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No Sense in Saying ‘There Is No Sense Organ for Time’

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Abstract

This paper explores the use of perhaps the most ubiquitous phrase in time perception literature, i.e., ‘there is no sense organ for time’. I argue here that its usage often highlights several misguided notions about how we perceive time and thus creates a problem in studying it. In this commentary three such underlying notions are discussed which are often drawn as conclusions from the lack of a sensory system to perceive time. These are that time is generated or created separately by the brain, that time perception is different from other kinds of perception and that the study of time is hampered by the lack of a dedicated sense organ. These notions are discussed and argued against. It is claimed that a sense organ for time is not possible, nor does this exclude time from our percepts in general. Moreover, rather than creating a problem, a lack of a sense organ for time offers an opportunity to theorize about our experiences across perceptual modalities and cognitive mechanisms. I conclude by suggesting an end to using this phrase and instead seeing mental time as existing across our experiences.

Keywords: Time perception, sense organs, temporal experiences

1. Introduction

'There is no sense organ for time' is perhaps the most commonly used phrase by those in the field of time perception[1]. In some form or another it can be found in various books and book chapters, empirical, theoretical and review papers that are published on the topic of time. It is sometimes used to imply that perceived time is a fabrication of the brain or an illusion. In some cases, it is used to differentiate other kinds of perception from time. Herein time perception is assumed to be different from vision perception because vision has eyes as sense organs, whereas time has none. Elsewhere it is also used to imply the mystery of perceiving time *without* a dedicated sense organ. And finally, it inexorably poses a problem of how an individual perceives time without a sensory organ. In this commentary it is argued that all these notions are misguided and there should be no befuddlement for the absence of a sense organ for time. In fact, the phrase 'no sense organ for time' contributes nothing meaningful and more worryingly such a portrayal has created a pseudo-problem to explain time perception. Its usage when motivated by these notions should probably now come to an end. To argue this, in three sections each notion is individually discussed.

Before moving on ahead, I would like to describe the approach I will take here. This paper would argue against the notion of a 'sense organ for time' as a conceptual critique and for the most part the claims will not be empirical in nature. The arguments here are limited to whether the talk of 'no sense organ for time' adds anything meaningful or whether it leads to conceptual confusions and language games (Wittgenstein, 1953). So, for instance a hypothetical pacemaker-accumulator or counter model that explains some empirical data is neither under consideration nor under contention here.

Secondly, it would be important to at least have a working definition of a sense organ and also of time perception. Defining a sense organ itself has a long history which has not been without debates and controversies, from the earliest claims of Aristotle, in *De Anima*, of there being only five senses and sense organs, to the more recent advocations of humans having up to 17 different sense organs (Rivlin & Gravelle, 1984). There are several criteria that have been

[1] A list of quotes (35 so far) where it is used in the last two decades is available on an osf repository here: https://osf.io/a3nfv/ . The quotes, while few, are meant to reflect a representative view of the use of the term 'no sense organ for time' within a wide variety of sub fields/approaches in time perception. The absolute number of similar phrases in the literature are probably much higher.

proposed to distinguish and define senses (for instance see Gray, 2005; Keeley, 2002) which themselves are not universally accepted as being sufficient. However, we can reasonably agree that sense organs are necessarily "dedicated to facilitating behaviour with respect to an identifiable physical class of energy" (Keely, 2002, p. 6). To be able to pull off this feat these organs have evolutionarily developed the appropriate neuroanatomical structure and connections. Though whether this definition is sufficient to show sense organs are dedicated or to distinguish between them is not clear (Gray, 2005; Macpherson, 2011).

Finally, it is also necessary to define and limit this commentary to the perception of time. That is, for the purposes of this paper 'time perception' is defined as the perception of succession, flow, persistence, change and continuity in the content of our conscious experiences (see also Phillips, 2012; Pöppel 1978). The temporal experience of succession here implies that succession of experience is not the same as experience of succession, that is there is a phenomenological perceptual difference in, say, watching the second-hand of a clock tick versus estimating or judging the movement of the hour-hand. While movements of both the clock-hands (after a second and after an hour say) are experiences that succeed each other, we can only experience succession for the second-hand. An example of persistence as a dimension of temporality is beautifully described in Kelly (2005) where he details the experience of hearing an opera singer holding a musical note over an extended period of time. Hearing the audible characteristics of an unchanging musical note is accompanied by the experience of its temporal extent. Similarly, the perception of time is also unending and experienced as a continuous flowing stream of percepts where we do not find our experience to be 'gappy'.

Perception of time also includes of course the ability to track and produce estimates of an interval. However, this definition for the moment excludes 'estimates of time' at durations longer than a few seconds and outside the psychological now or the specious present, which is the hypothetical non-zero breadth of our experiences that appears to us as if occurring right now. Empirical estimates of this breadth have been speculated to be around 2 to 3 s (Pöppel, 1997). So, while we may be able to judge the length of a long interval (say an hour), we do not necessarily perceive it as such (for instance for a distinction between perception and judgement see section 4.2 in Firestone & Scholl, 2016). The limits of the criticisms are thus constrained

within the immediately perceived moments in time, and it is within this boundary that the rhetorical use of the phrase ‘no sense organ for time’ is questioned.

1.1. Brief History of Sense Organs for Time

In the late 19th century as psychology was coming to its own from philosophy, it carried forth and borrowed conceptual knowledge available from philosophy. One such notion was of ‘time-sense’, for which a sense organ was needed to be found. Ernst Mach was of the view that the organ for time was most likely to be found in the ear. Hugo Munsterberg and Wilhelm Wundt saw the muscular architecture and its rhythmic processes as another possible avenue for the time-sense. Even at the time, though, there were opponents to the time-sense view, most famously Karl Vierordt for whom time was judged rather than sensed (for a more detailed historical perspective see Whitrow, 1980).

As our understanding of human physiology grew, so did the scope of the search for time’s sense organ. As studies began to show body temperature, arousal and consumption of drugs influencing perceived time, the search for a time-sense leaned towards a biological or chemical clock. With the movement towards information-processing approaches this led to the proposal of a dedicated internal timer which accumulates periodic pulses (Treisman, 1963) and the stored output of which is perceived length of an interval (Ornstein 1969). Thereon, the search for a sense organ for time was largely abandoned with perceived time becoming either an outcome of the totality of mental content (Fraisse, 1963) or the output of dedicated information-processing modules.

Ever since, the phrase ‘no sense organ for time’ has been more popularly used. Though there are several motivations for the use of the phrase, I contest here three motivations that are perhaps the most common.

2. Something Creates or Generates Time

“The brain is a machine that creates the sense of time. Unlike vision or hearing, we do not have a sensory organ that detects time” (Buonomano, 2017, p. 15)

The first notion we consider is that since there is no sensory organ for time, the brain generates or creates a sense of time. Leaving aside the mereological fallacy[2], the statement remains problematic because it does not consider that the brain functions in and over time. The dynamical evolution of states of the brain itself (or one's favourite consciousness-realizing entity) could itself suffice to explain the experience of time (Cohen, 2011; Edelman et al., 2012; Varela, 1999). Hence, saying that the brain needs to create a sense of time is unnecessary, especially if our conscious experiences are both *in* and *of* time, i.e., our conscious experiences unfold over time and also contain temporal content (cf. Dainton, 2008; Phillips, 2010). That is the trail of our experiences as they unfold in time themselves could account for the feeling of time.

2.1. Does Time Need to Be Created?

Unless one takes an atomist position on the nature of temporal experiences, there is no problem of 'creationism' in time perception (Piper, 2019). That is unless one believes that our experiences are fundamentally represented by non-temporal or atemporal bits and pieces of content that are subsequently stitched together and the experience of time is then added separately in combining these pieces. Of course, there are atomist positions where simply adding these pieces together is enough to generate the experience of time, much like frames in a movie, thus aptly named cinematic models. Thus, only for atomist positions where there is something extra that has to be added, is there a problem for 'creating' the experience of time.

For positions where temporal content is represented in our experience either through direct isomorphism (extensional models), or representation of only temporal content but no temporality in the representations themselves (retentional models), there is no problem for creationism with respect to temporal experience (see Dainton, 2010 for a full review). What else needs to be explained for the experience of time than temporality in perceptual content? The talk of sense organs here only adds an extra burden on the explanandum. While it is true that how temporality in our experience is represented may not always reflect temporal order of the events it represents (Dennett & Kinsbourne, 1997; Watzl, 2013), fallibility of our temporal experience is

[2] See for instance Bennett & Hacker (2003).

not prima facie an argument for the lack of temporality in it. That is, misrepresentation of the temporal order of events is not a sufficient argument to say that time is created. Moreover, while it is entirely possible that our experience of time is a persevering and inescapable illusion leaving the arguments presented here unnecessary, it does not however follow from there being 'no sense organ for time', since perceived time as defined above could still be a product of perceptual content from within and across perceptual modalities.

3. Time Is Different from Other Perceptual Modalities and Not Perceived

"*Perhaps one of the most perplexing issues surrounding our subjective experience of time is that there is no dedicated sense organ for duration, as there is for other senses (yet time is commonly referred to as being perceived)*" (Allman & Meck, 2012, p. 657)

This is yet another usage of the 'no sense organ for time'. Here it is implied that time perception is different from other kinds of perception (visual, auditory or olfactory) because of a lack of sense organ for it. To argue against this, the following two claims are made: (1) other perceptual modalities do not necessarily have dedicated sense organs themselves; (2) time can be thought of as a dimension across sense organs.

3.1. Do Other Perceptual Modalities Have Sense Organs?

"*The term time perception is a metaphor, there is no sensory organ that receives temporal stimulation in the way that our eyes and ears transduce light and sound*" (Friedman, 2000, p. 298)

There is no disputing the fact the photons are transduced in the retina which is located inside the eye and vibrations of the air are transduced in the cochlea located in the inner ear. However, our visual or auditory percepts are not necessarily the total sum of these stimulations. We already know that audition is not solely dependent on ears decoding sounds (McGurk effect; McGurk & McDonald, 1976) where watching lips mouth a syllable alters the perception of an auditory input; or vision solely dependent on eyes (double-flash illusion; Shams et al., 2000). That is when a single flash is accompanied by two quick tones, participants often tend to report two flashes instead of one. Thus, even though photons are transduced in the eye for only one flash, our conscious experience is of two flashes. Moreover, a stimulus can carry cross-modal

information, for instance the sound pouring water makes can be used to gauge its temperature (Velasco et al., 2013). While we continue to say we have eyes as a sense organ for vision or audition, that is not the whole story for the contents of our percepts (see also O'Callaghan, 2006, 2008).

3.2. Is Time Separate from Other Perceptual Modalities?

"However, unlike other basic dimensions, there is no dedicated sense organ for time. Rather, psychological time is an abstraction, a construct or epiphenomenon of our mind's functioning that we create in order to explain the coherence of events" (Matthews & Meck, 2016, p. 865)

Given that we know that time is not a form of energy or a fundamental property of matter (Calendar, 2017; Buonomano, 2017), it is not surprising that there is no 'dedicated' organ for the same. However, if mental time is conceptualized as the change, persistence, succession and/or continuity in our experiences (Pöppel, 1978), then any perceptual system that can represent these temporal features can represent time. Unlike what the above phrase implies, time is then not separate from other perceptual modalities because it has no sense organ, but rather time is what is common between different perceptual modalities and our conscious percepts. Regardless of a perceptual modality all percepts seem to have temporal features. In one reading, this may seem to argue that since time is pervasive across perceptual modalities (unlike other 'senses'), time is still different from other kinds of perception. However, the point here is that time is not separable from other kinds of perceptual content.

Another recurrent property across our percepts is of space. All our percepts seem to have the quality of 'where-ness' in their contents. While this is straightforward in vision and touch, where we see or feel an object as being *here* or *there*, even sound and smell percepts have a spatial property of coming from *here* or *there*. If perceptual modalities can all have spatial features ('where-ness') without a controversy on a sense organ for space, why does the feature of 'when-ness' specifically require a sense organ? The experience of *then* and *now* is, after all, a function of present perceptual experiences.

A possible counterargument to deny the claim that felt time is inseparable from perceptual content could be through a hypothetical 'dark room'. Imagine a situation where there

is no physical stimulation that impinges on our senses and no signals from proprioception and also no flow of thoughts. In this hypothetical experience, would an individual still experience time? Proponents who claim that perceived time is a function of an internal timer[3] that beats away keeping track of time, would argue that individuals in this dark room would still experience time. On the other hand, those who advocate for perceived time being inseparable from dynamics of perceptual content across modalities would perhaps suggest that there would be no experience of time in a state where there is total absence of mental content. The closest real-life situation that resembles this hypothetical dark room comes from people reporting contentless or minimal phenomenological experience (MPE) states. In these states participants report no perceptual or mental content, and these states are also often accompanied by a lack of temporality (James 1890; Metzinger, 2020; Srinivasan, 2020).

4. A Pseudo-Problem for Time Perception

"But how is duration comparison possible? Without a sense organ for time as such, how can we perceive a time interval as being longer or shorter than another?" (Hellström, 1998, p. 71)

Finally, I consider the usage of this phrase where it is deployed akin to an 'appeal to ignorance' fallacy. This usage is often seen for justifications of clock models in time perception as well, for how can we perceive time without clocks? Several criticisms of it have been made in the past (Gorea, 2011; Phillips, 2012; Wackerman, 2011), which elucidate the faults in appealing to ignorance. In the following subsections I discuss why there cannot be a sense organ for time and why thus it should not be a stumbling block in the field of time perception.

4.1. What Does a 'Sense Organ for Time' Look Like?

In this section let us entertain wholeheartedly the possibility of a sense organ for time. Let us say there could be such a thing. What would it look like? Of course, as mentioned previously, time is not a form of physical energy nor is it a fundamental property of matter, so this task is not going to be straightforward, since there is nothing 'out there' which can be transduced like photons or

[3] For now, let us assume this to be a special dedicated sense-organ-like entity for time.

air pressure. Right off the bat, this problem starts looking absurd. One way this problem has been approached is to postulate a periodic tick generator inside our brains, not much unlike a clock (Meck, 1984; Treisman, 1963). Here our experiences are tagged by these pulse generators to specify order and temporal passage. While clocks can come to represent time, they do not measure or sense it. For instance, there is evidence of perceptual complexity and its correlated visual cortex activity explaining temporal durations, and not separate or dedicated clocks (Roseboom et al., 2019). Moreover, it is unclear what clocks would represent in terms of psychological experience of time in the absence of perceptual content (Arstila, 2017). It seems absurd to think that there can be a sense of time without corresponding conscious experience (Madl et al., 2011; van Leeuwen, 2007). Assuming a dedicated clock timer that is the sense organ for time, would it still register perceived time in the absence of consciously experienced content?[4]

A possible objection here could be that clock models do explain certain empirical phenomena and do make falsifiable predictions. And thus, continuing to assume the ontology of the internal clock as a dedicated special sense organ for time is justified. Apart from not falling within the current definitions of a sense organ, this would also seem to follow an approach described by Willard Quine where analytical and synthetic truths could inform each another without a strict boundary between them (Quine, 1951).

4.2. Is the Field of Time Perception Doomed in the Absence of a Sense Organ?

"The study of time perception is obviously hampered by the inability to identify any organ which is obviously responsible for it" (Wearden, 2016, p. 15)

This is another corollary notion that begs the question for a sense organ for time by implying that in its absence, it is difficult to explain how we perceive time. It creates a (or perhaps reflects on an existing) pseudo-problem in the study of time perception. On the contrary, absence of a dedicated timer makes studying time easier and not more difficult (Ivry & Schlerf, 2008). When seen as a property of each experience, time removes this problem. For instance, in vision perception we do not talk of different sensory organs for brightness, symmetry, hue or lightness

[4] In an upcoming article we are making an attempt to empirically show that perceived time is a function of conscious experience and not of a dedicated time (Singhal & Srinivasan, in prep.).

and several other such dimensions. As in the previous section, the claim here is that time is a ubiquitous dimension across perceptual modalities. Thus, expecting to explain time perception separate from the dynamical states of a perceptual system (at either a mechanistic, algorithmic, phenomenological or neural level of explanation), creates a pseudo-problem. It misses out on the rich ways in which our experiences combine in time and ignores the ubiquity of time over and across our experiences. Instead of seeing it as a problem in understanding time perception, a lack of a sense organ actually offers the opportunity to bring together experiences across perceptual modalities and different cognitive mechanisms (attention, action, consciousness, etc.). It offers perhaps the only hope for a general theory of understanding the human mind and perhaps the most fundamental property of human experience, i.e., temporality.

5. Alternate Views and Concluding Remarks

"[…] *there exists no sense organ for time perception and, as such, all sensory modalities are possible entries at the interface of physical time with perceptual time.*" (Wittmann & van Wassenhove, 2009)

It would be remiss to conclude without mentioning that not all uses of the phrase 'no sense organ for time' imply the notions discussed in this commentary. Many do use it to convey the universality of temporal experience and to mention how it is not possible to have a sense organ for time in the first place. For instance, 'no sense organ for time' could be uncontroversially rephrased as 'all sense organs are sense organs for time' or 'there cannot be a sense organ of time'. Nevertheless, the aim of this paper has been to explicitly elucidate the underlying flaws in employing the phrase 'no sense organ for time'. Continued usage of the phrase in the light of these arguments must show: (i) what would a sense organ for time look like in the absence of time as such in the physical world? (ii) Why must time perception have the problem of a receptor system when there is no such problem for space perception? (iii) What beyond perceptual modalities and conscious content would account for the sense of time? (iv) Whether a lack of a dedicated sensory system for time is a problem or an ill-stated question given what we know about time in physics and time in mentality.

Future questions related to this theme could also explore whether time perception following (or not following) psychophysical laws could affect its status of being 'perceived'. Another analysis could look at whether the time perception follows or could follow the same

grammar[5] of say colour perception (or another dimension of a perceptual modality) in being a sense. Finally, of course the question of whether a sense organ for time exists, is always open to empirical investigations.

In this commentary I have argued that writing, believing or conceptualizing that time has 'no sense organ' often (without justification) implies that time is separate from other perceptual modalities and that there is a problem in how one must explain the experience of time in the absence of a dedicated sense organ. These notions create a pseudo-problem and detract us from seeing the commonality across perceptual modalities, i.e. the experience of succession, continuity, change and persistence, all uniting features of time. To some, the usage of 'no sense organ for time' may seem rhetorical with the purpose being to restate the mystery of time perception; however as discussed at length, the wonders of temporal experience need not rest on the use of this phrase, especially when it creates a problem in explaining it. While to others this commentary might seem trivial, if so, it would be even easier to get to rid of the phrase and its associated notions.

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[5] For instance, see chapters 7 and 8 in Hacker (2013)

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