difficult to execute whereas extreme changes in density and voicing structure are comparatively easy. Spontaneous production of a wide variety of fixed-interval voicings for parallel harmonisation has been a strong feature of many of my HTPS improvisations to date, and the ability to use a rhythmic pedal technique or play polyphonically sets the device apart from other pitch shifters and harmonisers.

A great deal of the potential that the harmonic table pitch shifter has to offer can only be unlocked through discovery and exploration of new techniques, and diligent practice. An ongoing aim of my research is the development of performance pieces typifying a refined idiomatic musical language and performance aesthetic for HTPS.

6. REFERENCES


THE FUZZINESS OF ‘EXPRESSION’ IN RELATION TO ALGORITHMIC MUSIC.

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ABSTRACT

All sorts of music expresses all sorts of ideas. Yet algorithmic music is often critiqued for its lack of expression. This raises questions about what makes any music ‘expressive’. This in turn leads to addressing notions of expression itself. A logical approach reveals that the concept of expression in music discourse is very vague. This fuzziness arises from three sources. Firstly, the idiomatics of English is inherently confusing and builds specific expectations about music and expression in general. Secondly, the accepted ways of listening to Western art music identified by Becker [3] cause difficulties in identifying the substantial meaning of the word ‘expression’. Thirdly, the conflation of composition and performance into the umbrella term ‘music’ such as the article ‘Expression’ in Grooves Music Online [24] generates its own confusion. Revealing these sources of confusion, places the alleged deficiency in the expressiveness of algorithmic music into the logical deficiencies of music discourse, rather than locating it in algorithmic music.

1. INTRODUCTION

“Music is a powerful, pervasive and crucial form of human communication and expression” is a proud assertion made on the website for a recent musicological conference [22]. Algorithmic music has been critiqued for being ‘un-expressive’. This may be because this music is not capable of being expressive, or because algorithmic music is so badly composed that the ideas are not articulated coherently, or because the fuzziness of ‘expression’ is highlighted by the intrinsic nature of algorithmic music. The last possibility returns the original problem to the logic of music discourse, rather than a deficiency in algorithmic music. This paper shows that an explicit understanding of expression through music clearly points to algorithmic music as a means of human expression of a broad range of ideas.

2. IDIOSYCRASIES IN USE OF ENGLISH LANGUAGE

The concept of ‘expression’ in music discourse is very messy. The words ‘expression’ or ‘expressive’ are regularly used in a wide range of diverse contexts. For example Jacobson writing in the CD liner notes of Beethoven’s string quartets manages to define ‘expression’ quite meaninglessly in his comment that a particular movement is “...the smoother and more sustained in expression” [18], or the CD liner notes to music by German algorithmic composer Barbara Heller says that her work is “...in search of new forms of expression, of possibilities of articulation...for her musical language” [27].

Similarly, some musicologists are quite free in their use of the terminology of expression. “The public quartet made possible an increase in expressive depth in the slow movement because an ensemble can say things which would be embarrassing or ridiculous if voiced by individual...” Griffith goes on to say in an analysis of a Haydn quartet “…that the prominence of Major and minor in a single movement, can be used to achieve expressive extremes...” [13]. Yet there are no clearly articulated ideas about what this word means, or consistent evidence which could provide insight into an implied meaning. The end result is that, rather than helpfully clarifying the attributes of ‘expressive music’, the use of the term seems to reflect some type of indefinable, subjective experience.
Sources of this implication and interpretation, lies within the pragmatics of English in every day usage, as well as the grammatical construction of English, specifically in relation to the usage of being 'expression' in music discourse. These are compounded by differences in readers and writers abilities to grapple with the complexity of expression. The inherent meaning behind the ideas associated with 'expression' build erroneous expectations regarding its meaning in relation to music in general.

Firstly, the term ‘expression in music’ often seems to refer to a discrete feature which can be dispassionately highlighted the core problem, because the act of performing or composing is motion oriented like 'dance, go, travel, play', so it seems that considering the use of verbs may be helpful. However, the activity of making music is not the same as music itself. Music (even as a transient performance) is an object with descriptive attributes including 'expression', and music with the quality of 'expressive' is similar to describing the music with the qualities of 'naused ' or 'bright' or 'loud'. This is clearly the case when someone says that music is played with expression or has expression. These are adjectives, descriptors, adverbs, not verbs whether transitive or intransitive. Hence there is no implicit question in either case of what “is a performer expressing when they perform...''expression’. "Expression marks" looks as if it might be getting down to specifics, may be insufficiently broad view of both expression and of music. Scuton's work is useful in that it points to the confusion in the meaning of 'expression' arising from the grammatical construction of English. However, it also reveals confused thinking. The issue he points to is a real and significant part of the reason for problems with the meaning of 'expression'. However, this article is an example of how difficult it can be to unpack precise meanings and implications from what seem to be simple and straightforward statements. Scuton's argument seems to be based on his erroneous presumptions along with a misrepresentation of music as an activity rather than a fixed object.

Scuton says: 'When it is said of a piece of music, 'by Schubert's Erlkönig’ it has 'expression', it seems natural to ask: what does it express? There is thus a presumption that expression in music is something, i.e. to have expression is to express something, (in this case a feeling of terror) [24].

Scuton also argues that it may be said of a performance that a certain passage is played with 'expression'. The piano teacher (or the critic), however, seems to be talking about expression in some intransitive sense, in a sense more like 'music gives expression to the poet's words'. 'To what am I expected to express?' [24].

Differencing between transitive and intransitive verbs turns out to be a significant part of the reason for problems with the meaning of 'expression'. Verbs describe the nature of an activity being undertaken by a given object, which might actually be a person, even perhaps a musician! Using a word transitively requires that the action must refer directly to a specifically named object [15]. For instance, 'I press the piano keys' makes sense while 'I press' alone makes sense, intransitively. Verbs describe a characteristic of a given object, not accompanied by a direct or specifically named object. For example ‘I sing’ makes complete sense just as it is. Of particular relevance here, is the observation by Brian Harvey, an American linguist, that composers of music, such as 'drive' or 'run', are generally intransitive [15]. Thus I suggest that Scuton has inadvertently highlighted the core problem, because the act of...
Sources of this implication and interpretation, lies within the pragmatics of English in every day usage, as well as the grammatical construction in English, specifically in relation to the usage of being 'expression' in music discourse. These are compounded by differences in readers and writers abilities to grapple with the complexity of expression. Variations in the ideas associated with 'expression' build erroneous expectations regarding its meaning in relation to music in general.

Firstly, the term ‘expression in music’ often seems to refer to a discrete feature which can be dispassionately observed similar to ‘rhythm in music’ or ‘melody in music’. The use of the term ‘expression’ with its specific semantic and contextual features is complex.

Hence, it is quite easy to interpret ’expression’ as an abstract inherent beauty of music. Even then, depending on perspective, expression was particularly beautiful or harmonious. Yet even the most sophisticated musician would be hard put to explain the vagueness of the phraseology it does not help in unravelling the technical aspects of ‘expression’ in relation to music. Music can express things, whether it be an idea, an emotion, the state of the natural world or the glory of god, but the idea being expressed is realised through music, as an alternative to other media such as dance, photography, or words.

Confused expectations can also be brought about through the incorrect attribution of the concept of ‘expression’ in music. This can lead to subtly different interpretations because of the multiple meanings attached to the term ‘musical’ in different contexts.

For instance, the term ‘facial expression’ indicates in a straightforward way that the expression is occurring through the medium of the face. Similarly ‘musical expression’ can indicate that the expression is occurring through the medium of music. However, in other contexts, the application of the adjective ‘musical’, when applied to another object, implies qualities like beauty, onomatopoeia, or nuclear war, even if the idea is not usually associated with ‘beauty’. Even then, depending on perspective, difficult things can have an abstract inherent beauty of shape, colour, or texture which can become apparent to the listener.

The notion of ‘expression’ music is so ubiquitous in Western thinking, that it appears in the popular press as well as in academic discourse and analysis. Looking at the common language definitions of ‘expression’[9] provides an interesting insight into what concepts people are communicating when using this phraseology. Of particular importance is that these common language definitions provide only two specific references to music, of which one of the references is to expression-marque not to music itself. While expression-marks looks as if it might be getting down to specifics, these marks are only considered indicative, rather than manifesting or exemplifying a particular quality regarding which and how those specific markings are particularly related to expression. The other reference to music simply refers to musical performance designed to bring out the ‘feeling’ of the music [9]. While this may explain the vagueness of the phraseology it does not help in unravelling the technical aspects of ‘expression’ in relation to music.

Roger Scruton, a British philosopher and composer, addresses the issue of ‘expression’ at length in Grooves Music Online.[24] His attempt to unpack some of knots in both the composer’s and the performer’s perspective in themselves may be an insufficiently broad view of both expression and of music. Scruton’s work is useful in that it points to the confusion in the meaning of ‘expression’ arising from the grammatical construction of English. However, it also reveals confused thinking. The issue he points to is a real and significant part of the reason for problems with the meaning of ‘expression’. However, this article is an example of how difficult it can be to unpack precise meanings and implications from what seem to be simple and straightforward statements. Scruton’s argument is based on his erroneous presumptions along with a misrepresentation of music as an activity rather than an object.

Scruton says: ‘When it is said of a piece of music (say, of Schubert’s Erlkönig) that it has “expression”, it seems natural to ask: what does it express? There is thus a presumption that expression in music means something in the sense that to have expression is to express something (in this case a feeling of terror) [24].”

Differentiating between transitive and intransitive verbs turns out to be a rather inaccurate representation of the real grammatical problem. It shows his view to be inaccurately thought through. Scruton says: “Verbs describe the nature of an activity being undertaken by a given object, which might actually be a person, even perhaps a musician! Using a word transitorily requires that the action must occur directly to a specifically named object [15]. For instance, “I press the piano keys” means sense while “I press” alone makes no sense, intransitively. Verbs describe the nature of activity being undertaken by a given object, which might actually be a person, and even perhaps a musician! Using a word transitorily requires that the action must occur directly to a specifically named object [15]. For instance, “I press the piano keys” means sense while “I press” alone makes no sense, intransitively. Verbs are ‘action’ verbs, while nouns are ‘descriptive’ verbs.

For example “I sing” makes complete sense just as it is. Of particular relevance here, is the observation by Brian Harvey, an American musicologist, that the verbs, such as ‘drive’ or ‘run’, are generally intransitive. Intransitive verbs, such as in the title of Scruton’s entry in Grooves Music Online, “I can’t drive this car”, make no sense. However, intransitive verbs are never used with a preposition, such as “I press the piano keys” makes sense while “I press.” alone makes no sense. Verbs, such as ‘drive’ or ‘run’, are generally intransitive. Verbs are ‘action’ verbs, while nouns are ‘descriptive’ verbs.

The second reason that expression may be a slippery concept to pin down is that perhaps critics perceive that using ‘expression’ is more acceptable than writing about the degree of their personal engagement with the music. Thus, the notion of how ‘expressive’ could be replaced by three main words: mobile (with associated words of animated, communicative, open, easy-to-read); meaningful (with associated words of significant, substantive, vivid, telling), and representative (with associated words of representing, demonstrating, signifying, indicative of, indicating) [6]. While ‘engaging’ could be replaced by attractive (with associated words of appealing, charming, winning), connecting (with associated ideas of fitting into place, attaching, joining, uniting, bonding), holding (with associated words of keeping, absorbing) [6].

So expression and engagement are not one and the same thing but they are closely related activities in that something that is engaging is likely to be engaging, as the features described as expression are likely to ensure that engagement happens. This is clarified by looking at how the opposite of expressive is categorised as bland, cool, aloof, deadpan, giving nothing away, unmusical, secretive, or enigmatic [6]. Yet these characteristics could be expressed through music, in which case that music would be ‘expressive’! However, the notion of being expressionless is not the same as music itself. Music (even as a transparent performance) is an object with descriptive attributes including ‘expression’. The music with the quality of ‘expressive’ is similar to describing the music with the qualities of ‘naive’ or ‘bright’ or ‘loud’. This is clearly the case when someone says that music is played with expression or ‘has expression’. These are adjectives, descriptors, adverbs, not verbs transitive or intransitive. Hence there is no implicit question in either case of what is a performer expressing when they perform something. Interpreting this is the grammatical deconstruction of a typical remark about ‘expression’ immediately raises the alternate question “How is the music expressing itself?”. These have no significant question in terms of compositional (and performer) decision making.

It is notable that Scruton’s line of argument arrives at a different subsequent question namely “what is the music expressing?”. This illustrates how easily differences in literal interpretation or logic can arise. Both the questions are valid, but their difference also leads to different associated meanings for the term ‘expression’. “What does it express?” refers to an idea or quality, whereas “What is being expressed?” refers to qualities which reside inside the music itself. These questions are both implied in discussions of expression in music. Yet, not only do different lines of thinking about expression arrive at the different subsequent sub-questions concerning the locus of ‘expression’ in music, which are not always explicitly stated.

3. ‘EXPRESSION’ IS A STAND IN FOR OTHER PERSONAL REACTIONS

The notion of ‘expression’ may be a slippery concept to pin down is that perhaps critics perceive that using ‘expression’ is more acceptable than writing about the degree of their personal engagement with the music. Thus, the notion of how ‘expressive’ could be replaced by three main words: mobile (with associated words of animated, communicative, open, easy-to-read); meaningful (with associated words of significant, substantive, vivid, telling), and representative (with associated words of representing, demonstrating, signifying, indicative of, indicating) [6]. While ‘engaging’ could be replaced by attractive (with associated words of appealing, charming, winning), connecting (with associated ideas of fitting into place, attaching, joining, uniting, bonding), holding (with associated words of keeping, absorbing) [6]. The second reason that expression may be a slippery concept to pin down is that perhaps critics perceive that using ‘expression’ is more acceptable than writing about the degree of their personal engagement with the music. Thus, the notion of how ‘expressive’ could be replaced by three main words: mobile (with associated words of animated, communicative, open, easy-to-read); meaningful (with associated words of significant, substantive, vivid, telling), and representative (with associated words of representing, demonstrating, signifying, indicative of, indicating) [6]. While ‘engaging’ could be replaced by attractive (with associated words of appealing, charming, winning), connecting (with associated ideas of fitting into place, attaching, joining, uniting, bonding), holding (with associated words of keeping, absorbing) [6].
4. THE DIFFICULTY OF ACKNOWLEDGING MUSIC AS AN AURAL ART FORM

Writers of textbooks use ‘music’ as “…short-hand of the scores of American and European modernist composers…” [2]. However, requiring musical and compositional knowledge of some emotion, intention or idea that the composer intended is not enough. To understand how to play the music for enjoyment [24], the performer needs to know the context of composition, may help the listener contextualise what they are hearing when listening to that music. Walser asks if there is any context of a performed piece that the performer thought a listener could understand even if they know that the music ‘...can be understood as a human utterance, in dialogue with other human utterances.’” [26]. This strongly suggests that the meaning of the music is purporting to communicate. The player's understanding of the score, or programme note, in the aural experience we know as music. Music is what we encounter with our ears and minds. Listeners perceive the surface of the music as it emerges over time. No matter what, the listener is only presented with the experience of an aural appearance.

Conventional score-based analysis does not explicitly include the vital element of the art form. Music exists as a temporally emergent aural experience, organised around ideas: Intrinsic fundamental dimensions of music are often unattained. “The multiple levels of musical organisation are rich spatio-temporal organisations, i.e. complex dynamic systems [16].” However, as an intangible art form, music does not actually contain any spatial dimension, apart from the aural space induced by particular compositions, such as mediaeval antiphons, or immersive sound environments. Audiences may hear music, they may actively listen. The relationship between musicology and criticism is established how music ‘expresses’ ideas. It does not matter what, the listener is only presented with the surface of the music as an aural appearance. The ambiguity of the English language, the implications and confusion of possible meanings in music discourse, is fraught. The problems lie in several domains both of which affect analytical and critical responses to music. The dichotomy of the term ‘musical’ builds erroneous expectations, while the pragmatic use of English through the various grammatical constructions of ‘expression’ tend to lead to different logical conclusions about the causal location of expression. Secondly, the elision of emotion and engagement into ‘expression’ has lead to the usage of ‘expression’ as an umbrella term which detaches the personal reactions to the music from the author of the discourse. Finally, the split between performance and composition has both contributed to, and been a result of, an unwillingness to confront the reality that music is an aural subjective experience, which requires performance for its existence, but which begins with the composer's ideas. Hence, I suggest that to present logical difficulties in understanding expression. However, if music is solely regarded as an aural experience then it is clear that the performer/composer split is a false dichotomy.

The difficulty introduces into the study of expression in music are summarised very well by Baker, in her introduction to ‘Expression’ in Grooves Music Online [2]. “In the simplest sense expression is applied to elements of a performance that depend on personal response and vary between interpretations.” Yet “it is not clear how this notion of ‘expression’ relates to the concept that occurs in music criticism (such as when a work is said to express some emotion, outlook, or idea. The relationship between musicology and criticism is another matter, however, it might be asserted that the branch of musicology concerned with analysis, often becomes a more moratorium of criticism, such as evidenced by Kerman [20] and Griffiths [13]. I suggest that the major reason for the word ‘expression’ being used with apparent meanings in the different contexts of performance and musicology arise from the problematic relationship that musicology has with music being an intangible aural experience. It is not clear how this notion of ‘expression’ relates to the musical performance of a piece of music. The performer must, by their very nature as intermediaries, impact on the presentation of the ideas, through all sorts of parameters of the performance. However, the impact is change implemented by the performer they may be effectively reconstituting aspects of the music, or more likely as they may be offering their interpretation of the basic ideas being expressed by the composer through this music. The decisions the composer makes will impact on how the underlying ideas transfer to the surface of the music, and hence to the listener’s (conscious or subconscious) awareness. “any piece of music is capable of having a story or series of pictures read into it by the imaginative listener...” [23]. If the composer is sufficiently skillful, there will be commonalities in the listening experience with regard to the ideas perceived in the music, just as occurs in any other shared human experience of life.

6. CONCLUSION

As musicians, critics, musicologists and psychologists are not the only ones who can engage with the music [7]. However, I contend that in all types of music discourse, the performer by publicly presenting their music, enters into a relationship with the audience, in which they are communicating ideas through the medium of music, as performed by composers or by human musicians.

5. ALGORITHMIC MUSIC EXPICLITLY MOVES BEYOND EMOTION

A composer may wish to communicate a variety of ideas: whether it is the compositional process itself, or something more abstract such as being used in a composition, or some other thought, feeling, or situation. For instance, the composer may produce uninterpretable music specifically to suggest ‘nonsence’. In German speaking regions, such a thought brought a notion of genius defined such as to be indistinguishable from madness. As psychoanalysis emerged as a discipline, many composers, including Schoenberg, use insanity as a model. Serialism is the epiphany of the convergence in music between genius and madness, because a very, autonomous, but rigorously integrated idea. Whether it is a shallow, but however idiosyncratic and incoherent [insane] it may actually sound [21].

Secondly, algorithmic music is composed to investigate ideas other than emotion. For instance, Brian Eno sets a number of audio processes in place which unfold at different rates in time, which “…resulted in such truly unexpected clusters of sound, ranging from moments of true calm to gigantic hiatus” [11]: “I use a lot of cold processes. They seem rather passionless...and suddenly these flowers come out, and they are surprisingly beautiful and complex...” [25]. Warren Burt espouses a similar philosophy of delight in the appearance of the unexpected [4].

Andrew Ford, an Australian composer, has gone so far as to say that when the audience experience the music in a concert situation, they are engaging in a relationship with the composer, whereby they undertake to concentrate, memorise and engage thoughtfully with the music [7]. However, I contend that in all types of music discourse, the need to give consideration to the implications of that situation. The composer, by publicly presenting their music, enters into a relationship with the audience, in which they are communicating ideas through the medium of music, as performed by composers or by human musicians.

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4. THE DIFFICULTY OF ACKNOWLEDGING MUSIC AS AN AURAL ART FORM

Writers of textbooks use ‘music’ as ‘...short-hand of the scores of American and European modernist composers.’[26] It is then required to bring all music into existence, whether by human performers or by machines. Performance transduces the composer’s ideas, whether sketched, precisely notated, or programmed into data, and the aural experience we know as music. Music is what we encounter with our ears and minds. Listeners perceive the surface of the music as it emerges over time. No matter what, the listener is only presented with the surface of the music as an aural experience.

Conventional score-based analysis does not explicitly include the aural art form. Music exists as a temporally emergent aural experience, organised around ideas. Intrinsic fundamental dimensions of music are often unstated. “The multiple levels of musical organisation are rich spatio-temporal organisations, i.e. complex dynamic systems”[16]. However, as an intangible art form, music does not actually contain any spatial dimension, apart from the aural space induced by particular compositions, such as mediaeval antiphons, or immersive sound environments. Audiences may hear music, they may actively listen. They will never see it, it does not exist in visual form. Yet music analysis is generally static and score-based, such as a Gillian Forte’s set of vocal music[12], in which the analytical structures cannot be heard in the music. Some, such as Kerman[20] acknowledge that listening is important but rely on the score as the basis for their analysis.

The difficulties this introduces into the study of expression in music are summarised very well by Baker, in her introduction to ‘Expression’ in Groves Music expression in music, are summarised very well by Baker, [1]. Conventional score-based analysis does not explicitly include a concept that occurs in music criticism (such as when the performer in realising the experience of music. Yet she is able to acknowledge that music begins its existence because of the composer’s ideas which are to be expressed through the music as an ‘expression’. The performer must, by their very nature as intermediaries, impact on the presentation of the ideas, through all sorts of parameters of the composition. She acknowledges that the performer may be effectively recomposing aspects of the music, or more likely they may be offering their interpretation of the basic ideas being expressed by the composer through this music.

Algorithmic music, especially when the music involves the use of electronic devices, contains the production, combines composition and performance into the same activity. It is possible that automated sound production does not hold the same nuances as does acoustic music performance, but criticizing algorithmic music on this basis is an elision of algorithmic music with the automation of sound production. It is not a question of the expressiveness of the compositional technique.

Andrew Ford, an Australian composer, has gone so far as to say that when the audience is in a concert situation, they are engaging in a relationship with the performer, whereby they undertake to concentrate, memorise and engage thoughtfully with the music[7]. However, I consider the language as well as the technical language of their individual professions, that would not be surprising to find that this range of meanings enter the definition of ‘expression’ in music discourse. This may explain why the use of ‘expression’ in the debate about how music functions in relation to ‘expression’ ranges across the concepts of manifestation, indication, or representation. These are significantly different degrees of expressing an idea.

The ambiguity of the English language, the implications and confusion of possible meanings, the habits of music researchers with their own shorthand terminology in relation to music and expression, along with the impact of the classical concert ‘habitus of listening’ that are present in particular questions, such as when discussing algorithmic music.

However, as I have argued throughout this paper, the whole notion of critical importance that music discourse is fraught. The problems lie in several domains both of which affect analytical and critical responses to music. The idiomatic use of the term ‘musical’ builds erroneous expectations, while the pragmatic use of English through the various grammatical constructions of ‘expression’ tend to lead to different logical conclusions about the causal location of expression. Secondly, the elision of emotion and engagement into ‘expression’ has lead to the usage of ‘expression’ as an umbrella term which detaches the personal reactions to the music from the author of the discourse. Finally, the split between performance and composition has both contributed to, and been a result of, an unwillingness to confront the reality that music is an aural subjective experience, which requires performance for its existence, but which begins with the composer’s ideas. Hence, I argue that composers present logical difficulties in understanding expression. However, if music is solely regarded as an aural experience then it is clear that the performer/composer split is a false dichotomy.

Together, all these factors, logically lead to the conclusion that the most accurate terminology is to use a term such as compositional ideas. Hence, the music is an aural experience which depends on human input. Both composer and performer are required in the germination and fruition of music for its existence as a musical idea. However, as I have argued throughout this paper, the idiomatic use of expression ideas. Algorithmic and computer music has brought this constellation of issues into the spotlight, not necessarily because the music lacks expression, but because it provokes conventions in which discourse on Western art music has been grounded.

5. ALGORITHMIC MUSIC EXPLICITLY MOVES BEYOND EMOTION

A composer may wish to communicate a variety of ideas; whether it is the compositional process itself, or being an item of pensum, to be used in the description, the composition, or some other thought, feeling, or situation.

For instance, the composer may produce unintelligible music specifically to suggest ‘nonsense’. In German speaking regions, Schenker’s thought brought a notion of genius defined such as to be indistinguishable from madness. As psychoanalysis emerged as a discipline during the early 20th century, Schenker’s ideas were used in a manner of genius defined such as to be indistinguishable (subconscious) from madness, because a very, autonomous, but rigorously integrated idea is heard to be an aural autodidactic and incoherent [insane] it may actually sound[21].

Secondly, algorithmic music is composed to investigate ideas other than emotion. For instance, Brian Eno sets a number of audio processes in place which unfold at different rates in time, which “...resulted in something truly unexpected clusters of sound, ranging from moments of true calm to gigantic hiatus”[11]. “I use a lot of cold processes. They seem rather passionless...and suddenly these flowers come out, and they are surprisingly beautiful and complex…”[52].

Warren Burt espouses a similar philosophy of delight in the appearance of the unexpected[4].

Algorithmic music, such as that by Bruce Jacob [17], work with generative models, using minimal input data sets with preconditions and reproductive rules, in an endeavour to produce meaningful and coherent results through automated procedures. While others, such as David Cope, use databases of predetermined materials which are then iterated and combined using extensive sets of rules in the algorithms in the styles of existing composers[6]. What differs between composers and methods, is the amount of, and which details in one or other of the dimensions of music they concern themselves with, as the remaining be left to compositional algorithms.

The decisions the composer makes will impact on how music discourse is fraught. The problems lie in several domains both of which affect analytical and critical responses to music.

6. CONCLUSION

As musicians, critics, musicologists and psychologists are capable of having a story or series of pictures read into it by the imaginative listener…”[23].

If the composer is sufficiently skilled, there will be commonalities in the listening experience with regard to the ideas perceived in the music, just as occurs in any other shared human experience of life.

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COMPOSING WITH SIEVES:

STRUCTURE AND INDETERMINACY IN-TIME.

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ABSTRACT

Introduced by Xenakis 50 years ago, sieves have proved to be a relevant and robust device for music composition. Examples of complex and symmetric sieves usage in original works are presented along with a few possible applications not explored before. The dichotomy between predetermined abstract structures such as sieves and their actualization through random procedures is discussed and it is also shown that in the hands of an innovative musician, sieves not only serve the craft aspect of composing but could also reveal as well as impact deeper levels of thinking.

1. PERIODICITY, WEIGHTS, AND SYMMETRY.

Sieves were introduced during the early 1960s by Xenakis in his works but remained a rather esoteric topic until rather recently when a number of writings on the subject have appeared - Ariza [1], Gibson [6], Exarchos and Jones [5], Solomos [7] to name some - testifying to the relevance of this device for music composition. Since many basic aspects and in particular sieve analysis and construction have been discussed previously, only a few brief reminders are necessary here.

Sieves are logical filters expressed as boolean operations on congruence modulo classes. A trivial case is that of a sieve containing equivalence classes denoted by various indices (following the notation used by Xenakis) of a single modulo:

\[ \begin{align*}
\lambda_3 \cup \lambda_2 \cup \lambda_1, \\
1, 2, 3
\end{align*} \]

This formula will generate a periodic sequence of numbers with 13 the only modulo able to define elements of the sieve since it is a prime number. Messiaen’s modes with limited transpositions can be generated with simple periodic sieves:

\[ \begin{align*}
3_3 \cup 3_1, \\
(2nd mode, an octatonic scale)
\end{align*} \]

while the expression offered by Xenakis in Formalized Music [13] for generating the major scale contains two modulo terms and a more involved set of operations:

\[ \begin{align*}
(3_3 \cup 4_3) \cup (3_1 \cup 4_1) \cup (3_2 \cup 4_2), (3_3 \cup 4_3) \cup (2, 3, 4) \cup (3_3 \cup 4_3)
\end{align*} \]

This formula will generate a periodic sequence of numbers with 13 the only modulo able to define elements of the sieve since it is a prime number.

Sieves and their actualization through random procedures is discussed and it is also shown that in the hands of an innovative musician, sieves not only serve the craft aspect of composing but could also reveal as well as impact deeper levels of thinking.

In this case, the period of the sieve is the lowest common multiple (LCM) of its modulo terms while the indices show the possibility of transposing the scale. Similar pursuits, albeit from a different perspective, may be found in Anatol Vieru's Book of Modes [12]. Xenakis favored "aperiodic" pitch sieves - actually, sieves with a period longer than the actual range of the sound source, hence making it impossible to determine its period. There is a clear and desirable distinction between such a pitch sieve and any octavating scales, tonal or atonal. On the other hand, oscillating in the same piece between periodic and "aperiodic" sieves, between a recognizable structure and apparent disorder offers an enticing way of organizing musical materials.

Multiple modulo terms and more intricate boolean operations allow for the addition of another feature: weights establishing preferences among the elements of the sieve. Weights may be assigned to individual elements in order to establish a hierarchy and to transform a "scale" - a list into a "mode". In DiSSCO, a Digital Instrument for Sound Synthesis and Composition developed at University of Illinois Computer Music Project and Argonne National Laboratory [2], weights could follow a pattern in sync with that of the sieve elements or they could have an independent cycle or no cycle at all (aperiodic). In turn, each cycle could have its own scaling factor: e.g., the mid range octaves could have more sway than the extreme ones. Although the weights may be assigned arbitrarily following the judgement of the composer, a more abstract arrangement assigns a particular weight to each modulo thus reinforcing the internal structure of the sieve:

\[ \begin{align*}
\text{sieve: } & (3_3 \cup 4_3) \cup (2, 3, 4, 5) \\
\text{modulo weight: } & 15, 15, 10, 11, 5, 5, 11 \\
\text{resulting elements: } & (5, 7, 5), (5, 11) \\
\text{element weight: } & 16, 12, 10, 7, 7
\end{align*} \]

Figure 1. Modulo weights

Applied to diatonic pitches, the results in this example would favor the tonic triad (0, 4, 7) over the dominant tritone (5, 11).

Sieves that produce symmetric intervals between numbers contain modulo terms that have symmetric indices. A simple nonretroradgradable rhythm: