. The duration between two events can sometimes be perceived, as the distance between two objects can sometimes be perceived. In both the temporal and the spatial cases, the perception of the magnitude is unit-free, just as the magnitude itself is unit-free. We do not perceive the length of time since the person left the room

in seconds or minutes, any more than we perceive the width of the desk in inches or centimeters. In the spatial case, we specify how the world seems to be to a perceiving subject in part by specifying how the space around the subject has to be filled in for her spatial experience to be veridical. This is what I called scenario content (Peacocke 1992). In the temporal case, we specify how the world seems to be to a perceiving subject in part by specifying how the recent past has to be filled out with events, at certain durations from the present, for her temporal experience to be veridical. Just as spatial magnitudes feature in the scenario-like content of perception, so temporal magnitudes should be included correspondingly in the representational content of perception. The notion of scenario content should be expanded accordingly, and given a temporal dimension. My question now is: if we conceive of durations as real magnitudes that are on occasion perceptible as such, then what is the nature of such perception? What makes an event an event of temporal perception?

2. What is Perception of Temporal Magnitudes?

For an organism to be sensitive to a magnitude of a given type, to be in states causally explained by some object or event having that magnitude, is not yet for the organism to represent that magnitude as such. Sensitivity is not representation. The point is developed forcefully by Tyler Burge (2010, Part III).

In the case of genuine representation of spatial properties and relations in perception, Burge says that what makes the difference between representation of such a property or relation, as opposed to mere sensitivity to it, are the perceptual constancies. Varying proximal states, themselves caused by the same constant property, cause the

same objective representational state representing that property, within a wide range of normal background circumstances. For example, different projected retinal sizes or shapes cause perceptual representation of the same objective size of object as distance from the object varies, or angle with respect to the object varies. Conversely, the same retinal size on two different occasions will cause states with representational contents concerning different objective sizes, when appropriate, and in a range of normal conditions. There are analogues of this for colour constancy, and so forth.

This constancy criterion does not carry over to provide a constitutive account of the representation of temporal properties and relations. The general problem is that in the spatial case, the very characterization of constancy involves either variation in three-dimensional conditions producing the same two-dimensional pattern of proximal stimulation, or else (as in colour constancy) involves multiple environmental conditions, instantiated in normal circumstances, producing the same proximal stimulation property (retinal colour in the visual case). Conversely, one and the same objective length, for example, produces many different sizes of retinal image at various distances of that length from the perceiver. The retinal image of the length varies also with the orientation of the perceiver. But neither of these kinds of variation in three-dimensional relations, nor of varying normal environmental conditions producing the proximal stimulus state, applies to the case of duration and to other temporal properties and relations. Consider as an example the perception of the whole duration of a temporally extended event, such as the sounding of a fire alarm bell. We can take the proximal stimulus event to be that of the series of sound waves hitting the ear drum, from the initial striking, up to their later cessation, just after the bell stops ringing. In normal circumstances, extended proximal

events of this kind *will* be reliably correlated (and explained by) the objective complete duration of the ringing of the alarm bell. In ordinary circumstances, there is no highly variable environmental feature or dimension such that a wide range of different such features or dimensions will produce the same extended event of pressure on the eardrum. The correlation, in normal circumstances, between objective duration of the bell ringing and the duration of the stimulation of the eardrum is uniform. Our perceptual systems are not in fact adapted, and do not need to be adapted, to circumstances in which there is no uniform correlation between the length of the objective event and the length of the auditory stimulation. This is a sharp contrast with the variability of projected retinal shape produced, according to the angle of the perceiver, of a given objective shape.

It is true that there is a limited subclass of cases in which the objective duration of some external event is not reliably correlated with the length of the proximal stimulus. There is in fact no reliable correlation in the special case in which the duration is an event of lateral motion across the visual field. The so-called Kappa effect is that the perceived duration between two events increases with the objective distance between those events, even when the corresponding retinal separation of those events is the same (Cohen et al., 1953). But there remains a reliable correlation when we are concerned with the perception of the duration of an event at a single location over time, and in many other cases than lateral motion. We have an obligation to explain philosophically why there is genuine temporal representation in the case of duration perception when there is reliable distal/proximal correlation. The Kappa effect is also not something that at all fits a model of constancy in which varying proximal stimulation is consistent with generally correct objective representation. On the contrary, the dilation effect of perceiving durations between distant events as longer means that some perceptions of durations between spatially

separated events must be non-veridical, rather than correct.

So does the inapplicability of the constancy criterion to a range of temporal examples mean that the distinction between representation of a property and mere sensitivity to it collapses in the temporal case? That does not seem plausible, for the notion of representation has real work to do everywhere. But what then is that work, if constancy is no longer the test of it in the temporal case?

Here we have to address two questions.

Question One: What is the nature, philosophically, of the distinction between mere sensitivity to temporal distinctions and representation of temporal distinctions, as temporal distinctions? This we can call "the constitutive question of the representation of time".

Question Two: Whatever is the correct answer to Question One, the constitutive question, what then unifies that answer with the constancy answer that is so plausible in such cases as spatial perception and colour perception? What makes all these kinds of cases genuinely representational? This is an equally pressing question, which we can call "the question of representational unification".

Burge's own proposal about temporal representation in *Origins of Objectivity* is as follows:

"I believe that, at least in actual animal life, the functioning of temporal sensitivity in perception (and hence representational agency) is necessary and sufficient for temporal representation. A functioning psychological coordination of perception of *other matters* with temporal sensitivity is both necessary and sufficient for temporal representation in

perception. […] First, sufficiency. Suppose that an animal tracks a moving particular. The tracking relies on sensitivity to temporal order. The particular is represented as the same through the motion. The coordination of later perceptions with earlier perceptions in representing the particular depends on sensitivity to temporal order. Then temporal sensitivity is incorporated into perceptual representation of movement. One represents the particular's being in one position as temporally after its being in an earlier position…..Or a single diachronic perception contains a representation of temporally ordered change. Such perceptions are further coordinated with actional representations guided by perceptual memory. … Incorporation of sensitivity to temporal order in perception of change or movement is probably the simplest sort of temporal representation in perception. Similar points apply to sensitivity to temporal intervals." (Burge 2010: 521)

So Burge's proposal is that in the temporal case, it makes a difference if the sensitivity to temporal distinctions is coordinated with genuine perceptual representation of other matters. Earlier in the book he also wrote, "A perceptual system achieves objectification by - and I am inclined to believe *only by* - exercising *perceptual constancies*" (2010: 408).

Here is a series of three examples that suggest that temporal sensitivity, even when coordinated with the genuine representation of other matters, does not suffice for temporal representation.

(i) Consider the nectar-feeding amakihi bird in Hawaii (Gallistel 1990: 292). The amakihi avoids flowers it has recently visited, because the nectar will not be replenished for a certain period of time. But it must also not leave a revisit too late, or else some other

bird will consume the nectar. It has to be sensitive to a certain magnitude of duration to return to the flower at the optimal interval. This seems to involve only a sensitivity to duration, not a representation of it as a duration. But this sensitivity can certainly be coordinated with a functioning perceptual representation of other matters. The creature that is sensitive to duration may have perceptual constancies for objective shape and shade, and representations of shape and shade may influence its actions. But adding a sensitivity to duration that is integrated with these spatial representational capacities in coordinated action is not enough to ground the claim that the organism represents temporal duration. Saying that there is representation of duration simply on these grounds would make the notion of representation add nothing in the temporal case that is not already explained by temporal sensitivity to a duration. It would be a violation of a content-theoretic version of Lloyd Morgan's famous canon.[1]

There is a way of making this vivid that can be helpful in thinking about the distinction between mere sensitivity and representation. All that is necessary to explain the actions of the amakihi bird is that after the relevant duration has elapsed, some system in the bird generates the means-end command "To obtain food, go to such-and-such location". The time at which this means-end command appears in the bird's systems is sensitive to the duration that has elapsed since the bird's last visit to the flower; but duration does not enter the content of the command. Nor does the past tense enter the

[1] "In no case is an animal activity to be interpreted in terms of higher psychological processes, if it can be fairly interpreted in terms of processes which stand lower in the scale of psychological evolution and development. To this, however, it should be added, lest the range of the principle be misunderstood, that the canon by no means excludes the interpretation of a particular activity in terms of the higher processes, if we already have independent evidence of the occurrence of these higher processes in the animal under observation" Lloyd Morgan 1904: 59.

content of the command. The bird's actions are entirely explained by the presence of that command whose content is duration-free and entirely in the present tense. The philosophical question becomes: what is it that can be explained only by the presence of a notion of duration and of the past in the content itself?

This point illustrated by the amakihi bird should, incidentally, make us suitably demanding when presented with a claim that a creature has episodic memory of a past event. It is not sufficient to establish the claim of episodic memory that the creature's actions are sensitive to how long ago a particular event occurred in the creature's history. If such sensitivity can be explained purely by present tense representations that arise after the corresponding duration, further evidence is necessary to establish the existence of episodic memories with a past tense content.

(ii) We can make a similar case about organisms which are sensitive in their actions to which stage they reached in some endogenously generated cycle, what Gallistel (1990: 240) calls "phase sense". Bees will reappear at a feeding site 24 hours after the last of several daily feedings, even in circumstances of constant light. They will also reappear at a local feeding site in a contained space 24 hours after the last feeding, even when the container is flown from its home site in Paris to New York (Gallistel 1990: 255, citing work of Renner (1960)). This kind of temporal sensitivity to the stage of an endogenously generated cycle could clearly be present in an organism with rich spatial representational capacities and constancies. But again, being sensitive to phase is to be distinguished from representing temporal phase. Mere sensitivity seems to explain everything that needs to be explained here. Again, we can put the issue in terms of what needs to be in the content of the creature's representational states and what does not. The

actions of the bees are fully explained by the generation, at a certain stage of the endogenously generated cycle, of the instruction "Get food now", and by the sensitivity of the time at which that command appears to the passage of a certain duration. Duration and the past do not need to be in the content of the representation.

(iii) Consider the case of fireflies that emit flashes of light, and whose conspecifics are sensitive to such flashes:

"Normally the flying male crisscrosses an area and rhythmically emits his species-specific flash pattern. In the simplest case this pattern is characterized by flashes of fixed duration emitted at fixed intervals. Stationary females, located in the underbrush, on bushes, or in trees, respond with simple flash answers whose latency is stereotyped, determined by their conspecific male's flash. Upon receiving an answer the male hovers in flight and orients his lantern toward the female, often dimming his lantern to locate the female more precisely. Eventually the male lands near the female and proceeds to her on foot." (Copeland 1978: 341)

"At dusk males can be seen flashing about 1 meter above the ground. Each flash lasts approximately 0.5 seconds at 20 degrees centigrade (flash timing is temperature sensitive) and is emitted during a short swoop that makes an upward arc of light. Flashes are repeated about every 7 seconds. Stationary females answer each flash with a 0.5-second flash of about 3 seconds latency." (Copeland 1978: 341).

Now, I do not know whether fireflies exhibit spatial constancies in their perceptual systems. But again, we can conceive of a creature that makes and is sensitive to flash

patterns, and also uses a perceptual system with spatial constancies to recognize and steer towards a female of the same species. This creature would exhibit temporal sensitivities, in a way that is coordinated with genuine perception of other matters, viz. spatial properties and relations. I do not think this would suffice for this creature to represent temporal matters, as opposed to merely being sensitive to them. It is compatible with this description of the creature that it has no capacity for temporal representation beyond the sensitivity described, and no capacity to represent the past. Its actions are entirely explained by the temporal pattern of its reception of light stimulation. At no point in the explanation of this creature's actions do we need to appeal to anything beyond that. To put the point again in terms of content: the fireflies need to have something that represents the command "Fly towards that light" that is sensitive to number of flashes, and to duration between the flashes. But duration, and the past tense, does not need to enter the content of these instructions or commands.

In these three examples, the mere sensitivity to temporal durations, or phase stages, or flash patterns, stands in sharp contrast to what we need to invoke in explaining the actions of a creature with objective spatial representations. Those actions do not involve merely a sensitivity to retinal or proximal stimulation patterns. Explanation of such spatial actions involves sensitivity to the spatial representational content of the creature's perceptual states.

The attribution of temporal representational content is correspondingly well-founded only if there are actions not fully explained by temporal features of proximal states, including properties of the time at which a command appear, but are explained by states of the creature whose content involves duration and the past. Our next task is to say

what capacities could be explained only by such temporal contents. Equivalently, our task is to say what it is to grasp such temporal contents.

When you are functioning properly, in normal circumstances, you have some conception of the layout of the world around you at any given time, and have various experiences at that time. As time passes, some of this conception is retained, and is given a suitably adjusted temporal and spatial labeling. The conception needs to be given the right past tense labeling, as time passes. If you have moved, the indexical spatial content in the conception needs to be adjusted too. If you have turned rightwards, then the earlier perception of the tree in blossom straight ahead of you needs to be adjusted to a representation of the tree in blossom to your left. Similar remarks apply to distance. The earlier perceptual demonstrative "that tree" generates a corresponding memory demonstrative of the same tree; and so forth.

Such a process of preservation of a conception has three crucial and interrelated components.

First, there is some kind of preservation, as just illustrated, of a conception. It may be tempting to call this 'objectivity preservation', but that may be too strong. The conception can certainly contain elements concerning the subject's own experiences and other subjective states, so it is probably better to call what is in question 'representational preservation'.

Second, the later representation is sensitive to time itself. When all is working properly, the representation is given a past tense label that is sensitive to how much time has passed. We are capable of thinking of a duration of a certain (unit-free) length, and,

again when all is working properly, the adjusted representation represents the world as being a certain way that same unit-free length of time ago.

For the third component, which is arguably implicit in the first two, consider the subject's total representational conception at the later time, a total conception that concerns the state of the world both past and present. This total representational conception is one that registers certain identities between objects, events, or places that are represented as being a certain way at the earlier time and objects, events, or places that are given to the subject at the later time. If you have moved a certain distance from the tree in blossom, that tree that you represent as having been in blossom earlier is also represented by you as having a certain distance from your present position. If your left ankle hurt earlier, that ankle is, in your total representational system, represented as being one of the same ankles you have now; and so forth.

So we are concerned here with temporally sensitive representational preservation that registers identities over time. I will label this, with capitals 'Representational Preservation' for brevity, the capitalized label being understood to cover all three components we just identified.[2]

I propose the hypothesis that Representational Preservation is what distinguishes the representation of time and temporal distinctions, as opposed to a mere sensitivity to time and to temporal distinctions. When there is Representational Preservation, we have representation of objective temporal relations, durations, and properties. In a case of genuine perception of the duration of an event, that duration is fitted into the perceiving

[2] There are obvious connections here with the notion of perspectival sensitivity in Peacocke (1983).

subject's local history of the world built up by the operation of Representational Preservation. There is of course no one type of action we should expect when there is perception of duration - any more than there is one type of action to be expected in the case of genuine perception of spatial extent. Any actions produced will depend on the appetites and projects of the agent. But when the duration of the ringing of the bell is perceived, a subject may be in a position to know what else was happening when the ringing began, whether someone would have had time to exit the building while the ringing continued, whether some other event occurred before or during the ringing, and so on. These are all species of objective temporal information of potential practical relevance.

To say there is representation of objective temporal conditions is not to say that the subject who is representing temporal matters has a conception of objectivity, is capable of representing the notion of objectivity. That would be a more sophisticated capacity, not required for minimal temporal representation. As in the spatial case, so also in the temporal case: we should always distinguish representing objective states of affairs from representing them as objective, which requires a notion of mind-independence. Both are distinct from the more primitive capacity of being merely sensitive to temporal states of affairs.

There is no Representational Preservation in the capacities we considered in the amakihi bird, nor in the bees whose actions are sensitive to the stage of an endogenously generated cycle, nor in the fireflies with their sequences of flashes. In all of these cases, there is indeed an explanatory and counterfactual sensitivity to temporal distinctions. If a certain duration has not yet been reached since the amakihi bird last visited the flower, it

will not return. This conditional is projectible to counterfactual situations that could easily have obtained. A similar point applies to the bees and the phase of their cycle that needs to be reached before they return to a food source. It is equally true that in the actual world and worlds that could easily have been actual, the fireflies will not respond to a non-standard number of flashes, or to flashing that is not at the regular interval. These cases illustrate the point that reliable counterfactual sensitivity can be present without any Representational Preservation.

What then are the kinds of actions that can be explained by the possession of temporal representation and which cannot be explained by mere temporal sensitivity? Obviously the requirement cannot be that present actions can explain what happened in the past. But it can be the case that present actions are rationally explained by what a subject represents as being the case in the past, together with the identities over time registered by the subject. Past states of affairs have significance for present action because of registered identities over time, or chains of identities over time.

Consider an everyday case. You discover that your wallet is not in your pocket. You remember where you were the last time you used it, and retrace your steps back to that location in searching for it. These actions are explained not only by what you represent as being the case in the past, but also by various identities over time that you register as holding. These identities include the identity of various places and objects that you now encounter with those you remember as encountering since you last saw your wallet. Your actions in searching for the wallet, the particular route you take, cannot at all be explained by a mere sensitivity to temporal properties and distinctions. How you represent the world as having been around you when you last saw your wallet is an

essential part of the explanation, and so too is your route since that last sighting of your wallet. If those past tense representational states were to have different contents, you would take or could have taken a different route now, different actions of yours would be explained. Your searching actions cannot be explained merely by simple conformity to an imperative "Go to such-and-such location to obtain your wallet". If such a practical maxim is eventually derived by the subject, it is derived in part from representational states with past tense content.

We can ask what would need to be added to the capacities and states of the amakihi bird to make it genuinely represent the past, and not, like that bird, to be merely sensitive to durations. Suppose we imagine a creature that needs to feed by consuming some organism, again at fixed intervals, but that the organism that it needs to consume moves around, and has to be located. The feeding creature needs to have information over what sort of distance it needs to look for its food source, needs to preserve a representation of where the source was last time it visited, in what direction it was then moving, a representation whose content may vary from occasion to occasion. It needs to register identities between directions it perceives now and the direction in which its prey was moving earlier. Even if there remains a fixed interval at which the food becomes available from the source, with this modification it becomes much more plausible that the feeding creature is operating with past-tense representations that explain its actions. The creature's mental states with durational contents and identities over time form an essential component of the explanation of the creature's representation of the likely current location of its prey, and hence of the creature's actions.

Under this treatment, the answer to Question Two, the question of representational unification, is that both temporal and spatial perception contribute non-redundantly to the explanation of a creature's actions. Perceptual constancies are a sufficient condition, but not a necessary condition, for such a non-redundant contribution to the explanation of action.

In emphasizing the importance of the registration of identities over time in a creature's past tense representations, there is a point of contact, but only of limited agreement, with Kant. Kant in various ways emphasized the importance of the identity of substances over time in our thought. From the above discussion, it should be clear that the conditions for the registration of identities over time can be met by the registration of identity of places over time, something much weaker than the identity of substance. But the enterprise in which I have been engaging is certainly Kantian in goal and spirit, if not in its conclusions. There is a common concern with the minimal constitutive conditions for the representation of temporal properties, relations, and magnitudes.

It is also a consequence of the fulfillment of the Representational Preservation condition that a creature that meets it will be able to use the same kinds of reasoning about how things are in the world at past times as it uses in the present tense about the world as it is around it now.

The capacities mentioned in Representational Preservation are those present when all is functioning properly. Subjects may not be functioning properly when ill, when taking drugs that affect the perception of time, when in some sudden life-threatening situation, or when suffering from damage that affects their ability to order remembered events (or even to remember at all). Subjects in one or another of these suboptimal

conditions are still capable of representing, and misrepresenting, temporal properties, relations, and magnitudes, but only because there is some applicable notion of what is proper perceptual functioning for them.

Under the hypothesis that Representational Preservation is what matters for temporal representation, it is one thing for a subject to be able to represent particular past states of affairs, events, and objects, and it is another thing for the subject to represent causal relations between earlier and later events. Under the hypothesis that Representational Preservation is what matters, a subject can represent particular earlier events and objects, and leave it open which, if any, of them cause, or have properties which causally explain, later events and states of affairs. The temporal sensitivity involved in Representation Preservation, and the role of Representational Preservation in the explanation of action, already supply a foundation for representation of temporal relations, and for thought about particular past events and times. Once Representational Preservation is in place, a subject can speculate about, and work out, which if any of the earlier events and objects have properties that cause the properties, or existence, of later events and states of affairs. But the subject does not need to exercise or rely on the notion of causation to grasp genuine temporal priority of particular events, or to represent particular past times, and perhaps does not even need to posses a notion of causation to do so. This is, evidently, a non-Kantian feature of the account.

3. Temporal Perception and Phenomenal Externalism

I have been presuming that the perception of magnitudes contributes to the phenomenal character of perception. If this presumption is correct, then the account so far is a version of what has come to be called phenomenal externalism. It has some immediate attractions. In treating magnitudes themselves as perceptible, it meshes straightforwardly with such ordinary attributions as "she heard the rumbling last for a certain length of time". We can form beliefs, and sometimes gain knowledge, about the magnitudes themselves by taking particular perceptual experiences of magnitudes at face value. Magnitudes themselves are cognitively accessible in perception itself.

The account also dovetails with the externalist character of what is explained in action-explanation (Peacocke 1993). Perception of a magnitude explains actions under relational characterizations, in relation to the very magnitude perceived. Asked how long the rumbling lasted, our subject may answer "From now…… to now", where the perception explains the magnitude of the duration between the two utterances of "now".

But for all these attractions, this form of phenomenal externalism is controversial. In particular, it contrasts strongly with the functionalism about spatiotemporal notions, and more generally the internalism about perceptual content, endorsed in important and interesting discussions by Brad Thompson (2010) and by David Chalmers (2012).

Here I outline the components of an externalist, anti-functionalist view of perceptual content involving magnitudes by addressing the considerations that have been offered in support of the Chalmers-Thompson functionalism. On the Chalmers-Thompson view, spatial and temporal expressions are 'Twin-Earthable': "let us say that two possible speakers are *twins* if they are functional and phenomenal duplicates of each other: that is their cognitive systems have the same functional organization and are in the same functional states, and they have the same conscious experiences […] We can then say that an expression *E* is Twin-Earthable if there can

be a non-deferential utterance of *E* for which there is a possible corresponding utterance by twin speaker with a different extension." (Chalmers 2012: 317). The Chalmers-Thompson view is that spatial and temporal magnitude expressions are Twin-Earthable, because, they say, two twins may be functional and phenomenal duplicates, but their spatial and temporal expressions refer to different magnitudes because, they hold, different magnitudes may produce the same functional and phenomenal states in the twins.

I dispute the thesis of the Twin-Earthability of the spatial and temporal magnitude terms. An initial argument offered for Twin-Earthability is that it is not coherent to suppose that our experiences and judgments of magnitudes are massively illusory, throughout time in the actual world (for the spatial case of this argument, see Chalmers 2012: 326). I agree. But this verdict of incoherence would also be delivered by the view that perceptual experience has contents concerning the magnitudes themselves, together with the thesis that which magnitudes those experiences have as their content is determined by which magnitudes normally cause them, when the conditions for genuine representation, and not mere sensitivity, are fulfilled.[3]

Alternatively we are asked to consider Doubled Earth, on which everything is doubled in length from actual Earth, or Slowed Earth, on which everything happens at half the speed on actual Earth. The functionalist view is that experiences of subjects on Earth and Doubled Earth, or Slowed Earth, can all be veridical. The phenomenal externalism I endorse agrees. It does not, however, agree that the experiences on Earth, Doubled Earth, and Slowed Earth, are phenomenally identical. They have different magnitudes in their content. The subjects on Earth, Doubled Earth, and Slowed Earth are also not functional duplicates if our functionalism is of the

[3] Chalmers (2012: 331, footnote 10) notes the availability of this response, and relies on the El Greco cases in rejoinder, on which see below.

'long-arm' variety that takes into account functional relations beyond the boundary of the body (cp. Harman 1982: 247). The experiences in the three kinds of world produce actions in relation to correspondingly different magnitudes in the environment. The fact that one could trick a subject, at least temporarily, in carefully designed circumstances, by moving her from one kind of environment to another does not establish that the phenomenal (subjective) contents are the same across the cases. Perceptual content is grounded in the relations to a baseline normal environment in which the subject is functioning properly. On the position which I am opposing to the Chalmers-Thompson view, the subjects on Earth, Doubled Earth, and Slowed Earth are not twins under the definition, and spatiotemporal magnitude expressions are not Twin-Earthable.

The phenomenal externalist will sharply distinguish between Twin-Earthability and relativity to a frame of reference. Spatiotemporal magnitudes are always nontrivially relative to a frame of reference. A subject can perceive a temporal or a spatial magnitude as it really is, relative to the frame of reference in which the subject is at rest. The fact that the magnitude between the two events will be different in a frame in which the subject is not at rest does not imply the Twin-Earthability of magnitude-expressions and concepts. In the temporal case, if a subject traveling with a clock in rapid motion relative to the Earth perceives his clock correctly, his phenomenal experience of that same clock will not be the same as those on Earth not in such rapid motion.[4] I doubt that there is any notion of phenomenal duplication on which the fast traveller's temporal experience of the clock must be a duplicate of those on Earth. Experience of a duration is always as of an objective duration, relative to the frame of reference centered on the subject.

[4] The phenomenon of time dilation in special relativity. See for instance Young and Freedman (2004: 1410).

It is sometimes objected to phenomenal externalism that it is committed to implausible verdicts on 'El Greco' examples. These are examples, originally suggested by Hurley (1998) in which everything in some part of the universe is stretched 2-1 in the vertical direction. "Bodies that seem rigid within the environment will be nonrigid by standards outside the environment, in that they change their shape when they rotate. And beings in that world will typically say 'That is a square' when confronted by what outsiders would call a rectangle that is twice as high as it is tall." (Chalmers 2012: 330). Chalmers wonders what an externalist would say of the experiences of twin subjects in an El Greco case: "will one have an experience as of a rectangle, despite insisting that she is confronted by a square?" (2012: 331, note 10). Externalism about phenomenal content is consistent with pervasive illusions. Suppose the objects around subjects in the special part of the universe really are stretched in one direction, say by special forces, but they still look square. If perceivers discover this fact, they will come to realize that when they reach to touch the top and bottom of a seemingly square object, their hands are actually twice as far apart as when they pick it up from the sides. Even in the actual world, there is what is called the vertical-horizontal illusion. Vertical lines seem to humans to be 6% to 8% longer than lines that are actually of the same length, but have a horizontal orientation (Rock 1973: 96-98). So even in the actual world, some things that look square in normal circumstances are not so. The externalist can consistently admit extensive and pervasive illusions, as long as these illusions gain their status as such from their relations to a base of cases in which subjects are perceiving correctly. The Muller-Lyer illusion is pervasive in the actual world, but it is not a counterexample to externalism about phenomenal content.

I do think that we can make sense of the inverted spectrum and of Ned Block's inverted Earth (1990). A functional account of color terms and concepts is highly plausible in these cases. So what is different, on my view, about the spatiotemporal cases? A crucial difference is that there is no difficulty in imagining inverted spectrum cases from the inside. We have a notion of phenomenal similarity, of looking the same way, on which we can clearly make sense of the possibility that everything that is actually green looks the way things that are actually red look. Imaginability is indeed not always a guide to genuine possibility, but it matters here that what is imagined is something in the imagined experience of the inverted state of affairs, not just something merely suppositionally imagined. (For the distinction, see Peacocke 1985). Similarly, we have no difficulty in imagining that our color experience is the same, but the reflectance properties of objects that cause those experiences are different from those which cause them in the actual world. For the temporal case to be like the color case, it would have to be that there is a constant phenomenal temporal property common to an alleged pair of twins, one on Earth and the other a subject traveling very fast, subject to time dilation. There would also have to be a constant phenomenal temporal property common to an alleged pair of twins, one on Earth and the other on Slow Earth. I surmise that there is no such phenomenal property.[5]

[5] This paper draws on material presented to my seminars at Columbia University and UCL in 2013-15, and in talks to Susanna Schellenberg's Marc Sanders Seminar at Rutgers, to a Seminar in Fribourg, Switzerland and to a joint NYU-Institut Jean Nicod Conference in Paris, all in 2015. I benefited from the discussions at all these occasions, and I have also learned from several conversations on these topics with Tyler Burge, David Chalmers, and Susanna Schellenberg. I thank Ian Phillips for his important editorial advice, both presentational and substantive. This short essay should be taken as a position paper on its topic: there are multiple issues in this territory that need a much longer treatment.

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