

## **Sonic Art and the Nature of Sonic Events**

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### Abstract:

Musicians and theorists such as the radiophonic pioneer Pierre Schaeffer, view the products of new audio technologies as devices whereby the experience of sound can be displaced from its causal origins and achieve new musical or poetic resonances. Accordingly, the listening experience associated with sonic art within this perspective is 'acousmatic'; the process of sound generation playing no role in the description or understanding of the experience as such. In this paper I shall articulate and defend a position according to which an adequate phenomenology of auditory experience must refer to mechanisms of sound generation. This position is shown to follow from a phenomenology of sounds as located events and a physicalist account of auditory properties as features of the temporal development of such events.

### I. Introduction

Over the last century, music practice has been transformed by technologies which allow the manipulation of sound material or musical events to be undertaken with greater speed and at ever greater levels of abstraction from acoustic reality. These tools have stimulated a theoretical and compositional emphasis on 'timbral' aspects of sound which resist regimentation within the traditional 'lattice' of pitch relations, harmonic structures or relative time values.<sup>1</sup> For example, whereas traditional composition employs permutations of discrete pitch or time values, digital synthesisers allow us to make a piece which consists of spectral transformations of a single developing sound.<sup>2</sup> Tape recording and, latterly, digital sampling have meanwhile allowed the use of pre-

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<sup>1</sup>Timbre is what differentiates – say – a concert A played for a certain time interval on a piano and the same note played on a clarinet or oboe. Similarly, much inharmonic or untuned sound – noise - is timbrally differentiated in spite of lacking definable pitch or rhythmic characteristics.

<sup>2</sup> Trevor Wishart, *On Sonic Art*, (Amsterdam OPA 1966) p. 25-27.

existent sonic material in ways that challenge both the formalism of traditional Western musical practice and the boundaries between artistic genres such as music, plastic art or film.

There have been numerous critical and philosophical responses to this new 'sonic art'. Arguably, the most influential approach in the current literature on electroacoustic music is the phenomenological account of the sound-object provided in the work of Pierre Schaeffer. Schaeffer views the products of new audio technologies as 'machines for feeling' which displace sounds from their causal origins and achieve new musical or poetic resonances.<sup>3</sup> Accordingly, the mode of listening proper to sonic art within this perspective is an 'acousmatic' or 'reduced' listening. The term 'acousmatic' alludes to Pythagoras' reputed practice of lecturing from behind a screen so that his disciples would attend to the content of his words rather than the personality behind them.<sup>4</sup> For Schaeffer, technologies like radio and analogue recording cut the intentional bond between the hearing of sounds and their physical or environmental causes: the latter being immaterial to their aesthetic impact. Thus Schaeffer relates how he recorded the sound of a bell without its attack or onset. He writes 'deprived of its percussive the bell becomes an oboe'<sup>5</sup>. The alteration of the temporal envelope of the sound obscures its causal origins and thus reveals hitherto concealed analogies between causally distinct kinds of sonic event (See section III below).

For Schaeffer, the sound object is the sound as heard, as opposed to the presumptive cause of the auditory experience. Schaefferian sound objects are constituted by an auditory mode of presentation purified of intentional references to physical sound events, physical properties or mechanical processes of sound generation. This implies that the aesthetic contemplation of *l'objet sonore* is likewise closed within this putative realm of subjective givenness and may neither draw on information about the physical or technological aspects of sound generation nor contribute to it (Schaeffer 1966).

It would be precipitate to deny the critical and practical value of Schaeffer's account. However, in what follows I suggest an alternative ontological framework which develops some recent ideas in the analytic metaphysics of sound. My argument rests on

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<sup>3</sup> John Dack, 'Pierre Schaeffer and the Significance of Radiophonic Art', *Contemporary Music Review*, 10(2), (London: Harwood 1994), pp. 3-11.

<sup>4</sup> Roger Scruton, *The Aesthetics of Music*, (Oxford: Clarendon 1997), pp. 2-3.

<sup>5</sup> 'Pierre Schaeffer and the Significance of Radiophonic Art'.

the assumption that the phenomenology and epistemology of hearing favour an ontology of sounds as located physical events. The version of the located events theory (henceforth LET) proposed by Roberto Casati and Jerome Dokic in their book *La philosophie du son* is briefly outlined in section II. In section III I discuss the status of phenomenal properties of sound in the LET and argue for its amendment to allow for a physicalist conception of such properties. In section IV I consider some difficulties for the LET presented by our experience of sonic art and attempt to reconcile it with these phenomenological facts. Finally, in section V I consider whether the phenomenology of algorithmic music and the existence of competing but empirically equivalent metaphysical views of sound reveal ineliminable indeterminacies in the location and character of sonic events.

## II. LOCATED EVENTS

When I hear a footfall in a street outside my window, a distant ambulance siren, a dog barking at night it seems incontestable that what I hear lies in the space beyond my ears. Some philosophers have cited this everyday phenomenology of auditory location as reason for rejecting the metaphysics of sound that is often implicit in textbooks of acoustics and psychoacoustics. According to Nicolas Bulot, Roberto Casati, Jérôme Dokic and Maurizio Giri this crops up in two main forms: ‘proximal theories’ according to which sounds are non-representational sensations or qualia produced by the auditory system and ‘medial theories’ which identify sounds with the transmission of acoustic energy.<sup>6</sup>

In contrast, Bulot et al. claim that sounds are generally found where they are heard. We hear sounds located in space. We hear moving sounds<sup>7</sup>. Sometimes we hear sounds badly or indistinctly – as when they are masked by other sounds.<sup>8</sup> We experience sounds as in the world through which we move. Since auditory objects are experienced as being in space, only a theory which locates them there can be true to the phenomenology.

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<sup>6</sup> ‘Sounding Objects’.

<sup>7</sup> In fact Casati and Dokic argue that since events and processes are temporally extended we cannot localize an event at a point where only one of its phases had occurred. However different temporal phases of a vibratory event occur at distinct locations, which is what reports regarding the ‘movement’ of sounds advert to. Here they follow Fred Dretske’s argument against the claim that events can move. Robert Casati and Jérôme Dokic, *la philosophie du son*, <http://jeannicod.ccsd.cnrs.fr>, (accessed 3 June 2005), Chapter 3, p. 41; Dretske, F., ‘Can Events Move?’, *Mind* (1967), 76, 479-92.

<sup>8</sup> *la philosophie du son*, Chapter 3.

They claim that this view comports with viewing sounds as vibrations in resonating objects.<sup>9</sup> As Casati and Dokic point out in *La philosophie du son*, this allows us to reconcile a theory of indirect perception with the rejection of mental intermediaries such as sense data. We get information about properties of objects *via their sounds*. Sounds are perceptual intermediaries which convey information about the physical dispositions of things in which the sounds occur and upon which their characteristics depend.<sup>10</sup>

### III. AUDITORY PROPERTIES

The located event theory (LET) is not without problems, however, since its proponents must reckon with classical epistemological issues regarding the mode of existence of our sensory 'ideas'. If sounds are events in resonating objects, does it follow that psychoacoustic properties such as experienced pitch or timbre are predicated of those same events or resonators?

Take the example of pitch. Psychometric assessments of subjective pitch differences are consistent between listeners but are not related in a consistent numerical way to differences in frequencies.<sup>11</sup> Thus pitch is not identical with frequency. This is generally assumed to support the view that pitch is a 'subjective psychological quality merely correlated with the frequency of a sound'.<sup>12</sup>

Psychoacoustic data can, then, be cited in support of a projectivist position according to which there are no physical entities with phenomenal properties like pitch or timbre - and that, insofar as these are properties of anything, they are mental properties (erroneously) projected upon the real world. Conceivably, it could also motivate Lockean-style accounts according to which pitch is treated as a secondary quality identified with the disposition to produce mental states characterised by the aforementioned subjective property.<sup>13</sup>

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<sup>9</sup> Ibid. See Casey O'Callaghan, 'Pitch', *Online Papers on Consciousness* compiled by David Chalmers, <http://consc.net/online1.html#sensory> (accessed 27 September 2004). See also Roberto Casati and Jérôme Dokic, 'Sounds', *Stanford Encyclopedia of Philosophy*, <http://plato.stanford.edu/entries/sounds>, (accessed 5 September 2005).

<sup>10</sup> *La philosophie du son*, p. 46. See sections III and V below.

<sup>11</sup> Casey O'Callaghan, 'Pitch', pp. 6-7; Roger Shepard, 'Pitch Perception and Measurement', in Perry R. Cook (ed.), *Music, Cognition and Computerized Sound* (Cambridge Mass.: MIT Press 2001), pp. 149-150.

<sup>12</sup> 'Pitch', p. 7.

<sup>13</sup> 'Pitch', pp. 9-10; *La philosophie du son*, chapter 11.

Both accounts, however, appear incompatible with the phenomenology motivating the LET. If auditory properties are mental or subjective they cannot be properties of resonance events or resonating objects.<sup>14</sup> This suggests that auditory experience is systematically misleading insofar as pitch and timbre appear to be properties of such events or objects. The claim that auditory properties are subjectively-typed dispositions, on the other hand, seems hard to square with the intuition that what we hear are the *actualisations* of various kinds of dispositions not dispositions as such.<sup>15</sup>

One way in which a proponent of a physicalist event theory can respond to this predicament is to look for a relationship between an auditory property, pitch, and a physical quantity like frequency which allows the former to be treated as property of the sound which varies as a function of the latter. O'Callaghan has employed psychometric data to argue that there is such a function and that it has a physiological basis in the critical frequency bands within which the inner ear (or cochlea) analyses complex sounds into component sinusoids.<sup>16</sup> O'Callaghan's solution coheres with a representationalist (or *wide* intentionalist) view according to which phenomenal characteristics of sound such as pitch are objective properties represented or 'tracked' by those experiences. Accordingly pitch difference would be an objective property of sounds mathematically related to frequency difference but not identical to it.

It is not within the scope of this paper to assess O' Callaghan's account of pitch.<sup>17</sup> However, his position can be juxtaposed with a more modest physicalism which does not presuppose a consistent relationship between auditory discrimination and a restricted set of physical quantities. This view, I think, is more *prima facie* plausible in the case of the audible property that is the chief concern of computer musicians: timbre. In traditional musical contexts we distinguish timbres in terms of typical mechanisms of sound generation: we distinguish the timbre of a piano playing a concert 'A' from that of a clarinet or violin playing the same note. We differentiate timbres in terms of morphology: for example, by contrasting sounds with a sharp onset or attack and exponential decay with continuant sounds such as drones or sustained strings.

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<sup>14</sup> This problem applies to phenomenal properties in other sense modalities of course. See Sidney Shoemaker, 'Phenomenal Character', *Noûs* (1994), 28(1), p. 25.

<sup>15</sup> Colin McGinn, 'Another Look at Color', *Journal of Philosophy* (1996), 93(11), pp. 540-41. See below.

<sup>16</sup> See 'Pitch', pp. 14-21.

<sup>17</sup> It is not clear that it can also accommodate musical pitch relations as opposed to the psychometric pitch relations employed in his statement of the pitch/frequency relation.

However, these discriminations utilize many different kinds of physical variation or pattern. For example, Jean-Claude Risset found that the characteristic sound of the trumpet depends on differences between the envelopes of partials in its onset or attack phase. The differences themselves are indiscernible for listeners yet provide a 'signature' distinguishing the trumpet from the oboe, say.<sup>18</sup> Other instrumental signatures are more dependent upon the spectral content of their 'sustain' phase. Whether a sound event is 'fused' into a single percept or is perceived as simultaneous sound events can also depend on whether each these frequency components exhibit random variations in frequency. John Chowning relates some experiments in the synthesis of a female voice which show that only when a common pitch variation was added to the individual harmonics of a synthesised voice did these manifest as a single sonic entity recognizable as a human voice.<sup>19</sup>

Timbral discrimination, then, does not plausibly 'track' a single type of physical feature, as O'Callaghan claims of pitch discrimination, but relatively idiomatic patterns of relations between such features. This is consistent with a qualified interpretation of timbral kinds as consisting of recurrent constellations of features of sound generation processes, but it need not entail an essential limit on what kinds of relationships between more basic physical features can be picked out through identification of timbres. This seems plausible given that we normally use timbre to track complex processes such as the crying of babies (or cats), the percussion of hail on corrugated iron, or the motion of a fan blade in an extractor - not basic physical properties.

When we perceive timbral properties, I propose, we perceive relationships between variable sets of physical features which, in turn, contain information about idiomatic features of the sound generation mechanisms and thus about the environmental objects in which the sounds occur. This is consistent with the phenomenal richness of timbre and its resistance to the kind of hierarchical organisation that pitch relations are susceptible to.

This position can be contrasted with that developed by Casati and Dokic in *La philosophie du son*. They reject the subjectivist theory according to which audible properties such as timbre or visual properties such as colour are non-intentional

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<sup>18</sup>Jean Claude Risset, *The Computer Study of Trumpet Tones*, (Murray Hill, N.J.: Bell Laboratories 1966), cited in Charles Dodge and Thomas A. Jerse, *Computer Music Synthesis, Composition and Performance*, (New York: Schirmer 1997), p. 55.

<sup>19</sup> John Chowning, 'Perceptual Fusion and Auditory Perspective', cited in *Music, Cognition and Computerised Sound*, pp. 264-267.

properties of perceptual states on the familiar grounds that we perceive these properties as inhering in the things perceived (see above). They likewise reject accounts of secondary qualities which identify them with dispositions to cause a given sensory response, whether this response is defined in relation to an independently characterised property of the sensation or as a disposition of the object to appear to have the dispositional quality in question. Dispositional theories, they claim, are also incompatible with the phenomenology since we do not see or hear objects as possessing a disposition to cause a given sensory response: 'From the phenomenological point of view, ordinary vision is non-reflexive'.<sup>20</sup>

They nonetheless concur with the dispositionalists in distinguishing between primary qualities like shape which can be defined without reference to a sensory point of view and secondary qualities which are real properties of sensed objects but whose conditions of existence (or exemplification)<sup>21</sup> are tied to human sensory responses.

Thus while holding that sounds are physical events and thus 'essentially non-phenomenal', phenomenal properties of sound such as pitch and timbre are said to be non-relational but contingent properties of sound (*propriétés accidentelles du son*) which only inhere in sonic events given a 'human' auditory perspective on the world.<sup>22</sup> While sounds essentially possess physical properties, then, they contingently possess phenomenal properties (*audibilia*) that are only accessible from a human auditory point of view and (by analogy with a related theory of *visibilia*) are existentially dependent upon an auditory sense modality.<sup>23</sup> Meanwhile, sounds themselves – being existentially independent of perceiving subjects – are non-phenomenal. That is to say, they necessarily bear physical properties while they contingently bear phenomenal

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<sup>20</sup> *La philosophie du son*, pp. 173-4, [my trans.]. One could object, with Sidney Shoemaker, that a complex relation such as a disposition could still be represented perceptually as monadic. So the fact, if it is one, that vision is non-reflexive is hardly decisive here. 'Phenomenal Character', *Noûs* (1994), 28(1), p. 25.

Shoemaker's objection is persuasive. Nonetheless, treating phenomenal character as relational in this way presents other difficulties. For example, what kind of relations fit the bill? Dispositions do not seem to, for reasons already mentioned above. It is difficult to reconcile the claim that phenomenal properties are causal relations with the assumption that the properties objects are *represented as possessing* in audition and vision appear to be there when nobody is around to have experiences with those contents produced in them. If phenomenal properties are indeed will o' the wisps then it is unclear how they represent persistent and observer-independent properties in an organism's environment. See Michael Tye, 'Shoemaker's The First Person Perspective and Other Essays', *Philosophy and Phenomenological Research* (2000), 60(2), pp. 461-464.

<sup>21</sup> *La philosophie du son*, p.175.

<sup>22</sup> *Ibid.* p. 179.

<sup>23</sup> *Ibid.*, pp. 175-176. The idea of existential dependence in supervenience theories is explicated towards the end of this section.

properties.<sup>24</sup> The phenomenal properties instantiated by a particular sound are accidental properties of that event but, as with visual phenomenal properties, *supervene*<sup>25</sup> on the dispositions of the sounding object to affect subjects in particular ways without being identified with them:

It is possible to affirm that the attribution of a secondary quality to an object... is only conceived adequately if it is conceived as being true in virtue of a disposition of the object to present a determinate phenomenal appearance.<sup>26</sup>

Contrary, however, to a traditional dispositional account of secondary qualities 'Colour [or timbre, etc.] is not identified with this disposition; it belongs to an ontological category that is *sui generis*, that of phenomenal appearances.'<sup>27</sup>

How does this theory compare with the physicalist alternative expounded above? Well, if we assume the LET and we are to attach any content to the claims that sounds are 'essentially non-phenomenal' we are committed to one of two paths: we must either 1) that we do not hear sounds, but only their phenomenal deputies (pitch, duration, timbre, etc.), or 2) import subscripts into the verb 'to hear' such that it has a different sense applied to sonic events from when it is applied to the phenomenal properties of sound (i.e. 'hear<sub>E</sub>' [event-hearing] versus 'hear<sub>P</sub>' [property-hearing]). Thesis 1) undermines the phenomenological premises of the LET and can thus be discounted. Thesis 2), then, seems inescapable: implying that the perception of a sound is distinct in some way from the perception of its pitch, timbre, loudness, etc. We must henceforth say that we hear<sub>E</sub> the ringing of a bell, but hear<sub>P</sub> its pitch or timbre.

This proposed ambiguity is not semantically objectionable.<sup>28</sup> However, a distinction between the perceiving of events and the perceiving of their auditory

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<sup>24</sup> Ibid., pp.179-80.

<sup>25</sup> The notion of supervenience is frequently used by non-reductive materialists to express the dependence of mental properties on physical properties without entailing their reducibility to the latter. Informally: M properties supervene on P properties if a thing's P properties determine its M properties. If aesthetic properties supervene on physical properties, if x is physically identical to y and x is beautiful, y must be beautiful. Supervenience accounts vary with the modal force of the entailments involved. 'Natural' or 'nomological' supervenience holds in worlds whose physical laws are like our own. 'Metaphysical supervenience', on the other hand, is often claimed to hold with logical or conceptual necessity (Section V). See Jagwon Kim, 'Concepts of Supervenience', *Philosophy and Phenomenological Research* (1984), XLV(2), pp. 153-176.

<sup>26</sup> Ibid, p. 177 [my trans.]. The theory is, in this respect, similar in its metaphysical underpinnings to the supervenience dispositional account of phenomenal qualities advanced by Colin McGinn. See 'Another Look at Color'.

<sup>27</sup> *La philosophie du son*, p. 177 [my trans.].

<sup>28</sup> The suggestion that there are discrete 'perceptual acts' for events, objects, properties and other ontological categories is not self-contradictory or absurd.

properties is particularly unfortunate in the case of audition since auditory properties are related to the temporal development of sonic events themselves.<sup>29</sup>

This relation varies according to the different components of timbre. The brightness or harshness of sounds is related to the spread of energy across its harmonic spectrum. As an illustration of this, let's consider a process of sound generation widely used by computer musicians over the last fifty years: the frequency modulation (FM) of a sine wave by another sine wave. The first is referred to as the 'carrier', while the second is called the 'modulator'. In FM synthesis the modulating wave displaces the frequency of the carrier by a value proportional to its amplitude over a period determined by the frequency of the modulator.<sup>30</sup>

FM provides a computationally efficient way of generating sounds with complex spectra from simple modulator/carrier sign wave pairs. This process is represented below in the time domain (amplitude on the y-axis against time on the x-axis). Figure 1 shows a virtual oscilloscope graph of a modulating sine wave at 16 Hz, figure 2 a carrier at 8 Hz. Figures 3, 4 and 5 show the effect on the carrier as the amplitude of the modulator source is ramped from 0.1, to 0.14, and to 0.28 (relative to a maximum amplitude of 1).

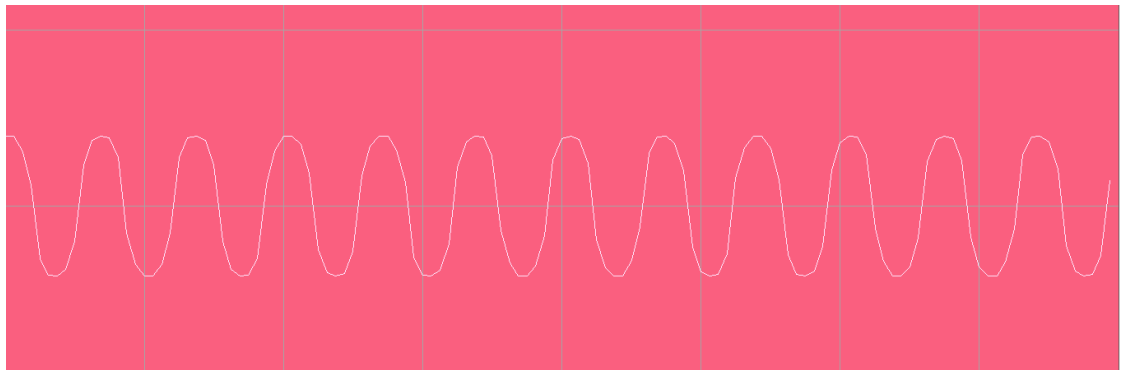


FIGURE 1

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<sup>29</sup> This should not be confused with the distinction between hearing a *sound* with a given auditory property (say, *fast attack*) and hearing *that* the sound has a fast attack (where the presence of a 'that' clause implies a perceptual judgment or the capacity to employ morphological concepts such as *attack* and *decay*). To perceive an event one must be able to perceive some features of its temporal development (if only that it begins or ceases). It does not follow that one will be able to form the correlative beliefs or wield the correlative concepts.

<sup>30</sup> *Computer Music: Synthesis, Composition and Performance*, pp. 115-135.

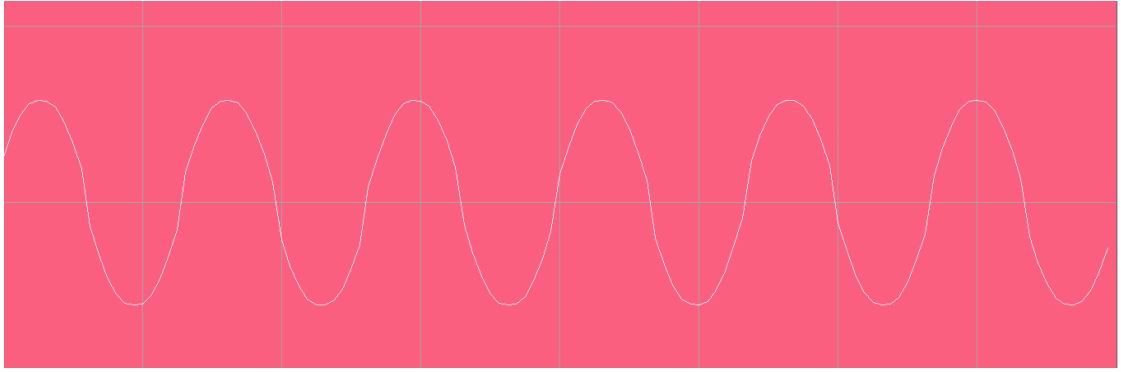


FIGURE 2

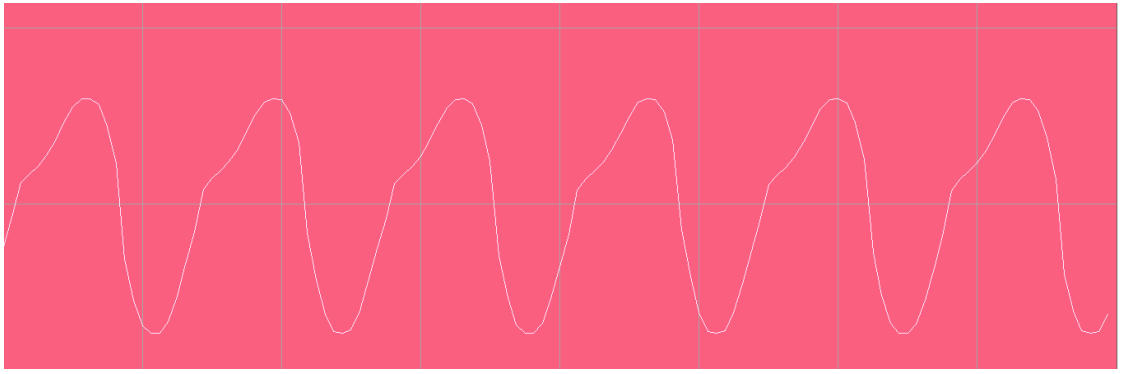


FIGURE 3

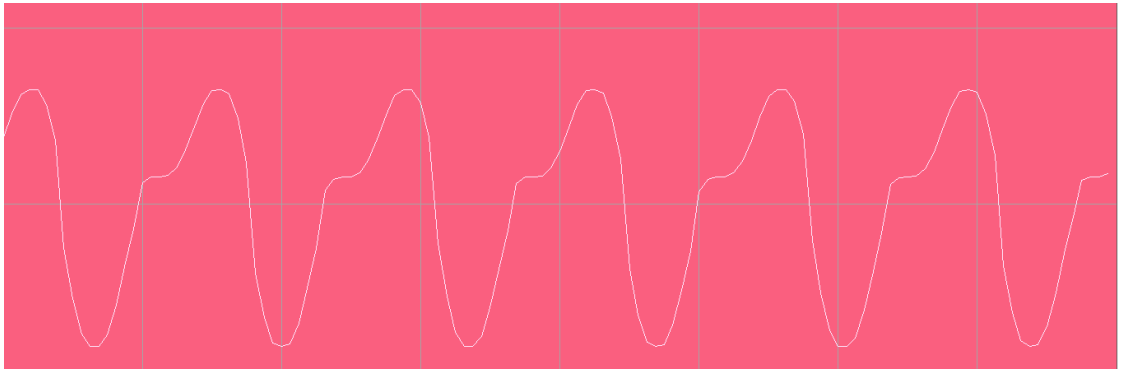


FIGURE 4

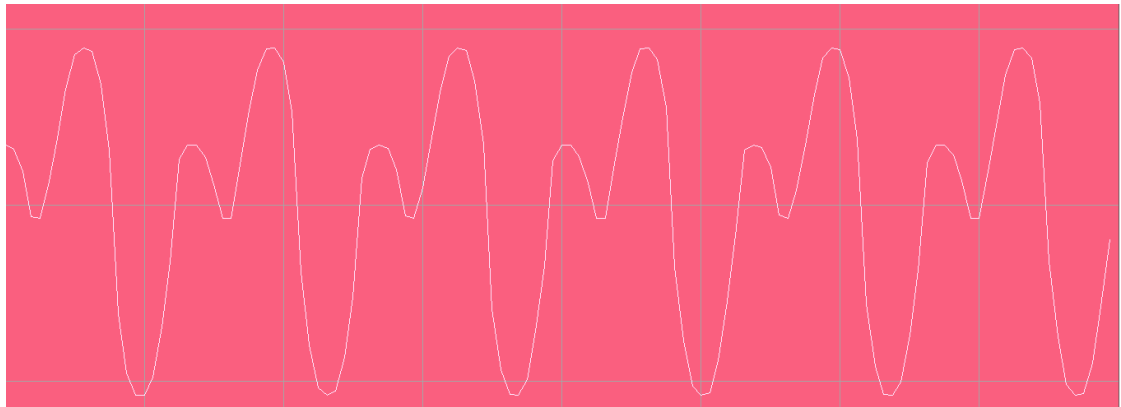


FIGURE 5

In the frequency domain this produces a sound with a complex spectrum containing the carrier frequency (8 Hz) but also with spectral components on ‘either side’ of the original frequency. Thus we have the original frequency and values above it determined by integer multiples of  $M = 16$  Hz:  $C = 8\text{Hz}$ ,  $C + 1 \cdot 16$  Hz,  $C + 2 \cdot 16$  Hz,  $C + 3 \cdot 16$  Hz... etc. ‘Below’  $C$  we have:  $C - 1 \cdot 16$  Hz,  $C - 2 \cdot 16$  Hz,  $C - 3 \cdot 16$  Hz, etc. In the case of audible carrier frequencies (8Hz is, of course, below the normal threshold of audition) as the modulation ramps up, we hear these emerging sidebands as a steadily increasing ‘harshness’ or ‘brightness’ in the sound. Here, the timbral alteration of the sonic event consists in increasing spectral richness, *itself an expression of the increased complexity of the periodic behaviour in the time domain displayed on the successive oscilloscope graphs.*

The *envelope* or change in loudness over time is – as noted above - an equally significant constituent of a sound’s timbre. A sound’s temporal envelope is analogous to an object’s spatial shape in that it seems like just as good a candidate for primary quality status. That is, even if we accept Casati and Dokic’s claim that some sensory qualities are dependent upon an observer’s sensory response most would agree that the concept of shape is ‘conceptually independent’ of observer response.<sup>31</sup> The only difference between spatial shape and the amplitude envelope of a sound is that the former is describable in terms of sets of points representing spatial boundaries while the latter is a boundary describable in terms of sets of points representing pressure over time. According to the LET a sound event is a disturbance within a resonating material which

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<sup>31</sup> ‘Another Look at Colour’, p. 545.

can be fully described (in the time domain) in terms of its envelope. The event consists in a particular pattern of change in these displacements which, in harmonic sounds, has a periodic form. Given that the envelope is no more observer-dependent than shape, it follows that an important *dimension* of timbre (the feature of sound most obviously analogous to colour) is not linked conceptually to observer response (whether this is cashed out in terms of dispositions, supervenience upon dispositions or qualia, etc.).

The only solution for those who would retain secondary status for some component of timbre - such as spectral richness - is to treat it as construction from putatively simple primary and secondary phenomenal properties. Whatever the logical merits of this view, though, it does not seem phenomenologically warranted. The spectrum of a periodic sound has an admittedly abstract relationship to the sonic event considered as a time series since it must be extracted from successive intensities or amplitudes via a Fourier transform or some other method of extracting harmonic constituents (such as is exploited by the cochlea). However, it is difficult to see why this suffices to accord this timbral dimension a categorically distinct status, since there is no reason to think that our perception of more familiar features of temporal sequences depends on processes that are in any way simple computationally speaking.<sup>32</sup> Certainly, a sound's temporal shape seems no less 'phenomenal' than its harmonic structure. We can learn to analytically dissociate the spectral properties of sounds from their envelopes, but we nonetheless hear sounds with distinct timbres. If there are no phenomenological grounds motivating a 'constructionist' view here it is difficult to see why considerations of any other kind should be persuasive.

Thus there is no categorical distinction to be made between our perception of a sonic event and our perceiving aspects of its temporal shape and thus of its timbre. Of course, we may hear qualitatively distinct aspects of that shape. The amplitude envelope is one such feature while the spectral properties we capture with terms like 'brightness', 'harshness', 'dullness' is another. Since both aspects are recognised as among the important components of timbre and since both qualify as primary qualities there is no

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<sup>32</sup> For connectionist treatments of this topic see Timothy Van Gelder, 'Wooden Iron, Husserlian Phenomenology Meets Cognitive Science,' in *Naturalising Phenomenology*, p. 260; Robert F. Port, Sven E. Anderson and J. Devin McAuley (1994), 'Towards Audition in an Open Environment'. Retrieved 16 August 2005 from <http://citeseer.ist.psu.edu/339605.html>.

obvious barrier to regarding sounds as i) particulars existing independently of subjects and ii) as phenomenal.<sup>33</sup>

It is possible to argue that Casati and Dokic's supervenience view of phenomenal properties as intrinsic but non-physical properties of objects is indirectly supported by appeal to thought experiments involving contrary perceptual responses to the same object or to physically identical objects under identical conditions. Suppose (using an example with which Colin McGinn illustrates his supervenience account of colour) we see ripe strawberries as red while Martians see them as green. According to the supervenience account the fact that they are red is entailed by the fact that they are disposed to look red to us while the fact that they are green is entailed by their disposition to produce an experience of green strawberries for Martians. As McGinn puts it 'Colour terms are not logically relational in themselves; rather their application is merely controlled by inherently relational dispositions'.<sup>34</sup>

Thus ripe strawberries *are* 'green', but only relative to a Martian standpoint warranting the ascription of 'green' to them. Likewise they *are* 'red' relative to a human standpoint which warrants the use of a contrary predicate. This neatly explains how Casati and Dokic's supervenience theory entails the existential dependence of secondary qualities upon perceptual standpoints. For any semantic account of the truth conditions of colour ascriptions would have to be relativised to the perceptual standpoints of relevant groups of perceivers.

Now, we can accept that observers with different sensory systems might experience different things when viewing the same object because they are sensitive to different properties of those objects. No implications flow for the sensory response-dependence of phenomenal properties. Likewise, perceivers with similar, but differently attuned perceptual systems may have veridical but phenomenally distinct perceptions of the same event or object. For example, a trained musician can hear the inner voices in a four part chorale, while beginners may only hear the upper melody and bass. Again, no implications follow regarding the dependence of ontology on access conditions.<sup>35</sup>

The only situation precluded by physicalism is one where different subjects have veridical perceptions of contrary phenomenal properties inhering in the same object (as

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<sup>33</sup> *La philosophie du son*, p. 179.

<sup>34</sup> 'Another Look at Colour', pp. 545-46.

<sup>35</sup> For a parallel discussion of cases of different colour acuity see Michael Tye, *Consciousness, Color and Content*, (Cambridge Mass.: MIT Press, 2002) pp. 92-93.

in the blue-red case). Here the physicalist only has to insist that no such special cases ever occur. Where they *seem* to occur, either the phenomenal properties are not contraries after all or one of the experiences is not veridical. Now, assuming that phenomenal experiences convey information about physical features of perceived entities there cannot be contrary veridical perceptions (hence no relativity of phenomenal properties to sensory viewpoint). Where I hear the sound of a tuning fork as a characteristic pure tone (sine wave) and another hears it as a rasping square wave, the latter is in error. His experience imputes a spectral complexity to the sound's periodic behaviour which it does not possess.

These arguments suggest that an amended, physicalist form of the LET (henceforth LET<sub>A</sub>) coheres better with the event character of sounds than its anti-physicalist competitors. LET<sub>A</sub> maintains the earlier versions claim that sounds are located and event-like but integrates audibilia more seamlessly within this ontology. Thus it is consonant with LET<sub>A</sub> to suppose that timbre is a cluster phenomenon analyzable along a number of physically specifiable dimensions (such as envelope and spectral spread). *But it is phenomenal only to the degree that the physical event which exhibits it is phenomenal.*

With LET<sub>A</sub> there is no difference in kind between our perceptual access to the physical sound event and our access to its phenomenal properties. A sound event consists of changes or differences in the state of a sounding object. To perceive a sound *just is* to perceive these changes or differences.<sup>36</sup>

#### IV. DECONTEXTUALISED SOUND

It can be objected, at this point, that the phenomenological underpinning of the LET (and thereby LET<sub>A</sub>) is challenged by the exigencies of sonic art. While in our ordinary lives we are concerned with sound events in *medias res*, the phenomenology of much sonic art is, for want of a better term, 'slack'. This is because its material is often dynamically 'other' with respect to familiar natural or musical sounds. Indeed, one

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<sup>36</sup> It might be objected that we can imagine a subject hearing a constant sound – a pure tone, say – without altering in pitch or timbre. However, this sound would have a characteristic timbre. In this case LET<sub>A</sub> entails that the subject would perceive the periodic behaviour constitutive of the sound even where the global character of these changes – their sinusoidal character - might never alter. The same point naturally applies to inharmonic, aperiodic sounds.

reason why its sound events can be conceived (if not heard) as 'other' is that we are unable to hear them as occurring *in objects*.<sup>37</sup>

This is true, for example, of synthesised sounds whose spectral profiles bear no resemblance to those of familiar musical resonators like vibrating strings, struck metal, etc. These sounds create an experience of *aesthetic estrangement* by forestalling identification of the types of events to which they belong. An experience of auditory dislocation can also be created through the spatial arrangement of directional speakers in a large chamber, as in Bruce Nauman's sound installation *Raw Materials*. If we stand near one of the speakers we hear only one of the twenty texts Nauman loops through each one. However, outside the focus of the speaker, the texts leak into one another and seem to 'fill' the space around us rather than being in a well-defined place - though both versions of the LET would locate the sounds in the space in which they are generated (roughly, the diaphragm of the speaker).<sup>38</sup>

How, then, can this phenomenology be reconciled with any version of the LET? The obvious response, perhaps, is to suggest that the experience of a sound as devoid of the auditory cues that would ordinarily relate it to a world of resonating objects is a kind of perceptual illusion. The 'distribution of sound waves in the environment' obscures the location of the sound, just as a mirror causes us to have an experience in which an object is misperceived as lying beyond the mirror plane.<sup>39</sup>

But it is not clear that we should assimilate cases where an object is presented in a location which it does not occupy to cases where a sonic event is not perceptually represented as possessing location at all (or as having an indeterminate location). Thus it can be objected that the event theory is not supported by the slack phenomenology of decontextualised sound and is disconfirmed by it insofar as it demonstrates that sounds are not necessarily located at all.<sup>40</sup>

The short answer to this is that where a sound is heard as lacking determinate location or clear causal origin, it does not follow that it cannot be subsequently located – either via cross-modal experience or by using empirical knowledge of the causal origins of different types of sound. The locatedness of sound

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<sup>37</sup> And (as Casati and Dokic argue) it is only by being heard in objects that we can locate events in space.

<sup>38</sup> Storr, Robert. 2004, 'Sound Waves'. Retrieved 14 November 2009 from <http://www.tate.org.uk/tateetc/issue2/soundaves.htm>. See section V below.

<sup>39</sup> *la philosophie du son*, Chapter 4, pp. 49-50; 'Sounding Objects' p. 4.

<sup>40</sup> Matthew Nudds, 'Experiencing the Production of Sounds', *European Journal of Philosophy* 9:2, pp. 210-229.

events does not entail that sounds are *experienced as having determinate location* at any particular phase of an experience.

The denial of an entailment from the experience of locational indeterminacy to non-locatedness per se is metaphysically correct, but it is not sufficient to shore up the LET. The main justification cited for the LET, after all, is the phenomenology of those experiences in which we hear sounds as located. Thus the LET theorist is being inconsistent if she draws on the phenomenology of sound where it lends prima facie support to her ontology, while denying that the phenomenology of dislocated sound has any ontological (as opposed to epistemological) implications: both phenomenologies surely need to be taken into account. Moreover, the decontextualised experience of sound arguably has more metaphysical force when we come to reflect on the necessary attributes of sound; for the fact that some sounds are perceived without determinate location means that our auditory sense is not (unlike our visual or tactile sense modalities) intrinsically spatial. Sounds can be perceived as located, but they need not be.

However, as Matthew Nudds points out, senses are not simply discrete windows on the world. They jointly contribute to a developing epistemic and cognitive relationship with entities in a common world. When we hear a sound in the mouth of a ventriloquist's dummy we mis-locate an event occurring in the throat of the ventriloquist through *visual* misdirection (the ventriloquist is not seen as speaking, the dummy is).<sup>41</sup>

But this only goes to show that spatial indeterminacy in audition is not a property of sound but a phase in a developing cognitive relationship to it. A continuous electronic whining may be initially mysterious, and then mistakenly attributed to a faulty a smoke alarm. Finally – after its loudness is shown not to vary with one's distance from the alarm – it may be correctly identified as the malfunctioning cell phone in one's pocket. We distinguish between  $\Phi$  being indeterminately represented and being indeterminately  $\Phi$  in situations where it is possible to progressively reduce that indeterminacy. The location of sounds in vibrating materials is one of the  $\Phi$ 's to which this distinction applies for the most part. Failing that it would be impossible to recontextualise sounds that are initially heard in a decontextualised manner.

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<sup>41</sup> 'Experiencing the Production of Sounds', p, 217.

It might be objected that the possibility of a purely aesthetic interest in sound presupposes the phenomenology of pure aesthetic or 'narrow' sound objects distinct from the physical or technical processes which bring about our experiences of them.

In response, we can deny that an aesthetic interest necessitates a special category of object apt for that interest. Upon hearing the malfunctioning phone we were concerned with the nature and location of an irritating electronic sound (with a view to stopping it!) while this interest may be lacking in aesthetic situations. Electronically generated musical sounds may be dynamically and spectrally anomalous but listeners may be largely concerned with their morphological relationships with each other or with their mimetic features. The difference is not between the kind of object experienced but in our attitude to subsequent cognitive relationships with it. Given the identification of sounds with located events (LET) and their phenomenal properties with their physical features (LET<sub>A</sub>) it is impossible to 'bracket' the generative mechanisms which cause our auditory experiences and attend to an object whose description entails no commitment to physical mechanisms (though, as I argue in the next section, those generative mechanisms may be delimited in different ways). However, if we distinguish ordinary and 'acousmatic' listening attitudinally, the ontological distinction between 'wide' and 'narrow' intentional objects becomes superfluous.

## V. ALGORITHMIC AUDIBILIA AND SOURCES OF INDETERMINACY

LET<sub>A</sub> need not entail that relations between physical states are the only *audibilia*. There are discriminable features realised by sounds with disparate phenomenal properties (such as tokening the English word 'cat') or that of being a variation upon a particular musical theme (which need not imply formal identity with the theme). Sounds can bear abstract properties. The serialist procedure of inversion creates a second phrase intervallically symmetrical with the original 'seed' phrase around its starting pitch and can be employed to create an audible 'mirror texture', with phrases simultaneously rising and falling.

Sounds can thus implement algorithms (and do so audibly!) and token semantic or syntactic types. They can act as non-mental perceptual intermediaries regarding the physical states of sounding objects<sup>42</sup>, but also inform us about other states or processes.

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<sup>42</sup> *La philosophie du son*, Chapter 3.

I have produced a simple drum machine in the software environment MAX MSP in which each rhythm is represented as a grid of velocity values at particular subdivisions of time. A zero value represents no ‘hit’ while a value of 127 represents the loudest hit. Once we represent this grid on a fixed length array we can manipulate it with a computer program that periodically rearranges these values. For example, we can ‘shuffle’ them by cycling around the grid by a fixed value. Thus if the grid is 16 time units and the displacement is 9 units, a hit at 1 is moved to 10 while a hit at 9 is moved to 2. This is a simple algorithm for generating new rhythms from rhythmic seed.

When we hear the rhythmic line being displaced by the computational process we hear alterations in the relationships between sound intensities which constitute the rhythm. However, we also obtain information – however partial – about computational processes within the mechanism generating the sounds.<sup>43</sup>

Allowing algorithmic properties within the charmed circle of *audibilia* presents no problems for LET<sub>A</sub>’s physicalism because the algorithmic properties of sound supervene on their physical properties in non-mysterious ways.<sup>44</sup> However, this formulation is somewhat open-ended as things stand because there are multiple candidates for the supervenience bases of the algorithmic properties. The recipe for beat manipulation described above depends on the vibratory properties (timbre, loudness) of the relevant sounds lining up in the right way at the right time. This would hold true even in a ‘metaphysically possible’ world in which speakers had two modes of operation. In ‘natural mode’ we apply an alternating voltage to the speaker’s electromagnet and create the sound in the usual way. In ‘magic mode’ spirits inhabit the diaphragm and make it oscillate in precisely the same way (implementing the algorithm as per ritual specifications).

Clearly, this world does not operate according to our laws. So it is arguable that the algorithmic properties of electronically generated sound *metaphysically supervene* on the behaviour of a vibrating diaphragm in a speaker. They also *naturally supervene* on the same behaviour insofar as all naturally possible worlds must be metaphysically possible. However, one of the ways in which the oscillatory behaviour of speaker

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<sup>43</sup> An equivalent point can, of course, be made about algorithmic processes implemented by living musicians, such as medieval isorhythms or Steve Reich’s phasing techniques.

<sup>44</sup> Expressive or linguistic properties are problematic, arguably, only if physicalism in the philosophy of mind generally is false. I would argue that most standard objections to physicalism in the theory of mind fail, but it is obviously beyond the scope of this paper to adjudicate on this topic.

diaphragms is caused is through being stimulated by voltage changes caused by the alternating output from a digital-analogue converter (DAC), these being triggered by a succession of digital samples represented in file locations in a computer's working memory. So if algorithmic facts naturally supervene on facts about the state of the speaker diaphragm over time, they naturally supervene on facts about local systems in which the speaker is contained which are causally sufficient for that behaviour.

Similar considerations apply to the timbral properties of the drum sounds themselves since – in the case envisaged – these will naturally supervene on the behaviour of a containing system which includes a computer, a DAC and a speaker (they could be also be produced by a spiritually inspired speaker in a world utterly unlike ours).

Casati and Dokic's event theory identifies sound with a 'vibratory event/process occurring in the stuff of a resonating material/physical object'<sup>45</sup>. If we single out this generative process or event as the one on which a particular auditory experience depends then these event/processes *could* involve not only vibrations but other distally accessible causal processes. With computer generated sound in particular, it is possible to locate the sound in a wider containing system rather than in the speaker diaphragm alone. From the purview of a computer musician or critic, locating the sound in a vibrating object alone may constitute an arbitrary and incomprehensible excision: for the succession of vibratory events may manifest an organizing process whose generative mechanism includes (say) a computer-audio system and gestural inputs determined by performers or various environmental contingencies. However, this view of auditory location is not mandatory and we can hardly expect intuitions about natural/metaphysical supervenience to be decisive here.

A similar source of indeterminacy shows up if we consider the implications of different versions of event-theory. O'Callaghan 'relational event view' proposes that sounds consists in the periodic disturbance of a medium.<sup>46</sup> Thus, for him, sound events are *caused* by vibration events. The distinction is consequential insofar as each theory delivers different answers to empirical questions about the presence of sounds. While Casati and Dokic's view implies that there is a sound located in a vibrating tuning fork contained in an evacuated jar; O'Callaghan's implies that there is none.

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<sup>45</sup> 'Sounding Objects'.

<sup>46</sup> Roberto Casati, 'Sounds'.

Now while this is certainly a difference between these positions, it is hard to see how it could be resolved in the way ordinary empirical claims concerning auditory location can be. Most people would probably judge that there is no sound in the evacuated jar. Yet were the air in a jar containing a vibrating tuning fork to be regularly evacuated and replenished we might perceive this as an alteration in the conditions of audition of a continuous sound, rather than the alternating presence and absence of successive sounds.<sup>47</sup> Thus the two theories trade truth values between particular judgements, while doing seemingly equal justice to the conceptual framework within which sounds are identified, located and sorted. This along with the issues of supervenience noted above suggests that there is some *metaphysical slackness* in matters of sonic location and the characterisation of sonic events.

## VI. CONCLUSION

LET<sub>A</sub> implies that experiencing sound is the experiencing of changes in a sounding object (Section III). It makes no distinction between experiencing sounds and experiencing sonorous properties since these are the ways sounds happen. We have already noted that these modes of variation do not correspond to more or less basic physical quantities like frequency or pressure but involve complex patterns of change along multiple 'dimensions' – where the distribution of spectral energy, say, might constitute but one dimension of timbral variation. Nonetheless LET<sub>A</sub> qualifies as physicalist because it entails that these relationships between physical states of sounding objects are *audibilia* and not avowedly non-physical properties existentially dependent upon observers' responses to those objects.

As we have noted, the phenomenology of auditory experience can be 'slack' insofar as sounds may be experienced as either unlocated or unrelated to any familiar causal mechanism. In most cases indeterminacy can be resolved through a developing cognitive relationship with the sound. Thus neither phenomenological slack nor the fact that our aesthetic interest often 'brackets' auditory location and causation supports the Schaefferian view that phenomenal sound objects can be distinguished from the spatially located processes or events which generate auditory experiences (Section 4) (Section IV). However, some competing metaphysical claims about the location of sonic

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<sup>47</sup> *La philosophie du son*, Chapter 3.

events do not seem to be rationally decidable along these lines (Section V). Different metaphysical conceptions of sonic events yield various distributions of truth values to judgements of auditory location and auditory existence. If there are no decisive considerations favouring one distribution over another, it seems reasonable to conclude there is no metaphysical fact to the matter regarding the precise boundaries or locations of sounds.