Presence, Environment, and Sound and the Role of Imagination

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<1> Introduction

In 2016, my colleague Mads Walther-Hansen and I presented a conference paper entitled 'Being in a Virtual World: Presence, Environment, Salience, Sound' (Walther-Hansen and Grimshaw 2016). In it, we discussed the role of sound in the development of presence in virtual worlds such as those forming the basis for computer games. That sound does indeed play a significant role in the formation of the feeling of presence should not surprise anyone but our interest was in *how* sound played this role and this led us to formulate a number of proposals regarding that process which arose from answers we put forward to various questions that, we claimed, were fundamental and necessary for answering the overriding question of how presence is formed. These questions revolved around definitions of sound, environment, and virtual world, factors such as metaphor and saliency, and conceptions of self and nonself and the localization of sound.

However, one aspect that we did not deal with is that of imagination in the context of sound and presence and, on reflection, it seems to me that some manner of imagination related to sound must be a significant factor in the formation of the feeling of presence not only when the available sensations, as a set, are multi-modal but also when sound provides access to and describes a sensorial world that need not be seen or sensed in any other modality for that world to be actual and present in some form to the sensor.

This chapter, then, looks at imagination in the context of sound and presence in both virtual and actual worlds. It builds upon the framework that Walther-Hansen

and I established in our paper and which itself was constructed on other frameworks and theories such as those concerning metaphor, sonic virtuality, embodiment, and perceptual hypotheses. Thus, before I can proceed to focus on imagination and to bring it into a conceptual framework of presence, I need to briefly survey the already identified building blocks of that framework that are relevant to my thinking here.

<1> Sonic Virtuality

In a 2015 book, Tom Garner and I set out our thinking on sound that we encapsulated under the concept *sonic virtuality* (Grimshaw and Garner 2015). This section is a very brief introduction to the concept; further details can be found in the above publication as well as in Grimshaw (2015).

At the core of sonic virtuality is a definition of sound that describes it as an emergent perception arising from a sonic aggregate of external factors and internal factors. External factors include perceptions deriving from sensations from the external world while internal factors include memory, experience, knowledge, reason, and, importantly in this context, imagination. This is clearly a definition that is at odds with the standard acoustics definition where sound is an "[o]scillation in pressure, stress, particle displacement, particle velocity etc., propagated in a medium with internal forces (e.g., elastic or viscous) or the superposition of such propagated oscillation" (American National Standard 2013).[1] For Garner and me, therefore, this standard definition describes a sound wave rather than a sound.

The sensation (and then perception) of a sound wave can be part of the sonic aggregate but it requires internal factors (prior experience of sound waves, whether similar or not, and reasoning about their origins and so forth) to actualize as sound the virtuality (potential) present in the aggregate and thus it is only at this point of

emergence that we can truly describe a sound as having meaning and, therefore, it is only at this point that an affordance becomes available (for the sense of presence, for example).

A sound wave, though, is not necessary to the emergence of sound. In other words, auditory or aural imagery is itself sound. This does not mean that no external factors are present in the sonic aggregate as sound emerges; it might be that the visual modality plays a role. This happens in many situations and can be experimentally observed by monitoring activity in the auditory cortex when watching an action that has accompanying sound waves compared to when watching the action muted (e.g., Bunzeck et al. 2005; Hoshiyama et al. 2001; Voisin et al. 2006).

Of particular importance here, is sonic virtuality's explanation of sound localization. In acoustics, sound localization is the determination of direction of sound (wave) travel relative to the listener in order to determine in which direction lies the vibrating object that is the source of the sound (wave). For example, the sound wave of an alarm travels through the air to our ears and, depending on a number of factors such as frequency, angle of wave incidence to our pinnae, and time of arrival and/or intensity differences of the wave at each ear, we can assess the direction of travel of the sound wave. In this way, in addition to the range estimation that comes with experience, we can discern reasonably accurately the direction the sound wave is coming from and, if we choose to look and the alarm is within sight, the location of the alarm itself.

Sonic virtuality takes a different approach to the process of localization of sound. In this case, if the emergent perception that is sound arises from a sonic aggregate that includes a sound wave, sound is then actively located (that is, placed) by cognitive processes on the likely origin of the sound wave. In most cases this will

be the actual origin of the sound wave; the sound of a telephone ringing is perceived and so it makes experiential sense to locate the sound on the telephone (seen or unseen) that stands in the corner of the room rather than the person you are talking to. But, perhaps increasingly so in modern times, we are able to locate sound at some point elsewhere than where the source of the sound wave lies.[2] This is not only in the rarely experienced case of ventriloquism, where the effect in the field of psychoacoustics is known as the audio-visual proximity effect or the ventriloquism effect (e.g., Warren et al. 1981), but also in common situations such as when watching a television show or sitting in the cinema. The latter case has been described by Chion (1994) as *synchresis*; the process of translocating the sensed location of sound waves from cinema loudspeakers to a perceived location centred on the action that takes place on screen because that is where it makes experiential sense to place it. In this context, the visual modality and prior knowledge of the cinematic experience control the outcome of the sound localization and it is partly for this reason that, in the theory of sonic virtuality, the sonic aggregate from which sound emerges includes contributing elements of other modalities such as the visual and factors such as knowledge and experience.

<1> Environment, Presence, and Perceptual Hypotheses

Particularly in the literature dealing with digital games and virtual reality (and not least the related discussions on immersion and presence) there is a synonymic relationship between the concepts of environment and world. Because Walther-Hansen and I wished to explore the process of attaining presence, we found it useful to distinguish between environment and world such that, where the world comprises the set of all sensory objects and events, whether they are currently being sensed by

one person or not, the environment is a perceptual construct (arising from a conjunction of sensation and cognition) that provides a metonym of a nonself within which our self can be present. This differentiation, and contingent conceptualization, is worthwhile exploring in greater detail because it provides a foundation stone to the discussion of imagination that is the focal point of this chapter (an extended explanation and argument can be found in Walther-Hansen and Grimshaw [2016]).

The view of the world used here is as a set of sensory things; objects that can potentially be sensed either through direct interaction with them (or indirectly and at a remove through the events these objects are involved in). Touch, for example, is a means to the former whereas sound waves are a vector for the latter although, like sound waves, touch can be an indirect sensory means to the perception of events and objects other than those directly in contact with the sensor.[3]

This set of sensory things, though, is not sensed in its entirety by any one person due to the limits of sensory horizons. Thus, one needs a concept of multiple subsets of sensory things, subsets of the world, that are available to be sensed by one or more sensors while other sensors are excluded from this experience. Furthermore, despite these subsets of sensory things being available to sense, each individual sensor has their own saliency horizons within which he or she is made aware of or chooses to be aware of particular sensory things. Thus, the *salient* world, the set of sensory things drawn from the immediate sensory world of which the sensor is aware.

The perception of the salient world comprises the basis of the environment. That is, the environment in this concept is a dynamic perceptual construct that arises from the confluence of cognition (especially experience, memory, and reasoning) and sensations from the salient world. In terms of presence, the environment is the perception of that salient world within which we can act – an enactive space – and

thus interact with the things in the salient world. This notion of the ability to act and interact with the world derives from a definition of presence devised by Slater who, writing about presence in virtual worlds, states that presence is "the extent to which the unification of simulated sensory data and perceptual processing produces a coherent 'place' that you are 'in' and in which there may be the potential for you to act" (2003, 2).

To forge a close link between environment as perceptual construct and presence, Walther-Hansen and I made use of the work of Waterworth and Waterworth who touch on the notion of salience when suggesting that presence arises "from an active awareness of our embodied environment in a present world around us" (2014, 590).[4] Waterworth and Waterworth actually define presence as that feeling that "distinguishes self from the nonself" (2014, 589). Walther-Hansen and I, while recognizing the utility of distinguishing self from nonself in the context of presence, rather than accepting the notion that it is presence itself that is the basis for this distinction, prefer to suggest that "it is the process of distinguishing the self from the nonself (discovering those parts of the world which we can act within and upon) that leads to the feeling of presence" (Walther-Hansen and Grimshaw 2016). Thus, it is the dynamic perception (emergent creation) of the environment that leads to presence and this is a process that involves a probing of the salient world, for example through the act of localization of sound (in the sonic virtuality sense).

Walther-Hansen and I state that: "the environment functions as a metonym for the nonself, a nonself that is the world beyond ourselves" (2016). Thus, in looking at metaphorical relationships between hearing and other modalities (e.g., the use of terms such as *thick*, *dry*, *sweet*, *bright*, and so on as descriptors for sound), we extended the metaphorical explanation to the concept of environment. Rather than

being a synecdoche of the nonself – the world of sensory things beyond our selves – we describe the environment as a metonym because it is a conceptual perception rather than a thing or set of things; it has an implicit, conceptual association with the nonself rather than an explicit, actual association.

There is one more building block to briefly deal with before I can turn my attention to imagination. In our thesis, presence in a world (actual or virtual) is the end result of a process of individuating self from nonself; this distinction is arrived at by an emergent perceptual process that forms an environment that functions as a metonym of the nonself. This process is driven by a constant probing of the salient world (as with sound localization in the sonic virtuality sense). The question that arises, then, is how and why this probing occurs.

To begin to answer this, Walther-Hansen and I turned to thinking on embodied cognition and perceptual hypotheses. Taking the latter first, the generation and selection of hypotheses as models of the sensory world around us has been used to explain the acquiring of knowledge about actual worlds (see, for example, Clark 2013) and has already been tied to presence in virtual worlds such as those generated by virtual reality systems. Slater suggests that competing signals from different environments (i.e., actual world and virtual world) and the selection of one hypothesis as a model of the environment over another is what forms the basis for action in a particular environment. Indeed, Slater claims that presence itself is "a perceptual mechanism for selection between alternate hypotheses" (2002, 435). These hypotheses are sensory or gestalt models of different worlds, worlds within which there is potential to act. However, as noted above, Slater (2003) describes presence as an assessment of the potential to act in a coherent place; presence arises from the extent of the unification of sensory data and perceptual processing. In other words,

presence derives from the formation and selection of hypotheses that are models of the world in which we can act.

This contradicts Slater's earlier statement that presence is the mechanism for the selection (and thus is causal to that selection). It is, however, the view that Walther-Hansen and I take: "presence arises in part from the selection of one hypothesis over the other(s) and this we equate to a *useful* distinction between self and nonself, a distinction that is fundamental to the ability to act within and upon a world of things external to self" (2016). Our logic for this is: that if presence is indeed the feeling of being in and having the potential to act upon an external world of sensory things, then that world must be modeled, defined, and selected by the brain *before* presence arises. In this we equate the selected hypothesis with our concept of environment as a metonym for the nonself.

The question arises: at what point is a hypothesis selected as that environment that is a sufficiently useful model of the salient world? One of Garner's and my inspirations for devising *sonic virtuality* was an essay by Brian Massumi (2014) where he explained virtuality with reference to the Kanizsa Triangle. In this well-known visual illusion (although Massumi denies it is such), there is an arrangement, on a white background, of three black pac-men or circles with a triangular slice removed from each such that a white triangle appears before our eyes though such a triangle is not actually drawn. Massumi explains this in accordance with a Deleuzian virtual cloud of potential whereby the appearance of the triangle is a result of tension within that cloud being released: "The pressure is unsustainable. Something has to give" (62). Garner and I view the sonic aggregate of *sonic virtuality* as just such a virtual cloud of potential from which sound 'pops out' as with the triangle. If there are any number of potential hypotheses as to the salient world and if potential sounds

(each with inherent meaning) form part of these hypotheses (from which the best fit is chosen), then the formation and selection of these hypotheses takes time.

Theoretically, it could take an infinite time to sift through and refine the pool of hypotheses, searching for the perfect match to the salient world in the actualization of a hypothesis as the environment. As I noted in a previous essay, "organisms do not, however, possess infinite time" and thus there is a time pressure to be present and ready to act that leads to the selection of a "best-I-can-do-under-the-constraints hypothetical model" (Grimshaw 2017). This notion of a limited time frame in which to perceive the salient world before acting upon and within it comes from thinking on embodied cognition where cognition is conceived of as being time-pressured (see, e.g., Wilson 2002), and Waterworth and Waterworth (2014) suggest that the evolutionary need to survive in a risky world, itself time-pressured, is what drives the formation of presence. (Usually, the selected hypothetical model of the salient world is more or less correct and allows us to go about our business but I have earlier suggested that it occasionally goes wrong [Grimshaw 2017] and this might provide an alternative explanation for various observed anomalies such as the McGurk Effect.)

<1>Imagination, Sound, and Presence

I am now at the point of being able to bring imagination into a conceptual framework of presence focusing on the role of sound. To summarize those building blocks of the framework that I presented above:

- Sound is conceived of as an emergent perception that is formed from a sonic aggregate
- The sonic aggregate comprises external factors such as sound waves and light and other sensory vectors accounting for the cross-modality of sound and

internal factors such as memory, experience, knowledge, reason, imagination, and so forth

- Within this concept of sound, the localization of sound is the locating of the emergent sound on likely sound wave sources in the immediate sensory world
- World is distinguished from environment and the salient world is a sensory world comprising that subset of the world of sensory things of which the sensor is aware
- The environment is a dynamic, best-fit, perceptual hypothesis of that salient world and is a metonym for the nonself that is the salient world
- The localization of sound is a means of probing the salient world, the nonself, that aids in the formation of hypotheses
- The creation of the environment takes place under time constraints because of the evolutionary requirement to be present in the salient world
- Presence arises from an individuation of the self from the nonself, a process that is contingent on the creation of an environment.

In conceiving of sonic virtuality, Garner and I conceptualized the sonic aggregate as comprising two components: the exosonus and the endosonus. While this provides a useful framework with which to describe how we perceive sound (whether the emergence of that perception is driven by sound waves in the exosonus or whether the sound derives purely from the endosonus and so is imagined sound), we also had an eye towards how the concept might be used in the design of audio for virtual worlds particularly in light of developments regarding biofeedback in such worlds. Furthermore, we tentatively suggested that the model we conceived of for sound might also be extended to other modalities. I now wish to explore that thought a little

further here and to highlight the role that imagination plays in the creation of the environment. Again, this theoretical (and admittedly speculative) exploration is undertaken not only as a means to describe how we perceive presence in the actual salient world but also to provide a framework within which to further design the immersive technology of virtual worlds, worlds that aim to support a similar sense of presence.

I begin by stating that the environment comprises (conceptually) two dimensions that I term the *exo-environment* and the *endo-environment*. As with the exosonus and the endosonus of the sonic aggregate, the exo-environment comprises the sensory input and the endo-environment the cognitive input. Together, they form an *environmental aggregate*, a dynamic soup of bottom-up sensory information and top-down cognitive processing of that information according to experience, memory, reasoning, and so on. Hypotheses are modeled from the base material of this aggregate and the successful hypothesis is the emergent environment that is adequate (under time constraints) to provide the space in which to be present.

I furthermore wish to suggest that it is imagination that is the driving force to the process of hypothesis modeling that ultimately forms the environment. In this, sound, particularly the localization of sound in sonic virtuality terms, plays a lead role. Hypotheses that are formed from the environmental aggregate are, as with any hypothesis, imaginings of what might be; in this case, imaginative models of the salient world. The localization of sound within these proto-environments is a means to sketch out, to imagine, the three-dimensional enactive space in which we can potentially be present and this is especially the case when the salient world is in large part unseen. Where Massumi suggests that the emergence of the Kanizsa Triangle is caused by the resolution of "a force field of emergence" (2014, 62), I suggest that it is

imagination that forms the basis of the resolution of tension in the virtual potential of the environmental aggregate. In the cognitive processing of the environmental aggregate, the endo-environment works imaginatively to provide form and meaning and spatiality to the exo-environment. While I describe this further below with the use of examples, the localization of sound is a case in point. The sensation of sound waves leads to a cognitive probing of the salient world whereby our imagination (using experience, memory, reasoning, etc.) constructs imagery – visual and spatial – that forms the basis for the imaginative hypothesis-modeling that ultimately leads to the emergent environment.

I do not suggest that it is sound alone that provides spatiality to the emergent environment. Clearly, the visual modality, the contributive effects of parallax and scaling, plays a significant role and it often acts in conjunction with sound, the two modalities having a strong spatial resonance together. Indeed, it has been noted before that there is a transitivity in the spatial sense of the acoustic dimension of the salient world towards the visual dimension. In suggesting that the development of medieval perspective was an expansion of the auditory into the visual world – "Perspective translated into visual terms the depths of acoustic space" (68) – Carpenter and McLuhan (1970) point out this relationship in pictorial art. One can go back further to Diderot's idea of imaginative transportation of "the beholder's physical presence" to within a painting (in Fried 1980, 131–132) to find an early conception of presence founded upon the translation of the acoustic dimension into visual perspective.

In the environment in which we can feel present, whether the perception of pictorial art or the actual salient world, it is the space-forming properties of sound that, when imaginatively applied to the process of hypothesis modeling, provides the spatial dimension to the environment. Restating the ideas of Carpenter and McLuhan,

Revill (2016) states that "space is made and shaped by the qualities of sound itself" (244). In the concept of the environment I present here, it is the imaginative localization of sound that forms the spatiality of the environment in which we are present.

<1>The Environments of Salient Worlds: Two Examples

To illustrate the above contentions, I present two examples of salient worlds and use each to demonstrate how the above environmental framework can be used to make sense of the processes involved. The first salient world is drawn from the actual world of my home. The second salient world derives from the virtual world of a typical first-person perspective computer game.

<2>An Actual Salient World

My salient world right now is a limited area of my home. Concentrating solely on the primarily visual modality (perhaps a cross-modal audiovisual perception) and the primarily auditory modality (perhaps also cross-modal in that the perception of sound might lead to imagery of the sound wave sources), there are the following components that I perceive as elements of my current environment. Visually, the exo-environment comprises the frame of my glasses through which I see my hand, holding a pen with which I write on a sheet of white A4 paper on a wooden desk on which also lie my watch, mobile phone, computer, cup of coffee, and scattered papers and books. On the edges of my vision are included the floor of my apartment, rugs, my piano, bookshelves and books, and art works all lit up by artificial and natural light, the latter coming through a window about five meters in front of me and on the periphery of my vision. Audiovisually, I perceive the scratch of my pen as it scrawls

spider-like across the paper and the occasional groan of the desk as I shift the weight of my arms on it. These are the main components of the exo-environment comprising both visual and audiovisual modalities.

It is the unseen dimension of my exo-environment, though, that interests me more. There are a number of sensory components here that are auditory in nature. Behind me I hear the gentle hum of the refrigerator in the kitchen, a low frequency throb of aural stasis, overlaid on which is the insistent, high frequency whine of tinnitus. To my left, I hear the noise of my washing machine as it enters its spin cycle and, because I also have my entranceway door open, I sometimes hear a neighboring apartment door opening and closing and footsteps in the building's stairway.

It will be clear from the above description of the exo-environment and, especially, the unseen component of that exo-environment that I essentially disagree with Bronowski (1979) when he states that "most of the time we use vision to give us information about the world and sound to give us information about other people" (10–11) and that imagination "is squarely rooted in [the eye] ... we cannot separate the special importance of the visual apparatus of man from his unique ability to imagine" (18); the special and perhaps more important faculty of the auditory apparatus to imagine was something Garner and I gave particular weight to in *Sonic Virtuality* and it is an importance that many others have also highlighted whether it is through work on the neurology of auditory imagery (e.g., Baddeley and Logie 1992; Bunzeck et al. 2005), work of a more philosophical or theoretical nature (e.g., Chion 1994; Sterne 2012), or even poetry (Wordsworth 1828[5]).

From the scenario of the unseen dimension of my exo-environment sketched out above, I am quite obviously able to ascertain, from my perception of sound and the formation of imagery (audiovisualization), a great deal of "information about the

world" I am currently confronted with while sitting here writing this chapter. It is here that the endo-environment comes into play in providing form and meaning to the sensory information of the exo-environment. Through the perception of sound, sound that is actualized with meaning from the sonic aggregate as it emerges, I can know about, and audiovisualize and spatialize, objects and events that are a part of the unseen dimension of my exo-environment.

As an example, the footsteps I occasionally hear, along with doors opening and closing, are sound waves originally, devoid of any meaning until they form part of the basis for the emergence of sound that becomes invested with knowledge drawn from the experience of having lived in this building for almost two years; this allows me to imagine what the sound wave sources are. Combined with visual and spatial imagery, the sounds contribute to my environment, part of which are the events and contingent objects of my next-door neighbor exiting her home and going downstairs and outside. Because she presently returns, and there is a difference in the weight and frequency of the sound waves compared to when she walked downstairs, I can imagine her having taken heavy bags of rubbish out to the nearby bins. Thus, the auditory modality, *pace* Bronowski, a great deal of the time *does* allow us to know about the salient world and at least the skeleton of that knowledge derives from justified true belief even if the details may vary. It is not only seeing that is believing.

<2>A Virtual Salient World

The sketch of the process of forming the environment that I give above in terms of the salient world of my home can also be applied to virtual worlds. Sketching the dimensions in this context – and, here, I give the paradigm of a first-person shooter computer game – is perhaps more pertinent because of the implications for designing

the conditions for presence. As part of the hardware apparatus of such a game, the screen provides the sensory basis of all visual elements of the potential environment and these elements are a part of the exo-environment. On the screen are displayed those signifiers of the first-person shooter *viz.* my character's arms and weapon. I see teammates flanking me and, ahead, the debris of a recent battle evidenced in the ruins of buildings, shattered trees, burnt-out tanks, and smoke on the horizon towards which the pot-holed track my character inches along is leading. Audiovisual components of this scenario include the scrabble of my character's boots on the track's surface, the sound of a cartridge being slammed into my gun as I nervously check my weapon's status, and, across the rubble of the town, similar sounds from my teammates along with their tense and terse verbal communications.

The unseen dimension of the exo-environment that is primarily auditory, is comprised of several sounds that fill in the hypothetical model of the salient world of the game. For example, there are the thuds of dull, distant explosions and the increasing frequency and intensity of gunshots of which the audio (i.e., the digital data forming the basis for the analog sound waves I sense) is processed by the game engine to be part of the salient game world behind my character. I occasionally hear the far-off drone of airplanes as they circle the battlefield out of sight and an increasingly loud mechanical rumbling signals the sound of an approaching tank further along the track. As with the unseen dimension of the exo-environment of my home, in perceiving these sounds, and undergoing the processes of audiovisualization, I can model, in conjunction with the visual dimension, the objects, events, and developing narratives of the salient game world to a level that allows me to interact with them, to act in the game world, and so to be present in the environment of that world.

In the same manner in which the visualized acoustic space in a painting incorporating perspectival technique provides depth, in the creation of the environment we use the localization of sound to create the enactive space in which to be present. We call upon experience to provide imagery on which to localize sound. Hence, in the first scenario I sketched out above, I am able to form a workable hypothesis that is the environment in which I provide the imagery of refrigerator, washing machine, doors, and stairway on which to localize the sensory input of sound waves. In the second scenario, my environment derives from the visual and audiovisual artifacts of the visual dimension and the sensation of sound waves that must be localized on the imagery of the unseen dimension of the exo-environment. This imagery and the ability to so localize comes from the experience of actual worlds and virtual worlds and it is the spatiality of the environment thus fashioned through imagination that provides the differentiation between self and nonself and the enactive space in which to act. This is how the sense of presence is formed.

<1>In Conclusion

To conclude, I restate the main points in my thesis. In creating a sense of presence, the feeling of being within and able to act upon a world of sensory things, we perceptually create an environment that functions as a metonym of the salient world, the nonself compared to the self of the perceiver, and in which we are present. This environment is actualized under constraints of time from a series of increasingly refined hypothetical models of the salient world. The selected hypothesis, the perceived environment, comprises an exo-environment and an endo-environment. The former comprises a primarily visual dimension and a primarily unseen, auditory dimension. The latter is the cognitive dimension comprising experience, memory,

reasoning, and so forth and the two act in conjunction in modeling hypotheses that are candidates for the successful environment. The driving force in the emergence of the environment is imagination, particularly so when perceiving the unseen dimension, and the environment so perceived is the enactive space in which to be present.

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[1] The ANSI document on acoustics provides also a second definition that sound is the "auditory sensation evoked by the oscillation [described in the first definition]." Another way of putting it is that "sound is evoked by sound."

[2] This may well confer an evolutionary advantage as our species rapidly adapts to technology that easily renders usable the experience of schizophonia (see Schafer 1994).

[3] Where Evelyn Glennie claims that hearing is a "specialized form of touch" (1993), then hearing, in her conception, would be touch at a remove with sound waves from a distant event impinging on the eardrum or elsewhere on the body.

[4] Our awareness of sensory things, evidenced by a sonic world at least, is an awareness of a past rather than present world (the authors, on p.589, directly relate the feeling of presence to "the present time"). Perception of the salient world through various sensory modalities involves an act of convergence of the perception of objects and events sensed across different time frames into a present perception. This is something Clark notes when he states that we perceptually "learn to construct the sensory signal by combining probabilistic representations of hidden causes operating at many different spatial and temporal scales" (2013, 29).

[5] *On the Power of Sound* opens thus: "THY functions are ethereal, As if within thee dwelt a glancing mind, Organ of vision!" and so Wordsworth ascribes the power of visual imagination to hearing.