Cybernetic systems of music creation

Simon Strange

Cybernetics stands for ‘openness, for the capacity to see things from several perspectives at once, for a refusal to adhere to a fixed and singular point of view and to a fixed hierarchy’ (Steenstra 2010: 34).

Introduction

The arm of the device is lifted with fingertips just above the perpendicular, to about 60 degrees. Gently it is left to fall of its own volition and as the force of gravity takes over, the downward motion starts a randomized movement in the second arm. It is beautiful; constantly changing, always original. Like a perfectly formed artistic creation. A double pendulum differs from a single pendulum in a simple mechanical way; it adds a second element to the construction. This is a simple device but the differences triggered are extreme, as something that started out with a simple back-and-forth motion suddenly becomes a random, multidirectional machine. For Brian Eno (2017), this helped to explain, and facilitated his demonstration of, the basic principles of cybernetic systems theory.

Cybernetics was a key part of Eno’s art college teachings and helped to define his production and composition processes, which imbibed key art works, and holds opportunities of investigation for music educators, especially for those working in songwriting. His first encounters with system-based creation came from the chance moment of enrolling on Roy Ascott’s revolutionary *Groundcourse* in 1964, within the

fine art department at Ipswich Civic College. Eno stressed how under Ascott, 'the first term at Ipswich was devoted entirely to getting rid of those silly ideas about nobility of the artist by a process of complete and relentless disorientation' (Scroates 2013: 24). This art course helped Eno to define himself and his future 'interest in systems, creative problem solving and thinking pan-culturally across the arts and sciences' (Bracewell 2007: 207). His time there also helped to inspire his 'fascination in the connection between intellect and intuition' (Bracewell 2007), and his exploration of complex results arriving from simple, defined processes. Eno's albums were influenced both compositionally and in production through these ideals, so a thorough examination of this canon within the context of Higher Popular Music Education (HPME) seems long overdue. Music journalist Paul Morley (2004) would outline Eno's impact by listing *My Life in the Bush of Ghosts* (Byrne and Eno), *Fear of Music* (Talking Heads), *We Are Not Men* (Devo), *Achtung Baby* (U2), *Low* (Bowie) and *For Your Pleasure* (Roxy Music) as his six favourite Eno-inspired albums; then admitting that they might overall be his six favourite rock albums.

All of these works contained elements that could be construed as demonstrative of paradigm shifts in the history of late twentieth-century popular music, both within compositional and production-based processes. The albums exemplified utilization of principles of change, where non-hierarchical concepts challenged those previously apparent in the making of music. The authentic auteur is replaced by a collaborative and self-determining creative group, outlining a systemized process that I believe could be productively explored in songwriting education, where specific hierarchies that outline the relationship between band members and also the audience can be examined. It is the

patterns within a field that are important within systemized creation, and as Ascott saw changes that were occurring in art, he was excited by the possibilities that were opening up with the arrival of new technologies, and also a concentration within art forms that centred on thought processes rather than specific techniques. He reasoned that 'a shift of human interest is from the thing, the object, the product, to the process, the system, the event in which the product is obtained' (Ascott cited in Shanken 2015: 66).

By the mid-1960s a wave of UK Art Schools (AS) supported the exploration of creative processes, reflecting the increasing influence of postmodernism, which challenged traditional artistic ideals where art forms such as conceptual, op and pop art grew in popularity (Ehrenzweig 1967; Madge and Weinberger 1973; Tickner 2008). There was a rethinking of the role of the artist which connected to the 'low' art ideals of pop music, where traditional musicianship was less important and creative development was centred closer to the concept (Frith and Horne 1987; Bracewell 2007). Ascott's 1967 manifesto *Behaviourables and Futuribles* highlighted the philosophy behind his teaching, which constituted a paradigm shift in art pedagogical thinking: '[W]hen art is a form of behaviour, software predominates over hardware in the creative sphere. Process replaces product in importance, just as system supersedes structure' (Ascott 2003: 3).

Art schools

The Coldstream Report of 1960 added regulations but also in addition gave UK AS the opportunity for freedom of course content and structure, which led to the enabling of many creative classroom experiments (Banks and Oakley 2016; Westley cited in Llewellyn et al. 2015). The traditional 'life room', where figurative techniques were

developed in the recreation of the human body, started to disappear and was turned into an experimental workshop, with Roy Ascott's *Groundcourse* or the Peter Kardia-inspired *Locked Room*, key examples. Within these courses concept and process were deemed more important than product or artefact, with pop art, formal abstraction, minimalism and performance art increasing in importance, so that 'in practice, this avant-gardism was supported by the state' (Westley cited in Llewellyn et al. 2015: 56). For colleges which embraced experimentation, the changes that were occurring within art reflected a pedagogical ethos 'in which process, imagination and spontaneity were elevated over technique' (Charnley 2015: 1).

Within AS, the sound studio became an extra space where a new medium could be worked with, sonic manipulation where musicians became sculptors. Collage techniques introduced by László Moholy-Nagy into photography and other art forms at the Bauhaus helped to redefine art, while the introduction of tape machines created a medium through which music artists could transform sound. This was an incredible opportunity for a visual and auditory artist such as Brian Eno, a self-proclaimed non-musician (Tamm 1995; Eno 1996), who was inspired by the ideas of experimental artist musicians such as Jean Dubuffet, John Cage or Cornelius Cardew. These artist musicians redefined perceptions of music where 'all sound, all manipulation of sound, was of interest, as was silence, quietness and self-generating not-quite-repetition' (Hegarty 2007: 93). For the songwriter or composer, inspired by the art college-based avant-garde, minimalist ideals opened up a new field that relied less on technical accomplishments, where the use of repetition of sound, rather than shifts in harmony and melody, was the key ingredient. For the non-musician there was the need to 'create parameters, set it off,

see what happens' (Eno quoted in Sheppard 2008: 55), and Steve Reich's (1968) *Music as a Gradual Process* was a key text whose main tenet was about the systematic development of the process of composition. Within this system chance was an additional compositional element, alongside trusting the listener to take time to unpick the complexity inherent within the simplicity of minimalist compositions.

The process

Roy Ascott declared that the artist's 'audience expects, not a fixed attitude or viewpoint to the work, but a field of uncertainty and ambiguity in which they can, endlessly take part' (Shanken 2015: 66). Within this postmodern ideal, the musician starts to collaborate with the listener and the creative process becomes something where 'a shift of human interest is from the thing, the object, the product, to the process, the system, the event in which the product is obtained' (Shanken 2015). This altering of hierarchical conceptions was a key element of cybernetics, and became a focus for popular musicians such as David Byrne and Eno (Steenstra 2010), inspired by minimalist composers such as Reich or Philip Glass. These system-based ideals are part of the pedagogical process that is still being approached by Ascott's students on the Technoetic Arts courses, at the Shanghai Institute of Visual Art (Ascott 2017).

Bristol-based improvisational group Marcy demonstrate cybernetic principles of system and control in their compositional work. Their performances are random and undertaken without recourse to conversation on issues of genre or instrument make-up, and limited to levels of planning on venue and performance times. Their work is always on the edge, with risk-taking being a key concept. They set the double pendulum in

motion, letting it swing under its own gravitational force and allowing the randomized chaos to ensue, within a system of samplers, effects, microphones and everyday objects that set the boundaries under which the three musicians can operate. There is no hierarchy. Music unfolds and develops with power and rawness. This is art inspired by John Cage or the 1960s experimental group Fluxus, that performance artist Allan Kaprow would have defined as showing how the artists motivations and values have a revolutionary potential, perhaps. Innocence, imagination, intuition, pride, passion, courage, endurance, independence, freedom, recklessness, adventure'. These revolutionary creators believed that if you could maintain adherence to these principles, then as an artist you could remain creative throughout your life (Filiou 1970: 42).

John Conway's *Game of Life,* created in 1970, defined principles that highlight influences of the cybernetic games that Ascott was seeking from his students. It revolved around pre-programmed computer data, consisting of cells that were transformed from single into multiple bodies, by some basic mathematical rules. Depending on these algorithms, the growth of the cells related to the computer data already provided, which replicated the systematic notion of complexity coming from simplicity (Sheppard 2008: 304). This cell development exemplifies a non-hierarchical standpoint which is key to cybernetic principles; the system is linear and feeds back within itself, as Eno explains with reference to classical music:

> Well there is god, who inspires the composer, the composer passes that music down to the conductor. These are all sort of diminishing god like figures. Then there are the leaders of the orchestra, the second section principles, sub principles, down to the people in the back row of the second violin, the ones who scrape away. But that picture of organisation, everything went in that direction (drawing downward lines); the power is at

> the top, power and intelligence is at the top and it diffuses down. […] What we started to learn with cybernetics was that first of all, all of these different nodes are not connected in a chain like that, but they are complexly cross connected […] you suddenly got used to the idea of ecology […]. It doesn't mean that all these nodes are necessarily important, or strong or substantial or whatever, but it does mean that they are connected in very complicated ways, and that they are inherently chaotic.
>
> (Eno 2017)

Nature

Growth in nature could also be deciphered as showing cybernetic processes that are organic and complex in form. The early work of pop artist pioneer Richard Hamilton, leading on from Paul Klee and Johannes Itten at the Bauhaus, was extensively influenced by D'Arcy Wentworth Thompson's *On Growth and Form* (1917). This book took a biological and mathematical look at the mechanics of nature, and its attractiveness to the artist could be attributed to elements of form and function embedded in nature's beauty (Romans 2005: 200). It was the patterns and systemized processes of life displayed within nature that attracted artists such as Hamilton, as beauty was synonymous with its systems of growth. This work informed his philosophies of creative development, and the possibility that an effective drawing could be seen as a diagram of thought processes (Romans 2005: 207).

Ascott consumed this information from his time with Hamilton and Victor Pasmore at Kings College, Newcastle, encouraging his students to develop progressive and diagrammatic descriptions of the development of artistic work. Fellow key AS pedagogue, Tom Hudson, taught students at Leeds and Cardiff colleges of art to create an

'idea sheet', which allowed ideas to flow diagrammatically across the paper; in this way it is the process, rather than some 'artyness', that would be apparent. He called these 'research explorations' (Tibbetts 2014: 214). Clifford Ellis, director at Bath Academy of Art, 'built up a considerable collection of natural specimens for students to study, and encouraged the development of a visual biology laboratory run by Geoffrey Spencer for the benefit of art and education students' (Yeomans 1987: 278). Harry Thubron, again at Leeds AS, believed it was essential to look at the natural world because it was a way of observing, analysing and synthesizing information; an example of this could be demonstrated by looking at the process of flowers gradually degenerating over the course of time.

Eno's album *Ambient 4: On Land*, released in March 1982, reflected nature and the systemized processes of construction:

> The album suggests an environmental re-creation as much as a music composition. This is the mystery of Eno's work: presented as art, yet calling into question the very nature of art, Eno's compositions encourage listeners to reappraise their understanding of music and the uses of music.
>
> (Albiez and Pattie 2016: 103)

The sounds resonate with Eno's life and influences, including a track 'The Lost Day', which includes noises that reference the metallic ropes of sailing boats clanging against each other, that he remembers from his childhood in Suffolk (Pattie and Albiez 2016: 2). The music takes its cue, and becomes indistinguishable from, the background. Eno went to Winchester College of Art in 1966, where he discovered an AS that was more like a traditional academy than Ipswich, where the focus was more firmly directed at the product. This did not sway him from keeping up his idea of concentrating on the process.

He created a Drip event that combined music and art: ‘it made the most beautiful, delicate noise’ (Scroates 2013: 36). There was the combination of the sound and visual of the water dripping through tubes and onto various objects that created a range of varied sounds, with the river bubbling in the background (Scroates 2013). The level of the music is lower and the background ambience becomes part of the evolving sound, always different, repetitive and connected, reflecting influences of Erik Satie’s ‘Furniture Music’ (Scroates 2013: 120).

Cybernetics

Ascott discussed how cybernetics was about change, and this was key to his pedagogical philosophy (Lambert 2017: 51), whilst being systems-based it is a process that is applicable to various disciplines, including all areas of the creative arts. Ascott thought it was a suitable framework for development within art education and could take the place of the traditional life room, due to its focus on ‘change, interaction and dynamics’ (Ascott 2017). Philosopher Marshal McLuhan (1964) helped spread ideas from cybernetics-based systems of artistic creation as an influence on conceptual art of the 1960s and 1970s; the notion that ‘the medium is the message’ is apparent in many things, so it is important how a message is packaged. He recognized the importance of individuals within the development of cybernetic-based systems and helped the construction of widely held media theory. Feedback is important and also adaptable so that the individual within the system can manipulate and develop it within its framework, which updates the Bauhaus doctrine, where ‘art and production can be reunited only by accepting the machine and subjugating it to the mind’ (Gropius quoted in Royal Academy of Arts 1968: 14). The

1960s were awash with revolutionary thoughts and ideas including *The Whole Earth Catalogue*, conceived by Eno accomplice Steward Brand, which was a Utopian counter-culture toolkit and an introduction to systems thinking and design. It examined and unpacked relationships between nature and technology, alongside ecological and cybernetic-based systems.

The work of David Byrne and Brian Eno was informed by the systems-based elements of cybernetics, especially that expounded by Norman Weiner and Stafford Beer. This manifests around the decision paths and levels of control exercised in their music making and production. Beer's cybernetic work, *Brain of the Firm: The Management Cybernetics of Organizations* (1994) helped to inform Eno's set of information cards that he developed with artist Peter Schmidt, called Oblique Strategies, which randomized procedures by attempting to eliminate musicians' preconceptions and habitual practices. He also manipulated technology within the studio through elements of cybernetics, which occurred in techniques such as those based around dub mixing, as well as through the process of routing all signals through his ubiquitous VCS3 synth. For Eno, the studio was akin to a form of integrated management, where the recording process and the development of musical impulses would be self-regulating and controlled (Steenstra 2010: 7).

One of the key elements of Beer's work which helped to define his cybernetic principles, was that of variety. This was related to Ross Ashby's (1956) Law of Requisite Variety, 'which states that control can be obtained only if the variety of the controller is at least as great as the situation to be controlled' (Beer 1994: 41). He outlined that many businesses and systems try adding variety into the system rather than including it into the

design. I argue that songwriters could benefit from including this element of variety, concentrating on how it is generated, reduced, filtered, amplified and controlled (Streenstra 2010: 8). As Eno stressed, there were keys and clues within experimental music where systematic approaches were at play, with defined limits and variety (1996: 335). He discusses Cardew's piece 'The Great Learning', identifying what appears to be unlimited freedom in the score, the end results tending to be quite similar due to the allegiances and constraints of the performers. These were developed through the expectations of the societal norms that were instilled within the musicians from their technique-based learning processes, so that variety is reduced by the inherent prejudices and practices of the performers. Cybernetic self-regulating systems can eradicate preconceptions, as the artist is out of control, meaning that this hierarchy is diminished.

The rise of postmodern ideals, including the redefining of what constituted 'high' and 'low' art, the implementation of new technologies (Huyssen 1984), and the subsequent rise of the non-musician was exhibited at the *Cybernetic Serendipity* exhibition, housed within the Institute for Contemporary Art (ICA) in 1968. This was a collision of art, music and science, where computers took artistic control for the first time. Exhibition curator Jasia Reichardt defined the importance of new technology, and this mixing of machines and art:

> People who would never have put pencil to paper, or brush to canvas, have started making images, both still and animated, which approximate and often look identical to what we call 'art' and put in public galleries. This is the most important single revelation of this exhibition. (1968: 5)

The idea of the lone genius was debunked and replaced by the machine, where automation, computers, systems took control of the creative process.

One of the main exhibits was Gordon Pask's *Colloquy of Mobiles*, which highlighted the utilization of cybernetic processes. It was an installation that interacted with the audience, depending on the level of enjoyment the viewer found at certain points in their interactive process with the art piece. They could use mirrors to reflect light back to different sections of the mobile, interactions that Pask referred to as male and female light sources, and aimed at mimicking societal conditioning. Pask described its aim:

> An aesthetically potent environment encourages the hearer or viewer to explore it, to learn about it, to form a hierarchy of concepts that refer to it: further, it guides his exploration; in a sense it makes him participate in, or at any rate see himself reflected in, the environment.
>
> (Reichardt 1968 'n.pag.')

He had previously built one of the first music systems that was developed around cybernetic principle, the Musicolour machine, which was based on Pask's interest in Synaesthesia:

> it altered visual patterns on a colour wheel according to filters that analyzed the frequency, attack and rhythm; these then caused the performers to alter their music as they became familiar with the patterns, so the music did not become repetitive.
>
> (Lambert 2017: 48)

The idea was that the machine was programmed to change its responses independent of the performer so that they could not affect its output, where it was able to create things that they would not be able to do on their own (Pickering 2002: 427).

Byrne and Eno attempted to define which exact control mechanism affected the development of their music (Steenstra 2010: 46). For Stafford Beer, 'the first principle of control is that the controller is part of the system under control', regulating the input that a songwriter could utilize, that relates to cybernetic principles, allowing the system to help take control of the process of creation (Steenstra 2010: 32). He felt that humans were

by nature overly introspective, and that this lack of looking outwards could confuse the artistic processes. This demonstrated a perspective where the creative artist needs to be externally active, panoramic in nature and reciprocal in manner. As anthropologist Gregory Bateson believed, 'we might say that in creative art man must experience himself – his total self – as a cybernetic model' (Steenstra 2010: 33).

Talking Heads songs were often deconstructed to their bare bones and then reworked; sometimes each artist played half a part and then these disparate parts were welded together. This facilitated increased randomness and less direct, intended thought in the creative process (Steenstra 2010: 52). Byrne used a Dada poem in *i Zimbra* from *Fear of Music,* showing that when meaning is taken out of lyric creation, a new definition is generally sought by the listener (Steenstra 2010: 53). Both musicians started reimagining their music-making craft, where the vocal was implied and numerous simple parts slotted together to create a complex and invigorating-sounding whole. Parts were looped and dropped in and out, taking reference from the dub production techniques with which Eno had started to become fascinated, involving a complicated set-up of signal paths and effects in which simple cut-and-boosts of auxiliary sends (used to send audio signals to reverb or delay units, e.g.) could deliver a multitude of results.

Cybernetic processes became increasingly utilized in their next work, *My Life in the Bush of Ghosts*, a record where the idea of 'interlocking parts' was key. This was interrelated with and deferential to the work of Steve Reich, where multiple repeated patterns, with slight variations, caused beautiful harmonic shifts; so that multiple versions of simple parts, when welded together, create a more complex final piece (Steenstra 2010: 339). Byrne's vocals and lyrics in *Remain in Light* were concocted and

developed from Eno's rough drafts, inflections from preachers, randomly dialled radio stations, and African chanting and vocalizations. The process reflected the non-hierarchical ways that some traditional African communities operate and that their music is an embedded part of these. Generally, *Remain in Light* and Bowie's *Low* were key examples of Eno restructuring traditional rock hierarchies and infusing influence from minimalist music, as defined by The Velvet Underground, where instruments and vocals are assigned equal levels of importance within the composition and the mix.

For a songwriter or producer, the creation of a structure can reduce their exerted influence and paradoxically, therefore a purer sense of self can be attained that is less constrained by artistic preconceptions. Byrne looked to take elements of personality out of his songwriting, finding personalized creation by taking the conscious self out of the equation. He noted, 'my own ambition is to write a song that sounds like I stole it, like I didn't write it, but it has always been there. To get the "I" out of the song is the ultimate compositional coup' (quoted in Steenstra 2010: 192). This influence could be attributed to avant-garde composer John Cage, whose creative philosophy contained the 'acceptance of accident and the elimination of conscious interference' (Diaz 2015: 92). His piece 'Imaginary Landscape No.4', written in 1952 for twelve radios, featured musicians tuning radios and using frequencies and gaps in the songs to create a random piece of music. They were 'like fishermen catching sounds' and Cage was most concerned with 'the perceptual relationship between composer, piece and audience' (Steenstra 2010: 192). The listener became a vital component of the composition, which reflects a more art-based ideal. More recently, British artist Stephen Willatts incorporated elements of cybernetics and semiotics into his work, allowing for a dynamic interaction

between creative ideas and society: '[i]f the artist was in a relationship with the audience, and the audience was part of society, the artist was in a relationship with society, so there was feedback' (Shanken 2015: 70).

Feedback loops and systemized composition, developed within tape-based processes, defined two albums recorded in 1975: Lou Reed's controversial *Metal Machine Music* utilized the studio live room as a space which interacted with instruments, where guitars were rested against Reed's amps and left to sound and interact, generating extreme feedback. Comparatively, Brian Eno's first Obscure label release and original ambient album, *Discreet Music*, used feedback directly, with a couple of tape machines building loops with the sounds expanding upon each other (Dayal 2009: 91–92). Within both these recordings there are multiple levels of feedback where the instruments used interact with themselves, as well as interacting with the space. Additionally, the rooms had a tone and generated enough noise so that they vibrated and created their own characters and resonances (Stearns 2017: 36). This is representative of the visual artist who uses a variety of contrasts and materials in the creation of an artistic piece.

Flow

Mihalyi Csikszentmihalyi (2013) found that interviewees in one of his research projects enjoyed the process of creation or work more than the finalized product. In a 'flow' state, creativity seemed to be based within systems and every small discovery within a process became an exciting moment (Csikszentmihalyi 2013: 109). Within the compositional process there are multiple times when unexpected eureka moments help spur the process,

and enthuse the direction or flow of the piece. Creating a structural outline helps to develop the interest and ideas that arise within the process, with the way that the controller shapes the direction of a piece of work being defined by their reaction to these moments. UK avant-garde composer Gavin Bryars allocates a large proportion of time planning and developing the ideas for a piece of music, before committing it to paper, thereby organizing the system into which the creativity can flow (Bryars 2017).

The incorporation of structural change alongside a redefining of the concept of music creation systems helps interesting and innovative work to flow. Alongside Cardew's improvisation-based Scratch Orchestra, Bryars' Portsmouth Sinphonia, formed at Portsmouth College of Art in 1970, was aimed at musicians of any standard and included an eclectic mix of mainly AS-based performers. This included at various moments, Eno on clarinet, Michael Nyman playing the cello and Deaf School's Clive Langer, lead flute. There was intent in the group to play as expertly as possible, it was just that there were quite a few lapsed or uncommitted classical musicians, resulting in music that was in parts stunningly discordant alongside moments of extreme beauty and oceans of humour (Bryars 2017). As Eno recalled:

> Something very magical happened when people tried their hardest to play things that they often had no hope of managing. There was something so touching about this. It was like flocking behaviour in birds: following the melody was a cloud of misinterpretations.
>
> (Eno quoted in Bracewell 2007: 240)

Keith Sawyer mentions that group performances or compositions help the development of a flow state, due to the complexity of creatives interacting and integrating 'their partners activity into their own unfolding activity' (2012: 350). He continues by stating

the importance of the group dynamic in blurring the boundaries between a musician's conscious and unconscious mind in the process of creation (Sawyer 2012: 351).

Tom Phillips, an art educator and musician who mentored, lived and worked alongside Eno, believed that being a member of the Portsmouth Sinphonia was an ideal way to get a music education, due to an appreciation of the results that could emerge from something that seemed so haphazard (Bracewell 2007: 240.). The basic system of the orchestra and the score was present, so it allowed a creative energy to be exercised within these bounds, which Clive Langer (2018) summarized as 'a bit like being on a roller coaster instead of being on a drag track. The music was being pushed and pulled in tempo and in pitch, which at times sounded really good'.

Chance

Eno, talking about the ideas behind his second solo album, *Taking Tiger Mountain (by strategy)*, said that he was attracted to the ideas of systems, such as those present within Maoist China. He was intrigued by the idea of strategy, saying it 'interests me because it deals with the interaction of systems, which is what my interest in music is really, and not so much the interaction of sounds' (Sheppard 2008: 176). This is also reflected in his generative music, using software developed by SSEYO called Koan Pro, which facilitated a reduction in the control of the performer, and an allowance that the system will make compositional decisions itself. Also Eno's Obliques Strategies were designed to take the will of the composer or performer out of the equation, linked to the chance procedures of Cage and George Brecht's 'Water Yam Box' (Sheppard 2008: 178–79). There was also a talk at Winchester School of Art by Tom Phillips, *Ephremides*, which

influenced the strategies through his deployment of 'randomised, aphoristic cards' (Sheppard 2008: 178).

The idea of utilizing chance-based techniques within creative development was explored in the 1950s by the New York School of musicians and artists, including Morty Feldman who was heard to say, 'you've hit it' to Cage about his use of I Ching, and from these early beginnings Cage used this directed chance element in his compositions (Johnson 2002: 25). *Silence* (1961) is a collection of Cage's most well-known lectures and articles, which have been inspirational for many, including popular musicians such as Eno and Bowie. These writings show how he used poetry to portray and expand on his Zen, Dadaistic and pedagogical overviews; taking as much care over the presentation of his words as he would do over one of his graphic scores, explaining his use of chance activities with foundations of thought out design. As Feldman explained: '[c]hance is the most academic procedure yet arrived at, for it defines itself as a technique immediately. And believe me the throw of the dice may be exciting to the player, but never to the croupier' (2000: 2). Eno encouraged Ultravox! to produce songs that were based around cybernetic principles, such as in 'I Want to Be a Machine' (Sheppard 2008: 234), and *The Dice Man* was a popular book of the time, being centred around undertaking chance occurrences through the role of the dice.

Time

'The parameter of duration was more hospitable, a more reasonable structural means for music, than pitch had been' (Cage quoted in Kostelanetz 2003: 54).

Time was one of the most important parameters that related to music as far as Cage was concerned (Kostelanetz 2003: 54), and that the duration of a piece of music is related to the sounds that exists, stating '[W]hen I come to an empty space it defines empty time' (The Poetry Foundation 2017). Alongside fellow minimalist composers such as La Monte Young and Terry Riley, he was influenced by eastern music traditions where the sense of time was more circular and less than one-directional, which reflects the basis of cybernetic systems. The sense of time was suddenly raised as a matter for debate within music – it did not have to be linear; tape machines saw to that. Long strands of ferric oxide stretched across studio spaces physically describing time stretching. The Eventide Harmoniser of Visconti and Eno 'fucks with the fabric of time' (Wilcken 2005: 60). Time helps to define the process as it is a vital element of the system, although it does not have to be considered a linear process, as in cybernetics it could be circular. The feedback loops that are inherent within delay units would have lengths defined by the controller, while Eno's current work, *Reflection*, is time-based by the length of the seasons. La Monte Young's *Trio for Strings*, consisting of a held B-flat and F-sharp, lasted for an indefinite period of time. By being viewed as static in this way, time can have a more pronounced effect and the apparent simplicity this invokes, can help to unfurl limitless complexity. Gavin Bryars values 'the idea that you can repeat something that can go on for a very long time and can be really understated, technically simple, conceptually very clean' (2017). This can help to create a meditative state that allows the listener to take time to unpick the complexity inherent within the simplicity: 'once the process is set up and loaded it runs by itself' (Reich quoted in Prendergast 2003: 91).

Roy Ascott stated that an artist's 'audience expects, not a fixed attitude or viewpoint to a piece of work, but a field of uncertainty and ambiguity in which they can endlessly take part' (Shanken 2015: 66). The audience is prepared and acceptant of art having random and indefinite lengths, but music tends to contain more finite time scales. The artist, the product and the audience interact together where a 'shift of human interest is from the thing, the object, the product, to the process, the system, the event in which the product is obtained' (Shanken 2015). In Conway's *The Game of Life*, simple rules produce complex results, without a time limit. Defining boundaries allows a multiplicity of ideas to have room to grow in a space where orderly or random elements can interlock.

The length of a piece of music can be arbitrary, as demonstrated in the differences between 3'52", which could be the prescribed perfect pop song length, compared to Max Richter's seven hours of 'Sleep'. Bryars (2017) discussed how the artefact could affect the elasticity of time elements, in various versions of *Jesus Blood Never Failed Me Yet*:

> Well *Jesus Blood*, for example, doesn't have a specific time because the duration of time has always been due to physical factors. The first time I did it live it was determined by how long was a reel of tape, which is 32 minutes. When I made the first record for Obscure and Brian it was one side of vinyl, 23/24 minutes; you could go longer but you would lose sound quality. When I did the CD version it was 75 minutes because you can have longer durations. Some live film versions, and a reel of film would last about 30 minutes, on a 16mm projector. It was always determined by physical things or how long you needed for a particular event. When I created the 1993 version with Tom Waits we made a single for Xmas for Shelter, for the homeless, but the rule for a single was that it had to be less than 4 minutes, which meant that it was 9 repetitions for 3 minutes 54 seconds. I then fit the piece within that time frame. I also did a B side, which would be now a remix, that uses other materials. One version lasted less than a minute.

(Bryars 2017)

The process of creation for a given piece of music is defined by the time framework. This reflects nature where the life cycle determines growth patterns, but these are never exact, and the fluidity of natural life can become apparent in the swings or slips in time, which often give music its magic and appeal (Morley 2004: 170). The ubiquitous Roland TR808 drum machine, as well as the Akai MPC samplers and Atari 1040 computer, were felt by hip hop and dance producers who used them to have almost mythical timing elements, that seemed to contain a natural swing. This echoes Reich's discovery whereby the space between the notes has an almost infinite number of lengths, through slips in the timing of tape machines running in parallel. The chance-induced phasing within these time-shifts added new dimensions and interest: '[p]erforming and listening to a gradual musical process resembles:

> pulling back a swing, releasing it, and observing it gradually come to rest; turning over an hour glass and watching the sand slowly run through the bottom; placing your feet in the sand by the ocean's edge and watching, feeling, and listening to the waves gradually bury them.'
>
> (Reich 1968 n.pag)

There is inherent complexity in the simplicity of gradually shifting time, as the music unfolds, allowing the listener to discover new details. As was the case for John Cage, the beauty of musical rhythm is that it can contain both sound and silence (Kostelanetz 2003: 64).

Outro

Cybernetic systems of creation became an important element of art college education as the rise of postmodernism within the mid-1960s was reflected in a rise of new technologies, and a redefining of creative processes. This element of AS pedagogy was important in helping to define the work of popular musicians, especially Brian Eno, and for HPME, cybernetic, systems-based songwriting and music creation should be an embedded facet.

The pendulum still moves in random spheres as each push on the first hand sends energy into the second; this then rotates in random directions within different levels, at various forces. Eno explains how the device relates to defining a cybernetic idea, where random and beautiful events can occur within a simple system:

> This is so quick and easy to understand. So I am having one made that will be 2 1/2 metres tall and have it in here. The bigger you make it the slower it is, the easier it is to see this little thing spinning. This is why I want to make a big one; It is such a lesson, so simple systems when connected to each other become very complex systems. It's counter-intuitive because we always think of complexity as sort of linear. You do this, you add a bit and it just goes up step by step. But this is like a phase shift; a complete step difference.
>
> (Eno 2017)

Writing a piece of music can be outlined and created within a systematic process that is defined by its parameters, into which complexity and a wide range of ideas can be fostered. Byrne and Eno created music that was defined by interactive systems, chance decisions and a stripping away of the self; a creative space where organization and sounds are paramount. The arrival of the tape machine helped in delivering feedback and also recorded the results, so the cybernetic device arrived.

Musicians studying on programmes and courses in HPME should be encouraged to engage with their unconscious, untutored selves and concentrate on creating music systems that are self-regulating. Songwriters can embed their skills and create structures so that within these defined boundaries they can creatively unleash. Eno defines this by summarizing that art students 'relish the experiment; I'm just going to do that and see what happens. Simplicity for me is the magic. That's why this pendulum is interesting: you can see exactly what it is, yet it does something fascinating' (Eno 2017).

References

Albiez, Sean and Pattie, David (eds) (2016), *Brian Eno: Oblique Music*, London: Bloomsbury Academic

Albiez, Sean and Pattie, David (eds) (2011), *Kraftwerk: Music Non-Stop*, New York: Continuum.

Ascott, Roy (2003), *Telematic Embrace: Visionary theories of art, technology and consciousness*, University of California Press.

Ascott, Roy (2017), interview with Roy Ascott, Bristol, 27 July,

Ashby, W. Ross (1956), *Introduction to Cybernetics*, London: Chapman and Hall.

Banks, Mark and Oakley, Kate (2016), 'The dance goes on forever. Art schools, class and higher education', *International Journal of Cultural Policy*, 22:1, pp. 41–57.

Bateson, Gregory (1972), *Steps to an Ecology of Mind: Collected Essays in Anthropology, Psychiatry, Evolution and Epistemology*, Chicago: University of Chicago Press.

Beer, Stafford (1994), *Brain of the Firm*, 2nd ed., New York: John Wiley and sons.

Bracewell, Michael (2007), *Remake/ Remodel: Becoming Roxy Music*, London: DaCapo Press.

Bryars, Gavin (2017), in person interview with Simon Strange, Kings Cross Station, 11 November.

Byrne, David (2013), *How Music Works*, Edinburgh: Canongate Books.

Cage, John (1961), *Silence: Lectures and Writings*, Wesleyan University Press.

Charnley, James (2015), *Creative License: From Leeds College of Art to Leeds Polytechnic 1963-1973*, Cambridge: The Lutterworth Press.

Csikszentmihalyi, Mihalyi (2013), *Creativity: The Psychology of Discovery and Invention*, London: Harper.

Dayal, Geeta (2009), *331/3: Brian Eno's Another Green World*, London: Bloomsbury.

de Duve, Thierry (1994), 'When form has become attitude—and beyond', in Z. Kocur and S. Leung (eds), *Theory in Contemporary Art Since 1985*, pp. 19–31.

Diaz, Eva (2015), *The Experimenters: Chance and Design at BMC*, Chicago: University of Chicago Press.

Ehrenzweig, Anton (1967), *The Hidden Order of Art: A Study in the Psychology of Artistic Imagination*, California: Weidenfield and Nicolson.

Eno, Brian (1996), *A Year with Swollen Appendices: Brian Eno's Diary*, London: Faber and Faber.

——— (2017), in person interview with Brian Eno, Notting Hill, 1 December.

Feldman, Morton (2000), *Give My Regards to Eighth Street*, Cambridge: Exact Change.

Filliou, Robert (1970), *Teaching and Learning as Performing Arts*, Berlin: Gebr Mann Gerlig.

Frith, Simon and Horne, Howard (1987), *Art into Pop*, London: Routledge.

Hamilton, Richard (1982), *Collected Words*, London: Thames and Hudson.

Hegarty, Paul (2007), *Noise / Music: A History*, New York: Continuum.

Huyssen, Andreas (1984), 'Mapping the postmodern', *New German Critique*, 3:1, pp. 5–52.

Johnson, Steven (ed.) (2002), *The New York Schools of Music and the Visual Arts*, New York: Routledge.

Kostelanetz, Richard (2003), *Conversing with Cage*, London: Psychology Press.

Lambert, Nick (2017), ‘The cybernetic moment: Roy Ascott and the British cybernetic pioneers’, 1955-65’, *Interdisciplinary Science Reviews*, 42:1&2, pp. 42–53.

Langer, Clive (2018), video call interview with Simon Strange, Bristol, 15 February.

Llewellyn, Nigel, Williamson, Beth, Westley, Hester and Crippa, Elena (2015), *The London Art Schools: Reforming the Art World, 1960 to Now*, London: Tate.

Madge, Charles and Weinberger, Barbara (1973), *Art Students Observed*, London: Faber and Faber.

McLuhan, Marshall (1964), *Understanding Media: The Extensions of Man*, Oxon: McGraw-Hill.

Morley, Paul (2004), *Words and Music: A History of Pop in the Shape of a City*, London: Bloomsbury.

Nyman, Michael (1999), *Experimental Music: Cage and Beyond*, 2nd ed., Cambridge: Cambridge University Press.

Parkinson, Tom and Smith, Gareth-Dylan (2015), ‘Towards an epistemology of authenticity in higher popular music education’, *Action, Criticism and Theory for Music Education*, 14:1, pp. 93–127.

Pickering, Andrew (2002), ‘Cybernetics and the mangle: Ashby, Beer and Pask’, *Social Studies of Science*, 32:3, pp. 413-437

The Poetry Foundation (2017), ‘John Cage’ [Podcast], Spring, 2007, http://www.ubu.com/resources/podcast.html. Accessed 15 April 2018.

Prendergast, Mark (2003) *Ambient Century: from Mahler to Moby - the evolution of sound in the electronic age,* London: Bloomsbury Publishing.

Reich, Steve (1968), *Music as a Gradual Process*, Oxford University Press http://www.bussigel.com/systemsforplay/wp-content/uploads/2014/02/Reich_Gradual-Process.pdf. Accessed 3 April 2018.

Reichardt, Jasia (ed.) (1968), *Cybernetic Serendipity: The Computer and the Arts*, special edition September, London: Studio International.

Romans, Mervyn (ed.) (2005), *Histories of Art and Design Education: Collected Essays*, Bristol: Intellect Books.

Royal Academy of Arts (1968), *50 Years Bauhaus*, Barbican, London: Royal Academy of Arts.

Sawyer, Keith (2012), *Explaining Creativity: The science of human innovation*, Oxford University Press.

Scroates, Christopher (2013), *Brian Eno: Visual Music*, San Francisco: Chronicle Books.

Shanken, Edward (ed.) (2015), *Documents of Contemporary Art: Systems*, London: Whitechapel and MIT Press.

Sheppard, David (2008), *On Some Faraway Beach: The Life and Times of Brian Eno*, London: Orion Books.

Smith, Gareth - Dylan, Moir, Zack, Brennan, Matt, Rambarran, Shara and Kirkman, Phil (2017), *The Routledge Companion to Popular Music Education*, Oxon: Routledge.

Stearns, Matthew (2007), *331/3 Daydream Nation*, New York: Continuum International Publishing Group.

Steenstra, Sytze (2010), *Song and Circumstance: The Work of David Byrne from Talking Heads to the Present*, New York: Continuum.

Stoyanova, Minka (2017), ‘Reading makers’ from digital culture and society (DCS)’, in A. Richterich, K. Wenz, P. Abend, M. Fuchs and R. Reichert (eds), *Making and Hacking*, 3:1, pp. 73–94.

Stubbs, David (2009), *Fear of Music: Why People Get Rothko But Don’t Get Stockhausen*, Winchester: O Books.

Tamm, Eric (1995), *Brian Eno: His music and the vertical colour of sound*, Boston: De Capo Press.

Thompson, D’Arcy Wentworth (1917), *On Growth and Form*, Cambridge: Cambridge University Press.

Tibbetts, Susan (2014), ‘Tom Hudson: A study of his vision for art education’, doctoral thesis, Huddersfield: University of Huddersfield.

Tickner, Lisa (2008), *Hornsey 1968: The Art School Revolution*, London: Francis Lincoln.

Wilcken, Hugo (2005), *331/3: Low*, New York: Continuum International Publishing Group.

Yeomans, Richard (1987), ‘The foundation course of Victor Pasmore and Richard Hamilton 1954-1966’, Ph.D. thesis, London: Institute of Education.