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A stride towards sentient cities: Architecture as performance art

ABSTRACT

My researches into 'architecture as music' have led me to investigate how a synchronicity of sound and space, acting together, can enable buildings to become not only smart but also sentient. It was one particular building in the City of London that prompted me to join the patterns of architecture with the rhythms of music in an experimental audio-visual performance called Citirama. Each of the piece's three movements throws some new light on what makes a building 'musical' – i.e. capable of exerting some power over our emotional response. I take a journey back in time to find that architecture is a world of relationships very close to that of the performing musician but, if we are to apply the lessons of music more widely, it will be necessary that we obtain some understanding of how our brains' pathways and neural mechanisms enable us to see and hear through a process of pattern recognition. Only then will the indelible links between architecture and music enable architects to act more as composers in rebalancing the challenges that underpin the future of our cities. I illustrate what I mean by 'musicality' with reference to a specific urban community that is close to home – the Barbican.

KEYWORDS

architecture
visual music
pattern recognition
le modulator
Le Corbusier
Parthenon
Pythagoras
auditory and visual
scene analysis

MUSIC: A CATALYST FOR CHANGE

I am taking up the challenge that we need cities that are both smart and sentient. By this I mean the creation of an urban environment, which is not only intelligent but, also, has some capability to learn from experience and adjust to changing conditions. My response to the challenge is informed by the two distinct but syncretic disciplines that have underpinned my life's work and pleasure – architecture and music. It is the rare occasions when these disciplines meld together in a synchronicity of sound and space that have sparked off my thoughts on how, for the future, questions on the form and structure of buildings will become overshadowed by ambitions for their dynamic performance and intelligence, their ability to interact with each other and with us, to communicate, learn and evolve.

Unlike my architectural friends, who look askance at the notions I am putting forward, my fellow musicians take my thoughts on 'architecture as music' in their stride. To them, the idea that architects, like composers, can learn to play with the expectations of their audiences to achieve buildings that are 'musical' comes not as a surprise but, more, as a statement of the obvious. They recognize that our behaviour and responses to the environments in which we live and work are conditioned not only by what we see but, also, by the way we are made to feel by the rhythmic ebb and flow and sounds of the spaces we inhabit. It is by bringing the lessons of music to bear on these experiences that I believe we can gain not only some new understanding of the factors, which determine our emotional responses to buildings but, also, knowledge on how we can learn to stimulate specific emotional outcomes as part of the design process. I am investigating this largely unexplored territory through the advent of personal experience. It is by reliving my own journeys of architectural discovery throughout Europe, both past and recent, that I am recalling times when I have felt the tensions of music in the spaces of architecture; in hindsight I can now see that these moments in time reveal a slim heritage of musical buildings that, in one way or another, might hold the key to making our urban environments more sentient, more able to respond to the ever-changing physical and emotional needs of the people they serve.

VISUAL MUSIC CELEBRATING THE 'CHEESEGRATER'

I am starting my journey in the City of London, where I live, with the Leadenhall Building, colloquially known as the 'Cheesegrater'. The unexpected realization that this building possesses the qualities of music came when I visited the site before the building was finished and during discussion with one of the two project architects involved. No doubt, he was somewhat surprised when I announced that I saw the Cheesegrater as the basis for producing a piece of visual music expressing the relationship between architecture and music. Nevertheless, from that time onwards, the architects of the Cheesegrater, Rogers + Stirk + Harbour, supported my idea and have remained enthusiastic ever since. Although they had not set out to produce architecture with a musical agenda, music had happened anyway in a structure that generated its own harmony, pattern, discord, repetition and silence. It was my sensing of these qualities at the Cheesegrater that prompted my venture to join the patterns of architecture with the rhythms of music in an experimental audio-visual performance called *Citirama* (Trickett 2017).

Now, a few years later, enough time has elapsed for me to take a retrospective look at what I produced so as to formulate a considered view on how



Figure 1: *The Cheesegrater invites people inside rather than presenting a closed façade to the world.*

music and architecture can be found to coexist: how an art form concerned primarily in mapping sound in time can be brought closer to an art form focused on what we experience in moving through space. All three movements of *Citirama* throw some light, each in its own way, on what makes a building musical. At the same time, I find that the images and sounds of *Citirama* conjure up memories of other buildings in my mind, past and present, which have exerted some power over my emotional response. This has happened, I believe, because hidden within *Citirama*'s flights of fancy lies a significant fact; buildings can become as emotional as they are instrumental, as intuitive as they are ordered. I will begin to explain this phenomenon with reference to my journey's start at the Cheesegrater.

As with all of Richard Rogers' buildings, the Cheesegrater makes its mark by revealing structure, services and circulation routes on the outside; the workings of the building are not hidden but, instead, they become the means of expressing its nature and function. It invites people inside rather than presenting a closed façade to the world (Figure 1). All in all, the character of the building offers a rich source of pattern making material. But what are these patterns? First and foremost, what I see is a series of leitmotifs. (I am making use of the musical connotations of this term quite deliberately.) Sometimes these are small details. At other times they are whole elevations or complete spaces. But always they serve to capture a design language that produces architecture of exceptional quality. This is what drew me to the building in the first place and explains why I have taken delight in joining the patterns of architecture with the rhythms of music and, conversely, joining the rhythms of music with the patterns of architecture.

CITIRAMA: FIRST MOVEMENT

In the first movement, I introduce a set of repeat patterns, all derived from the building's leitmotifs, which I then project on to the slanting façade of the Cheesegrater (Figure 2). (It is this slanting façade that has given rise to the building's nickname). Of course, my giant animated display could never happen in reality; the building is 45 floors high (currently, the tallest in the City of London)

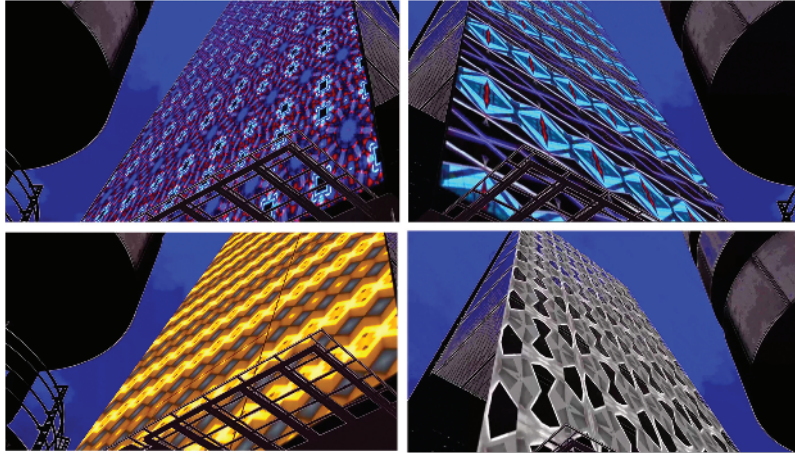


Figure 2: *The First Movement of Citirama reveals patterns projected on to the Cheesegrater's slanting façade.*

so, inevitably, my projections must remain a computer simulation. But this does not prevent them presenting a continually moving graphic interpretation of the leitmotifs where the rhythms of music join with those of architecture to promote a close interchange between the two art forms. In *Citirama*, the visual and aural elements of the performance are given equal prominence.

THE JEWISH MUSEUM, BERLIN

My projections on the Cheesegrater are an outward expression of the building's intrinsic musicality but where such a quality is extrinsic, as in Daniel Libeskind's Jewish Museum, Berlin, it can be allowed to speak (or sing) for itself. The Museum's geometry, based on distortions of the Star of David, produces not just a zigzag spatial experience internally but, also, a graphic expression of the Museum's musical score on its external elevations and roof plan (Figures 3 and 4). It is a building that elicits a strong emotional response from visitors which exemplifies Libeskind's belief that the way architecture is produced and received can be very similar to music – a fact that is less surprising when you know that, before becoming an architect, he was a high-calibre performing musician. As Libeskind comments:

I see architecture as musical. When I look at buildings, I do not just see them as planes, two-dimensional or three-dimensional projections. I see them as a musical composition. I hear them acoustically. Architecture is a world of relationships that is very, very close to my experience as a performing musician. My own response is that architecture, the way it is produced and received, is very similar to music.

(2008)

Libeskind had practiced long and hard to achieve his success in Berlin; the building itself was thirteen years in the making. It was influenced by studies carried out during Libeskind's previous occupation as head of the Architecture Department at Cranbrook Academy of Art in Bloomfield, Michigan, where he had produced a series of *Chamber Works* in which musical notation appeared

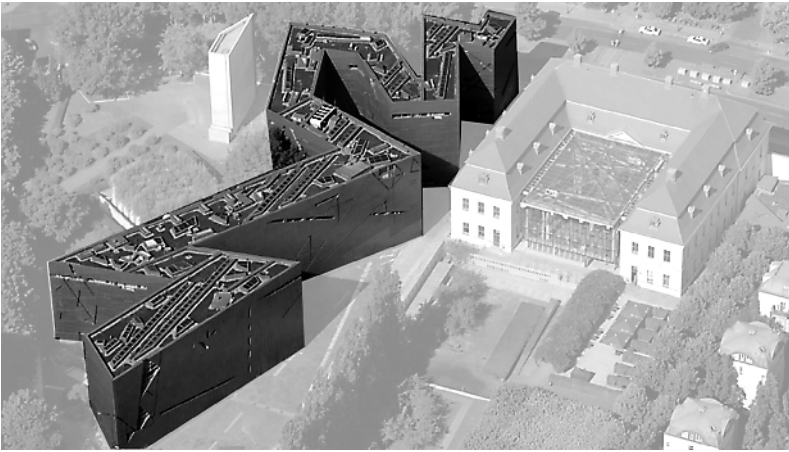


Figure 3: Aerial view of the Jewish Museum, Berlin. The zigzag geometry of Daniel Libeskind's building is based on distortions of the Star of David.

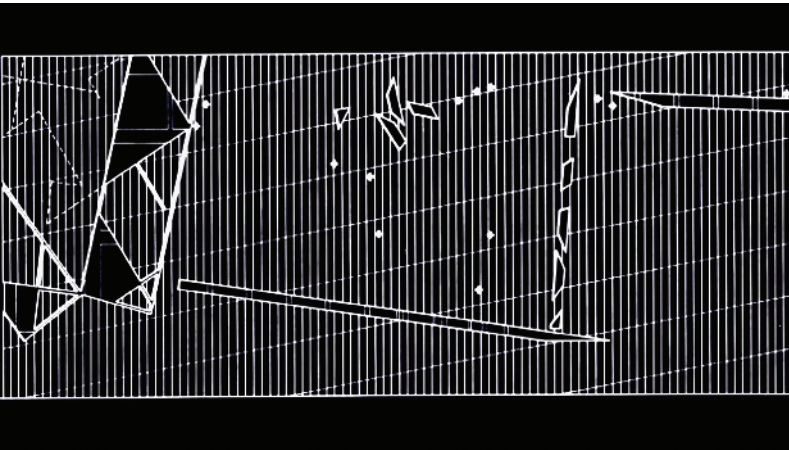


Figure 4: Part exterior elevation, Daniel Libeskind's Jewish Museum.

to be transcribed into 'spatial music' – a kaleidoscopic collection of lines and symbols that represent the structure of sound (Figure 5) (Libeskind 1983). They were not fantasy projects but architectural explorations which, as Libeskind states, 'embedded themselves in [his] own experience' (Libeskind 2008: 11). He used them continuously in his architectural work; in fact, they were the scores through which he orchestrated commissions.

For Libeskind, the 'sound' of the spaces he creates is as significant as the visual impact that unwinds within them; he orchestrates his compositions with reference to the abstract forms of his *Chamber Works* and, as in the case of the Jewish Museum, a particular musical work becomes instrumental in delivering a specific emotional impact. In Berlin, we are made powerfully aware of the Museum's sounds and silences; we can sense that the Void, which cuts across the whole of the building, was the architect's response to an episode in Arnold Schoenberg's *Moses and Aaron* – an incomplete opera that



Figure 5: Chamber Work by Daniel Libeskind – a kaleidoscopic collection of lines and symbols.

ends prematurely with 'o Wort, du Wort' no longer sung but spoken to convey the plight of Moses as he laments his inability to lead the people to the promised land. Libeskind's skill in conveying the emotions of melancholy, sadness and desolation, using only the techniques of architecture, is extraordinary and almost unique (Figure 14).

A COMMON LANGUAGE OF EXPRESSION

Libeskind's *Chamber Works* give the impression of being musical although they contain no specific signs of notation. For him, they act as devices for projecting the sound of spaces but, sometimes, similar graphic works, in the hands of composers, can be the means of producing the sounds of music. An example can be found in the work of Cornelius Cardew who, in his short life, experienced a remarkable musical volte-face. As a student, he introduced *Pierre Boulez's Structures* to the Royal Academy of Music, London, and later, in the late 1950s, he became Karlheinz Stockhausen's assistant preparing the score for 'Carre' – a project that caused him to fall under the spell of John Cage. As a result, Cardew abandoned formal notation in favour of improvisation where 'the subtlest interplay on the physical level can throw into high relief some of the mystery of being alive' (Cardew 1971). In 1965 he joined a group of four musicians in London to perform a pure form of improvisation operating without any formal system or limitation. About this experience, Cardew stated 'informal "sound" has a power over our emotional response that formal "music" does not, in that it acts subliminally rather than at a cultural level' (Cardew 1971).

Cardew's increasing anathema towards formal notation systems led him to produce *Treatise*, which consists of 193 pages of graphic score with no systematic instructions as to its interpretation and only the barest hints to indicate that the interpretation is to be musical (Figure 6) (Hall 2017). He believed that, ideally, *Treatise* should be played by musical innocents who have a certain facility in reading graphics. The performances that were most rewarding, at least to his ear, were by people who had acquired a visual education, escaped a musical education but had nevertheless become musicians. (That is me, by the way!) Cardew felt that the musical and the real worlds are one; musicality is a dimension of perfectly ordinary reality. He never expressed a view on

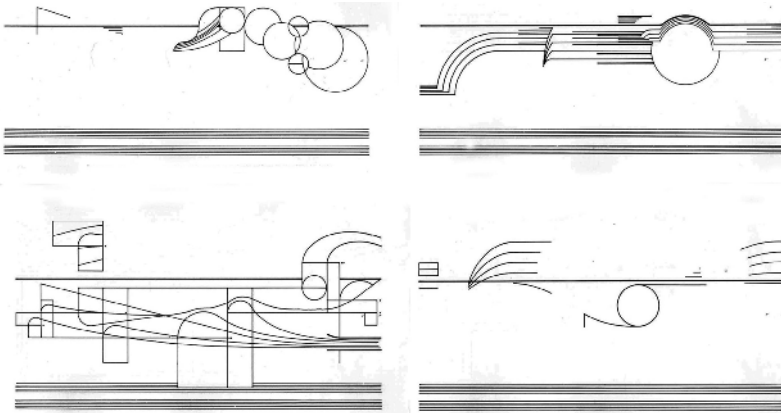


Figure 6: Four pages from *Treatise* – a graphic score created by Cornelius Cardew.

the ordinary reality of architecture although the quality of his graphic scores suggest, to me, that in addition to his well-trained ear he possessed an equally finely tuned eye. If ever he could have visited the Jewish Museum, I have no doubt that he would have reacted to the Museum's musicality as being something well beyond the ordinary. In my imagination, too, I see him raising his eyes skywards to experience the improvisatory impact of graphic fantasies played out on the Cheesegrater's façade. He would have recognized, I think, that it is through such pattern-making exploits that music and architecture can be seen to fuse together in a common language of expression.

THE MUSIC OF CITIRAMA

Before turning to the second movement of *Citirama* and the spatial patterns it weaves, I should explain why I choose visual music as a medium of expression for communicating ideas that are complex and/or controversial. In his book, *Emotion and Meaning in Music*, Leonard Meyer comments that 'music employs no signs or symbols that refer to the non-musical world of objects, concepts or desires' (1956: vii). It is for this reason, that the meanings that music imparts differ in important ways from those conveyed in architecture; the communication of emotional meanings as well as aesthetic and intellectual ones is the ultimate aim of those creating music whereas, in architecture an emotional impact happens only occasionally, sometimes intentionally or more often as an unexpected outcome. The expression marks used by composers in their musical scores indicate that, from the outset, the affective power of music underlies their reason for putting notes on paper. For their part, listeners are consistent in reacting to music emotionally and with feeling which explains why, as a participatory form of communication, visual music succeeds in engaging with audiences at both an intellectual and emotional level.

My choice of music for *Citirama*, Richard Rodney Bennett's *Sonatina* for Solo Clarinet, is improvisatory without being an improvisation. Like his saxophone concerto written for Stan Getz, it can be described as combining jazz harmonies with the composer's own free-flowing serial technique. Its constantly changing rhythms give the piece a compelling musical momentum, which expresses Richard Rodney Bennett's versatility in a wide range of modes and styles. Interestingly, as a student, he was contemporary with

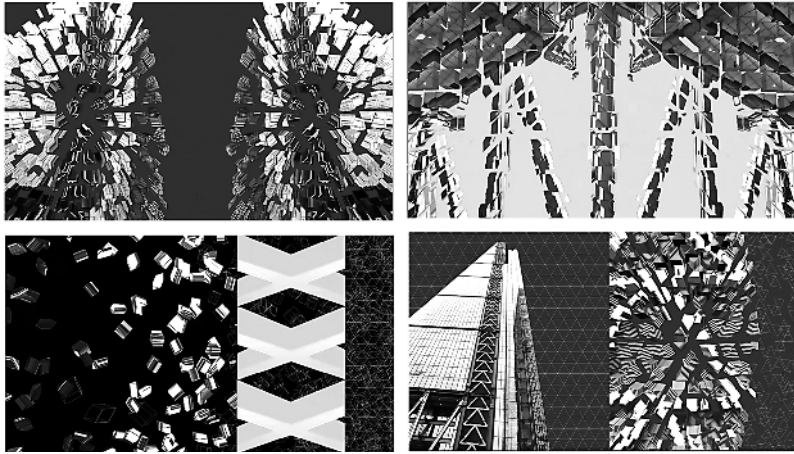


Figure 7: The Second Movement of *Citirama* reveals a series of explosions as the *Cheesegrater's* leitmotifs gradually come together or spin apart.

Cornelius Cardew; it was as a pair of virtuoso pianists that, together, they gave the performance of Boulez's *Structures* that I have already mentioned as being particularly significant in Cardew's early development. Richard Rodney Bennett spent further formative years working with Boulez in Paris where he embraced serialism but eventually decided to find his own way by fusing lyricism, jazz and classical conventions within a musical language that was to find success in over 50 film scores. The choice of his *Sonatina for Solo Clarinet* as the musical component of *Citirama* gives me an opportunity to demonstrate the composer's prodigious musicality in a piece of visual music, which I can only hope he would have enjoyed.

Moving on now to the Second Movement of *Citirama*, you will see that I create a series of reverse explosions as fragmented components of the building's leitmotifs gradually come together or spin apart to reveal the architectural elements from which they are derived (Figure 7). It is in taking a retrospective look at these visual events, that I am reminded of a comment made by Iannis Xenakis with regard to equivalent explosions in sound:

A complex sound may be imaged as a multi-coloured firework in which each point of light appears and instantaneously disappears against a black sky. But in this firework there would be such a quantity of points of light organized in such a way that their rapid and teeming succession would create forms or spirals, slowly unfolding or, conversely, brief explosions setting the whole sky aflame.

(Xenakis 1992)

Xenakis made this comment in connection with his own Stockastic Music, produced after he had both denounced polyphony and demonstrated the contradictions of serial music. In their place he proposed a world of sound masses, vast groups of sound-events, clouds and galaxies governed by new characteristics such as density, degrees of order and rate of change. In *Metastasis*, his first piece for full orchestra, Xenakis developed his Stockastic ideas in the form of *glissandi*; sonic spaces of continuous evolution derived

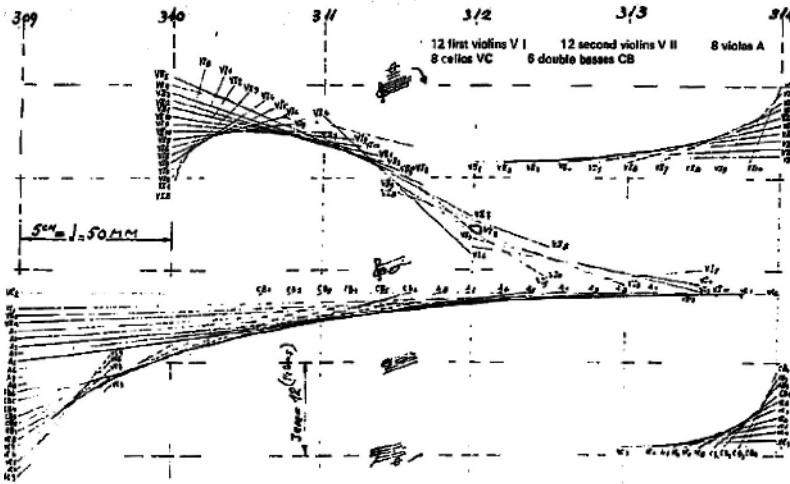


Figure 8: Bars 309–314 from *Metastasis* by Iannis Xenakis showing string 'glissandi'.

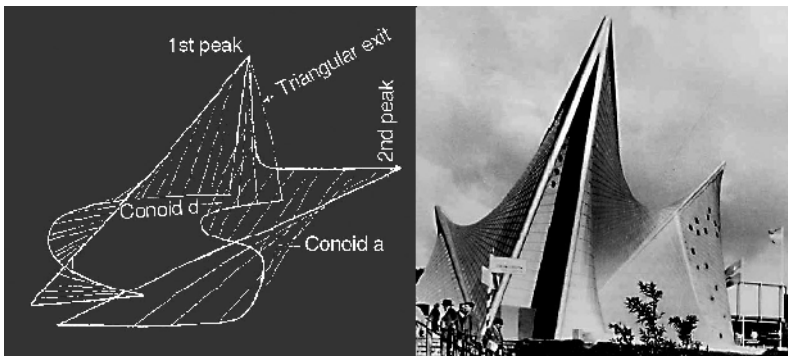


Figure 9: A visual representation of glissandi-produced forms that led, eventually, to the design of the Philips Pavilion at the Brussels World's Fair.

from long and interlaced sounds produced by dragging the bow across the strings of a violin, cello, viola or double bass (Figure 8). Further, he made a visual representation of *glissandi* by drawing a set of incremental straight lines to produce forms, which, eventually, led to designs for the Philips Pavilion at the 1958 Brussels World's Fair (Sterken 2001) (Figure 9). As an architect working in the atelier of Le Corbusier, he was given free rein to experiment with space, time and music – a rare opportunity that, to my knowledge, has not been repeated since.

THE PHILIPS PAVILION

Xenakis has been described as an 'architect of music'. In designing the Philips Pavilion, he combined the mathematics of Le Corbusier's proportional scale, *Le Modulor*, based on the Fibonacci series, with his own research on hyperbolic conoids to create a causal chain of ideas where music and architecture could be bound together in intimate connection. With an interior shape that

resembled the stomach of a cow, Xenakis's design involved creating tensile structures of steel cables strung from steel posts at the ends of the 'tent' to form his hyperbolic conoids. The Pavilion's complex shape meant that it could not be built as a conventional poured concrete structure so the final solution was to create a system of precast concrete panels hung in tension from the steel cables. The resulting *Poème électronique* combined architecture, film, light and music in a total experience made to function in time and space. Musically, Xenakis was responsible for composing a transitional piece heard by audiences before they were enveloped in the main space of light and sound pulsing to a score by Edgar Varese, a composer who Le Corbusier had chosen in preference to Benjamin Britten or Aaron Copland. The young Xenakis must have been less than pleased with his secondary musical role at the Philips Pavilion but, still, he had gained hugely from the opportunities it had given him to experiment with space and time.

A JOURNEY BACK IN TIME

It was as an architectural student that I visited the Brussels World's Fair, in 1958, to experience, at first hand, the all-enveloping sights and sounds of the *Poème électronique*. I still have an awareness of what it was like to be inside Xenakis's hyperbolic conoids; it is an experience that can never be repeated but it did provide, for me, some sort of measure by which the musicality, or otherwise, of a building could be assessed. But my journey did not end there; it continued, via discursions and vicissitudes, to the steps of the Parthenon. For many architects this building, and the Acropolis on which it is sited, is a place of pilgrimage. For me, the allure of its architecture had been prefaced by visits to the *Elgin Marbles*, in the British Museum, where the sense of movement and rhythm conveyed by these relief sculptures from the frieze of the Parthenon was a cause of wonder. They sent out a strong signal that I must find out for myself whether or not their birthplace, on the hill of the Acropolis, would exert a similar impact.

THE PARTHENON

Many before me have felt the pull of the Parthenon. Almost more than any other observer, Le Corbusier, in his *Towards a New Architecture*, regarded it as an exemplar of almost every quality he admired in architecture; he devoted far more words (and illustrations) to the Parthenon's features than to any of his other references. He found in the Parthenon a work that 'rings within us in time with a universe whose laws we obey, recognize and respect' (Le Corbusier [1927] 1986: 19). He described a site, which is surprisingly uneven and out of square, as a place where visitors experience vistas stretching from the mountains to the sea (Figure 10). The buildings themselves, the Parthenon, the Erechtheum, the Propylea and the temple Athena Nike, are arranged asymmetrically with the relative distances between buildings creating a variety of rhythms:

rhythms apparent to the eye and clear in their relationship to one another. And these rhythms are at the very root of human activities. They resound in man by an organic inevitability, the same fine inevitability which causes the tracing out of the Golden Section by children, old men, savages and the learned.

(Le Corbusier [1927] 1986)



Figure 10: Aerial view of the Acropolis. In his visit of 1911 Le Corbusier saw a 'system which appeared to satisfy a spiritual order through the pursuit of ingenious and harmonious relations' (Le Corbusier [1927] 1986: 75).

The Parthenon was the apogee of a long process of development and constant refinement. Sophisticated techniques were used to combat the optical illusion that a large-scale building appears to be curved. To create the illusion of straightness, the columns lean over slightly inwards, a device that makes the Parthenon appear lighter than its heavy marble construction would suggest. Also, the stylobate, or floor of the temple, is not exactly flat but rises slightly in the centre. The columns have an entasis (i.e. a slight widening towards the halfway point in their height) and the four corner columns are almost imperceptibly wider than other columns. The combination of these refinements makes the Parthenon seem perfectly straight, symmetrically in harmony and gives the building a sense of vibrancy. As Le Corbusier comments, 'if we are brought up short by the Parthenon, it is because a chord inside us is struck when we see it' ([1927] 1986: 212). It's an impact that can't be felt in other Doric temples, which, by comparison, seem static and fail to raise the emotions.

My own visit to the Parthenon all those years ago was the start of a process of inquiry that has continued ever since. Sitting on the temple's steps in the company of Richard Rogers and Paul Koralek, watching the sun go down was a life-changing experience. Today it would be difficult to recreate the same sense of a 'work ringing within us in time with a universe whose laws we obey' because of ongoing restoration work which has caused the monuments to be hidden behind a plethora of scaffolding. But, back in 1958, for all three of us at various stages of becoming architects, the Pentelic marble cast its magic spell. The fact that it was a visit to Richard Rogers' Cheesegrater, which prompted me to set out on this current, vicarious journey through space and time seems, in retrospect, to be both apt and inevitable.

THE MEASUREMENTS OF SPACE AND MUSIC

Le Corbusier had found, at the Parthenon, an exceptional piece of architecture that can 'make people serene or gay [*sic*] as can music' ([1927] 1986: 183). He had recognized that there was nothing accidental about the subtleties of measurement and optical devices employed to ensure the temple's effect on

those who came to worship. Its form of architectural expression communicated emotional meaning by means of the meticulous measurement of space and the calculated delineation of light and shade on solid marble. We can only wonder at the system of dimensional coordination that produced such perfection; as an expression of the universality of the Golden Section, the Parthenon, more than any other building, has influenced the course of western architecture ever since. Moreover, at the time it was built, the Parthenon represented the apotheosis of mathematical discoveries and deductions that had taken place just one century earlier at the Pythagorean School in South Italy. It is a story that begins to explain the Parthenon's musicality.

As a young man, Pythagoras undertook a journey to Babylon and Egypt, the birthplaces of mathematics, and returned to what is now South Italy with the conviction that all of creation exists in a perfect harmony of numbers; he divined that the orbits of the planets play musical notes whose pitch is dictated both by the speed of their movement and their distance from the sun. He was not far wrong in his conjecture because physicists now believe that the universe is fundamentally wave-like and can be represented by a temporal evolution of sound wave forms (Alexander 2016). In matters of measurement, too, Pythagoras was responsible not only for his famous theorem, $a^2 + b^2 = h^2$, but, also, for the western music scale. He picked out, from the repeated hitting of a blacksmith's hammers on an anvil, sound vibrations, or notes that were pleasing to the ear. As the hammers used by the blacksmith differed from each other by ratios of one half, he was able to deduce the interval of an octave and, then, by applying this same principle to vibrating strings with lengths that were successively divided in halves, Pythagoras produced the notes of a major scale. It is a very similar set of intervals that produce the Fibonacci Series and, thereby, the proportions of the Golden Section, an irrational number which features in nature and, reputedly, became the subject of a treatise written by Theano, wife of Pythagoras, who ran the Pythagorean school in southern Italy following her husband's death. It was the Pythagoreans, then, husband and wife, who established the indelible links between architecture and music that, ever since, have remained viable and immutable (Figure 11).

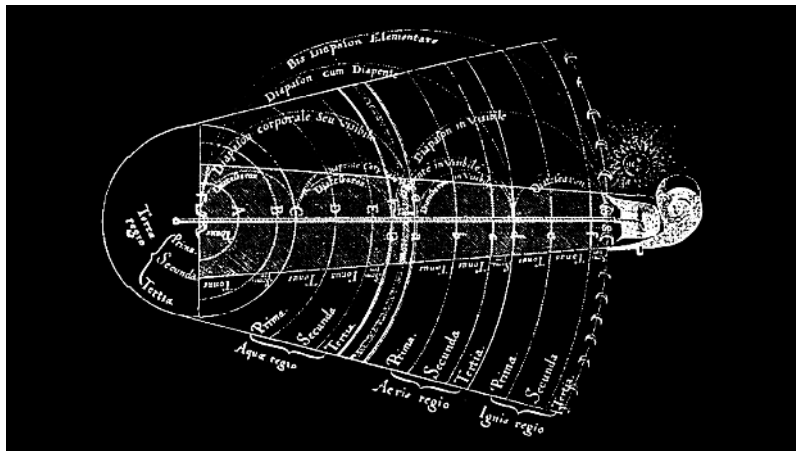


Figure 11: Pythagoras conceived the universe as an immense monochord with its single string stretched between heaven and earth. His law of the octave set out the mutual relationships of planets, colours and musical notes.

The measures and rules of mathematics underpin both the creation of visual harmony in architecture and the aural ‘tensions’ between the pitch of notes in music. Time tensions are produced, too, in music by setting up clear fixed points by which time is measured. Such regular tensions create the rhythm of a piece. In the earliest period of western musical history (represented by plainsong) rhythm was largely unmeasured. Today, the opposite applies; complex irregular rhythms are meticulously measured down to the last fraction of a beat. This is the subject of *Citirama*’s third movement.

CITIRAMA: THIRD MOVEMENT

In this final movement; a series of quick-change *collage* confound the eye as each image, showing a different arrangement of the Cheesegrater’s leitmotifs, appears and disappears in time with the constantly changing rhythms of Richard Rodney Bennett’s music (Figure 12). As ever, the Greeks have a word for it – *rhythmos* – movement, fluctuation or variation marked by the regular recurrence or natural flow of related elements.

UNITÉ D’HABITATION, MARSEILLE

To exemplify rhythm in architecture, Le Corbusier again becomes my muse and mentor. He had seen, at the Parthenon, a system which appeared to satisfy a spiritual order; as he said ‘it confers on the work the quality of rhythm’ ([1927] 1986: 75). He knew instinctively that it is through rhythm that architecture can begin to speak the language of music and, by this means, evoke an emotional response from its audience. In architecture the notation of rhythm is achieved through geometry which explains why, after his 1911 epiphany on the Acropolis, Le Corbusier dedicated himself to finding a method for fixing the fundamental geometry underlying art and architecture. His appreciation of the Pythagorean definition of harmony achieved by numbers led, eventually, to his own *Le Modulor*, which provided a harmonic set of human scale measures as an ‘assurance against capriciousness’. It was a project, developed



Figure 12: The Third Movement of *Citirama* reveals a series of quick-change collage with each one formed from a different assembly of the Cheesegrater’s leitmotifs.



Figure 13: At *Unité d'Habitation* in Marseille, Le Corbusier disposed of arbitrary metric measurements and replaced them with 'the remarkable resources of numbers' derived from his *Le Modulor man*.

during the 1930s and 1940s so that, by the time Le Corbusier started to receive post-war commissions, he was ready to test the tenets of *Le Modulor* on a real building – the *Unité d'Habitation* in Marseille (Figure 13). Here, he put into practice his ideas for a 'vertical garden city' by supporting the structure on massive *pilotis* to allow for circulation and gathering space flowing through at ground level. Designed like a huge liner, *Unité d'Habitation* 'disposed of arbitrary metric measurements in construction and replaced them with the remarkable resources of numbers and, in particular, the fruitful and inexhaustible Golden Section' (Cohen 2014: 14). Its proportions and leitmotifs reveal musical meaning just as Le Corbusier intended because, always, in giving presentations of *Le Modulor*, he described it as 'a tool of linear or optical measures similar to a musical script' (Cohen 2014: 2).

ARCHITECTURE AS PERFORMANCE ART

So, what can be learned from these memories of past journeys that *Citirama* has conjured up in my mind? In particular, I think we can see more clearly what Libeskind means when he says that architecture is a world of relationships that is very, very close to his experience as a performing musician. His buildings create an emotional response because they create the conditions necessary for the arousal of affect; the minds of visitors to his Jewish Museum are activated by a stimulus that is purely architectural which, nevertheless, produces a tendency for them to respond because the spaces are not 'concluded' as expected. They have meaning precisely because they are uncomfortable and seemingly unfinished (Figure 14). Clearly, this is not the purpose of architecture generally but Libeskind's work does make the point that meaning and emotion can be projected in architecture as it can in music. Visitors are made to feel what the creator intended.

In terms of music, Leonard Meyer puts forward the idea that emotion or affect is aroused when a tendency to respond is arrested or inhibited (1956). In everyday life the tensions created by the inhibition of tendencies often go unresolved; they are meaningless and accidental. By contrast, in art, the inhibition of a tendency becomes meaningful because the relationship between the tendency and its necessary resolution is made explicit and apparent. However, precisely how completion will be accomplished cannot always be anticipated; the listener can be left guessing as illustrated by two excerpts shown here (Figure 15). Haydn, in the Minuetto of his 'Symphony



Figure 14: At his Jewish Museum, Libeskind's skill in conveying the emotions of despair, sadness and desolation, using only the techniques of architecture, is extraordinary and almost unique.

Minuetto from Haydn's Symphony No. 104 in D Major

Opening to Sergei Prokofiev's 'Peter and the Wolf'

Figure 15: These two excerpts show how composers set up 'surprises'. Haydn produces a surprise tension by creating a 'structural gap'; it arouses the keenest expectation because the listener does not know how it will be resolved. In the third bar of Sergei Prokofiev's 'Peter and the Wolf', the composer repeats a wrong note sequence to confirm that he meant it. This is surprising because the wrong notes are not those that the listener might have been led to expect.

No. 104', creates a 'structural gap' which produces a hiatus – a surprise tension. It arouses the keenest expectation because the listener does not know how it will be resolved. Another example occurs in the opening bars of Sergei Prokofiev's 'Peter and the Wolf'. When compared with the melodic intervals in the first two bars, the intervals in the third bar are strikingly improbable; they sound 'wrong'. But Prokofiev immediately repeats the wrong note sequence to confirm that he meant it. A 'surprise' is produced because the wrong notes are not those that the listener might have been led to expect. These examples show how composers play with the expectations – tendencies to respond – of their audiences; they continually *take the attitude of the other* into consideration by anticipating the listeners' response to a deceptive sequence of notes (or structural gap) and, then, controlling the subsequent stages of a composition with reference to that supposed response. The performer, too, adopts a

similar *attitude to the other* or, as Leopold Mozart put it, the performer must play everything in such a way that he himself will be moved by it.

When we listen to music, it is our recognition of countless moments of 'surprise' that keeps our attention and enables music to cast its spell. The way a composer chooses to engineer his or her surprises is what produces the individual sounds and rhythms by which we instantly recognize and react to a piece of music. Harrison Birtwistle provides an apt insight to the composer's art when he says:

What we do is to set up a surprise. The continuity of music and the continuity of tonal harmony sets up a certain context. If it is just mundane and ordinary then it simply goes through the process of this. But the great composers can set up something which is in a continual state of surprise.

(2004)

Is such an attitude to communication either possible or even desirable in the world of architecture, I wonder? If music is to become the key to instilling more 'feeling' and responsiveness in our buildings, it will require a big step forward from processes of design, which produce only occasional 'musical' buildings to a system that enables the lessons of music to be applied more widely. I am given some hope in this endeavour by recent progress into the mysteries of how we see and how we hear. Investigations by neuroscientists are beginning to penetrate the extremely complex methods by which our brains' pathways and neural mechanisms recognize shapes and hear sounds. In this article, I can give only a brief summary of results so far but they will be sufficient, I think, to reveal how science can provide the lead in enabling architecture and music, once again, to sing in unison.

THE BIOLOGICAL LINK BETWEEN ARCHITECTURE AND MUSIC

'The science of auditory and visual scene analysis' is the all-encompassing title of what has become a new scientific discipline (Kondo et al. 2017). Visual scenes (which embrace buildings) consist of a complex array of reflected light from objects and surfaces, which impinge on our retinæ and, thereby, stimulate neural signals to the brain's visual cortex. Although the sensation of seeing occurs extremely rapidly and is seemingly effortless, the visual input is highly complex and dynamic, changing with each fixation as we move our eyes. The features of a scene, its spatial layouts, boundaries and textures, are somehow combined seamlessly into a coherent overall picture. It is known that the process involves the brain's pathways and neural mechanisms bringing together multiple 'snapshots' to form an invariant representation of a scene (or building); the separate properties of a scene are 'recognized' by breaking them down into their basic shapes and patterns. It is the entry of these patterns into the brain's short-term memory which causes the automatic activation of specific matches that might exist in the long term memory. This process of recognizing patterns allows us to predict results and expect what is coming. When I think of it, I must have applied a system of visual scene analysis during my visits to the Cheesegrater; no doubt, my brain was engaged in just such a process of pattern recognition in defining the building's leitmotifs (Figure 16).

Pattern recognition is again the key to the way we hear – i.e. our systems of Auditory Scene Analysis. When listening to a musical phrase for the first



Figure 16: The brain's neural mechanisms analyse the contribution of multiple 'snapshots' to achieve an invariant representation of a scene.

time, the recurring nature of the music's note clusters allows the listener to recognize features such as the phrase's time, pitch and rhythm. It is when established patterns are broken that the excitement of listening increases and a problem solving opportunity arises. At this point, the brain may activate its long term memory to reference material and additional stimulation stored there and, as in Visual Scene Analysis, it is the entry of this further information into the auditory short term memory that enables the brain to solve problems by reconstructing all the musical features of the phrase into a perceptual whole. The longer the listener is denied an expected pattern, the greater the emotional arousal when the pattern returns. Neuroscientists now believe that music engages the brain regions connected to motor actions, emotions and creativity. Also, when watching or hearing music being played, neurons associated with the muscles needed for playing an instrument fire; they act as 'mirror' neurons which light up when non-musicians as well as musicians listen to a piece.

THE GLOBAL CONSCIOUS WORKSPACE

Auditory and visual scene analysis reveals how our brains interpret information, interact with it and act upon it. In all, the brain may contain up to 100 billion neurons and a large proportion of these, assembled together in clusters, are involved in processing what we see and hear. Each neuron performs a specialized function according to instructions encoded in its DNA, its history and chemical influences from other tissues. A large proportion of these tissues are unconscious; there is no centralized command that tells neurons what to do; just as each cell in the body is controlled by its own molecular code, the adaptive networks of the brain are controlled by their own aims and contexts (Baars 1997). The result is a 'global workspace' where conscious contents appear to be disseminated globally to a great multitude of networks throughout the brain that are unconscious (Figure 17). It is this consciousness network, including the auditory and visual cortices, that creates access to the knowledge sources of the brain (contained in the long term memory). The concept of the global workspace makes consciousness comprehensible.

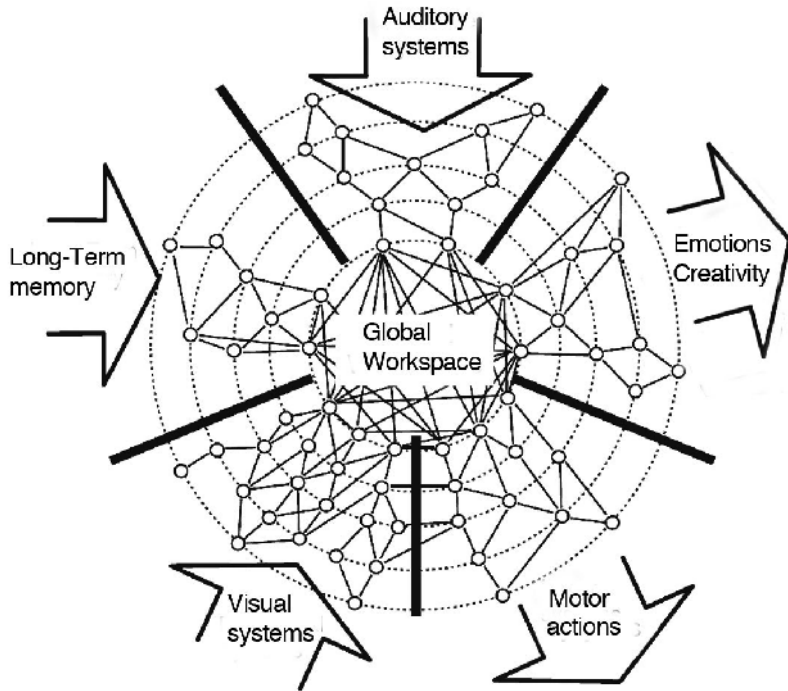


Figure 17: The massive connectivity of the brain's 'global conscious workspace' (Dehaene et al. 2011).

Varying concepts of the global conscious workspace are still at the conjectural stage but it is possible to envisage a diagrammatic structure where distinct areas of activity are linked into a global workspace, which is characterized by massive connectivity. This structure would account for the way auditory inputs generate motor activity (like dancing) and the fact that, in our efforts to understand the world around us, every visual signal has an auditory counterpart. It is by this means that architecture and music are fused inevitably together in our brains; the links between the two art forms are not only mathematical but also biological – a fact that might enable architects to act more like composers in *taking the attitude of the other* and by giving increased emphasis to how buildings see us and their world.

AN EXEMPLAR OF 'MUSICALITY'

As I stated at the outset, architecture and music have underpinned my life's work and pleasure although, for the most part, these two worlds of activity have been parallel rather than intertwined. It has taken a vicarious journey through time and space, as described in this article, for me to make connections which, somewhat to my surprise, reveal that my own predilections for experiencing architecture as music are not entirely quixotic but can now be established as scientific fact. Given some confidence from this discovery, I am now going to illustrate what I mean by 'musicality' with reference to a specific urban environment that is close to home – in fact, it is home!

It is only in the last year that Lynn (my wife) and I have moved into the Barbican in the City of London (Figure 18). Known as a 'brutalist' housing



Figure 18: The Barbican is an exemplar of architecture as performance art that delivers constant surprises to the eye and ear along high-walks of life, revealing unexpected vistas amid the sounds of fountains.

estate, the Barbican is located within a stone's throw of the Cheesegrater, which was not only the inspiration for *Citirama* but, also, acted as the launch point for my present journey through space and time. In spite of its location in the heart of the City of London, the Barbican provides total separation between vehicular and pedestrian traffic; it is one of the safest environments in the United Kingdom, its imaginative planning of 2000 separate housing units keeps people connected without being 'on top of one another'; it offers a wide range of living options, low rise and high rise, within a generous provision of landscaped gardens. The fact that it is an estate that has embraced and retained, without compromise, the benefits of 'garden city' planning principles laid down initially by Le Corbusier makes the Barbican one of a very few large-scale housing schemes, worldwide, that survive and prosper. But none of the above facts really explain the Barbican's enduring quality, nor its 'musicality'.

Above all, the Barbican demonstrates what I have been seeking to explain – an approach to *taking the attitude of the other* which far exceeds normal architectural problem solving, where buildings are not seen as merely two dimensional or three dimensional projections but, instead, regarded as an opportunity to communicate emotionally as well as aesthetically and intellectually. The architects, Chamberlain, Powell and Bon, were not musicians as far as I know but they still revealed a composer's instinct by taking obsessive account of the expectations – tendencies to respond – of the Barbican's intended inhabitants. The City of London Council's long-deliberated decision, in the 1950s, to build housing, and not offices, on the largely destroyed West side of the City was a closely won victory for common sense. Thereafter, the City stuck to its guns and refused to suffer compromise – hence the Barbican's reputation as one of the bastions of design that register at both the level of form and behaviour. The architects' determination to implement the ideals of Le Corbusier were characterized by a proportional system based on his *Le Modulor* as shown to full effect in the Barbican's fenestration which resembles that of the *Unité d'Habitation*. Overall, the Barbican is a masterpiece of brutalism where the overall composition exhibits almost the complexity of a natural environment that can make people *serene or gay [sic] as in music*. It is an

exemplar of architecture as performance art which delivers constant surprises to the eye and ear along high-walks of life revealing unexpected vistas amid the sounds of fountains – a paradigm for our future cities, no less.

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The Idea of the Avant Garde And What It Means Today, Volume 2

Edited by Marc James Léger

The concept of the avant garde is highly contested, whether one consigns it to history or claims it for present-day or future uses. The first volume of *The Idea of the Avant Garde – And What It Means Today* provided a lively forum on the kinds of radical art theory and partisan practices that are possible in today's world of global art markets and creative industry entrepreneurialism. This second volume presents the work of another 50 artists and writers, exploring the diverse ways that avant-gardism develops reflexive and experimental combinations of aesthetic and political praxis. The manifest strategies, temporalities and genealogies of avant-garde art and politics are expressed through an international, intergenerational and interdisciplinary convocation of ideas that covers the fields of film, video, architecture, visual art, art activism, literature, poetry, theatre, performance, intermedia and music.

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