OF RENOUNCING TO DO SOMETHING GRANDIOSE

Guido Kramann[1]

[1]Brandenburg University of Applied Sciences

kramann@th-brandenburg.de

Abstract. *A central idea of ubiquitous music is that music does not arise from the ideas of an isolated genius, but rather from the interaction of several participants [Keller et al. 2014]. But this requires a certain amount of restraint on the part of the designers of the respective setting and at the same time seems to require a full disclosure of the underlying theoretical and aesthetic concepts to the participants, if the participants are really to be taken seriously and given the means to actually be able to become creative themselves in an understandable way within the given context. In this paper, the consequences of such a demand are first discussed theoretically. Finally, for the concept developed by the author, "Every human being can compose on the basis of natural numbers", an attempt is made in this specific case to determine in what form such a concept could be passed on in order to meet the above criteria.*

1. Introduction

Almost everyone knows the piece 4'33 by John Cage. Almost always, when people discuss this piece, at some point the conversation reaches a point where a person says something like: "Anybody can do that." And the other person then replies something like: "Yes, maybe. But it's famous because John Cage did it, and it doesn't make sense for you to compose 2'33 now." But isn't that exactly the message of this composition?: With an invitation to listen carefully, composing already begins and anyone can be the person who invites to listen carefully and any other person can accept this invitation. The piece corresponds to an actual trend in sound art creation in which the composer is no longer the creator of a musical structure, but determines the setting in which the composition then happens [de la Motte-Haber 2018]. But typically, in such settings, art is not, so to speak, left free, but the artistic genius merely acts on a meta-level and continues to claim the sovereignty of interpretation and copy rights to the work published in this way.

What is wanted here is perhaps most likely to be found in the traditions of folk art and folk music. There the knowledge of an art form is not anchored in a single individual, but within a larger community. However, the aspect of preservation often dominates so strongly in these traditions that these traditions threaten to freeze. If one sets oneself the goal of making realtime composition generally available to laypersons, on one hand external availability through interconnectable, widespread mobile devices of a similar type and through data available on the Internet may be helpful. On the other hand, the knowledge about the possibilities of composing music must be made generally accessible in a transparent way. Why is this important? Isn't it enough that corresponding programs sonify, for example, arbitrary gestures in a way that is not further explained? What is the difference between using a software to perform a musical performance, or to be used as a real-time composition program, in an informed way, in an experimental way with feedback, or without a deeper understanding of the users and without feedback?

That depends, of course, on the demands made here. Everybody can find something great because it gives you a great feeling without understanding what's behind it. Maybe a deeper understanding would even destroy the feeling. This may be the case with the reception of music and art in most cases. But what about the creation of music, what about comprovisation?

Without understanding the laws according to which an interactive musical comprovisational performance works, one cannot act intentionally in relation to this performance, and without intentional action by the individual, there can be no mutual interaction between the people involved, and thus, no collaborative creative process can be established. Of course, the creator of the setting could reject this intentionality of the participants. However, in that case, no bond would be created by the joint interaction within the comprovisational performance, but only in the sense of a feeling of community based on joint participation and involvement, and this in turn would do much less to fulfill the basic idea of a socially effective art form. Not to mention the fact that the available technical resources would then not have been used to their full potential.

This much may be said as motivation for why it might make sense to disseminate comprovisational tools that provide an explicit understanding of composing, before going on to discuss what the nature of such tools must be in order to satisfy this. However, in line with the introductory comments on 4'33, the following seems clear: In the end, the point is to convey so much motivation and understanding that an impulse to try out and develop the things conveyed can keep itself alive.

To anticipate: minimalist concepts are easy to communicate and understand and also motivate by quickly getting into practical work. As an indication for the validity of this claim, it may be said that in the pedagogical-didactic field, concepts of minimal music, but also Orff's pentatonic, are often used to introduce pupils to musical improvisation and composition – yes, let's say to compose their own 4'33 or 10'33 or 2'22 – without any great theoretical burden [Götte 2002],[Straus 2014],[Saliba 2010].

2. The publication of gamelike settings as a method to convey an easy mastery of compositional practices

One skill that many people share is mastery of board games. A look at board games such as chess or GO, suggests that a game is particularly popular over a long period of time if its complexity and degree of interest result mainly from complex and interesting game situations, but the rules of the game are kept relatively simple in comparison. Games of this kind can provide valuable clues, or a kind of blueprint, to create easy-to-learn composition games, which, however, allow a high degree of intentional contribution by the players and, with a low entry threshold, open up the perspective of an ever higher level of mastery despite unchanged simple rules.

It is possible to lend musical meaning to extra-musical actions in a way that in the end the musical meaning is inherent in the playful actions. However, this is usually not achieved simply by reference to a given game, but requires certain adjustments both on the playing side and on the musical side. Exactly these adaptations are the remaining parts that should be learned by the laymen who are involved with the game. But it is enough to learn the rules of the game first and to experience the musical context bit by bit from the practical game. The sound-processes are inherent in the game and the rule-setting can be regarded as successful, if the connection between the actions of the players and the resulting sound-process can be anticipated and imagined by the players in an appropriate and lively way.

It should be emphasized that the correlations between the game turns and sounds are arbitrary determinations by the makers of the game. It is also generally the case that the connection between a sign and what it designates is essentially arbitrary and can lead to a more or less rich perception. Or, to use the words of Edmund Husserl, who in the context of the development of his phenomenology in his "Logical Investigations II" deals in detail with the connections between signs and the character of our resulting imagination of the signified:

> "*In the transition from a significant intention to the corresponding imagination, we do not just experience a mere increase, as in the transition from a faded picture or a mere sketch to a fully vivid painting. Rather, the significative intention in itself lacks any fullness, only the intuitive imagination brings it closer to it and, through identification, into it.*" ([Husserl 2009], p. 607, translation. Original is german.)

As Husserl makes clear in the same treatise, on the way from a symbolic representation to the object intended by it, there is a sequence of stages of fulfillment that must be passed through:

> "*We make the number* $(5^3)^4$ *clear to ourselves by falling back to the definitory idea: 'Number which arises when one forms the product of* $5^3 \cdot 5^3 \cdot 5^3 \cdot 5^3$*'. If we want to make this latter idea clear again, we have to go back to the sense of* 5^3*, i.e. to the formation* $5 \cdot 5 \cdot 5$*. Going even further back, 5 can be explained by the definition chain* $5 = 4 + 1, 4 = 3 + 1, 3 = 2 + 1, 2 = 1 + 1$." ([Husserl 2009], p. 601-602, translation. Original is german.)

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One would expect such a conditional connection of successive fulfillments, also in the case of a correspondingly complex connection between game symbol and correlated musical performance. But one can also imagine stages of fulfilment that are not mutually dependent, such as the mere mention of a person's name, a remembrance of the person, and finally his physical appearance. This provides a useful indication of how a close relationship between the symbolic game situation and the concrete sound events represented by it can be guaranteed: The sequence of fulfillment levels associated here should be kept as flat as possible. For example, it would be very, very flat if simply the noise when placing the game pieces was amplified very loudly. But there would be no direct relation between the meaning of the moves as such and the sound that occurs. In the following, a practical attempt is described to bring both together as good as possible, namely a directness of the sound production due to the moves and a meaning of the sounds, which is closely related to the meaning in the game, together.

3. Pulse235 – Design of a board game with an inherent correlation to music

The primordial way of forming tone scales goes back to the ancient Greek culture and is based on frequencies or – what comes out to be the same – time periods corresponding to ratios of integers that differ from each other in a few small prime factors, see for example [Düring 1987]. The tempered tone system preferred today in Western culture also refers to these primordial scale definitions. It represents a good compromise between cleanness and modulation possibilities [Lerdahl 2005].

The basic idea for the board game is to go back to integer sound frequencies, whereby these frequencies can be formed by the product of the first four prime factors, i.e. 2,3,5 and 7. A sound is represented on the board as a diagonal triple chain of coloured game pieces. The colours code the four prime factors with 2=blue, 3=red, 5=green and 7=yellow. The aim of the game is to create as many different triple chains as possible by moving pieces on a 9 by 9 field, starting from an initial distribution of a given number and colour of tiles. In order to increase the selection of the frequencies that can be formed without making the game more complicated, a fourth prime factor corresponding to the actual number of the permutation is selected.

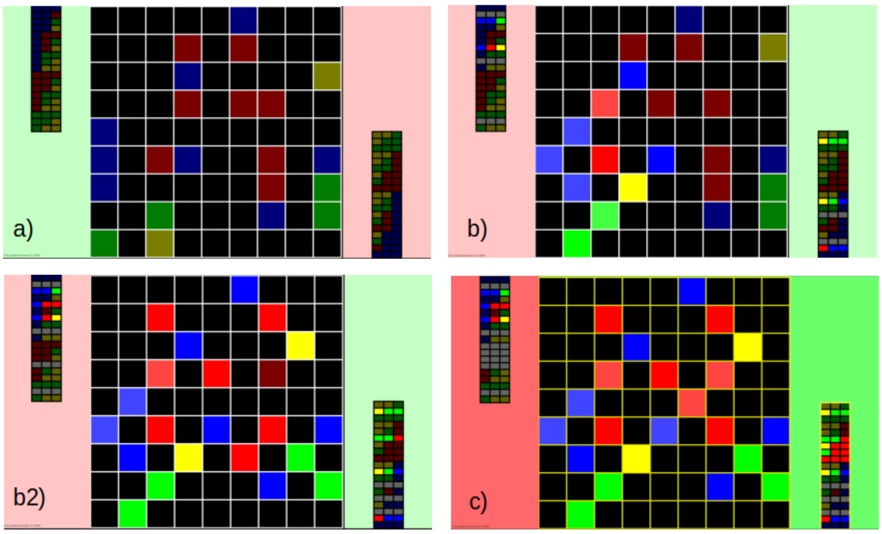

Figure 1. Game phases for Pulse2357: a) beginning, b) and b2) middle phase, c) final configuration.

Two players take turns touching an empty square. If there is exactly one tile closest to this position in either horizontal or vertical direction, that tile will move to that empty position. Those diagonal triple chains completed by a move that have not previously appeared are awarded as winnings to the player who has just made a move (Figure 1 b), b2). If at least fifty percent of the possible different triple chains have already appeared, the player who made the most of them may continue to make moves alone until a state is reached where all tiles in at least one triple chain are involved (Figure 1 c). This means that overlaps are also allowed. When this final state is reached, after touching a board again, a starting situation for a new game is established. These starting positions are random. But they have the property that not a single tile has a neighbour in the diagonal. In summary, this means that all pieces always remain on the board. It begins with no chain of three (Figure 1 a) and ends in such a way that each tile is part of a chain of three. The game, as it is described now, could be played without any musical performance. In the following, we will determine in more detail to what extent the chosen rules of the game are particularly suitable for forming the basis of a musical dramaturgy and how the sound generation was implemented to ensure that the connection between the sound events and the course of the game is as transparent as possible.

So how is music generated from such a game process? In each phase of the game there are a certain number of different integer frequencies that are interpreted as sound events in time. In order to allow an easy assignment between pitch and time, the series of whole numbers is considered a temporal sequence. A tone is played exactly when the currently valid natural number has the corresponding frequency as a divisor. This requires a detailed explanation:

4. The natural numbers as a time sequence taken as the basis for the sonification of the moves in pulse2357

In the following, we will show that the sequence of natural numbers – with or without zero does not make much difference here – understood as a time sequence, as far as the relationship between horizontal rhythm and vertical harmony is concerned, has a great affinity to classical musical structures. For this purpose, attention is drawn from the successive natural numbers to the divisors belonging to each individual number.

Any arbitrary integer positive divisor d occurs regularly in the sequence of natural numbers at a constant distance, which is also d.

Two arbitrary but different divisors d1 and d2 occur simultaneously relative to their size, the less dissimilar they are to each other. The degree of dissimilarity can be taken as the number of prime factors that they do not have in common, or more differentiated, it can also be demanded that the dissimilarity is greater the larger the prime factors in which the numbers do not match. Leonard Euler proposes a formula for this. From those powers k_i of the prime factors p_i, in which two compared numbers (frequencies) differ among themselves, the degree of dissonance designated after Euler with "gradus suavitatis" (GS) results according to the following formula $GS = 1 + \sum_{i=1}^{n} (p_i - 1).k_i$ [Busch 1970]. (The much discussed problems in the application of the gradus to classical harmony theory will be ignored in this context.)

Now the sequence of numbers, which have a certain divisor d in common, itself forms a progression, thus fulfilling the Peano axioms, see e.g. [Russel 1993], pp. 1-10. All in all, all these progressions are interwoven in such a way that such pairs whose divisors d1 and d2 have a high GS seldom occur in the same number, whereas this occurs more often in those with a low GS.

If one understood these dividers directly as frequencies of tones, then such tones appear more often in combination, which harmonize well, and such rarely appear in combination, which harmonize less well, all within the context of the concept introduced here. For the sake of simplicity, this should be called "vertical" resp. "harmonic" property.

However, if we look further, it is also the case that frequencies of similar pitch tend to occur in short succession rather than those with large frequency differences. This shall be called the horizontal or melodic characteristic.

Both together, i.e. the harmonic and the melodic properties of ℕ obviously show a great similarity to the structuring of music according to classical understanding. Also, for example, in classical choral music it is required (very roughly formulated) that successive notes should not show too large leaps, while at the same time sounding harmonics should sound together.

It is quite clear that what is said here for the natural numbers is of course not identical with classical harmony or counterpoint, but it shows – and this cannot be denied – amazing similarities with it. Neither shall we go into the problem further here that there are serious differences in the physiological consonance and dissonance perception compared to what is calculated with GS. Thus we hear a frequency ratio of two prime numbers such as 3001 to 1999 (GS=4999) to 3 to 2 (GS=4).

But as already mentioned, in order to make the fundamental similarities between a classical musical movement and the natural numbers, understood as a time sequence, visible at all, this should be sufficient.

Listing 1. Simple sonification of the natural numbers

```
import processing.sound.*;
SinOsc sino; // sine Oscillator
int t=0;     // counter for natural numbers

public void setup()
{
  size(640, 360);
  textSize(100);
  background(255);
  sino = new SinOsc(this);
  sino.freq(1);
  sino.amp(0.1);
  sino.play();
  frameRate(8); // draw() is called eight times per second
}

public void draw() // cyclically executed function
{
    background(255);
    fill(0);
    text(t,100,height/2);
    int tt = t;
    int f = 2*2*2*3*3*3*5*7; // base number (see text)
    int num2=0,num3=0,num5=0,num7=0;

    // Divide the base number by the prime factors 2,3,5,7
    // occurring in the current natural number:
    while(tt>0 && tt%2==0) {f/=2; num2++; tt/=2;}
    while(tt>0 && tt%3==0) {f/=3; num3++; tt/=3;}
    while(tt>0 && tt%5==0) {f/=5; num5++; tt/=5;}
```

```
    while(tt>0 && tt%7==0) {f/=7; num7++; tt/=7;}
    if(num2<=3 && num3<=3 && num5<=1 && num7<=1 && f>=110
    && f<=1760)
        sino.freq(f); // audible sound
    t++; // natural number incrementing
}
```

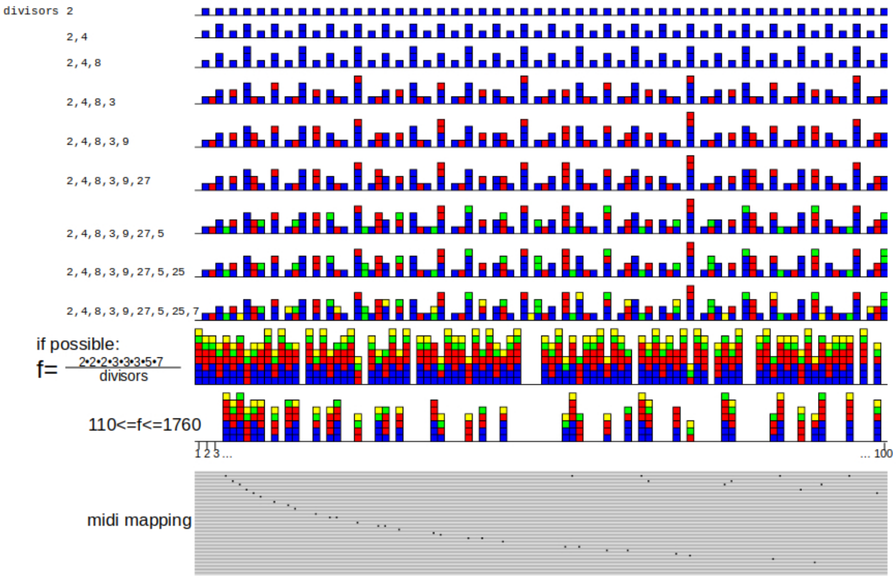

Figure 2. Visualization of what the program does in Listing 1, except the midi-mapping. Line by line, more and more dividers between 1 and 100 are added in color-coded form: 2=blue, 3=red, 5=green, 7=yellow.

In addition, a very short program is presented here (code 1), which sonifies the natural numbers in a very simple way. It was implemented in Processing / Java, see `https://www.processing.org`. To keep it short, no effort was made to achieve a particularly interesting sound. A more elaborate realization of the same thing can be watched as a youtube video: `https://youtu.be/e81wd1b3FEE`. Not the entire actual natural number is taken, but only its parts of 2s, 3s, 5s and 7s. And also these parts are not used directly, but they are taken as divisors of another constant number, which I call the base number (here $2 \cdot 2 \cdot 2 \cdot 3 \cdot 3 \cdot 3 \cdot 5 \cdot 7 = 7560$). Finally, the result of this division is interpreted as frequency and translated musically. Only if this division is possible without remainder and the result lies in the frequency range of the used musical instrument, also a tone sounds (Figure 2). The procedure thus filters out those tones that are in simple ratios to each other and are playable. It should be seen as a kind of humanization process that is applied to the original natural numbers. The musical form is essentially created by not playing parts that lie outside this frame.

The fundamental correlation was thus demonstrated. **And the challenge in the sense of ubiquitous music could now be: do something on the basis of the natural numbers by conceiving this sequence as a temporal sequence and using the divisors of each number as the basis for your own composition. This would be the supra-individual part of the contribution, so to speak, resp. the part that refers to something comprehensible for everyone, to which all people in general have equal access.**

5. Real world implementation (overview)

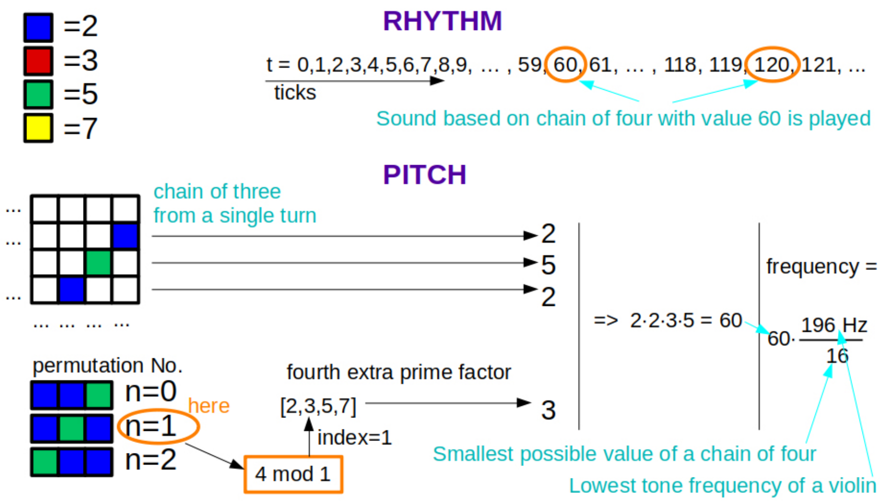

Figure 3. Extract pitches and rhythms from the chains of three.

The game was implemented as an Android app to test it and to have a reference and is available here for free: `https://play.google.com/store/apps/details?id=processing.test.pulse2357`

In order to derive tones and their rhythms from the initially abstract integer values resulting from the chains of three, the following steps were taken in this implementation:

A counter was implemented, which counts up the natural numbers with a constant time step, uninfluenced by the course of the game. One tick of this counter corresponds to the shortest duration possible in the real-time composition. The current value of this counter shall be called t here.

After each move, all triple chains on the playing field are automatically detected.

In order to increase the amount of tones that occur and to make full use of the available information contained in a chain of three, a fourth element is selected based on the color permutation of each chain of three, so that in the end there are all the chains those of four (Figure 3).

In order to make every chain of three in the game audible, the initially abstract values, which are obtained by multiplying the prime factors of the elements of the chains of four resulting from the chains of three, are multiplied by a factor that ensures that the smallest possible value of a chain of four corresponds to the lowest playable frequency (Figure 3, right side).

Finally, frequencies that are too high are octaved down until they are within the playable range. The range used is that of a violin. In order to lighten the sound set somewhat, the current values from the chains of four were ordered by size and the largest was always preferred if the current value of t had both as divisors. Since the largest value is also the rarer divisor of $\mathbb{N}$, this results in the fact that all notes corresponding to the quads are always played. This reduces the sound to a single voice. In order to bring back more voices into play, simply not only the tone with the highest value in the chain of four was played, but the n largest. To achieve again a certain variety of sounds, the sounds kalimba, marimba, pandrum and violin were used in various playing techniques and were assigned to rank n in combination with other game parameters, which will not be discussed further in this presentation.

6. Discussion

What have we gained by implementing a real-time composition program in the form of a board game like pulse2357? Basically you can also think of it as a programming language for musical processes, like Max or Pure data. The possibility of adapting and using languages like this for collaborative, distributed live composing and thus as an approach for the realization of ubiquitous music has already been tested and discussed [Messina, M., Svidzinski, J., de Menezes Bezerra, D., da Costa, D. F. 2019]. Especially during the presentation of this work at the CMMR 2019 conference, it became clear that a major difficulty in the implementation of cooperative distributed composing is not only the technical feasibility, but also the different views of the partners involved on how to deal with an appropriate tool. Indeed, the presentation expressed a certain disappointment that some of the partners, located in different countries and even continents, did not trust in the cooperative interaction and gradually added structures appropriate to the current events, but tended to copy ready-made structures into the current sketch, thus dominating the process on the one hand, but preventing something completely new from emerging out of the cooperation with the others. Apparently, the concrete success of ubiquitous music depends to a considerable extent on whether the sense and functionality of a provided software tool is also understood by its users. It seems obvious to see such experiences as a kind of legitimation for the efforts made in the present work, which essentially consist of looking at what preconditions which are needed to mentally grasp a musical theory and application structure behind a software tool.

Due to the fact that the ticks of the musical performance are not coupled to the turns of the game at pulse2357, this game would also be suitable for a distributed application. However, considered as a programming language, the game represents one which allows the user only a very limited range of action. This seems to be the price for the fact that it can be learned so quickly and the user is aware of what he can do at all times. On closer inspection, it has been possible in many places to make musical rules and rules of the game identical. However, very little has been done to make this connection visible to the user. This can be explained very well by the used tiles: The tiles represent the prime factors 2,3,5,7 and the reference is made by a colour coding with 2=blue, red=3, green=5 and yellow=7. This is very simple, but the colours do not show this relation to the numbers. It is expected that the players learn and internalize this relationship. Neither is the relation to the sound resulting from the combination of three pieces and its rhythmic occurrence directly evident from the constellation on the playing field. Here, too, the user must learn that he must multiply the numbers corresponding to the colour codes with each other in order to get an idea of the rhythm and sound that might result.

Although it was said that through the audible feedback and the automatic control of the game moves for their correctness, the player gradually develops an inner model for the interrelationships between the game situation and the resulting music. But without the study of a playing instruction, these relationships are very difficult to discover just by experiencing the playing situations. The connection between game and music and the game itself is kept simple, but nothing is done to make these simple connections comprehensible other than by pure experience.

How did it come to this? The following explanatory model appears to be appropriate: The use of symbols (in this case the tiles on the playing field) reduces the task to be mastered to providing practical options for action. The meaning behind these options for action is hidden from the user as unnecessary ballast, so to speak. Thus, easy handling and transparency of a matter seem to be in direct contradiction to each other.

In the short term, pulse2357 or similar approaches can be used to get people to compose (cooperatively) very quickly. In the long run, the practice conveyed in this way by no means guarantees an understanding of the principles behind it, as described in chapter 4, even though everything has been done to keep these principles simple.

7. About the idea of using transparent symbols (Future prospects)

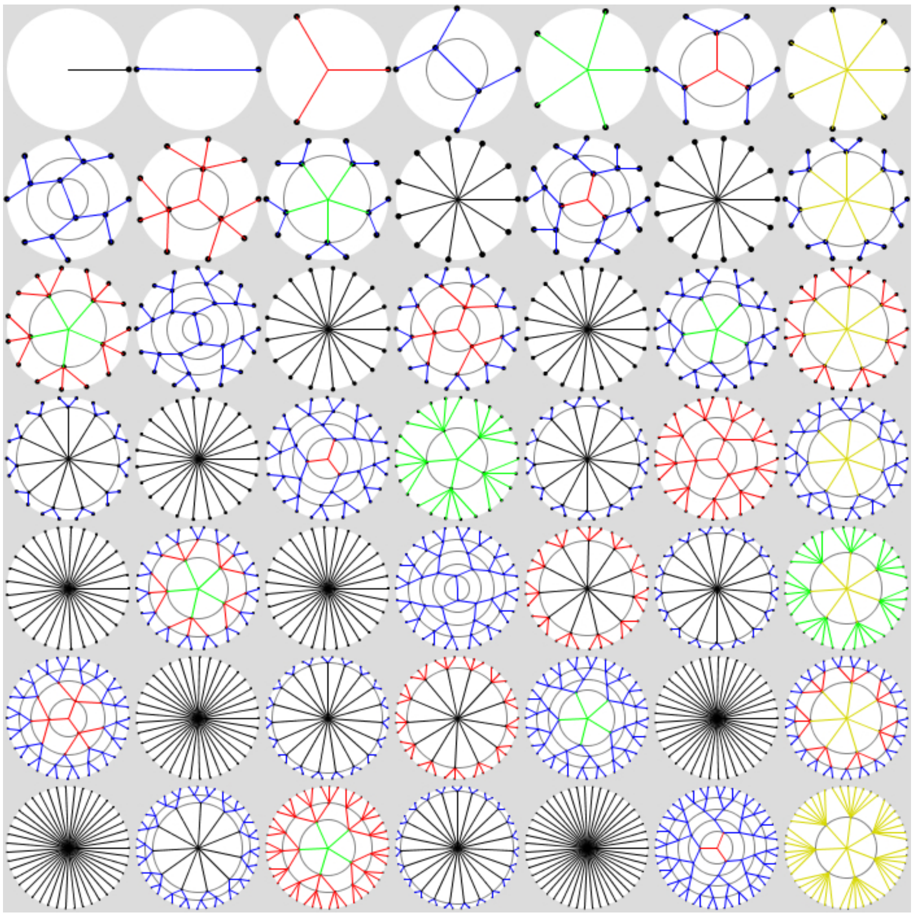

Figure 4. Symbolic representation of the natural numbers from 1 to 49 considering their prime factor decompositions.

To get ahead at this point, just think about making the approaches to composition introduced here available to children. No doubt a first grader would be able to understand and play pulse2357 quickly. But only with a very weak knowledge of basic arithmetic and without an idea of what the divisors of an integer number are, there would be no chance of making the method of composition fruitful for himself. But wasn't arithmetic initially assumed to be an already learned inner model and described as a wonderful basis for the basic understanding of the compositional method introduced here? When presenting the above figure to people of different ages and educational levels, it became clear that the vast majority of them could not find out what this figure represents without further explanation (Figure 4). Explanation: The number of points evenly distributed on the edge of each of the displayed circles corresponds to the natural number that is represented. These run in their natural order from 1 to 49. In the circles, a separate layer is inserted for each prime factor of the current number. These are arranged from inside to outside in order of size. A multiplication between prime factors is represented by a branching. Accordingly, prime numbers are represented by symbols that have no further division into layers on the inside. So 6 is $3 \cdot 2$ and thus there is a three-star in the center of the corresponding symbol, whose three ends branch outwards binarily.

As mentioned above, even educated adults, unless they were mathematicians, were not able to say within a reasonable time (a few minutes) what the figure above represents. Thereby it represents a conceptual design to introduce a kind of transparent symbols into future musical board games, thus such symbols that show what is represented by them, here the inner structure of natural numbers, in order to be able to quickly recognize similarities in this respect. Of course, after a short explanation, most people recognized that this illustration was meaningful. But why does it also fail to meet the demand made on it to let that which is symbolically represented through it shine through immediately? One reason could be that normally nobody is really aware of the fact that there is a difference between a number and the set represented by it. Accordingly, one will not be able to identify an alternative number representation as such when confronted with it. Another explanation would be that the representation in the figure does not actually explain what prime factors are with respect to the set represented by the number symbol, but that an understanding of these new number symbols, as one has to admit, rather goes beyond the representation of numbers as a decimal system that we are familiar with.

One idea to meet these problems could be the drop in sets to symbolically represent numbers and their divisors. And dynamic computer-based representations could help to handle the otherwise expansive representations. However, the symbolic character and the associated advantages of simple practical handling may also be lost here. To substantiate this idea, the divisibility of a number is visualized in the following figure by the various possibilities of arranging the set representing it in a rectangle (Figure 5).

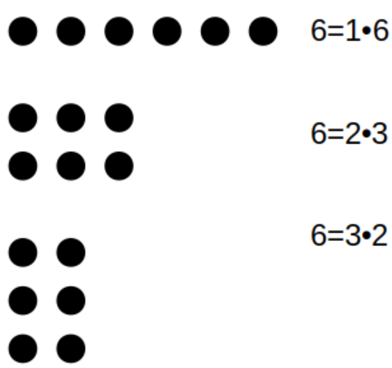

Figure 5. Visualization of the divisors of a number through the different possibilities to arrange the set representing it in a rectangle.

This still would have given no idea whatsoever of how also sounds could be better understood using symbolic representations and thus, would give a kind of explanation for their inner inter relationship.

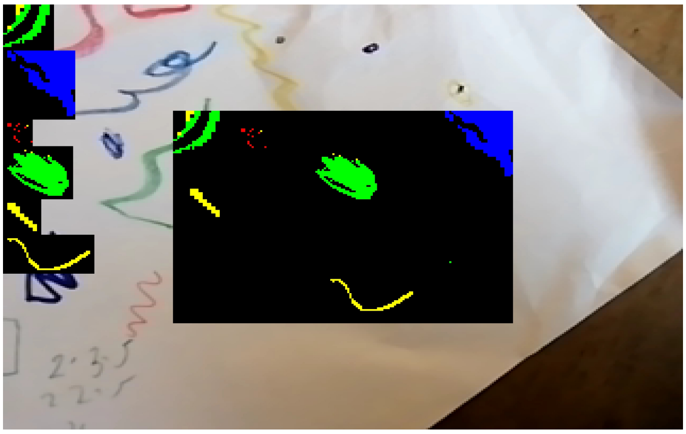

Figure 6. Composing for children.

Trial and error is the basic approach of children. Children tend not to deal with a thing in theory. They prefer to just try something. This makes them a very challenging target group. If a concept is to be suitable to enable everyone to compose, it should be adaptable so that children can do something with it. The idea of representing the divisibility of sets by showing all the rectangles in which this set can be arranged led to the idea of obtaining such rectangles from image sections that are continuously recorded by a camera. Using the appropriate Android app, children can then create a visual score of colorful shapes on a piece of paper. Continuous objects are recognized by the software and are displayed in the rectangle surrounding them on the left (Figure 6). The pixels of these rectangles must be thought of numbered line by line. Where a pixel is coloured, the corresponding number n is active. The colour encodes the instrument with which the corresponding tone is played. The principle of when a tone sounds corresponding to n follows the concept described above: A variable t is continuously incremented. t corresponds to the time sequence of the natural numbers. Whenever n is a divisor of the current value of t and n is also a divisor of a constant base number b, which is composed only of multiple prime factors 2,3,5 and 7, then a tone is played whose frequency f is calculated as f=b/n. During the actual implementation of the app, the size of the base number was adapted to the size of the rectangular objects. The app can be seen in action here: `https://youtu.be/Zrd5mLkp4sE`. The app is expected to be tested by first and second graders at a primary school during a STEM project week in April 2020.

An extended PC-based version, in which the sound generation is done by physical modeling, was used to accompany a movie with sounds that was created during the flight of a drone (Figure 7): `https://youtu.be/nbw-LRxXVCY`

8. Conclusion

As a basic approach to open composing to as many people as possible, a simple variant of a musical theory was sought that could be presented well by means of mathematics, and formulations for simple playing were sought that would allow manipulations in the field

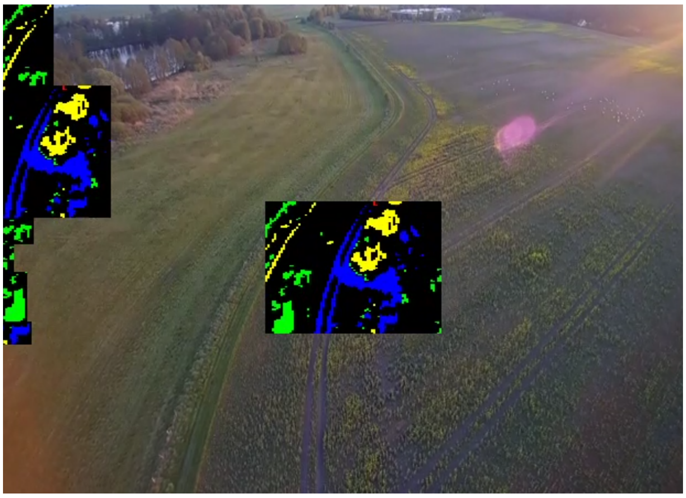

Figure 7. Algorithmic sonification of a film recorded by a drone during flight. The film was kindly provided by Klaus Stanjek, see `https://www.cinetarium.de/`.

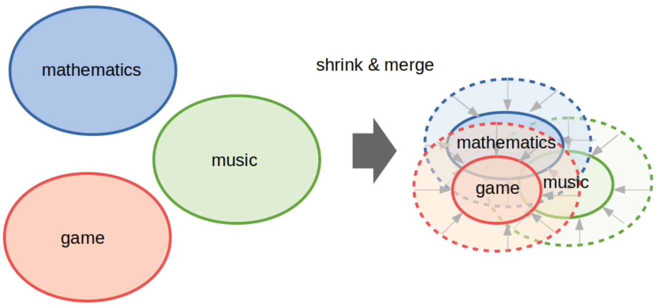

Figure 8. Selection of suitable subsections of mathematics, music and gaming for a fusion.

of this simplified musical theory, thus making it possible to compose. To put it somewhat simply, suitable areas in the fields of mathematics, music and possible games were sought which correspond well to each other and in the best case merge with each other (Figure 8). The reason for this was that it is then possible to carry out actions in an understandable way within a field that one already has a good command of – here mathematics – which then have an equally understandable effect in the musical field. The purpose of transferring the whole thing to a game was to give the user a goal to pursue and thus to ensure a secure continuation of a corresponding performance. Likewise, the rules of the game show the user his possible options for action, without the user having to know the musical laws behind them. In any case, this has led to the development of practical software tools. However, it has also been shown that the relative simplicity of the overall arrangement does not guarantee that the overall context will be understood by the user. The latter, however, has been identified as a basic prerequisite for ensuring that the composition methods behind the real-time composition tool can be made fruitful by the users themselves in the pursuit of their own creative goals. In the following attempt to open up the use of the compositional method presented here to children as well, it became rather clear that a profound transparency cannot be created here at all, because the target group is basically neither openly nor mentally able to grasp the concepts behind it theoretically. Instead, the corresponding Android app, similar to the implementation as a game with its rules, limits itself to an action-oriented comprehensibility. And if one thinks about this in more depth, one has to realize that everything we deal with is always connected with arbitrarily complicated and complex interrelationships under the often seemingly simple surface, which we at best only guess at, but never fully understand. How is that meant? – For example, someone might have fully understood the theory of Pulse2357 and then still know nothing about how playing technique and timbre for the instruments are derived from the playing configuration. Furthermore, someone who is familiar with this area does not need to know how the physical modeling instruments used work. And finally, someone who understands all of this may know very little about hearing physiology, hearing psychology and why something like a positive aesthetic feeling is created in connection with the method presented here. This complex can be further deepened and expanded as desired. And so, after this long search, which this work also represents, the only realization that simplicity is always an illusion may stand.

On the positive side, however, one could also try to defend the approaches presented here in the following way: Music has something to do with the fact that a relationship between temporal events is established and transcended by the listener to the extent that, after recognizing certain harmonic-rhythmic principles, the listener builds up expectations for musical events that will occur in the future. The attraction of a successful composition is then usually not simply to confirm the expectations, but to interpret the expected in a new and different way by means of the new things that really sound, in a way that is unexpected to the listener. In Buddhism there is the concept of dependent emergence, to which everything in the world is subjected. While in Buddhism it is said that nothing lasts and thus, always becomes a source of suffering (see e.g. [Batchelor 2015]), the reverse could be said for music: composing creates dependencies on sound elements that previously existed independently of each other, whose relationship to each other awakens passion in us. In the approach presented here, this relationship between the elements is ensured by the use of natural numbers and their natural relationship to each other.

In this fact lies the transparency and simplicity of all the approaches discussed here. And actually, with every algorithmically based compositional method, one must ask oneself the fundamental question of where the experienced relationship of the structures generated by it comes from. Has it somehow been brought in by rules that go back to the intuition of the programmer, is this reference brought in by the user of the program (and can he fail in it?), or does the inner order of the resulting compositions, as here, come from a source that can be explicitly stated and objectively described and further investigated? As a consequence of this fact, all the variants of algorithmically / generatively supported composition programs presented here, no matter what you do with them, always produce something like music in the sense described here. However, the prerequisite is always that the composition system as a whole is always permeable to the described mathematical / musical principle, which is based on the natural numbers as a temporal sequence. When designing these programs, a certain reluctance was always required not to supplement the whole thing with aesthetic rules of any kind that the developer intuitively felt to be correct. According to the title of this work one is required to renounce doing something (too) grandious (special / intransparent / complicated). Above the recognized always existing and never quite intellectually penetrating depth layers, there is always a superficial layer in the examples here, which in a varying way forms simple relationships that can be easily explained and in which an explanation is already included why relationships arise on a rhythmically harmonic level through the regular use of the respective program and thus, opening the door to become ubiquitous.

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