

# Twelve Tone Serialism

Elizabeth Moorhead

April 14, 2003

## Introduction

Math and music have always been closely related, even though they were predominantly considered separate entities. People with strong mathematical abilities were accredited with thinking logically, whereas musicians were considered artists. While this mindset is still present to an extent, it has been recognized that there is a strong connection between the two subjects. It has even been proven that musicians tend to make better mathematicians. This correlation, however, can be viewed in different ways. Basic math is inherent in music through the rhythms and subdivisions of the notes. Simply being able to read music is a test in division skills, and there is an undeniable logic behind the composition of music. Although music has not always been considered logical, but rather catered towards expression and emotion, there is a science to it. The creative process can be traced through the generations, culminating in something that is not always considered musical, but that is extremely logical and mathematical in its construction.

## Background to music composition

Music has been present for as long as conscious life has inhabited the earth. Whether it was considered music or not, humans have always made sounds in imitation of nature, for communication, and simply to please themselves. However, the first written music belongs to the Middle Ages. Although written using a completely different method than modern notation, Gregorian chant is the first form of music to be recorded. There were no established rules of composition; instead, people sang what was satisfying to their ears. The melodies were usually very simple and did not encompass a large vocal range or include jumps between the different pitches. A single line was sung, usually

referring to a portion of the Latin mass, and harmonies were not involved (Forney, 72-73).

As the years progressed, people began experimenting with the musical form. A second voice was added to the Gregorian chant, sometimes singing the same words, and sometimes singing something completely different (Forney, 74). This evolved into the incorporation of three, four, or even six voices. Eventually instruments were included as well. Although, they were originally used as a background noise, a drone that would enhance certain notes but not add anything on its own (Forney, 75).

As more instruments were used in composition, music gained a new dimension. People began recording the dances of their native countries and creating entertaining stories of love and heroism (Forney, 82). This led to music becoming more widespread, and used for entertainment rather than sacred purposes only. New techniques were created for composition and it was discovered that there are twelve tones that continuously repeat within the bounds of music. These twelve notes came to be considered an octave, and chromatic scales were built from them. In order to compose, a single note was chosen, and a scale was built starting at that note and including six other tones within the chromatic scale. This first note was considered the tonic, and it was soon discovered that the music was most enjoyable when the fourth and fifth notes of the scale were used for harmonization (Forney, 13-14).

However, it was not until Bach that the rules for classical composition were firmly established. The progressions he used and the harmonies he created were completely based on what he enjoyed hearing. There were no established rules that said a piece should end in a certain progression, for example. Bach was able to use his ears to

find the most consonant sounding combinations, and from his works, rules were created that have lasted through the centuries (Forney, 139).

As time progressed, music continued to evolve, and different forms were established for composition. These forms have their own set of rules concerning where and how the melody should repeat and change, but Bach's rules concerning harmonic progressions remained. It was not until Beethoven that music began changing dramatically. Beethoven did not like following the rules of compositional structure, and created music that was both powerful and unique. His fifth Symphony is a perfect example. Throughout the various movements, he used the same rhythm continuously. It was considered very dramatic and single-minded. Nevertheless, though his rhythms were different and his structure was altered, he maintained the same harmonics established by Bach (Forney, 235).

As life became more turbulent through wars and strife, music came to reflect the emotions of the populace. Composers like Wagner created piercing melodies and sometimes very unpleasant harmonies in order to convey emotion (Forney, 351). Experimentation began to alter the musical structure, but it was not until the twentieth century that music took a dramatic turn. Discordance, long considered unpleasant to the ear, was now being used for effect instead of avoided. New scales were created and new styles of technique were developed. No longer were compositions meant to be easy listening (Forney, 368 & 380).

Composers felt that the classical style of music had been exhausted. They wanted to create music, but felt that all of the melodic lines and harmonies had already been utilized by the composers of the past. In order to create new ideas, new sounds, and new

styles, reasoning was employed rather than the human ear. This is where twelve-tone serialism was born (Forney, 381-382).

### The logic behind twelve tone serialism

In order to analyze the logic behind twelve tone serialism, one must take into consideration the history of music and the time period in which this new method was developed. Nineteenth-century music was predominantly occupied with attempting to portray a story, a poem, or an image to the listeners. Music was meant to have a song-like melody that could be hummed or sung, even if it was written for an instrument other than the voice (Forney, 363-364). By the twentieth-century, composers were seeking new ways of expression. They wanted to create a music that spoke for itself, without an established script. This form of music was known as absolute music. Rhythms began to change, and music was no longer written in symmetrical measures of two, four, or six beats. Harmonies were also changing. Chords were no longer built on three notes, but instead they were built of six, seven, or even nine notes. These complex chords created dissonance that had not been heard before in the musical world. In some instances, this new practice resulted in polytonal or atonal music without any definitive structure (Forney, 380-382).

Arnold Schonberg, having accepted that it was time to move forward with new tonal systems, sought to develop a unifying method of composition. He created a technique that he simply called “the method of composing with twelve tones”. It provided rules of composition, and resulted in legitimizing the new style of music. This new system was very structured, but still allowed for some artistic development on behalf of the composer (Forney, 382).

No longer was this new form of music the unexplainable, irrational method used by up-start musicians, but rather a practiced technique that required skill in order to form meaningful compositions. Composers took great care in deciding the order in which they placed the twelve notes. Some composers were even able to imitate melodies from compositions by Bach and others through this technique, altering and perhaps enhancing the original melodies.

#### Axioms of the twelve tone technique

- 1) A twelve-tone composition must be based on an arrangement or series of the twelve pitches of the chromatic scale as determined by the composer. This arrangement is known as the tone row or set.

Corollary to axiom 1: the tone row may begin on any of the twelve pitches, as long as the arrangement, or intervals, remains the same.

- 2) No pitch may be used again until all other pitches have been sounded.

Corollary 1 to axiom 2: a pitch may be repeated immediately after it is heard.

Corollary 2 to axiom 2: repetition may occur within the context of a trill or tremolo: a trill consisting of the fast repetition of a note and the note directly above it in the scale, a tremolo consisting of the same note repeated more frequently than is possible to measure.

- 3) The tone row may, within the confines of the system, legitimately be used in its original form, retrograde, inversion, or retrograde inversion.

4) It is possible to set up the twelve notes in a hexachord arrangement. This means that the second group of six pitches in the chosen row is the exact reverse of the first six pitches.

Corollary 1 to axiom 4: If the row is constructed in such a manner, there are a total of twenty four different row possibilities available to the composer.

Corollary 2 to axiom 4: If the twelve tones are not to set up in two groups of six, and the second group is not the exact reverse of the first, there are exactly forty eight versions of the row available to the composer.

(Kostka, 535)

#### A helpful hint for twelve tone composition

When creating a row order, the twelve notes of the chromatic scale can be represented by their note names or by the numbers zero through eleven. A matrix can then be created that displays all of the possible arrangements of the chosen tone row.

This twelve-by-twelve matrix can be read from any direction: top to bottom, bottom to top, left to right, or right to left, as long as a single row is followed.

An example of a matrix is as follows:

#### Original Row

a a# b c c# d d# e f f# g g#

A	A#	B	C	C#	D	D#	E	F	F#	G	G#
G#	A	A#	B	C	C#	D	D#	E	F	F#	G
G	G#	A	A#	B	C	C#	D	D#	E	F	F#
F#	G	G#	A	A#	B	C	C#	D	D#	E	F
F	F#	G	G#	A	A#	B	C	C#	D	D#	E
E	F	F#	G	G#	A	A#	B	C	C#	D	D#
D#	E	F	F#	G	G#	A	A#	B	C	C#	D
D	D#	E	F	F#	G	G#	A	A#	B	C	C#
C#	D	D#	E	F	F#	G	G#	A	A#	B	C
C	C#	D	D#	E	F	F#	G	G#	A	A#	B
B	C	C#	D	D#	E	F	F#	G	G#	A	A#
A#	B	C	C#	D	D#	E	F	F#	G	G#	A

Another example is as follows:

### Original Row

0 1 2 3 4 5 6 7 8 9 10 11

0	1	2	3	4	5	6	7	8	9	10	11
11	0	1	2	3	4	5	6	7	8	9	10
10	11	0	1	2	3	4	5	6	7	8	9
9	10	11	0	1	2	3	4	5	6	7	8
8	9	10	11	0	1	2	3	4	5	6	7
7	8	9	10	11	0	1	2	3	4	5	6
6	7	8	9	10	11	0	1	2	3	4	5
5	6	7	8	9	10	11	0	1	2	3	4
4	5	6	7	8	9	10	11	0	1	2	3
3	4	5	6	7	8	9	10	11	0	1	2
2	3	4	5	6	7	8	9	10	11	0	1
1	2	3	4	5	6	7	8	9	10	11	0

Both of these matrices are exactly the same, the only difference is that one is represented with note names and one is represented with numbers. These also represent matrices that have only twenty four possible row combinations. It is easier to see why there are only twenty four possibilities by analyzing the matrix made up of numbers. The two separate groups of numbers are split between the five and the six. With this in mind, it can be seen that the distance between the corresponding numbers on each side of the matrix is the same. From one to two there is a difference of one. From ten to eleven, there is also a difference of one. This correlation remains throughout the entire original row. Because this one to one correspondence exists, some rows are repeated in a different portion of the matrix. For example, the row in the top left hand corner that is read from left to right is exactly the same as the row in the bottom right hand corner that is read from bottom to top. They both have the order: 0,1,2,3,4,5,6,7,8,9,10,11. This doubling of rows is what causes the matrix to produce twenty four options instead of forty eight (Cavanagh).

A matrix that contains forty eight possible rows is as follows:

### Original Row:

0 7 6 3 2 11 5 9 8 10 1 4



0	7	6	3	2	11	5	9	8	10	1	4
5	0	11	8	7	4	10	2	1	3	6	9
6	1	0	9	8	5	11	3	2	4	7	10
9	4	3	0	11	8	2	6	5	7	10	1
10	5	4	1	0	9	3	7	6	8	11	2
1	8	7	4	3	0	6	10	9	11	2	5
7	2	1	10	9	6	0	4	3	5	8	11
3	10	9	6	5	2	8	0	11	1	4	7
4	11	10	7	6	3	9	1	0	2	5	8
2	9	8	5	4	1	7	11	10	0	3	6
11	6	5	2	1	10	4	8	7	9	0	3
8	3	2	11	10	7	1	5	4	6	9	0

Analyzing the difference between consecutive notes reveals that the second six notes are not the reverse of the first six notes. The split between the groups of six occurs between the eleven and the five. In order to compare the two groups, one must begin where they are split and work outwards, evaluating the corresponding numbers. In the top row, this means comparing the distance between the five and the nine to the distance between the two and eleven. When this is done, the distinction is clear: the difference between five and nine is two, whereas the difference between two and eleven is nine. As long as a discrepancy exists, forty eight rows are created (Cavanagh).

#### The founder of serialism and a compositional model

According to Schoenberg, the accredited founder of the twelve tone system, only the notes must follow a certain pattern. He did not serialize every aspect of his music, meaning rhythm, dynamics, and note length can be determined by the composer (Forney, 382). In an attempt to demonstrate how twelve tone music sounds, and how a chosen row can be manipulated, the following piece was composed using only Schoenberg's rules. The first twelve notes are from the original Row. The rhythm was chosen because of personal preference. The second group of twelve notes is written in reverse. Because it

is allowable to start on any pitch, the fact that the second group did not start on G, the zero pitch in this instance, is of no consequence. The third group of twelve notes was written in the third possible version that is allowable; they consist of the original row inverted. Again, the starting pitch was altered. The fourth group of twelve notes was written in the last allowable mode, reversed and inverted. According to the matrix, there are forty four more possibilities, but each of these options is a version of the original four. The only differences are the starting pitches.

The rhythm was altered upon completing the first line of the composition. This was done out of personal preference and is allowable according to Schoenberg's rules of composition. In order to create the harmony, corresponding rows were utilized. For example, if the melody was an inverted version of the original row, the harmony was made up of the corresponding reversed and inverted row. This was done to create cohesion between the melody and the harmony, but extra notes were added as well to make larger chords.

While using this method of developing harmony was acceptable to Schoenberg, his successors may have found a problem with this technique. Two composers, Anton Webern and Olivier Messiaen, believed in total serialization. Serialization refers to the ordering of the components in a piece of music. According to this technique, all rhythms, dynamics, and note duration must maintain the same order of appearance throughout the entire piece (Kostka, 548). Had the model composition followed these rules, the rhythmic pattern would have repeated throughout the piece instead of varying. It is even possible with this technique to create a chart referring to note duration (Watkins, 512). For example, perhaps every "a" that was played in the piece would have to be one and one half beats long, or every d-sharp that was played would have to be the length of a

one-eighth note. Ultimately the composer could determine the length of each note, but it would have to remain consistent for the entire duration of the piece.

### Implications on the future

One interesting result of twelve tone serialism is the creation of a new type of melody known as Klangfarbenmelodie. This literally translates into “sound color melody” and refers to the juxtaposition of minute melodic fragments of contrasting timber and register. Composers were able to take groups of three to four notes and arrange them in a way that resulted in completely different tonal centers. As the music rapidly shifted between the various groupings, a new type of sound was created. No longer was music simply happy, sad, tragic, or ecstatic; it had become something completely different, something that was able to shift between all of these moods within the space of a heartbeat (Kostka, 543).

Composers have continued to create music using many of Schoenberg's techniques. Some composers have created music that is completely serialized in every aspect, while others have created rows that involve more than just twelve notes. Stravinsky, for example, makes use of a twenty eight notes series for the variations found in the second movement of his “Sonata for Two Pianos” (Kostka, 545). Obviously, since there are only twelve notes in a chromatic scale, Stravinsky had to repeat notes in order to come up with a twenty eight note series. However, he stayed with Schoenberg's principles by creating a series that repeated throughout his composition.

As time progresses, music will continue to develop. New sounds are constantly created, and technology is allowing for music to be performed without performers. While it is impossible to tell in which direction music will head in the future, it will be

interesting to hear the sounds produced and to note the logic behind the techniques that are invented.

## Works Cited

Cavanagh, Dan. "Twelve Tone Row Converter." [Online] Available:

[http://www.geocities.com/dan\\_cavanagh/matrix.htm](http://www.geocities.com/dan_cavanagh/matrix.htm). April 24, 2003.

Forney, Kristine & Machlis, Joseph. The Enjoyment of Music. W. W. Norton & Co.,

New York: 1999.

Kostka, Stefan & Payne, Dorothy. Tonal Harmony. McGraw Hill, San Francisco: 2000.

Watkins, Glenn. Soundings: Music in the Twentieth Century. Schirmer Books, New

York: 1988.