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ORIGINAL RESEARCH

Peripersonal space as the haptic field

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Abstract
A topic of interest in the philosophy of perception concerns similarities and differences between the senses. One way of approaching this issue is to focus on structural differences. An interesting question in this respect concerns whether, and in what respect, perceptual modalities other than vision might possess a *spatial field* which is in some respects similar to the visual field. This paper argues that haptic touch is structured by an external spatial field, namely peripersonal space. I first provide a clarification of the general characteristics of an external spatial field. The paper then outlines the notion of peripersonal space. Finally, I argue that peripersonal space functions as the external spatial field of haptic touch insofar as it meets the necessary conditions for a spatial field.

Keywords Peripersonal space · Spatial field · Haptic touch · Perceptual experience · Visual field

1 Spatial fields and haptic touch

A persistent topic of interest in the philosophy of perception concerns similarities and differences between the senses. One way of approaching this issue is to focus on structural differences between perceptual experiences in different modalities. An interesting question in this respect concerns whether perceptual modalities other than vision might possess a *spatial field*. At first blush, a spatial field is simply the relevantly bounded part of space that is represented by the mode of perception in question, although as we shall see matters are somewhat more complicated once we

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attempt to provide detail on the precise way in which any modality-specific spatial field functions such as to structure the relevant perceptual experiences. Indeed, by investigating this issue we stand to gain a phenomenological clarification of the specific way in which space is represented by the perceptual experiences in question. Now, importantly it is worth making explicit that for any given perceptual modality, its involving spatial representation *per se*, or having the capacity to form spatial representations, isn't equivalent to its presenting the relevant objects as located in a spatial field, insofar as there are forms of spatial representation that do not present the relevant objects as located in a spatial field: A particular spatial perceptual modality might merely present the spatial properties of the relevant objects (e.g., their shape or size), or perhaps the spatial relations between such objects and the perceiving subject (e.g., their 'closeness' to me), and yet not present those objects as located in a spatial field.

My interest in this paper will be in whether haptic touch possesses a spatial field which structures haptic perceptual experiences in a way that is analogous to the way that the visual field structures visual experience. Take visual experience and its being structured by way of the visual field: as Michael Martin puts it, 'We can think of normal visual experience as experience not only of objects which are located in some space, but as of a space within which they are located'.[1] Now, whatever the precise characteristics of the visual field, it operates as a kind of background structure, relative to which a variety of visual phenomena take place and are made possible. For example, consider that the focusing of visual attention on objects in visual experience takes place relative to the visual field, picking out particulars in that field and foregrounding them in a way that places other objects in the background. Alternatively, think of the way that the structuring of visual experience by the visual field allows for a variety of occlusion phenomena; given a particular arrangement of objects in the visual field, certain parts of those objects occlude various parts of other objects. Further to this, modifications to the visual field can have distinctive effects on spatial phenomenology: consider the drastic reduction of the size of the visual field given the loss of peripheral vision in tunnel vision (usually the effect of glaucoma, retinal detachment, or severe migraines); contrastingly, consider an imagined case in which one's eyes were positioned more toward the sides of one's head, resulting in a more panoramic view, and therefore a much smaller 'blind spot'. Clearly, the visual field structures visual experience, and so in detailing characteristics of the visual field we better understand the overall structure of visual experience and its spatial phenomenology, also providing a context for understanding a variety of visual phenomena.

Importantly, my interest is specifically in investigating whether haptic touch is structured by a *spatial field*, and not whether there is a 'sensory field' for haptic touch. A spatial field and a sensory field are not identical: many features that one might ascribe to spatial fields (see Sect. 2 on ego-centricity, empty space, etc), are not plausibly features of 'sensory fields'. Consider, for example, gustation or taste. One might think that a mix of flavours and sensations in one's mouth constitutes something like a 'sensory field' for gustation, a 'gustatory field', but it is far from clear that this is a *spatial field*. Further to this, I will not be concerned to defend the more or less

[1] Martin (1992, p. 189).

controversial claim that there is a proprietary modality-specific spatial field for each sense-perceptual modality. My focus will lie squarely on the more or less plausible claim that visual experience and haptic touch have different spatial fields, and indeed that haptic perceptual experience is structured by a spatial field.[2]

There is, however, an immediate complication given that there are two distinct forms of touch. First, consider haptic touch. Haptic touch is a particular type of perceptual experience of a concrete particular in one's environment 'out there', indeed one that we in some respect or other lay hold of, and are often in the process of 'exploring'.[3] Given this, haptic touch involves not just cutaneous stimulation – skin contact and related pressure sensations – but also kinaesthesis and proprioception, and so prototypical forms of bodily awareness. And critically, and in connection with the aforementioned bodily awareness, haptic touch as active touch, involves a sense of agency which typically takes the form of (voluntarily initiated) exploration of or interaction with the relevant object(s).[4] Indeed, in the empirical literature, a range of prototypical exploratory movements are detailed, as so-called *exploratory procedures* (EPs). These EPs characterise optimal patterns of manual (hand-based) exploration of external objects, which perceivers make use of when they are prompted to identify a particular property of an object.[5] A paradigmatic example of haptic touch is grasping an object, say picking up and holding a spherical object in one's hand. Such an instance of haptic touch involves not just cutaneous stimulation and pressure sensations at the end of one's fingers, but the activation of muscles, joints, and grip tendons in the hand, forearm, and shoulder. Simply put, grasping (and holding) is something *one is doing*.[6]

Now, compare haptic touch with what is usually called tactile experience or tactile sensation. Paradigmatic examples of tactile sensations are as follows: a tingling sensation spread over one's forearm; a searing pain in one's toe after one has stubbed it. Critically, such tactile sensations lack the active and exploratory character of haptic touch, and arguably don't necessarily provide their subjects with perceptual awareness as of objects 'out there' in one's external environment (being typically body-directed, and so interoceptive in character).

This distinction between haptic perception and tactile sensation is present in all philosophical and psychological studies of touch.[7] Once in view it allows us to dis-

[2] There is an interesting question whether the visual spatial field and the auditory spatial field are necessarily distinct or only contingently so. My discussion here will have nothing to say on this difficult question (see Mandrigin & Nudds, 2021).

[3] I use the terms haptic touch and haptic perception interchangeably.

[4] For a recent perspicuous discussion of voluntary and intentional action see Hyman (2015).

[5] See Lederman and Klatzky (1987); Jones and Lederman (2006).

[6] It is important not to conflate the active character of haptic perception with the sequential-non-sequential distinction (see Martin, (1992) on the latter). Haptic perception can be 'active' in the relevant sense, as initiated and in certain cases sustained by *something I am doing* (holding, grasping) without involving a series of exploratory movements.

[7] See, for example, Ratcliffe, (2012); Martin, (1992); O'Shaughnessy, (1989); Smith, (2002); Skrzypulec, (2022); Mizrahi, (2023); Kalderon, 2018; de Vignemont and Massin (2020). Fulkerson (2014) and Matthen (2021, p. 197) provide the most comprehensive recent arguments in favour of the distinction. On the psychological side see Klatzky and Lederman (2004); Lederman and Klatzky (2009).

tinguish between two questions concerning touch and its possession (or not) of a spatial field. (1) Does haptic touch possess a spatial field? (2) Does tactile sensation possess a spatial field?[8] My interest here will exclusively be in (1). Whether or not there is a tactile field for tactile sensation, as what Martin calls a 'bodily space' (a region wherein bodily awareness is possible), is a strictly separate issue.[9] With this in mind, we now get the following question: does haptic touch have an *external* spatial field that structures haptic perceptual experiences in a way that is analogous to the relation between visual experience and the visual field. Simply: is there a haptic field?

Now, at this point it is worth noting that the predominant answer to the question has been *no*, usually drawing on the issue of 'empty space'. Fulkerson gives expression to the general line of resistance on this point, and the comparison with the visual field: 'Vision, it seems, provides a rich felt awareness of objects in a spatial field – an area where there are potential objects but where none currently reside (that is, we seem in vision to be able to see empty space). Touch, on the other hand, doesn't seem to present features in this way. Instead, like audition, touch seems only to bring awareness of individual objects that each seem to occupy a specific location'.[10] On this picture haptic touch doesn't involve *feeling* 'empty space' in the way that visual experience, as structured by the visual field, involves *seeing* empty space. Indeed, if it were true that all that haptic touch affords us is an awareness of individual objects that each seem to occupy a specific location, then it seems we would at best struggle (at worse fail) to be able to distinguish between a haptic perceptual experience of empty space and an absence of haptic perceptual experience whatsoever.[11] Indeed, these considerations loom large in Michael Martin's classic discussion (inspired by Brian O'Shaughnessy) of the supposed structural differences between sight and touch, and his broader scepticism about whether haptic touch possesses a spatial field in anything like the way that visual experience does. Rephrasing Martin's claim above about visual experience and the visual field, but in the negative and for haptic touch, we could say that we can think of haptic perception as experience *only of objects which are located in space*, but *not* as of a space within which they are located.[12] We will have occasion to provide a detailed response to Martin's sceptical arguments, and the issue of 'empty space' for haptic touch, in Sects. 4 and 5.

My aim in this paper is to argue that haptic touch is in fact structured by an external spatial field, namely peripersonal space, as the 'action possibility space' in close proximity to the body. The roadmap is as follows. Section 2 provides a clarification of the (necessary) general characteristics of an external spatial field. Section 3 details the notion of peripersonal space. Finally, Sects. 4 and 5 argue that peripersonal space

[8] Blazej Skrzypulec (2022) makes a distinction between what he calls the *exteroceptive tactile field* and the *interoceptive tactile field* (for haptic touch and tactile experience or sensation respectively). See also Serrahima (2023) for a more general notion of a 'sensory field'. My interest is in the *exteroceptive haptic field*, or what I call the *haptic field*.

[9] Martin himself is guardedly sceptical (see his 1992, p. 203).

[10] Fulkerson (2024).

[11] See Martin (1992).

[12] This scepticism also finds voice in see Strawson (1959); O'Shaughnessy (1989); Skrzypulec (2022). See also discussion of Martin's and O'Shaunessey's views in Soteriou (2013), who discusses differences between structural features of visual awareness and bodily awareness.

functions as the external spatial field of haptic touch and meets the necessary conditions for a spatial field specified in Sect. 2.

Before proceeding let me speak to further motivation for the project. It might be asked what is at stake if we were to deny, or indeed accept, that haptic touch has a spatial field. Firstly, there is an interesting question about how the results of cognitive neuroscience might bear on phenomenology, and specifically the phenomenology of haptic touch; this paper contributes to this project by drawing on recent work on peripersonal space to inform an account of the spatial phenomenology of haptic touch.[13] Secondly, as we shall see by the end of the paper, once we have available a specific notion of peripersonal space, haptic touch, in virtue of being structured by way of peripersonal space, doesn't have to be limited to active occurrent exploratory activity (contrary to what has often been assumed), given the role of a perceiver's awareness of *haptic possibilities* that is brought into view by specifying peripersonal space as the spatial field for haptic touch (Sects. 4 and 5). This is a significant result, since in accepting that peripersonal space functions as the external spatial field of haptic touch we gain a more nuanced view of what is involved in haptic perceptual experience and its spatial phenomenology.

2 Necessary characteristics of a spatial field

To make headway on our question we need an account of the necessary characteristics of an external spatial field in general (in what follows I'll drop the *external* qualification, and take this as read). Once we have that in view, we will be able to assess whether our candidate – haptic touch – has a field which exhibits the relevant necessary characteristics. However, before detailing those characteristics let me note a methodological worry. The paradigm case of a spatial field is the visual field, and many of the characteristics detailed in what follows are exemplified by the visual case. Nevertheless, we should be mindful that we don't take what are distinctive features of the specifically *visual* field to be necessary features of anything that is going to count as a spatial field whatsoever. Further to this, and connected to it, we should also bear in mind that we should not expect that the specific way in which a general characteristic is manifest will be exactly the same in the case of the visual field and some (putative) haptic field (or indeed any other spatial field) – we should expect marked differences in the way certain general characteristics are manifest across the senses.

Let's get started with the *egocentric point of origin condition*. Any spatial field must have some spatial point from which it originates, indexed to the perceiver's location (hence egocentric), or a sense-organ or body-part, and which might be expressed by way of demonstrative or indexical expression like 'here' or 'from here'. It will be relative to this egocentric point of origin that the spatial field is in some respect *spread out in space*. And while always in fact located at a specific point or region in absolute space, the relevant point of origin will not itself be presented as a part of the relevant spatial field, but rather functions as what classical phenomenologist Edmund

[13] See de Vignemont (2023) for a similar approach.

Husserl called the 'zero point of all these [spatial] orientations'.[14] We can see this in the case of the visual field: the egocentric point of origin is the eyes; it is relative to the location of my eyes that the visual field is 'spread out' (in a cone-like shape), and which is the point of origin of our visual perspective or spatial point of view. Now, there are substantive debates, both in historical and contemporary discussions, concerning what more precisely is implicated by talk of perspectives and points of view, from issues concerning how object-perception is constrained by visual perspective to whether such perspectival points of view are experientially represented as self-locations or not.[15] Such issues won't be relevant for our purposes here. What is worth noting, however, is that it is relative to an egocentric point of origin that we have the possibility of 'spatial field movement'; when a perceiver moves, the relevant point of origin of the spatial field comes with them. Take the visual case: as I move around my perceptual environment, or perhaps more minimally just turn my head, my visual field 'comes with me', it moves with me, bringing previously unseen and unrepresented regions of space into view.[16]

Now it is also worth noting that any form of exteroceptive spatial representation will meet something in the vicinity of the *egocentric point of origin condition.* For example, I might, in a significantly restricted setting, visually represent just one object at a specific distance from me, but not as situated or located in a 'visual field' *per se*. Nonetheless the claim here isn't that having an egocentric point of origin is proprietary to the structuring of any perceptual experience by way of spatial field, but rather just that insofar as a spatial field involves, at a minimum, the relevant parts or expanse of space that is represented by the perceptual mode in question, that it must do so from a point of origin, and indeed that it is because it does that when I move my field 'comes with me', thus changing the relevant part or expanse of space that is 'in view'.

Next, we have the *spatial limit condition*. Any spatial field will not just be an entirely open spatial expanse from its (egocentric) point of origin, but will be in various respects spatially delimited – there will be various boundaries to the spatial field. Again the visual field provides a clear example insofar as there are both vertical and horizontal plane limits at specific degrees. Take the horizontal plane: focusing one's eyes on an object in one's visual field hold your hand behind your head. Staying focused on the object ahead slowly bring your hand back around toward where you are focused. At a specific point your hand will come into view; more specifically given the standard line of sight is set at 0degrees, the visual (horizontal) limit of either eye in typical human perceivers is around 62degrees. Similarly for the vertical plane, where the upper visual field limit is around 50degrees, with the lower visual field limit at around 70degrees. It is these field limits which support thinking of spa-

[14] See Husserl (1989 [1952], p. 166). Husserl thought that the 'lived body' is what functions as this 'zero point', characterised in terms of what he calls 'the mode of the ultimate central here'.

[15] On the first issue see e.g., Noë, (2004); Green & Schellenberg, (2018). On the second see e.g., Schwenkler, (2012); Campbell, (2002).

[16] See Richardson (2010, p. 233).

tial fields by way of the metaphor of a 'container'.[17] Indeed, we can imagine modulations to these spatial boundaries or limits: consider the contraction or expansion of the visual field, that is of the relevant limits of the horizontal and vertical planes, leading to variations in the extent of peripheral vision. This supports the claim that in general such limits on the field are set, and can be experientially recognised.

We also have the *object location and relation condition*. For any spatial field, linked to a particular sense-modality, it will be 'in the field' that the objects of perception are experienced as being located. Note that what we are interested in here is perceiver-relative experienced object location, rather than absolute location in space. We usually take the two things to match up, but where something is *experienced as being* and where it in fact is can come apart, as is shown in various location-illusions (for example, the *flash-lag* illusion).[18] Importantly, insofar as objects are experienced as located in the spatial field, any spatial field will also allow for manifest spatial relations between various objects in the field, and the perceiver. And these will typically be manifest egocentrically, expressible by predicates like *to the right, to the left*, *above, behind*, rather than in terms of determinate quantifiable distances.

Next, consider the *field-independence condition*. For any spatial field there will be an important sense in which the overall spatial structure of the field is relatively stable relative to *object-variation or re-arrangement*. In general, objects may appear, disappear, move, and more generally be spatially re-arranged without it generally being the case that the overall spatial structure of the field changes (e.g., by contracting or expanding).[19] Consider the way this typically works in visual experience: an object may enter one's visual field on the left side, move on a curved horizontal plane through the field, only to exit the visual field on the right side. This can take place without any manifest change in the spatial characteristics of the visual field itself. Contrast how phenomenologically different things would be if as a matter of course the visual field extended or contracted as objects moved or were spatially rearranged in the field. This is compatible with cases like tunnel vision in which there is a significant contraction of the visual field due to the loss of peripheral vision, which may be induced by *using objects* like microscopes, telescopes, and binoculars. In these cases the use of specific objects to look through can modify the size of the visual field. Nonetheless the objects represented as present or located in the visual field itself, even in a significantly contracted one, don't themselves modify the spatial characteristic of the visual field itself. Variation in objects experienced as being in a significantly contracted 'tunnelled' visual field – say by those objects moving or being re-arranged – doesn't typically alter the size or characteristics of the *tunnelled field*.

Next, any spatial field will allow for or include the experiential representation of empty space, that is regions of the field that are experienced as currently unoc-

[17] In the case of the visual field, the cone-shaped container is 'open' (relative to a light of sight) to the horizon line, but is usually occluded by various objects which 'block' portions or the entirety of the field at the 'far end'.

[18] The flash lag illusion (also sometimes called the flash-lag effect) is a reasonably simple visual illusion in which a moving dot and a dot which quickly flashes on the screen (a 'punctuate flash') are misperceived as being spatially displaced, specifically as not being located on the same vertical plane, with the moving dot being misperceived as *ahead* of the dot which flashes.

[19] Skrzypulec calls this *relation independence*. See also Richardson (2010, p. 233).

cupied. Call this the *empty space condition*. Drawing on recent literature on this topic, we might say that it is relative to the spatial field, and its structuring of some perceptual experience, that we in some sense *perceive absences*. However, we need to be careful here. There is a sense in which it must be false to say that we literally *perceive absences* if 'perceive' is read as a factive term; one can't veridically perceptually experience no-thing, insofar as there is nothing to perceive, and in any case we might think there are in fact no truly empty spaces insofar as all space contains light and various current unperceivables (e.g., microscopic things currently too small to be seen by the naked eye). Nevertheless, we find an intelligible notion of perceiving absences in the discussion of the visual case by various authors. Drawing on remarks by Michael Martin, Louise Richardson provides a cogent sense of what seeing absences could amount to:

> The space between the bookends in my example is not a void. It contains tiny invisible objects, and it also contains light. My experience of this space is an experience not of the absence of everything, but of something in particular. And what it is an experience of the absence of, is visible objects. To see a region of space as empty, is to see it as empty of visible objects. And to see a space as empty of visible objects is to see it as, in Michael Martin's words 'a place where something could be seen' (1992, p. 199). I see the place between the bookends as empty in that I see it as a place in which if some visible object were there, I would see it.[20]

This provides us with instruction concerning how to understand the *empty space condition*: any spatial field will allow for the experiential representation of empty space, of regions of the spatial field that are experienced as currently unoccupied, relative to the possibility of perceptual objects being there in the relevant modality, that is where some such modality-specific perceptual object could be perceived. As such, the experiential representation of empty space, relative to a spatial field, should be a modality-specific (vision, audition, haptic, olfaction, etc) representation of empty space, as a space where modality-specific objects could be. There is significantly more to be said about the *empty space condition*, and we will come back to it when discussing haptic touch and peripersonal space, but this suffices for now.

Penultimately, consider that for any spatial field, it will be relative to the spatial field that there is the possibility of occlusion phenomena. These phenomena piggyback on the object location and relation condition, and the empty space condition. Insofar as objects can be rearranged in a spatial field (without altering the spatial structure of the field itself), perhaps coming to occupy regions that were previously experienced as unoccupied, they can occlude one another. Take allo-occlusion: given a fixed line of sight, consider a case in which one relatively smaller object is placed in front of a larger object, such that the former allo-occludes some portion of the object

[20] Richardson (2010, p. 237) (cf. Laasik, 2018). See also discussion in Farennikova (2013, p. 431); Munton (2022).

behind it.[21] In the visual case, allo-occlusion is the norm in perceptual environments populated by a range of objects of different shapes and sizes.

Finally, and drawing together various claims in the discussion of these conditions, any spatial field will not just be a 'static' or 'inert' field, that is something like a snapshot or 'fixed image' of the relevantly delimited spatial expanse. Rather spatial fields might plausibly be thought to structure our perceptual experiences as dynamic *action-possibility* spaces. For instruction, consider how Maurice Merleau-Ponty describes the case of a footballer and the football field: 'For the player in action the football field is not an 'object' … It is pervaded by lines of force (the 'yard' lines; those which demarcate the 'penalty area') and articulated into sectors (for example, the 'openings' between the adversaries) which call for a certain mode of action'.[22] Making use of this example, we might say that it is relative to a spatial field as a dynamic action-possibility space, that we have some sense of both our and objects' perceptual-spatial possibilities. Different regions of the spatial field might come to be occupied by us or indeed by objects through various forms of movement. Now, while extensive further defence of this claim about spatial fields, as dynamic action possibility spaces, will not be possible here, let me emphasise that I am not claiming that spatial fields are structured by *currently occurring actions*, that is by bodily actions currently being undertaken by the perceiver. Likewise there is no commitment here to the claim that spatial perceptual experience more generally is constituted by action.[23] It is strictly *action-possibility* not *actual action* that I am suggesting is a central characteristic of spatial fields.

We can see how this idea of spatial fields as dynamic *action-possibility spaces* plays out more concretely in the visual case. Similar to the way Merleau-Ponty describes the situation for the footballer on the football field, the visual field (and the objects within it) is given as a *dynamic space* affording something like 'action possibilities' within that space. Indeed, such an understanding of the visual field, as what we might somewhat metaphorically call the 'arena of visual possibilities', is arguably central to any plausible resolution to the puzzle of perceptual presence.[24] Standing in front of a house it is incontestable that we are only visually presented with its front side from our perspectival location. Nonetheless, we enjoy a visual experience as of a complete three-dimensional entity: We enjoy a visual experience as of a house, complete with hidden sides, not a *mere façade* of a particular house-like geometrical form (e.g., a stage-prop or collection of flat 2-d surfaces). How then is it the case that we enjoy a visual experience as of the relevant complete three-dimensional entity, given the fact that we are limited in any particular perceptual moment to seeing the

[21] The possibility of occlusion phenomena is central to Martin's (1992) account of the visual field.

[22] Merleau-Ponty (1967 [1942], p. 168). Briscoe (2011, pp. 15–6) has some brief discussion of this idea.

[23] Of course this claim is more or less familiar from various 'enactivist' views of perception (see Noë, 2004, p. 90; O'Regan & Noë, 2001 . For critical discussion see; Aizawa, 2007; Schellenberg, 2007; Briscoe, 2008). Brewer (1992) argues, drawing on distinctive ideas from Schopenhauer and Evans, that there is a constitutive link between perceptual experience, in terms of the kind of spatial representation it involves (including self-locating content), and world-directed action possibility.

[24] See, e.g. discussion in Noë (2004); Schellenberg (2007); Dokic (2012). This was also a central issue in classical phenomenology (see discussion in Husserl 1997 [1907]).

side(s) facing us from a specific spatial perspective? This is the puzzle of perceptual presence for *visual experience*.[25]

At a general level, the resolution should be framed in terms of our sense of perceptual possibilities. More specifically, the object is in some sense given as *perceivable from spatial locations other than the one that the subject happens to (currently) occupy.* Put metaphorically, the object 'suggests' the possibility of there being alternative points of view on itself, as 'indicating' its visual potential. Yet critically, such perceptual possibilities need to be understood as being actualisable relative to the visual field as a dynamic action-possibility space: while more of the details would need fleshing out, it is relative to our sense of action-possibilities in the visual field that we have a sense of there being alternative points of view on the focal object. Indeed, consider, for example, the way in which we might move to occupy some currently unoccupied region of the visual field, bringing into view parts of objects that were previously occluded.[26]

Now, before moving on, let me respond to a sceptical line of thinking concerning the condition of spatial fields being given as action-possibility spaces, specifically in the case of vision. After all, aren't there visual experiences, structured by the visual field, where there simply are no action possibilities presented. Consider observing clouds in the sky. What action possibilities are plausibly presented when I am just watching the clouds drift across the sky? Now, while I will come back to this example shortly, it is important to note that insofar as our visual fields are populated by what are given as complete three-dimensional objects the above-discussed form of action-possibility in terms of there being alternative points of view on the focal object relative to possibilities indexed to alternative spatial locations will be in play. This serves to block a worry, drawing on Merleau-Ponty's discussion of action-possibilities relative to the footballer on the football field. The worry would be that for the *non-expert,* the football field will merely be visually presented *as an expanse of grass* (a literal field), with no experience of action possibilities in relation to it. Yet, insofar as any object within the visual field is given as a complete three-dimensional object, then regardless of whether I possess relevant practical concerns, interests, or expertise, I should still have a sense of perceptual possibilities for the relevant focal object (where as noted above these need to be understood as being actualisable relative to the visual field as a dynamic action-possibility space). So, while for the footballer, the football on the field might 'call out' for kicking over the goal line, and so their experience of the visual field should have more specific and interest-relative action-possibilities in

[25] See Mitchell (forthcoming) for a book length study of the puzzle of perceptual presence for visual experience.

[26] A similar idea to my claim about spatial fields as dynamic action-possibility spaces – although framed in a non-phenomenological dispositional way – is developed by Gareth Evans (1982) with his notion of *behaviour space*. Evans claims that 'having spatially significant perceptual information consists at least partly in being disposed to do various things' (Evans, 1982, p. 155), and later that 'there is only one egocentric space, because there is only one behavioural space' (160). Evans' main thought here is however not so much about a conscious level experience of perceptual possibilities in terms of action-possibilities relative to the visual field (or spatial fields more generally), but rather turns on specifying an enabling condition on being able to perceptually represent space egocentrically, such that one's perceptual experiences being egocentrically structured depends on our capacities and so dispositions to *act in relevant ways on what we perceive* (see Alsmith, 2021; Mandrigin, 2019 for further discussion).

play, even for the non-expert disinterested spectator, the mere perceptual presence of a football, say, as a complete three-dimensional object, will imply perceptual possibilities relative to the visual field as a dynamic action-possibility space.

However, at this point we need to return to the above example. After all, the clouds in the sky are not presented as having the relevant form of perceptual presence – they are not given as complete three-dimensional objects relative to which I could plausibly have a sense of how I would 'move around' them to bring into view their occluded sides (if there are such). Similar cases might be looking up at the moon in the night sky, or peering out over the ocean. However, even in these cases, arguably the visual field can still involve the presentation of action-possibilities in a minimal sense relative to a possible re-direction of visual attention, say by focusing on something different, and so moving one's eyes. In our examples this would work as follows: a sense of action-possibility tied to (i) looking at a different cloud than the one that one is currently focused on; (ii) observing more closely a particularly dark spot on part of the moon in the night sky, bringing that portion into line with foveal vision; (iii) attending to a different portion of the currently perceived but not focused on, ocean-expanse. What unites these cases is the idea of attention-guided visual exploration of some portions of the visual field, or parts of objects within the visual field, that are not currently being attended to. Indeed the possibility of *perceptual* exploration more broadly, as tied to possible redirections of perceptual attention 'in the field' might be thought to be the most *minimal sense* in which a spatial field could present action-possibilities.[27] So, as long as we do not hamstring the notion of *action-possibility* in spatial fields to alterations of the perceiver's spatial location (action-possibilities tied to moving from *here to there*) then this route remains open to defender of the claim that spatial fields typically structure our perceptual experiences as dynamic *action-possibility* spaces (and in this sense what we have hit upon here is not merely something that only seems to be in play in rare cases or under very specific conditions of interest or expertise).[28]

Now, doubtless more could be said about these conditions, however, it is worth noting that the relevant additional detail will likely be modality specific, and the goal here is to pitch a sufficiently general notion of a spatial field. As we have seen, the visual field is the paradigm case of an external spatial field insofar as it exhibits all these characteristics. Our question is whether there is a haptic field that has these characteristics.

However, before proceeding it is worth noting that denying that haptic touch has a spatial field need not involve denying that this form of perception is genuinely spatial, that it is or involves forms of spatial experiential representation (a point that

[27] Similarly if auditory perception is structured by a spatial field, then that might minimally involve a sense of action possibilities relative to a possible re-direction of auditory attention.

[28] It is worth noting that de Vignemont (2018, 2021) goes in a different direction, arguing that in fact action-possibility or action-relatedness is proprietary or specific to peripersonal space, as the distinctive signature of peripersonal space compared with the rest of perception. However, given that there are action-possibilities tied to both perceptual presence and visual exploration, there seems to be good reason to think of the visual field as a spatial field that structures our visual perceptual experiences as a dynamic action-possibility space. As we shall see in Sects. 3, 4 and 5, peripersonal space has a distinctive way of meeting this condition, as the spatial field for haptic touch.

was made more generally concerning spatial representation in the introduction). For example, haptic touch is generally thought to provide perceivers with awareness of the intrinsic spatial properties of its objects, that is their size, shape, and location (and perhaps even spatial relations between parts of such objects, or indeed multiple objects). That can hold without it being the case that haptic perceptual experiences are structured by way of a spatial field. This would indeed mark out a structural difference between visual experience and haptic touch.[29] This is just to again clarify what is at stake in denying that haptic touch has a spatial field: my goal in the next three sections is to show that haptic touch does possess a spatial field in the form of peripersonal space.

3 Peripersonal space

Given that I am going to propose that peripersonal space is the spatial field for haptic touch, this section introduces the notion of peripersonal space (PPS hereafter).

We traditionally think of there as being a sharp division between external space and our bodies. External space is 'out there', separated from our body, with the skin serving as the boundary between ourselves and the external world. The notion of peripersonal space overturns this traditional picture. A significant body of evidence from cognitive neuroscience suggests that our perceptual systems process objects in the external space in close proximity to our bodies (up to 30-50 cm) in a distinctive way, and critically as different from far space, leading to an increase in relevant behavioural responses (e.g. better accuracy in shape recognition, faster reaction times to stimuli etc.).[30] The general approach in cognitive neuroscience to the study of peripersonal space has been to focus on the mechanistic processes involved in multisensory integration via studying the activation of multimodal neurons when visual, auditory, and tactile stimuli or 'cues' are close to the body. Decades of neuroscientific research have now demonstrated that the relevant set of posterior periacrucate neurons (and associated brain regions) only discharge or 'activate' when the relevant stimuli are *close to the body*, not discharging when stimuli are (sufficiently) far away from the body – thus demonstrating the existence of dedicated multisensory mechanisms in the brain for the representation of peripersonal space.[31]

On the basis of this research, peripersonal processing is often thought to involve a remapping of external objects located in close proximity to our bodies in a somatosensory (i.e. tactile-bodily) frame of reference, typically making use of visual and auditory cues. Peripersonal space is therefore thought to function as a 'buffer zone' between the 'external' and the 'internal', that is, between the external world and

[29] See Martin (1992) for this view. Martin concedes that touch may possess a spatial field in an etiolated sense, i.e., one that would not meet what he takes to be the more substantive conditions on an external spatial field (as his 1992 discussion shows, this would be the empty space condition and the occlusion-obstruction condition, see Sect. 5 for discussion).

[30] See Rizzolatti et al., (1981); di Pellegrino et al., (1997); Bufacchi & Iannetti , (2018); Blini et al., (2018).

[31] See discussion in Rizzolatti et al. (1981); di Pellegrino et al. (1997); Serino et al. (2009); Gentile et al. (2011). Central to much of the early research on peripersonal space has been discussion of cases of sensory extinction and tactile neglect which occur due to lesions in the parietal cortex.

one's body (or a relevant part thereof). As such, objects represented by our perceptual systems as being in peripersonal space are those with which we can have *immediate dealings* in a way that we can't with objects in extrapersonal or far space – it is, to put it broadly for now, *the space of here and now action-possibility*.

Given the above characterisation, peripersonal processing is claimed to have two critical functions: (1) bodily protection (as the 'margin of safety'), since objects represented as being in peripersonal space may soon come into contact with us (potentially harming us), and (ii) guiding immediate exploratory interaction with objects nearby the body. This has led some researchers to posit at least two 'peripersonal spaces', a *defensive* peripersonal space (or DPPS), whose function is bodily protection, and an exploratory peripersonal space (EPPS), whose function is goal-directed action.[32] Given the context of haptic touch, it is clearly EPPS which will be relevant for our purposes going forward (see Sects. 4 and 5).

With this understanding of PPS is view, it is, moreover, important to distinguish PPS from related notions. PPS is clearly not equivalent to personal space which concerns the proximity of individuals (usually con-specifics), and so is socially defined. Contrastingly, as seen above, PPS relates to the close proximity of objects per se, not any particular kind of object. PPS should also be distinguished from reaching space. As Frederique de Vignemont articulates the differences, 'reaching space is typically larger than peripersonal space although they can spatially overlap. A second difference between the two notions is that reaching space refers to a unique representation that is shoulder-centred. By contrast, there are several distinct representations of peripersonal space, which are centred respectively on the hand, the head, the torso, and the feet'.[33] And in further contrast to reaching space, PPS, as noted above, also serves a protective function, priming a perceiver for protective movements such as withdrawal or avoidance.

Now, I want to provide some more detail on the conception of PPS I will be working with. Let's return for a moment to the level of cognitive neuroscience. Here is how Rizzolatti et al. pose a pertinent question concerning the nature of peripersonal representation at the neuronal level:

> What is the nature of this representation? There are two main possibilities. The first is that the premotor neurons [involved in peripersonal processing] code space visually: that is, given a reference point (for example, the body parts on which the visual receptive field is anchored), the neurons signal the location of objects by using a Cartesian or some other geometrical coordinate system (visual space). The alternative possibility is that the discharge of neurons reflects a potential action, a motor schema, directed towards a particular spatial location (motor space) (Rizzolatti et al., 1997)[34]

[32] On the distinction, and discussion surrounding whether there is a *single or multiple* peripersonal spaces see de Vignemont and Iannetti (2015).

[33] de Vignemont et al. (2021, p. 5).

[34] Rizzolatti et al. (1997) provide three central reasons, couched at the neuronal level, for preferring the motoric conception.

It is this second 'motoric' possibility which is most appropriate in our context of haptic touch, drawing on a strand of current research on PPS that conceives of it in terms of an *action field*, or better *action possibility field*. Indeed, Bufacchi and Iannetti more recently frame peripersonal space as a 'set of graded fields describing behavioural relevance of actions aiming to create or avoid contact between objects and the body', as an 'action field' more akin to a 'magnetic field' which they specifically contrast with conceptualising peripersonal space as a 'single, distance-based, in-or-out zone within which stimuli elicit enhanced neural and behavioural responses.[35]

This notion of PPS as an 'action possibility field' should therefore be clearly distinguished from a mapping of an object's location which uses some exclusively distance-based Cartesian or similar geometrical coordinate system. In the case of PPS (bodily) *action-possibility comes first*. Put in less slogan form, it is because we 'plan to act' or need to 'prepare to act' that we need to represent the specific portions of external space just beyond the relevantly implicated body parts, as the specific space relative to which a body-object contact may well take place (e.g., the 'peri-hand' space, the 'peri-head' space, and so on) – as what Bufacchi and Iannetti call a 'contact-related action field'.[36] Simply, possible actions that the perceiver can perform are what give shape to PPS. On this 'motoric' conception, the coordinates of external PPS are first and foremost *action-possibility* coordinates, and so cannot be defined in an *action-independent* way; they have to be thought of as tightly indexed to a subject's 'here and now' bodily capacities for action and so bodily action possibilities (here we also require somatotopic coordinates since it is relative to a part of the body that the action-possibilities are *live*).[37] Nonetheless, as the subject moves PPS 'comes with them', so to speak, insofar as the relevant action-possibility coordinates require a mapping relating to a somatotopic or bodily frame of reference. We should also bear in mind that it is not just that there is a possible bodily action at that location, but that the possible bodily action at that location is or will be a *basic* action in the sense that body-object contact could be made *just by doing one thing*, and so 'directly', rather than having to go through a *mediate action* first.[38]

Let me now present one significant line of research supporting this conception of PPS. There is a significant body of empirical research in cognitive neuroscience suggesting that when using a tool to extend the space in which one can act, that objects near the tip of the tool are now processed as included in 'peri-hand space' (with an increase in cross-modal congruency near the tip of the tool).[39] Again, what is significant here is that the co-ordinates of the extended peri-hand space are mapped in a somatotopic cum action-possibility way rather than an action-neutral or Cartesian way (say just in terms of enlarged spatial extension). It is usually thought

[35] Bufacchi and Iannetti (2018). See also Finisguerra et al. (2015) who define PPS in terms of its sensorimotor function rather than in metrical terms.

[36] Bufacchi & Iannetti (2018, p. 1085).

[37] Similar ideas are somewhat broached in Fulkerson (2014: 160); see also de Vignemont (2021, p. 177).

[38] Cf. The broader Evans (1982) notion of 'behaviour space' which also covers non-basic bodily actions, e.g., getting up to open the door.

[39] See Farnè and Làdavas, (2000); Farnè et al., (2007). Holmes et al., (2007). Although cf. Wu, (2021) for an attention-based hypothesis concerning this empirical data.

that it is because the tool extends one's action possibilities regarding objects in the nearby space surrounding the tip of the tool – that is where contacts can be made or avoided – that we need spatial representation of the specific extended peri-hand space. Indeed, Farne and colleagues suggest that extension of the peri-hand space using a tool requires that the tool can be used in a *functionally effective* way, i.e., that interaction with objects nearby the tool is a live possibility.[40] Legrand and colleagues suggest something similar on the basis of studies conducted with both normal subjects and brain-damaged patients, such that 'passive change of the corporeal configuration (hand + tool) is not sufficient' for the relevant extension of the peri-hand space, claiming that 'some goal-directed activity is needed'.[41] What looks to be required is that action-possibility is a 'live option', as I have put it. In this sense, the relevant remapping and elongation are necessarily relative to what Legrand and colleagues call the *operational length of the tool*, such that the peri-hand space is remapped relative to the tool's functionally effective length, which is to be contrasted with its absolute length (as a metric distance).[42]

There is no doubt significantly more to be said about PPS and this 'motoric' or 'action-possibility first' understanding of it, but on the basis of this discussion we can now understand more concretely why it makes sense to say, as we did above, that PPS is the *space of here and now action-possibility*, such that objects represented in PPS are those with which we can have *immediate dealings*, in a way we can't with objects in extrapersonal or far space.

Now, before proceeding to show how PPS meets the conditions we outlined in Sect. 2, it is important to deal with a worry which problematises PPS being appealed to as the spatial field for haptic touch *as such*. As noted by Blazej Skrzypulec, if we construe PPS as a multimodal space – that is as a form of spatial representation which is guided by visual, haptic, and auditory cues – then we potentially trivialise whether and in what sense there might be a specifically *haptic* field.[43] Here is why: objects located in PPS may well be located in a spatial field, but they would merely be located in a specific nearby region of the visual field. As such, the appeal to PPS as the spatial field for haptic touch would bottom out in the role that vision plays in PPS, and so in specifying how PPS meets the relevant field conditions we would just be specifying how some 'nearby' region of the visual field meets those conditions. PPS would not provide a *proprietary* spatial field for haptic touch, with haptic touch only being structured by a spatial field on the condition that vision provides one via its role in PPS.

However, given our 'motoric' or action-possibility first conception of PPS we can see that this worry rests on a mistake. Peripersonal space should not be thought of merely as some nearby-the-body container or 'inert' bubble for possible and actual objects, 30–50 cm from the body or a part thereof (as a Euclidean distance), as merely some 'nearby' region of the visual field. As Rizzolatti et al. say, in defending a motoric vs. visual conception of peripersonal spatial representation, 'the movement-based

[40] See Farnè et al. (2007, p. 422).

[41] Legrand et al. (2007, p. 694).

[42] Ibid. See also Bufacchi and Iannetti (2018).

[43] See Skrzypulec (2022, p. 320).

space … becomes then our experiential peripersonal visual space', quoting Merleau-Ponty's claim that space is not a 'sort of ether in which all things float … the points in space mark, in our vicinity, the varying range of our aims and our gestures'.[44] In that sense, we shouldn't think of PPS and its 'boundaries' as equivalent to the geometrical boundaries of a nearby 'portion' of visual field, as a (Euclidean) distance-based in-or-out zone; the bounds of PPS, such as they are, are always defined and experienced relative to a subject's here and now *action-possibilities*.

4 PPS has the necessary spatial field characteristics

The goal of this section (and the following one) is to demonstrate that PPS serves as the spatial field for haptic touch, structuring the relevant perceptual experiences, by showing how it meets the conditions and exhibits the characteristics detailed in Sect. 2.[45] By doing so we will also be responding to a sceptical worry, namely that it is not at all clear what might be meant by the notion of a 'tactual field'.[46]

Let's first consider the *object location and relation condition*, since this brings together haptic touch and PPS. Insofar as the objects of haptic touch are experienced as being located anywhere, which they surely are, it is in PPS.[47] Mohan Matthen presents a transcendental argument for this conclusion.[48] In general transcendental arguments operate as follows, as summarised by Robert Stern and Tony Cheng: 'as standardly conceived, transcendental arguments are taken to be distinctive in involving a certain sort of claim, namely that *X* is a necessary condition for the possibility of *Y*—where then, given that *Y* is the case, it logically follows that *X* must be the case too.'[49] Matthen's argument for locating the objects of haptic touch in PPS follows this pattern of argumentation: the possibility of distinguishing between haptic perception and tactile sensation is necessarily dependent on the objects of haptic perception being in some way represented in 'external' or 'exteroceptive' space. Given that we are readily and with ease able to distinguish between haptic perception and tactile sensation, then it follows that the objects of haptic perception are in some way represented in 'external' or 'exteroceptive' space. Now, given that it doesn't make sense to think of the objects of haptic touch as located in *far space* or 'extrapersonal' space –

[44] See Rizzolatti et al. (1997, p. 2), and Merleau-Ponty (2002 [1945]), p. 284).

[45] I agree with Skrzypulec (2022, pp. 318–20) that cutaneous information (with or without kinaesthetic data) would be insufficient to present 'tactile objects as positioned in an exteroceptive tactile field'. Likewise I find the proposal that 'skin space' is the external spatial field for haptic perception unconvincing (on 'skin space' see Haggard et al., 2017; Fardo et al., 2018; Cheng, 2019)

[46] See Strawson (1959, p. 65); Martin, (1992); O'Shaughnessy, (1989, p. 38). It should be noted that Strawson (1959, p. 65) at least holds open the possibility of a 'tactual field', of a spatial field for touch, or at least spatial concepts being available in a purely tactual mode: 'if we combined tactual with kinaesthetic sensations, then at least it is clear that we have the materials for spatial concepts; of the congenitally blind one does not wonder whether they really know what it means to say that one thing is above another, or father from another than a third thing is'.

[47] See Fulkerson, (2014, p. 160; Kalderon, (2018, Ch. 1).

[48] Matthen (2021, p. 198).

[49] See Stern and Cheng (2023).

which are spaces 'beyond the reach' of tactual interaction – then the prime candidate, indeed the only candidate, for the location of the objects of haptic touch is PPS.

Importantly, we can also have a sense of manifest spatial relations between various objects located in PPS. There is a phenomenological difference between something which I am holding close to my body and something I am pushing away at arm's length, and I can have a sense for how far or close in PPS two objects I am grasping are. Indeed, this is hardly surprising given that even in PPS we often need to prioritise action related to something that is about to come into contact with our body vs. something that is approaching but is still an arm's length away (where both are represented as being in PPS). In keeping with our motoric understanding of PPS though, we shouldn't think of such spatial relations as manifest to the perceiver in terms of determinate quantifiable distances, but rather as defined relative to those previously mentioned action-possibility co-ordinates. In this sense 'closeness' or 'further away' are experienced in action-possibility relative or relevant ways.

Moving on, PPS also meets the *egocentric point of origin condition*. PPS is centered relative to a bodily or somatotopic frame of reference, Yet the point of origin of PPS is not just the *body per se*, but rather centres around 'haptic organs', that is those parts of the body I make use of in haptic-action and exploratory movements (hands, legs, arms, feet, torso etc; notice not the 'skin' per se) and so from which haptic perceptual experiences 'originate'. From this point(s) of origin PPS 'spreads out', as it were, and so we have a spatial centre (albeit one that can 'emerge' from a large number of relevant such points of origin).[50] And just as in the visual case, where the field 'comes with me' as I move around my perceptual environment, so too as I move, I bring my PPS with me. Again, there is no reason to think that this condition is only met due to vision's role in PPS. Blindfolded, and airdropped into an unknown region of physical space, I may have absolutely no sense of objects located in a *visual* field, and so no visual sense of my perceptual environment, but as I move around in that space, I still take my PPS with me, as a *multimodal form* of spatial representation, drawing on auditory and haptic 'cues'. Much less do I have to visually represent my 'haptic organs' for them to function as the egocentric point of origin of my haptic perceptual experiences.

Now, at this point it will be illuminating to draw on a contrast case in which the egocentric point of origin condition isn't plausibly met. José Bermudez notes that in the case of tactile sensations, and specifically the 'bodily space' of proprioception – where the objects of proprioceptive awareness are states of the body, and they are located relative to the limits of the body (the primary form of awareness here being interoceptive) – there isn't an egocentric point of origin.[51] Bermudez' main train of thought runs as follows: in the case of both visual experience and haptic touch, as paradigmatically spatial forms of exteroceptive perception, we get substantive and credible answers to the question of why we locate the *point of origin* at a specific

[50] This suggests an interesting point, which warrants further development in future work, as to whether we have just one PPS for haptic touch, or whether they are many PPSs individuated by the different 'points of origin', so a peri-hand space, peri-head space, and so on. The idea of *multiple* PPS representations is a live issue in the empirical research on PPS; see de Vignemont and Iannetti (2015) and Bufacchi & Iannetti (2018) for discussion.

[51] See Bermudez (1998).

body part rather than another (i.e., roughly the eyes for vision, the relevant 'haptic organs' for haptic touch, see above). Yet, as Bermudez highlights, 'somatic proprioception is not like this at all. It is not clear what possible reason there could be for offering one part of the body as the origin of the proprioceptive frame of reference'.[52] By his lights this contrast, qua possessing an egocentric point of origin (or not), is further borne out in the fact that questions of relative distance are unintelligible for somatic proprioception or tactile sensation. For visual perception and indeed haptic touch as structured by PPS, it makes sense to ask which of two objects is further away, and indeed this is, as Bermudez makes clear, implicitly a way of asking 'which of the two objects is farther from me'.[53] However, critically such questions have no traction for somatic proprioception, in terms of our awareness of the relevant tactile sensations: 'one does not find oneself asking whether this proprioceptively detected hand movement is farther away that this itch, or whether this pain is in the same direction as that pain',[54] and the reason why is due to the plausible claim mooted above – there is simply no specific part of the body, as a privileged part, that stands to count as the egocentric point of origin of 'bodily space', such as to ground intelligible answers to these kinds of questions about spatial distance and the spatial relations that two 'objects' have to each other, relative to some location in space. Clearly then, PPS meeting the *egocentric point of origin condition* is by no means a trivial matter.

Next, consider the *spatial limit condition*. On the motoric conception of PPS, the 'boundaries of PPS' are defined in terms of the extent of a perceiver's 'here and now' exploratory activities, that is as relative to temporally and spatially proximate basic action possibilities – what I previously labelled action possibility co-ordinates. And just as with the visual field there are regions of absolute space which fall outside of PPS, and regions that fall within it, and in that sense, PPS has (more or less clear) spatial limits (30–50 cm from the body). But, as we saw in our detailed account of PPS in the previous section, the sense in which PPS specifically has limits or 'boundaries' is notably different from that of the visual field; it is relative to *possible action*, relative to a perceiver's 'here and now' exploratory activities, such that haptic interactions are taking place or could take place, that PPS is 'bounded'. In that sense, PPS is the proprietary 'touch' space within which I can exercise a range of haptic competences, picking up objects, placing them down, moving them away, drawing them in, etc.[55] And connected to this, and given what we have said so far, it is clear that PPS will meet the *field independence condition*. PPS exhibits a (relatively) stable spatial structure, within the aforementioned limits.

Before we turn to the two conditions that are more difficult to meet, we can note that given our motoric understanding of PPS – as the external, but proximal, space of *here and now* action possibility – that PPS is the space relative to which perceivers

[52] Bermudez (1998, p. 152).

[53] Ibid, p. 153.

[54] Ibid, p. 153.

[55] Analogously to the visual field there are abnormal conditions in which these spatial limits can be extended or contracted. For example, there is empirical evidence suggesting that in schizophrenia a subject's experience of PPS is significantly contracted (see Hyeon-Seung et al., 2021). See also the discussion of extension of PPS in Sect. 3.

represent relevant sets of *haptic possibilities* indexed to haptic touch. In this sense, PPS occupies the role of being an *action-possibility* space for haptic touch; it is the space relative to which we have some sense of haptic possibilities precisely in that space – both that we could actualise some haptic componences and that objects could move, appear, disappear etc. In that sense, as follows from our motoric conception of PPS, it is not merely a 'static field' but *a dynamic action possibility space*. This brings home a point that was made in our introduction; namely, that once we have available the notion of PPS, haptic touch, in virtue of possessing a field by reference to that space, doesn't have to be limited to *active occurrent* exploratory activity (contrary to what has often been assumed). This is because the structuring of haptic touch by way of PPS brings into view the importance of an experiential sense of *haptic possibilities* in that space, possibilities that I can have some awareness of without either *actually moving*, or indeed intending to do so (we will see these ideas concerning 'haptic possibilities' in play in more detail in Sect. 5).[56]

It is also worth noting that insofar as PPS occupies the role of being an *action-possibility* space for haptic touch, then this also explains the way in which haptic touch, as structured by PPS as *multimodal* – drawing on the full range of tactile, visual and auditory 'cues', when the relevant objects enter into PPS – affords us genuinely multimodal experiences of objects' spatial location, as a shared action-possibility or 'behaviour' space 'nearby the body'. Indeed, the object I reach for in PPS is typically the one I can see near my hand; the fly I get ready to swat away is the one I hear as 'too close' to my head. In this way PPS, as what Bufacchi and Iannetti call a 'contact-related action field', is a multimodal spatial field which structures haptic touch such as to provide the haptic perceiver with the relevant sense of haptic possibilities for objects in PPS, as the external space relative to which body-object 'interactions' *can take place*.

5 Empty space and obstruction in haptic touch via PPS

Arguably, the hardest condition for any supposed spatial field for haptic touch to meet is the *empty space condition*. Indeed, as we saw in the introduction, scepticism about haptic touch having a spatial field which structures haptic perception like the visual field structures visual experience has paradigmatically turned on this issue.

We can at this point remind ourselves of the relevant line of thought that Fulkerson gives expression to on this point, and the comparison with the visual field: 'Vision, it seems, provides a rich felt awareness of objects in a spatial field – an area where there are potential objects but where none currently reside (that is, we seem in vision to be able to see empty space). Touch, on the other hand, doesn't seem to present features in this way. Instead, like audition, touch seems only to bring awareness of individual objects that each seem to occupy a specific location'.[57] There is, however, a way of sharpening this worry, namely that haptic touch doesn't involve *feeling* 'empty space'

[56] See de Vignemont (2021, p. 182–3), for a similar idea concerning the motor function of PPS in terms of merely anticipating possible movements.

[57] Fulkerson (2024).

in the way that visual experience, as structured by the visual field, involves *seeing* empty space. Consider that it is phenomenologically evident that there is a distinction between a visual experience of empty space and the absence of visual experience; I have an experience of the empty space between myself and the tree I can see across the road in a way that is phenomenologically different from the absence of visual experience concerning the space behind my head. However, in the haptic case arguably we cannot make this distinction, or at least it is much more difficult to do so. Let me again explain why: if it were true that all that haptic touch affords us is an awareness of individual objects that each seem to occupy a specific location – if its objective spatial content was exhausted by what is given by what we are currently touching – then it seems we would at best struggle (at worse fail) to be able to distinguish between a haptic perceptual experience of empty space and an absence of haptic perceptual experience whatsoever.[58]

Indeed this line of thought is reflected in a phenomenological contrast Martin tries to bring to the fore in his discussion of a visual experience of a Polo mint, which has a hole in the centre, and a haptic perceptual experience of holding the rim of a glass: in the visual experience of the Polo mint, 'one is aware of the hole as a place where something potentially could be seen, not as where something is actually seen to be'.[59] Martin contrasts the kind of *visual awareness* we have of the 'hole in the middle', with the putative absence of precisely some such modality-specific awareness of empty space in haptic touch: 'When one grasps the rim one comes in contact with it at only five points, where one's fingertips touch it … In being tactually aware in this way, is one aware of the parts of the rim in between the points of contact in the same way as one is aware of those points [the 'non-touched points'], and is one aware of the region of space lying inside the rim? The answer would appear to be not: one comes to be aware of the glass by being aware of the parts one touches. In this it contrasts with the Polo mint, since one is aware both of the ring-surface and of the hole *in the same way*'.[60] Martin's central line of thinking here seems to be as follows: a condition on touch having a spatial field analogous to the visual field would be its meeting this modality-specific 'double awareness condition' – awareness, in the relevant perceptual mode, of both space occupied and space unoccupied. According to Martin touch doesn't and can't afford that: in any given moment of touch, of 'perceptual contact' with the object, it only affords awareness of a space occupied, such that haptic awareness is, so to speak, exhausted by its points of contact, and so only provides us with a haptic awareness about *where things are*, and not a haptic awareness of *where things are not*.[61]

However, with our candidate for the spatial field for haptic touch being PPS we can respond to Martin's line of thinking, and show how the empty space condition can

[58] Cf. Mac Cumhaill (2017). Mac Cumhail provides a series of arguments supporting the idea that there is a *figure-ground* structure in touch. She uses this to argue that we do indeed feel 'empty space' in haptic touch, as related to the surfaces of objects we are currently in contact with.

[59] Martin (1992, p. 197).

[60] Ibid, p. 200.

[61] See also Martin (1992, p. 199) 'At any one time one only has contact with one point on the surface of the glass, so there does not seem to be at any time an awareness of the relations between many points in space'.

be met. Remember that what is in view here is a condition (offered by Martin) about the experiential representation of empty space: any spatial field needs to allow for the experiential representation of empty space, of regions of the spatial field that are experienced as currently unoccupied, relative to the possibility of perceptual objects being there in the relevant modality, that is where some such modality-specific perceptual object could be perceived. As such the experiential representation of empty space, relative to a spatial field, should be a modality-specific representation of empty space, as a space where modality-specific objects could be. According to Martin, it is only on this basis, such that the relevant perceptual experiences meet what I called above the modality-specific 'double awareness condition', that we can legitimately think of there being a modality-specific awareness of empty space.

Turning now to PPS, we can see that a central aspect of our experience of PPS is an experience of an extended spatial region nearby the perceivers' body – delimited relative to a subject's 'here and now' exploratory actions and possible actions – where tactual objects *might be*, more precisely as a site of potential objects for haptic interaction (where body part and object interactions *could* take place). In that sense we plausibly do experience regions of PPS as currently unoccupied, as 'empty', in the sense that some possible haptic object *could be there* (indeed dynamically 'monitoring' PPS for potential objects is critical to its function) – as a place where something could be touched (to adapt Martin's phrase).[62] Consider the following example:

> Skilful boxer: In the boxing ring two opponents spar. One however, is exceptionally good at keeping *just out of reach*, such as to persistently avoid any punches landing. However, as the fight goes on, the skilful boxer tires, and his opponent senses exactly the right moment to strike, at that moment when the skilful boxer has not retreated quite far enough, landing a knockout blow.

Now to throw the punch at exactly the right time, just when his opponent is within reach, looks to have required an almost '6th sense', a priming or preparation for contact that, in this case, is the purview of only the most skilled boxers. This requires, no doubt amongst other things, a spatial representation of the boxer's *peri-hand space*, that is, the nearby external space relative to his actual hand into which the opponent may and then eventually does stray. Indeed, it is apt to describe this situation as one in which there is a distinctive haptic sense of possibility: at that very moment when the opponent strays within range of the boxer's punches, within 'peri-hand' space, that body-object contact is *right here and now* a 'live option'. Indeed, we might again say that it is this 'anticipatory sense' of haptic possibilities relative to PPS, that, in a flash, allows the boxer to then *throw the punch and land the knockout blow*. In this sense we can see how Martin's 'modality-specific double awareness condition' can be met for haptic touch if haptic perceptual experiences are structured by PPS; since it is relative to PPS that we have a sense or awareness of where tactual objects *might be felt*, but are currently not being felt, as precisely a space in which there are opportunities for haptic interactions. And further to this, insofar as haptic touch is structured by PPS, as a spatial field, there is going to be a critical phenomenological

[62] Martin (1992, p. 199).

difference between experiencing some region of PPS as currently unoccupied – say the peri-hand space where the boxer will throw his punch if the opponent strays too close – and the absence of any haptic perceptual experience whatsoever (say if all our 'haptic organs' were anaesthetised).[63]

Now, there is of course a persistent temptation to think that the empty space condition can't be met for haptic touch if we model our sense of the perception of empty space too closely on visual experience. But if we adopt Martin's condition that a perception of empty space is best understood in terms of a modality-specific representation of space where a modality-specific object currently *isn't*, but where it could be (or more specifically *could be perceived* in the relevant sense-modality), then it is reasonably clear that haptic touch, insofar as it is structured by PPS, can include this insofar as it involves this sense of haptic possibility. Of course the phenomenology of empty space in the visual field will be different from the phenomenology of empty space in PPS – and clarifying either of these in significantly more detail is a distinct project in its own right – but this is an instance in which we shouldn't allow the dominance of the visual modality in our theorising about perceptual experience to undermine our sense of how a non-visual modality might possess a spatial field which meets an important condition.

Finally, let me detail how relative to PPS, there is, in haptic perceptual experience, the possibility of occlusion phenomena, that is perceptual situations in which something can occlude perception of an object, by interposing itself between a perceiver and the perceived object. Now, there is important argument that haptic touch won't be able to meet this condition (and so manifest this kind of phenomena), again drawing from Martin, who provides what we might call *An Argument from Occlusion and the Re-orientation of Objects in Space*, whose conclusion is that there is no haptic field, or at least one that plays an analogous structuring role that the visual field plays for sight. Here is how he frames the issues at hand:

> The occluded areas of the visual scene count as part of visual space in the sense that one could come to be aware of something at that location without altering the limits of the visual field provided by the angle of vision at that time. An area can come into *view simply by rearrangement of things within the field, rather than by changing the field itself* … . So one might ask whether points on the rim of the glass with which one has no contact nevertheless fall within a tactual space. If this is to be analogous to the visual case this must mean that we are to ask whether these points are themselves potentially points which can be felt *as the tactual field stands*. For the visual case we could determine this by asking whether if objects were re-arranged within the limits of the angle of vision one could come to experience that point. So in the tactual case we may ask what the limits of the tactile field would be … to this there appears to be no obvious answer … there is no clear sense of what would be the limits to a tactual sense field in which (potentially) objects would be felt to be. If there is one, then we

[63] One might also think that to come to hold some haptic object, and feel it as a distinct thing, with certain boundaries, necessitates some awareness of the empty space surrounding it where 'it is not' (see Mac Cumhaill, 2017).

> would have to think of it as being somehow boundless. The re-arrangement of objects within it would just be the re-arrangement of objects in space. (Martin, 1992, p. 199–200, my italics)

Martin's argument is complex but can be reconstructed as follows: starting with a conditional, if there were a haptic field, then akin to how matters go for the visual field, we should be able to make sense of a situation in which some currently occluded part of the field, or occluded part of an object within the field, could 'come into view', merely by a re-arrangement of objects in the field while holding fixed the point of origin of the field (as the 'field stands'). These perceptual spatial possibilities of re-arrangement, as a particular set of perceptual 'coulds and cans', have to be delimited relative to the limits of the spatial field in which they could take place, such that a rearrangement of objects *in the field* is not co-extensive with the re-arrangement of objects in absolute space. Reflecting this, there needs to be a critical (and phenomenologically self-evident) distinction between (1) a case of spatial occlusion and the perceptual possibilities tied to it given a fixed point of origin ('as the field stands'), and (2) a region of space or object therein simply not being a possible object or region open to perception given a fixed point of origin ('as the field stands'). We see this in the visual case: given a re-arrangement of objects in the visual field, holding a fixed line of sight, a previously occluded region or part of an object *could* come into view. But given a fixed light of sight no amount of re-arrangement of objects in space directly behind my head will bring them, or any space in that region, into view. In this sense, Martin seems to be suggesting that occlusion phenomena like this are to be made sense of in terms of a limited set of perceptual possibilities where the limits are set relative to precisely the origins and boundaries of the spatial field itself.

Martin's worry is that in the case of haptic touch it isn't clear what the field limits would be. And in that case, in which perhaps there were no limits – a 'boundless' field so to speak – then we are not able to make that critical distinction between what should be a relevantly delimited set of perceptual possibilities tied to a case in which the 'tactual fields stands' and there is a re-arrangement of objects within the field, and the perceptual possibilities tied to a case in which the 'tactual fields stands' and there is re-arrangement of objects in absolute space; the perceptual possibilities tied to the re-arrangement of objects within some such boundless field would be co-extensive with the re-arrangement of objects in absolute space, as entirely open or unlimited (everything would be possibly open to touch, so to speak). And our failure to be able to make this distinction for haptic touch should, Martin thinks, undermine our confidence that what we really have in play here is something like a spatial field which structures haptic touch.

Now, the appeal to PPS as the spatial field for haptic touch allows us to respond to this line of thought. The best way of proceeding will be show that we do indeed get something akin to occlusion phenomena in haptic touch, and that critically the relevant perceptual possibilities that are brought into play can be tied to a re-arrangement of objects within PPS (in which the 'tactual field stands') in a way that is *not* co-extensive with, and so doesn't collapse into, a re-arrangement of objects in absolute space (in which the 'tactual field stands'). And this is precisely for a reason we have already detailed: namely that PPS meets the spatial-limits condition.

First, it is worth noting that occlusion is likely best thought of as a distinctively visual phenomenon. As A.D Smith notes, 'the notion of occlusion applies literally only to the sense of sight, where the possibility is obvious. Nevertheless, something analogous to occlusion holds for touch, despite its being a 'contact sense'. For while you are touching something, a thin rigid object can always in principle be interposed between your body and what was being touched, so that you feel it obstructing your perception of the latter'.[64] So, for haptic touch it is obstruction which is the relevant notion. And again, we might think that insofar as haptic obstruction takes place, it takes place in PPS. Now, there are two key forms that such obstruction can take: what we can call allo-obstruction (as analogous to allo-occlusion) and self-obstruction (as analogous to self-occlusion); since allo-obstruction is more clearly relevant to Martin's argument let's focus on that.

Consider the following situation: a holed metal grate is placed between oneself and another object one is touching. In such a case there would be a central sense in which despite still being 'in contact' with part of the original object your perception of it is now partially obstructed. In that kind of situation (and those like it) it seems right to think that we can have a sense of *relevantly delimited perceptual possibilities*, and so we can respond to Martin's argument. The currently untouched parts of the original object, which are being allo-obstructed by the holed grate, fall within PPS, and as such *could be felt,* by a re-arrangement of the objects in PPS as *PPC stands*, they are *potentially open to touch*. The perceptual possibilities in play, as what is open to possible touch, are delimited relative to precisely the limits of PPS, where those limits are defined in terms of a subject's here and now (possible) exploratory activities. As such we are able to recognise that the perceptual possibilities tied to a re-arrangement of objects in PPS where we hold PPS fixed (where we don't move or shift in space, so moving or shifting the point of origin of PPS), are clearly *not co-extensive* with some entirely open set of perceptual possibilities tied to re-arrangement of objects in absolute space where we hold the point of origin of PPS fixed (as reflected by a case in which some object is moved which *falls outside* of PPS, and so *falls outside* of the relevant set of delimited perceptual possibilities). Indeed, the very possibility of allo-obstruction phenomena as described above bears out the cogency of this distinction for haptic touch. We therefore have a response to Martin's argument and a way of seeing how haptic touch, as structured by the spatial field of PPS, allows for the possibility of obstruction phenomena.[65]

[64] See Smith (2002, p. 137).

[65] It is worth noting that Martin (1992), section 3, offers a detailed discussion of the role that bodily awareness might play as a putative 'tactile field', as part of his broader template theory of touch. There is no doubt an interesting comparison to be made between my proposal here that PPS structures haptic touch as a spatial field, and further details of Martin's account of the role of bodily awareness in haptic touch (as something perhaps akin to a multimodal bodily frame for touch). However for reasons of space I save a detailed discussion of this comparison for further work.

6 Conclusion

What I have said here should be sufficient to show that PPS can meet the field conditions and characteristics detailed in Sect. 2, and that it should be considered as the spatial field that structures haptic touch experiences. As such, we now have an answer to our question 'is there a haptic field'. The answer is yes. And by detailing how PPS meets the relevant field conditions we gain a richer understanding of the distinctive spatial phenomenology of haptic touch, insofar as it becomes clear that PPS structures haptic touch experiences in a way that is somewhat analogous to how the visual field structures visual experience. We also have a clearer sense of the connection between haptic touch and haptic *possibilities*; it is relative to its being structured by PPS as a 'contact-related action possibility field', that haptic touch involves an experience of a range of distinctive 'haptic possibilities'. The resulting picture is a more nuanced understanding of haptic touch and its spatial phenomenology.

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References

Aizawa, K. (2007). Understanding the embodiment of perception. *Journal of Philosophy*, *104*(1), 5–25.

Alsmith, A. (2021). The structure of egocentric space. In F. de Vignemont, & others (Eds.), *The world at our fingertips: A multidisciplinary exploration of peripersonal space*. Oxford University Press.

Bermúdez, José Luis. (1998). *The paradox of self-consciousness: Representation and mind*. MIT Press.

Blini, E., Desoche, C., Salemme, R., Kabil, A., Hadj-Bouziane, F., & Farnè, A. (2018). Mind the depth: Visual perception of shapes is better in peripersonal space. *Psychological Science*, *29*.

Brewer, B. (1992). Self-location and agency. *Mind*, *101*(401), 17–34.

Briscoe, R. (2008). Vision, action, and make-perceive. *Mind and Language*, *23*(4), 457–497.

Briscoe, R. (2011). Mental imagery and the Varieties of amodal perception. *Pacific Philosophical Quarterly*, *92*(2), 153–173.

Bufacchi R. J., & Iannetti G. D. (2018). An action field theory of peripersonal space. *Trends in Cognitive Science*, *22*(12), 1076–1090.

Campbell, J. (2002). *Reference and consciousness*. Clarendon Press.
Cheng, T. (2019). On the very idea of a tactile field, or: A plea for skin space. In T. Cheng, O. Deroy, & C. Spence (Eds.), *Spatial senses: Philosophy of perception in an age of science*. Routledge.
de Vignemont, F. (2018). Peripersonal perception in action. *Synthese*, *198*, 4027–4044.
de Vignemont, F. (2021). A minimal sense of here-ness. *Journal of Philosophy*, *118*(4), 169–187.
de Vignemont, F. (2023). *Affective bodily awareness*. Cambridge University Press.
de Vignemont, F., & Iannetti, G. D. (2015, Apr). How many peripersonal spaces? *Neuropsychologia*, *70*, 327–334. https://doi.org/10.1016/j.neuropsychologia.2014.11.018
de Vignemont, F., Serino, A., Wong, H. Y., & Farne, A. (eds.). (2021). *The world at our fingertips: A multidisciplinary exploration of peripersonal space*. Oxford University Press.
di Pellegrino, G., Làdavas, E., & Farné, A. (1997). Seeing where your hands are. *Nature*, *388*, 730.
Dokic, J. (2012). Pictures in the flesh presence and appearance in pictorial experience. *British Journal of Aesthetics*, *52*(4), 391–405.
Evans, G. (1982). *The varieties of reference*. Oxford University Press.
Fardo, F., Beck, B., Cheng, T., & Haggard, P. (2018). A mechanism for spatial perception on human skin. *Cognition*, *178*, 236–243.
Farennikova, A. (2013). Seeing absence. *Philosophical Studies*, *166*(3), 429–454.
Farnè, A., & Làdavas, E. (2000). Dynamic size-change of hand peripersonal space following tool use. *Neuroreport*, *11*(8), 1645–1649. https://doi.org/10.1097/00001756-200006050-00010
Farnè, A., Serino, A., & Làdavas, E. (2007). Dynamic size-change of peri-hand space following tool-use: Determinants and spatial characteristics revealed through cross-modal extinction. *Cortex*, *43*(3), 436–443.
Finisguerra, A., Canzoneri, E., Serino, A., Pozzo, T., & Bassolino, M. (2015, Apr). Moving sounds within the peripersonal space modulate the motor system. *Neuropsychologia*, *70*, 421–428. https://doi.org/10.1016/j.neuropsychologia.2014.09.043
Fulkerson, M. (2012 [revised 2024). *Touch*. Stanford Encyclopaedia of Philosophy.
Fulkerson, M. (2014). *The first sense: A philosophical study of human touch*. MIT Press.
Gentile, G., Petkova, V. I., & Ehrsson, H. H. (2011). Integration of visual and tactile signals from the hand in the human brain: An FMRI study. *Journal of Neurophysiology*, *105*(2), 910–922.
Green, E. J., & Schellenberg, S. (2018). Spatial perception: The perspectival aspect of perception. *Philosophy Compass*, *13*(2).
Haggard, P., Cheng, T., Beck, B., & Fardo, F. (2017). Spatial perception and the sense of touch. In F. de Vignemont, & A. J. T. Alsmith (Eds.), *The subject's matter: Self-consciousness and the body*. MIT Press.
Holmes, N. P., et al. (2007). Tool use changes multisensory inter-actions in seconds: Evidence from the crossmodal congruency task. *Experimental Brain Research*, *183*, 465–476.
Husserl, E. (1989 [1952]). *Ideas pertaining to a pure phenomenology and to a phenomenological philosophy, Second Book* (R. Rojcewicz, & A. Schuwer, Trans.). Kluwer Academic Publishers.
Husserl, E. (1997 [1907]). *Thing and space: Lectures of 1907* (R. Rojcewicz, Trans.). Kluwer Academic Publishers.
Hyeon-Seung, Lee, Hong SJ, Baxter T, Scott J, Shenoy S, Buck L, Bodenheimer B, Park S. (2021). Altered Peripersonal Space and the Bodily Self in Schizophrenia: A Virtual Reality Study. *Schizophr Bull, 47*(4):927–937. https://doi.org/10.1093/schbul/sbab024
Hyman, J. (2015). *Action, knowledge, and will*. Oxford University Press.
Jones, L. A., & Lederman, S. J. (2006). *Human hand function*. Oxford University Press.
Kalderon, M. (2018). *Sympathy in perception*. Cambridge University Press.
Klatzky, R. L., & Lederman, S. J. (2004). Haptic identification of common objects: Effects of constraining the manual exploration process. *Perception & Psychophysics*, *66*(4), 618–628.
Laasik, K. (2018). Visual field and empty space. *European Journal of Philosophy*, 403–411.
Lederman, S. J., & Klatzky, R. L. (1987). Hand movements: A window into haptic objection recognition. *Cognitive Psychology*, *19*(3), 342–368.
Lederman, S. J., & Klatzky, R. L. (2009). Haptic perception: A tutorial. *Attention, Perception & Psychophysics*, *71*(7), 1439–1459.
Legrand, D., Brozzoli, C., Rossetti, Y., & Farnè, A. (2007). Close to me: Multisensory space representations for action and pre-reflexive consciousness of oneself-in-the-world. *Consciousness and Cognition*, *16*(3), 687–699.
Mac Cumhaill, C. (2017). The tactual ground, immersion, and the "space between". *Southern Journal of Philosophy*, *55*(1), 5–31.

Mandrigin, A. (2019). The where of bodily awareness. *Synthese*, *198*(3), 1887–1903.
Mandrigin, A., & Nudds, M. (2021). Sameness of place and the senses. In F. de Vignemont, & others Eds.), *The world at our fingertips: A multidisciplinary exploration of peripersonal space*. Oxford University Press.
Martin, M. G. F. (1992). Sight and touch. In T. Crane (Ed.), *The contents of experience* (pp. 196–215). Cambridge University Press.
Matthen, M. (2021). The dual structure of touch: The body versus peripersonal space. In F. de Vignemont, A. Serino, H. Wong, & A. Farne *The world at our fingertips* (pp. 197–214). Oxford University Press.
Merleau-Ponty, M. (1967 [1942]). *The structure of behavior*. Beacon Press.
Merleau-Ponty, M. (2002 [1945]). *The Phenomenology of Perception, trans Donald A*. Landes. London: Routledge
Mitchell, J. (forthcoming). *A sense of the possible: On the horizons of visual experience*. Oxford University Press.
Mizrahi, V. (2023). Touch and bodily transparency. *Mind*, *132*(527), 803–827.
Munton, J. (2022). How to see invisible objects. *Noûs*, *56*(2), 343–365.
Noë, A. (2004). *Action in perception*. MIT Press.
Olivier, Massin, & de Vignemont, Frédérique. (2020). *"'Unless I put my hand into his side, I will not believe'*. The Epistemic Privilege of Touch. In Dimitria Electra Gatzia & Berit Brogaard, The Epistemology of Non-visual Perception. Oxford, U.K.: Oxford University Press. pp. 165–188
O'Regan, J. K., & Noë, A. (2001). A sensorimotor account of vision and visual consciousness. *Behavioral and Brain Sciences*, *24*(5), 883–917.
O'Shaughnessy, B. (1989). The sense of touch. *Australasian Journal of Philosophy*, *67*(1), 37–58.
Ratcliffe, M. (2012). What is touch? *Australasian Journal of Philosophy*, *90*(3), 413–432.
Richardson, L. (2010). Seeing empty space. *European Journal of Philosophy*, *18*(2), 227–243.
. Rizzolatti, G., Fadiga, L ., Fogassi, L., and Gallese, V.(1997). The space around us. *Science*, *277*, 190–191. https://doi.org/10.1126/science.277.5323.190
Rizzolatti, G., Scandolara, C., Matelli, M., & Gentilucci, M. (1981). Afferent properties of periarcuate neurons in macque monkeys: II. Visual responses. *Behavioural Brain Research*, *2*(2), 147–163.
Schellenberg, S. (2007). Action and self-location in perception. *Mind*, *116*(464), 603–631.
Schwenkler, J. (2012). Vision, self-location, and the phenomenology of the point of view. *Nous*, 137–155.
Serino, A., Annella, L., & Avenanti, A. (2009). Motor properties of peripersonal space in humans. *PLoS One*, *4*(8), e6582.
Serrahima, C. (2023). Sensory fields: The visual and the bodily. *Philosophical Studies*, *180*(2), 679–700.
Skrzypulec, B. (2022). Is there a tactile field? *Philosophical Psychology*, *35*(3), 301–326.
Smith, A. D. (2002). *The problem of perception*. Harvard University Press.
Soteriou, M. (2013). *The Mind's construction: The ontology of mind and mental action*. Oxford University Press.
Stern, R., & Cheng, T. (2023). Transcendental arguments. In E. N. Zalta, & U. Nodelman (Eds.), *The Stanford encyclopedia of philosophy* (Fall 2023 Edition).
Strawson, P. (1959). *Individuals: An essay in descriptive metaphysics* (W. Wang, Ed.). Routledge.
Wu, W. (2021). Dissecting the experience of space as peripersonal. In F. de Vignemont, & others (Eds.), *The world at our fingertips: A multidisciplinary exploration of peripersonal space*. Oxford University Press.