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Why Can Sounds Be Structured As Music?

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RESUMEN

Cuando oímos la ejecución de una obra musical, oímos sonidos en tanto que estructurados musicalmente por un compositor y los ejecutantes. Cuando oímos sonidos –no sólo los sonidos producidos por instrumentos que poseen una altura sino también los sonidos producidos por instrumentos de percusión con altura indeterminada– oímos directamente propiedades auditivas particulares. Además, y esto es una tesis central, oímos directamente relaciones auditivas particulares. Los sonidos son paquetes de tales propiedades y relaciones auditivas. Puesto que tales propiedades están interrelacionadas por medio de tales relaciones, los sonidos están intrínsecamente estructurados. Y puesto que los sonidos están intrínsecamente estructurados de este modo, pueden estructurarse como música.

PLABRAS CLAVE: *percepción auditiva, estructura musical, instrumento de percusión, altura,* qualia*, relación, sonido, tono, teoría del tropo*.

ABSTRACT

When we listen to the performance of a work of music, we hear sounds as musically structured by composer and performers. When we hear sounds – not only the sounds produced by pitched instruments but also the sounds produced by percussion instruments of indefinite pitch – we directly hear particular auditory properties. Additionally, and this is a core thesis, we directly hear particular auditory relations. Sounds are bundles of such auditory properties and auditory relations. Because such properties are interrelated by such relations, sounds are intrinsically structured. And, because sounds are thus intrinsically structured, they can be structured as music.

KEYWORDS: *Auditory Perception, Musical Structure, Percussion Instrument, Pitch,* Qualia*, Relation, Sound, Tone, Trope Theory*.

In listening to music, we hear sounds. What is it about sounds that enables them to be structured as music? In this paper, I explore one way of answering this question. To illustrate my answer, I consider especially the sounds produced by percussion instruments of indefinite pitch.

There is a related question in the philosophy of music: what are works of music? According to Jerrold Levinson, a musical work is (roughly) a structure of performed sounds [(1990), p. 291]. Such an answer to the question of what musical works are presupposes an answer to the question: why can sounds be structured as musical works?

When we listen to the performance of a work of music, we hear sounds as musically structured. More specifically, we hear sounds as structured primarily by the composer and secondarily by the performers through their interpretations and improvisations. A main thesis of this paper is that, in order for sounds to be thus musically structured, they have to be intrinsically structured.

How are sounds intrinsically structured? When we listen to music, the auditory 'input' is, according to Fred Lerdahl and Ray Jackendoff, a 'raw sequence of pitches, attack points, durations, dynamics, and timbres' [(1983), p. 13]. But how raw is this input? A standard answer is that it is a chaotic manifold of unrelated auditory qualia. An assumption of this answer is, it would seem, that relations between directly heard qualia are not themselves directly heard. By contrast, my answer is (roughly) that what we directly hear is a manifold of particular auditory properties and particular auditory relations. It is because such properties are interrelated by such relations that sounds are intrinsically structured. And it is because sounds are thus intrinsically structured that they can be structured as music by composers and performers.

I. What Are Sounds?

I want to emphasize that the focus of this paper is on the sounds that we actually hear. The focus is on that which is present to consciousness: sounds as auditory phenomena. It is assumed that the phenomenology of sounds can be studied largely in abstraction from the physics of sound and the physiology of hearing. Additionally, some ontological topics are discussed – in particular, events and tropes. Sounds can be studied both phenomenologically and ontologically because they are only appearances, that is, phenomena of which we can ask: what are they?

A cogent answer to this question is provided by Roger Scruton in his book *The Aesthetics of Music*. 'Music is an art of sound', he declares, 'and much that seems strange in music can be traced to the strangeness of the sound world itself' [(1997), p. 16]. I find his book on the philosophy of music important partly because it begins with a thorough discussion of the topic of sounds. (See also [Scruton (2009)].) Central to his discussion of that topic is the following ontological claim: sounds are 'pure events' [(1997), p. 12].

Why should sounds be categorized as events? In contrast to a standard account of things, sounds have temporal parts. A pianist plays a note on a piano, and we hear a sound begin (its attack), last for awhile (its decay), and

end (its release). While this sound is happening – while these three temporal parts are successively occurring – the piano remains (numerically) identically the same. But the sound that we hear is not a thing that remains identically the same from attack through decay to release. Rather than being a continuant, the sound is an event (or occurrent). When we hear sounds of any sort – e.g., street noises – we hear events that begin, last for awhile, and then end. What we do not hear are things that remain identically the same from beginning to end.

What is meant by 'sounds are *pure* events'? Ordinarily, the concept of event is understood in terms of the concept of thing: events 'are what *happen* to' things [Scruton (1997), p. 10]. The playing of a piano by a pianist is such an event. What happens to the pianist and the piano is that the pianist plays the piano. But the sound that we hear, although produced by this playing, is not something that happens to the piano and the pianist. In general, sounds are not happenings to things. Instead, a sound is a 'pure event, in which no individual substances participate' [Scruton (1997), p. 12]. Sounds in themselves, in abstraction from their sources and their auditors, are appearances that are devoid of things. They are pure – i.e., thingless – events.

II. The Alphabet of Sounds

How, then, can sounds be 'bearers of auditory properties (pitch, timbre, and so on)' [Scruton (1997), p. 7]? With the aim of supplementing the claim that sounds are pure events, I discuss one way that this question can be answered. In so doing, I state my own theory of sounds.

A sound has auditory properties, but its auditory properties are not properties of a substratum in it. For it is a pure event – there is no thing in it – and so there can be no such substratum (or substance) in it. Accordingly, instead of a substance-attribute theory, I answer the question in terms of a bundle theory [Armstrong (1989)]. A sound consists of its auditory properties (and no thing more). It is just a bundle of them. In particular, a musical sound consists of such properties as pitch and timbre (and no thing more).

Similarly, Hume claimed that a substance is 'nothing but a collection of sensible ideas' [(1978), p. 16]. However, appearances can be bundles of properties, even if things (or substances) are not. Sounds can consist just of auditory properties, even if things consist of substrata with attributes. After all, appearances are only appearances. That they are in themselves devoid of substrata should not occasion surprise. For brevity, I leave open the question: what are things?

According to Scruton, each musical sound that we hear is 'the instance of a type' [(1997), p. 19]. Similarly, my view is that, when we hear sounds, we hear instances of determinate auditory properties. And we also hear instances of determinate auditory relations. What is meant by 'determinate'

[Campbell (1990), p. 83]? Just as there are determinate (i.e., maximally specific) shades of any determinable color, so there are (for example) determinate (i.e., maximally specific) 'shades' of any determinable timbre. (To enhance this comparison, note that timbres are also called 'tone colors'.) Although maximally specific, each determinate auditory property or relation is still repeatable (i.e., it is a 'type'). It still has instances (i.e., 'tokens'). Following Donald C. Williams, I call instances of determinate properties and relations 'tropes' [(1953), p. 7].

My theory of sounds is a sort of trope theory [Armstrong (1989)]. In summarizing it, I said that a sound consists of auditory properties. I want now to correct that summary: a sound consists of auditory tropes. It is just a bundle of them.

Indeed, trope theory is 'controversial' [O'Callaghan (2007), p. 23], but so is every philosophical theory of what there is. Williams coined the term 'trope', but tenets of his trope theory have well-known antecedents in the history of philosophy. For example, according to George Berkeley, sounds are 'combinations of sensible qualities', and the maxim that 'everything which exists is particular' is 'a universally received maxim' [(1979), pp. 11, 28].

In the philosophy of music, the idea of something being an instance of a type is quite familiar. According to Peter Kivy (and other musical platonists), 'musical works are universals, or types or kinds, and the performances of them are particulars, or tokens, or instances' [(1993), p. 59]. When we listen to a performance of a musical work, we hear sounds. Accordingly, a musical platonist might also hold that sounds are instances of universals (or types or kinds).

Instead of being a realist (or platonist), Williams was a nominalist: a universal is 'the set or sum of tropes precisely similar to a given trope' [(1953), p. 9]. A trope is an instance, not of a (real) universal, but of a resemblance class. Even though recent trope theories are mostly nominalistic [e.g., Campbell (1990)], there are also realist trope theories [e.g., Mertz (1996)]. Accordingly, in saying that auditory tropes are instances of determinate auditory properties and relations, I want to leave open the question: what are properties and relations? My theory of sounds is, I think, compatible with both realist and nominalist answers.

Tropes are, according to Williams, 'the primary constituents of this or any possible world, the very alphabet of being' [(1953), p. 7]. Rather than make such a sweeping ontological claim, my claim is that auditory tropes are the primary constituents of the world of sounds, the alphabet of sounds. But what are the letters of this alphabet?

Specifically, what are the letters of the alphabet of musical sounds? A musical sound has auditory properties of pitch, timbre, and so on, because it is a bundle of auditory tropes – namely, a pitch trope, a timbre trope, and so on. The primary constituents of musical sounds are pitch tropes, timbre

tropes, and so on. (The words 'and so on' arguably encompass loudness tropes and duration tropes.)

How does the phenomenological study of auditory tropes differ from the study of sensory attributes of musical sounds by music psychologists? First, music psychologists want to provide causal (i.e., psychoacoustical) explanations, whereas I am concerned with auditory tropes largely in abstraction from their causes. Second, they want to answer the question: how do we recognize (or categorize) the sensory attributes of musical sounds? My view is that, just as we can see a determinate shade of a color without being able to recognize it, so we can hear an auditory trope (e.g., an instance of a determinate pitch) without being able to recognize it. I am exploring the ontological question: what do we hear? For lack of space, I have to set aside the epistemological question: how do we recognize what we hear?

We can hear an auditory trope without being able to recognize it, and we can hear it without being able to describe it. According to Andy Hamilton, 'timbre is characterized in terms of the instrument or voice that produces it' [(2009), p. 162]. However, determinate timbres are very qualitatively various. When we listen to the performance of a musical work, our references to instruments might suffice to individuate determinate timbres, but not to describe them. When the instrument is a prepared piano, we can hear the novel determinate timbre of a particular sound produced by striking middle C, without being able to describe it. A piano can be 'prepared' in many diverse ways. We can hear a timbre trope, without being able to describe it.

Sounds are appearances. Therefore, auditory tropes – for they are what constitute sounds – are appearances. Consequently, the phenomenological study of auditory tropes is the study of the auditory tropes that we actually hear. For example, the phenomenological study of pitch tropes – whether the definite pitches of violins and pianos or the indefinite pitches of wood blocks and brake drums – is the study of the pitch tropes that we actually hear. The focus of this paper is on what actually is heard.

Such auditory property tropes are actually heard directly (or immediately). They are ontological letters, but they are also phenomenological letters. (I leave open the questions: Are they epistemological letters? Are they 'sense-data'?) Similarly, Diana Raffman claims that what 'we actually hear' as auditory input includes 'many fine-grained determinate pitches' [(1993), p. 65].

It might also be claimed that what we actually hear as auditory input is 'a chaotic manifold of unrelated pitch sensations' [Raffman (1993), p. 69]. By contrast, my view can be summarized as follows. We actually hear instances of relations between such auditory property tropes. For example, we actually hear instances of relations between pitch tropes. Such auditory relation tropes are directly (or immediately) heard. The alphabet of sounds includes relation tropes.

III. What Are Tones?

In review, I have been considering the question: what are sounds? Briefly, my answer is that sounds are bundles of auditory tropes. In light of this answer, the remainder of this paper is devoted to the question: why can sounds be structured as music? With the aim of answering this question, I consider first the question: what are tones?

Scruton provides a cogent answer to this last question, an answer that emphasizes pitch. He contends that there is a 'comprehensive distinction between sound and tone' [(1997), p. 19]. In particular, he defends a thesis about the 'transformation of sounds into tones' [(1997), p. 17]. Let me state his transformation thesis briefly: by ordering certain sounds (in the right way), we transform them into tones.

By contrast, I hold an auditory thesis about tones: Tones just are sounds. Tones are ordered, but then so are sounds generally. When we hear sounds, we hear them as interrelated by relation tropes. And so, when we hear sounds that are standardly called tones, we hear them as interrelated by relation tropes.

The word 'tone' is ambiguous. I use it to mean roughly: a sound that has a pitch. Thus it does not mean simply 'pitch', nor does it abbreviate 'whole tone'. There is a problem with this rough definition. It might be thought that a tone is repeatable, that (numerically) identically the same tone can be heard on different occasions. However, each sound that we hear – whether it has a pitch or not – is a pure event, a bundle of auditory tropes. Accordingly, I am using the term 'tone' to mean: a (particular) sound (event) that has a pitch.

There is a second problem: what is meant by 'has a pitch'? In terms of his transformation thesis, Scruton would, I suspect, answer this question as follows. When we transform certain sounds into tones, we order them in a pitch system (e.g., a system of equal temperament) [Scruton (1997), p. 15]. However, there are alternative pitch systems (e.g., various just intonations, microtonal scales, and tunings of gamelan music) [Scruton (1997), p. 16]. The act of transforming sounds into the tones of one of these pitch systems is an intentional act; each tone in a particular pitch system is an 'intentional object' [Scruton (1997), p. 16]. Pitch systems are human creations, and so are their tones. Accordingly, the answer to the question is: each tone is a sound that has a pitch – that is, it has a definite place in a pitch system. And coupled with this answer is a thesis of pitch-system relativity: to be a tone is to be in a pitch system.

My answer to the question is quite different. Each tone is a sound that has a pitch – that is, it is a bundle of auditory tropes among which is a pitch trope. In brief, tones are musical sounds. Such a pitch trope is an instance of a determinate pitch property. To hear the pitch of a tone is to hear its pitch trope. (We can hear a pitch trope without recognizing it.) Because a musical sound includes a pitch trope, it just is a tone. It is not transformed into a tone by an intentional act.

My answer does not involve the idea of a pitch system, and so I couple it with a thesis of pitch-system invariance: tones exist independently of pitch systems. This thesis is supported by the following illustration. It is customary to distinguish between percussion instruments of definite pitch (e.g., xylophones, chimes, and tympani) and percussion instruments of indefinite pitch (e.g., tom-toms, cymbals, and brake drums). To understand what is meant by 'indefinite pitch', let us presuppose the standard system of equal temperament. For example, brake drums obtained from a junk yard can be expected to produce sounds of indefinite pitch – that is, sounds that do not have definite places in the presupposed pitch system. Now suppose that we were to strike such a brake drum (in the right way) with a metal ball mallet. We would hear a 'very clear, bell-like' tone, a 'strong bell-like tone with many high overtones' [Reed and Leach (1978), pp. 58-59]. Thus we would hear (among other tropes) an instance of a determinate pitch property. The point is that this percussion sound is a sound that has a pitch; it is indeed correctly described as a very clear, bell-like tone.

There is a third problem. Organ sounds have pitches that are steady (or unvarying), whereas violin sounds sometimes have pitches that are not steady – for example, when a note is played with (sufficiently slow) vibrato (or glissando or a sliding attack or a sliding transition) [Francès (1988), pp. 16-18]. Although we might think abstractly of the pitch of such a violin sound as its 'mean pitch level' [Francès (1988), p. 17], what we actually hear is a pitch that is nonsteady (or varying). Other instruments can produce sounds with nonsteady pitches. In John Cage's 'Second Construction', a glissando is produced by beating a gong while lifting it out of a container of water. Insightfully, Henry Cowell developed a notion of 'sliding pitches' (and 'sliding tones'), and used the term 'steady pitch' [(1996), pp. 19-21].

But how can a tone with a nonsteady pitch be construed as a bundle of auditory tropes among which is an instance of a determinate pitch property? The pitch trope of a tone is not a continuant that remains identically the same from the beginning to the end of that tone. Instead, the pitch trope of a tone is an event. For sounds are events, and so the auditory tropes that constitute sounds are events. When a tone has a steady pitch, its pitch trope is an instance of a pitch property that is uniform from its beginning to its end. And, when a tone has a nonsteady pitch, its pitch trope is an instance of a pitch property that is multiform (in a maximally specific way) from its beginning to its end. (Cf. the infinity of spatial shapes.)

IV. INTERVALS

A tone is a bundle of auditory tropes among which is a pitch trope. But the alphabet of sounds also includes relation tropes. How are pitch tropes in-

terrelated by auditory relation tropes? In this section, an answer to this question is rejected; and, in the next section, a different answer is defended. For simplicity, the discussion is confined to tones with steady pitches. Thus the term 'pitch' is henceforth used as an abbreviation of the term 'steady pitch'.

'The distance between pitches', Scruton remarks, 'provides our only way to compare them as pitches' [(1997), p. 21]. Accordingly, the question could be answered as follows. When we hear two pitch tropes, we also hear an interval between them. (We can hear an interval without recognizing or identifying it.) Intervals are distances between the pitches of tones. To hear an interval between two pitch tropes is (more exactly) to hear an instance of a relation of distance between them. This relation trope is directly heard. (We can directly hear it without recognizing it.) In order to directly hear it, the two pitch tropes have to be intrinsically interrelated by it. Similarly, Raffman holds that, in addition to hearing (as auditory input) fine-grained determinate pitches, we also hear 'fine-grained intervals' between those pitches [(1993), p. 66]; and such intervals are distances between pitches [(1993), p. 155]. In short, the answer is that pitch tropes are interrelated by (directly audible) distance relation tropes.

This answer could be supported by a psychoacoustical argument. The tones that we hear are caused by sound waves impacting on our auditory systems. There is a correlation between the fundamentals of the sound waves that cause the tones that we hear and the pitches of those tones. This correlation is one-one. When a pair of fundamentals is correlated with a pair of pitches, the quantitative difference between the frequencies of the fundamentals is correlated with the (directly heard) interval between the pitches. This correlation is a sort of distance isomorphism. The argument is that distance relation tropes are thus caused by sound waves. Similarly, Raffman holds (roughly) that fine-grained intervals are 'a function of frequency' [(1993), p. 67].

I am skeptical that there is such an isomorphism. Why should we think that sound waves cast such clear and distinct shadows in the insubstantial world of auditory appearances? My view is that there are no such distance relation tropes. We do not directly hear intervals. Of course, the intervals of music theory (e.g., a perfect fifth) can be defined numerically in a pitch system. Hence, by placing two tones in a suitable pitch system, we can say what the interval between them is in that pitch system. But pitch systems are human creations, and thus intervals are human creations. The microtonal intervals of Harry Partch's scale with 43 tones per octave are his creations. The chromatic intervals of the standard system of equal temperament are human creations (by Andreas Werckmeister et. al.). Nonstandard equal-temperament systems might divide the octave into 'any number of equal increments' [Butler (1992), p. 207]. Although I reject the thesis of pitch-system relativity for tones, I accept an analogous thesis for intervals: to be an interval is to be in a

pitch system. Intervals – distances between the pitches of tones – do not exist independently of pitch systems.

V. Higherness Tropes

There are no distance relation tropes that can be directly heard. Tones are not intrinsically structured in intervals. Instead, intervals are an elementary kind of musical structure. When we listen to the performance of a piece of music, we hear tones as musically structured in intervals. When we listen to a performance of a piece from Bach's *The Well-Tempered Clavier*, we hear sounds as structured by Bach in intervals of a system of equal temperament. But what is it about tones that enables them to be thus musically structured in intervals? With the goal of answering this question in the next section, I state in this section my own answer to the question raised in the preceding section: how are pitch tropes interrelated by auditory relation tropes?

Most percussion instruments of indefinite pitch can produce sounds with 'relative pitch differences – at least high and low, or high, medium, and low' [Reed and Leach (1978), p. 130]. Now suppose that we were to obtain two brake drums of different sizes from a junk yard. And suppose that we were to strike them (in the right way) with a metal ball mallet. We would hear two very clear, bell-like tones. These tones would not have definite places in our presupposed pitch system, and so there would not be a definite interval between them in that pitch system. Nevertheless, we would still hear one of them as higher than the other [Reed and Leach (1978), p. 59].

In general, when we hear two pitch tropes, we sometimes hear one of them as higher than the other. More exactly, when we hear two pitch tropes, we sometimes hear between them an instance of a relation of *being higher* (or *higherness*). This higherness trope is directly heard. (We can directly hear it without recognizing it.) In order to directly hear it, the pitch tropes have to be intrinsically interrelated by it. The higherness relation is not a relation of distance. Instead, it is a sort of (non-quantitative) relation of order. When we hear a higherness trope between two pitch tropes, we are not hearing an instance of a distance relation. Instead, we are hearing an instance of a sort of order relation. In short, pitch tropes are interrelated by higherness tropes.

Strictly speaking, the relation of higherness holds among pitch tropes. However, elliptically speaking, it holds among tones. That is, when the pitch trope of one tone is higher than the pitch trope of another tone, it can be said elliptically that the former tone is higher than the latter tone. Accordingly, for simplicity, I usually say in what follows that one tone is higher than another.

Let us turn to the field of music psychology. While summarizing studies of relative pitch, David Butler remarked: 'If the test for relative pitch is simply to determine whether one of two tones is higher, the same, or lower

than the other, most people will probably perform at a fairly equivalent level until the pitch differences between the two tones become exceedingly small' [(1992), p. 51]. My suggestion is that most people can determine whether one of two tones is higher than the other (partly) because there are higherness tropes that they can directly hear.

In addition to the word 'higher', Butler's remark contains the words 'the same' and 'lower'. In hearing one tone as higher than another, we hear the latter as lower than the former. Does this mean that we hear two relation tropes, a higherness trope and a lowerness trope? Since the relation of lowerness is the converse of the relation of higherness, it is assumed, for the sake of ontological economy, that there is just one trope that is both an instance of the relation of higherness and an instance of its converse. The lowerness trope just is the higherness trope (cf. 'the Morning Star is the Evening Star'). Furthermore, it is assumed that two tones are 'the same' when neither is higher than the other.

It might be thought that Butler's qualification about exceedingly small pitch differences is problematic. However, sounds are only appearances. Suppose that, in the above illustration, the two brake drums are almost equal in size. Then you might hear one tone as higher than the other, whereas I might hear neither tone as higher than the other. A higherness trope might actually appear to you, whereas a higherness trope might not actually appear to me.

That pitch tropes are interrelated by higherness tropes could be supported by a psychoacoustical argument. The tones that we hear are caused by sound waves impacting on our auditory systems. There is a correlation between the fundamentals of the sound waves that cause the tones that we hear and those tones. Since acoustics can discriminate frequencies more finely than consciousness can discriminate pitches, this correlation is many-one. When the frequency of one fundamental is greater than (or equal to) the frequency of another fundamental, the tone correlated with the former fundamental is higher than (or the same as) the tone correlated with the latter fundamental. This correlation is 'order-preserving' (Davey and Priestly (1990), p. 10]. (If the correlation were one-one, it would be an order isomorphism.) The argument is that higherness tropes are thus caused by sound waves.

My answer to the question of how pitch tropes are interrelated by auditory relation tropes does not involve the idea of a pitch system. Pitch systems are human creations, and so are intervals, but higherness tropes are not. Accordingly, I want to enlarge the thesis of pitch-system invariance: tones and the (non-quantitative) order of their pitches exist independently of pitch systems.

VI. The Higherness Relation

Why, then, can tones be musically structured in intervals? Briefly, my answer is that tones are intrinsically structured by higherness tropes. With the

aim of stating this answer more fully, I answer first some questions about the relation of higherness.

What are the formal properties of that relation? It is irreflexive, asymmetric, and transitive. That is, it is a 'strict partial ordering' [Suppes (1957), p, 222]. (It is not a serial relation, because it is not connected.)

But is the higherness relation transitive? To hear one tone as higher than another, we have to hear them (in some sense) together (in one consciousness) [cf. Levinson (1997)]. However, the relation *x is heard as higher than y* is different than the relation *x is higher than y*. The former relation is not transitive. Suppose that we hear one tone as higher than a second, and the second as higher than a third. If we do not hear the first and third together, we do not hear the first as higher than the third. Nonetheless, had we heard the first and third together, we could have heard the first as higher than the third. For the first is higher than the third. Thus the latter relation is transitive.

How is the higherness relation not connected? Let us add to the above illustration a third brake drum, one that is almost equal in size to the other two. If we were to strike successively the three brake drums (in the right way) with a metal ball mallet, we would hear in succession three very clear, bell-like tones. Because of very small differences between the frequencies of the respective sound waves, the three tones that actually appear to us might be interrelated as follows. The first tone is neither higher nor lower than the second tone, the second tone is neither higher nor lower than the third tone, but the first tone is higher than the third tone. What this illustration shows is that the relation *neither higher nor lower* is not transitive. Instead, it is a similarity relation (i.e., it is just reflexive and symmetric). In general, when a relation *xRy* is a strict partial ordering, the relation *neither xRy nor yRx* need not be transitive.

In terms of the higherness relation, how can we define a relation of betweenness [cf. Scruton (1997), p. 21]? Let X, Y, and Z be tones, and let X be higher than Z. Then Y is *between* X and Z just in case X is higher than Y and Y is higher than Z. This relation of betweenness is a sort of (non-quantitative) ordinal relation. When we hear one tone between two other tones, we are not hearing relations of distance among them. Instead, we are hearing (non-quantitative) relations of order among them.

Additionally, we can define a relation of immediate higherness (relative to a collection of tones). Let S be a collection of tones, and let X and Y be tones in S. Then X is *immediately higher in S* than Y just in case X is higher than Y and there is no tone in S between X and Y. This relation is also a sort of (non-quantitative) ordinal relation.

Let us return to the question: why can tones be musically structured in intervals? To illustrate how this question should be answered, I consider an elementary kind of interval: semitones. According to the thesis of pitch-system relativity for intervals, to be a semitone is to be in a pitch system. Accordingly,

I consider specifically the semitones in the standard system of equal temperament (i.e., there are twelve equal semitones per octave and A = 440 Hertz).

To concretize this illustration phenomenologically, we strike the 88 keys of a (suitably tuned) piano, and we hear 88 tones. These tones (as ordered by the higherness relation) are named as follows: T_1, T_2, and so forth (up to and including T_{88}). For example, two tones that have between them the interval of a semitone in the stated pitch system are T_{39} and T_{40}. What is it about T_{39} and T_{40} that enables them to be musically structured in this semitone? T_{40} is higher than T_{39}. T_{40} and T_{39} are interrelated by a higherness trope. However, none of the other 86 tones is between T_{40} and T_{39}. T_{40} is immediately higher than T_{39} in the collection of 88 tones. It is because T_{39} and T_{40} are intrinsically structured in this way (independently of pitch systems) that they can be musically structured in a semitone (in the stated pitch system).

Suppose that, in addition to these 88 tones, we also hear a tone produced by a brake drum, a tone that is between T_{40} and T_{39}. Even though this percussion sound does not have a definite place in the pitch system, it is still linked nonquantitatively by the higherness relation with the 88 piano tones. That is, it is between T_{40} and T_{39}.

To generalize from the case of semitones, I want now to answer the question: why can tones be musically structured in intervals? Tones are intrinsically structured by higherness tropes in various ways that are definable in terms of the relation of higherness. It is because tones are intrinsically structured in these various ways (independently of pitch systems) that they can be musically structured as intervals (in a given pitch system).

VII. Concluding Remarks

In conclusion, I want to indicate how the question that serves as the title of this paper should be answered. We directly hear higherness relations between tones, but we also directly hear relations of other sorts. Tones are intrinsically structured by higherness tropes, but they are also intrinsically structured by other sorts of auditory relation tropes. It is because they are thus intrinsically structured (in various definable ways) that they can be structured as music.

Some tones are louder (or softer) than others. We directly hear instances of various qualities of loudness (i.e., loudness tropes). When we hear two qualitatively different loudness tropes, we hear one of them as louder than the other. More exactly, we hear between them an instance of a relation of *being louder* (or *louderness*). This louderness trope is directly heard. (We can directly hear it without recognizing it.) In order to directly hear it, the loudness tropes have to be intrinsically interrelated by it. But we do not directly hear a quantitative difference between the loudness tropes. Instead of being a sort of relation of dis-

tance, the louderness relation is a sort of (nonquantitative) relation of order. In brief, tones are intrinsically structured by louderness tropes.

Some tones are of longer (or shorter) duration than others. And some tones occur later (or earlier) than others. Tones are ordered in time. My suggestion is that there is a (non-quantitative) temporal ordering relation that holds between tones. Tones are intrinsically structured by this time-order relation. However, the philosophy of time is difficult and controversial, and so I do not venture to answer such questions as: Are there duration tropes? Do we hear temporal relations? Are there (directly audible) time-order tropes?

For simplicity, in focusing on the topic of pitch, I largely abstract from the topic of time. Let me illustrate briefly how those two topics might be integrated. Suppose that we hear a temporal series of tones – namely, ones that comprise a melody. What is it about these tones that enables them to be musically structured as a melody? Butler characterizes the idea of 'melodic contour' thus: 'Contour, in the loose sense of up, down, arch, and inverted arch' [(1992), p. 110]. Adapting this idea of 'melodic contour', the question is answered as follows. We hear some of the tones as higher than others, and we hear some of them as later than others. The tones together with their higherness relations and their time-order relations constitute a 'melodic contour instance'. It is because these tones are thus intrinsically structured (independently of pitch systems and methods of writing scores) that they can be musically structured as a melody.

Different musical sounds have different timbres. We directly hear instances of determinate timbres, and we directly hear instances of relations between determinate timbres. Musical sounds are intrinsically structured by timbre relation tropes. However, I have no space to explore the difficult subject of timbre (and the subjects of 'consonance' and 'tone chroma').

With the growth of modern science, various kinds of reductionism about human experience have flourished. In this paper, I oppose two kinds of reductionism. Auditory relations are not reducible to auditory qualities, and auditory qualities and relations are not reducible to quantities. When we listen to the performance of a work of music, we listen to musical structures clothed in sounds rich in qualities and relations. The auditory qualities and relations matter.

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