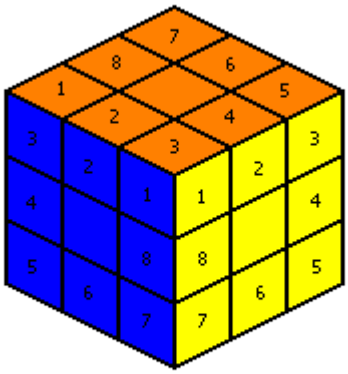
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Zachary Seldess

MUSIC OF THE CUBE

For 48 musicians, a conductor (who manipulates a 3x3 Rubik's Cube) and a Shockwave Flash program manipulator (who transfers the conductor's manipulations to the computer screen)

Overview

Forty-eight musicians create music in reaction to the changing configuration of a 3x3 Rubik's Cube, manipulated by the conductor. Each of the forty-eight musicians tracks the movement and positioning of a different colored square-face on the Cube (there are forty-eight square-faces, excluding the six center square-faces, one of each color). Each musician perpetually assesses his square-face's position and surroundings and then reacts with various musical realizations of these factors (according to parameters indicated later in the score). The combined effect of all forty-eight musicians tracking and reacting to their individual square-faces will appear, from the conductor/Cube manipulator's and audience's perspective, as a sonic manifestation of the Cube in its various permutations.

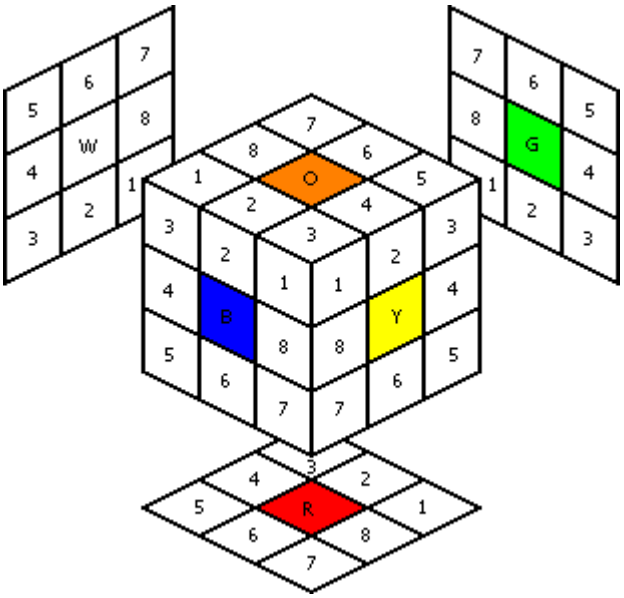
The musicians' ability to accurately track the movement of their square-faces is essential for a successful performance of this piece. To facilitate this ability, an additional performer controls a Shockwave Flash program designed to simulate the movement of the Cube on the two-dimensional surface of a computer screen (see the accompanying CD-ROM [*program created by Ryan Battista*]). This program allows the musicians to see all sides of the Cube simultaneously on the computer screen. The Flash program manipulator sits at the computer, in close proximity to the conductor, closely observes each change in the Cube's configuration, and promptly mimics the change in the configuration of the computer program's Cube. Several monitors are connected to the computer and positioned around the musicians, allowing them to easily follow their square-faces' movement without having to see the conductor's Cube.

The conductor/Cube manipulator, in effect, sculpts the sound of the orchestra through the manipulation of the Cube. She does not have any formal knowledge of the musicians' musical instructions; she may only acquire this knowledge experientially through rehearsal or performance. Therefore, initially, she has no insight into the relationship between the musical behaviors of the orchestra and the configuration of the Cube. For each change in the Cube's state, she will hear one or more changes/developments in the corresponding music. She observes these changes, and as time passes and experience grows, she begins to intend sound out of the orchestra (conduct) through her handling of the Cube. After extensive exploration of the relationship between the Cube and the orchestra, she begins her attempt at solving the Cube. Her *primary* intention from this point on is to solve the Cube, and as such the music's relationship to the Cube's configuration becomes a *secondary* influence on her decisions in manipulating the Cube. On the other hand, if at any point during this second phase of Cube manipulation she gains a deeper understanding of the Cube's relationship to the resulting music, or if she simply hears something that interests her, she may postpone her solving of the Cube and explore this new discovery further. There is no limit to the amount of detours that can be taken while en route to the Cube's solution (and it should be noted that these changes of intention are not apparent to either the musicians or the audience). Upon solution of the Cube, the conductor allows the orchestra a short while to realize the corresponding music and then the piece ends.

On the Preparation of the Cube

Number the square-faces of each side (color) of the Rubik's Cube according to the following diagram:

Figure 1



Note: *Although there are 3x3 Rubik's Cubes available with various styles and designs (different colors, pictures, etc.), for the purposes of this piece only a Cube with the original colors of white, green, red, orange, blue and yellow (as pictured above) may be used.*

The square-faces of each side are numbered 1 through 8 (not including the 6 center square-faces). The numbers are positioned on the Cube in such a way that all numbers on three adjacent sides of the Cube (red, blue and yellow for example) appear upside-down and backwards on the other three sides of the Cube. In other words, the numbering configuration on one half of the Cube's square-faces appears in retrograde inversion on the other half of the Cube's square-faces.

This numbering serves two purposes. First, each performer must closely and accurately follow the movement of his square-face throughout the piece. The number makes his square-face, being one of either four corner square-faces or four middle square-faces of the same color, easily and clearly identifiable. Second, each performer will use the numbers of his own and other performers' square-faces as a factor in determining various aspects of his sonic realization.

Instrumentation

All instruments must be able to sustain pitch as well as control the duration of sustain (no plucked instruments or struck percussion [bowed percussion may be possible]).

Each of the forty-eight musicians is assigned an individual square-face of the Cube's forty-eight square-faces (excluding the center square-faces of each side, which do not move). The musicians are divided into six groups by colors/sides of the Cube, and the groups are organized in one of the following ways:

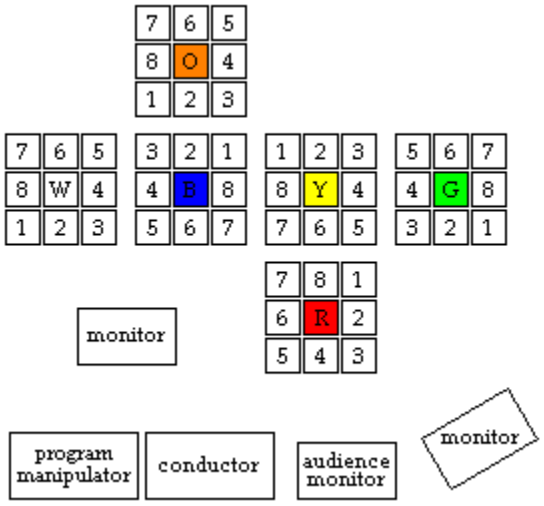
A. By subgroups within an instrument family (strings, woodwinds, etc.).
   i.e., reds as violins / blues as cellos / yellows as violas and double basses / oranges as saxophones and clarinets / whites as flutes, oboes and bassoons / greens as trumpets, horns, trombones and tubas
B. By instrument type.
   i.e., reds as violins, violas, cellos and double basses / blues as oboes, English horns, bassoons / yellows as sop., e-flat and bass clarinets / oranges as soprano, alto, tenor and baritone saxophones / etc.
C. By instrument.
   i.e., reds as violins / blues as cellos / yellows as soprano clarinets / oranges as soprano flutes / etc.

Positioning

The performers, conductor and Flash program manipulator may be positioned in one of two ways:

1. The musicians sit on stage facing the audience, grouped by their respective colors/sides in likeness of the Cube as if it were unfolded. The conductor stands towards the front of the stage, also facing the audience, with Cube in hand. The Flash program manipulator sits at the computer, in close proximity to the conductor. A few monitors (attached to the computer) are positioned near the musicians, allowing them to easily follow the Cube's changing configuration. One other monitor (also attached to the computer) is positioned near the audience, allowing them to watch the changing Cube.

Figure 2



2. The musicians sit or stand at various locations around the audience (including above and below, if possible). They are grouped by their respective colors (six groups for the Cube's six sides) in a square shape (in imitation of their square-faces' positions on the Cube), single-file line, half-circle, or any other shape that lends itself to the particular performance space. The conductor stands facing the audience, easily visible to them (perhaps on stage, if one exists), with Cube in hand. The program manipulator sits at the computer, in close proximity to the conductor. Six monitors (attached to the computer) are positioned near each of the six musician groups, allowing them to easily follow the Cube's changing configuration. One other monitor (also attached to the computer) is positioned near the audience (again, perhaps on stage), similarly allowing them to watch the changing Cube.

   Note: *Try to keep a somewhat equal distance between the disparate musician groups (colors/sides of the Cube) and the center of the audience, if possible.*

In an ideal situation: (see Figure 3)

The audience sits (all facing forward) on an elevated square platform (about ten feet off the ground) with the conductor standing at the front facing them. The platform is made of a translucent or semi-translucent material that light and sound easily penetrate (strong wire mesh perhaps). The program manipulator sits at the computer, in close proximity to the conductor. One monitor (also positioned at the front of the platform and attached to the computer) faces the audience, allowing them a clear view of the changing Cube.

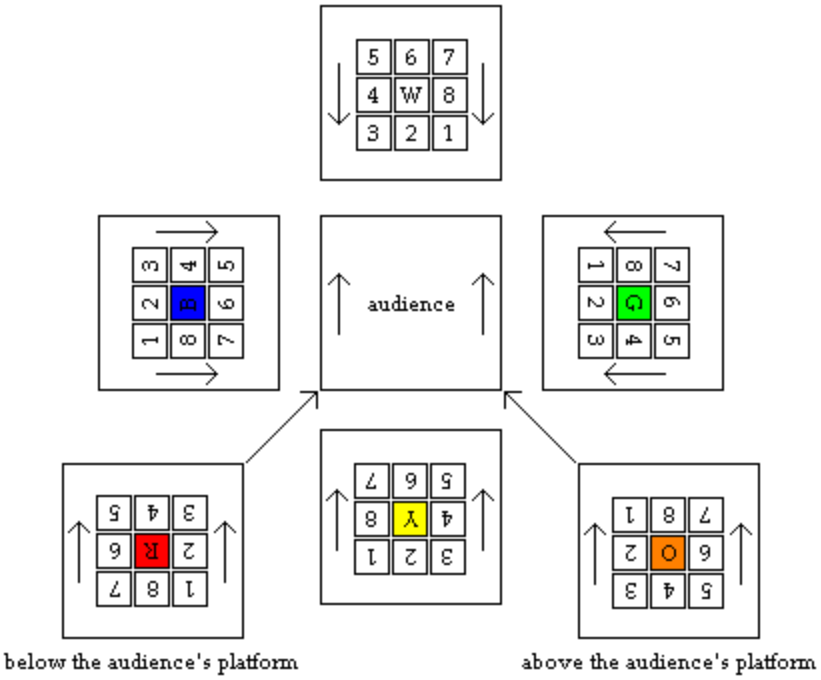
Directly above the audience's platform (ten feet or so) is another platform of the same proportions and material. On this platform sit all the musicians assigned to square-faces on the orange side of the Cube (all facing forward like the audience). Their seating arrangement corresponds with the arrangement of their numbered square-faces on the Cube when in its solved state (orange 3 in the back left corner, orange 8 in the front middle, orange 5 in the back right corner, etc.). A monitor (attached to the computer) is positioned at the front of the platform, facing the musicians. These musicians must attempt, if possible, to direct their sound *down* towards the audience beneath them. If this is not practical or possible, reflective surfaces may be used to redirect the sound downwards.

Directly below the audience's platform (ten feet or so) sit all the musicians assigned to the square-faces on the red side of the Cube (all facing forward like the audience). Their seating arrangement corresponds with the arrangement of the their numbered square-faces on the Cube when in its solved state (red 7 in the back left corner, red 3 in the front right corner, etc.). A monitor (attached to the computer) is positioned in front of the group, facing the musicians. These musicians must attempt, if possible, to direct their sound *up* towards the audience above them. If this is not possible or practical, reflective surfaces may be used to redirect the sound upwards.

Four other elevated platforms (raised to the same height as the audience) are situated on each of the four sides of the audience's platform. On these platforms sit all the musicians assigned to the remaining sides of the Cube (all facing inward towards the audience). On the platform to the audience's left sit the blues; On the platform in front of the audience sit the whites; On the platform to the right of the audience sit the greens; And on the platform in back of the audience sit the yellows. On each platform, the musicians are seated in three rows (corresponding to the three rows of their sides of the Cube). On each platform, the row closest to the audience sits on the surface of the platform, and the second and third rows sit on sequentially higher risers (the third higher than the second). Each group's seating arrangement corresponds with the arrangement of their numbered square-faces on the Cube when in its solved state. In the first row of each platform (the row closest to the audience) sit the musicians assigned to the bottom level of the Cube (moving clockwise around the audience: blue 7, 6, 5 / white 3, 2, 1 / green 1, 2, 3 / yellow 5, 6, 7), in the second row sit those assigned to the middle level of the Cube, and in the third row sit those assigned to the top level of the Cube. A monitor (attached to the computer) is positioned in front of each group, facing the musicians.

This positioning attempts to loosely simulate, for the audience, the feeling of sitting inside the Rubik's Cube as the sounds/square-faces of the Cube rotate around them.

Figure 3



On Coordinating the Flash Program with the Rubik's Cube

To begin a performance of this piece the Rubik's Cube must be in a scrambled (unsolved) state. The Cube in the Flash program must be in the exact same scrambled state as that of the physical Cube, therefore some preliminary coordination is required between the conductor and the program manipulator.

Conductor and program manipulator:

Begin with both the physical Cube and the Flash program's Cube in their solved states (Note: the program always begins in its solved state, whereas the physical Cube, if not new and unaltered, will first need to be solved in order to coordinate with the program's Cube). The conductor then alters the configuration of the Cube, one move at a time, while the program manipulator mimics her alterations on the program's Cube. This continues until the Cube is in a thoroughly scrambled state, at which point the Cube and the program are ready for performance.

On Preparing the Musicians for Performance and On Designating the Resonant Pitch Classes of the Cube

Musicians:

You are each assigned a specific square-face on one of the six sides/colors of the Rubik's Cube. Your square-face has a number (1 through 8) on its surface. This number will help you quickly and accurately follow your square-face around the Cube as it changes position. This number will also play an important role in your generation of pitch and duration throughout the performance. Look at the picture of the Rubik's Cube on your 'Performance Key' page (the last page of this score) and become familiar with the position of your square-face in the context of the entire Cube. When a square-face is in its position as indicated in this illustration (or in Figure 1), this I will call its *Final Solved Position*. Your two-dimensional square-face is one of either two or three visible square-faces on a three-dimensional cubelet (three square-faces [of different colors] if on a corner cubelet; only two square-faces [of different colors] if on a middle cubelet). Again referring to the picture on your 'Performance Key' page, determine the sum of the numbers on your cubelet's two or three visible square-faces and write this number in the space provided. This number will also play an important role in your sound generation.

Prior to a performance of this work, you musicians (as an entire orchestra or grouped by color/side) must assign a single pitch class to each color/side of the Cube. A different pitch class may be assigned to each side of the Cube (resulting in six different pitch classes), the same pitch class may be assigned to opposite sides of the Cube (resulting in three different pitch classes), or a combination of these two possibilities may be done (resulting in four or five different pitch classes). I will refer to these designated pitch classes as a side's *Resonant Pitch Class*. Write your side's Resonant Pitch Class on your 'Performance Key' page. Your resonant pitch class will play an important role in your generation of pitch throughout the performance.

Beginning the Performance

Prior to the beginning of the performance, the audience must not be able to see the physical Rubik's Cube or the Flash program's Cube (as displayed on the monitors). So as the audience enters the space their monitor is turned off and the physical Cube is hidden from sight (perhaps under a sheet on a stand by the conductor). The musicians' monitors are turned on at least a few minutes before the beginning of the performance, giving them time to assess both the Cube's state and the corresponding musical behavior that is required of them.

To begin the piece, the conductor reveals the Rubik's Cube to the audience. Simultaneously the audience's monitor is turned on and the musicians start playing.

Proceeding with the Performance

Conductor: (Your task is divided into two phases)

Phase One

Change the configuration of the Cube, one move at a time. After each move, be sure to allow the program manipulator sufficient time to mimic your movement on the program's Cube. Aside from this necessary time restraint (which may be virtually irrelevant if the program manipulator observes you and responds quickly and accurately), feel free to pace your movements in a way most suitable to your preference. As you change the Cube's state, you will hear corresponding musical changes. Observe these changes. Try to provoke interesting musical reactions in the orchestra. Notice the relationship between the Cube's state and the musical behavior of the orchestra. Explore this relationship extensively. Stumble upon intriguing, dense, redundant, empty musical scenarios and react to them. As your insight into the musicians' relationship with the Cube deepens, intend specific musical reactions/behaviors through your manipulations with the Cube.

Phase Two

After thorough exploration of the relationship between the Cube and the orchestra (you may or may not feel satisfied with your understanding of this relationship), begin your attempt at solving the Cube. Your *primary* task from this point on is to solve the Cube, and as such the music's relationship to the Cube's configuration becomes *secondary* in importance. On the other hand, if at any point during this second phase of Cube manipulation you gain a deeper understanding of the Cube's relationship to the resulting music, or if you simply stumble upon a musical sound/behavior/scenario that interests you, you may (and probably should) postpone your solving of the Cube in order to further explore this new discovery. You may postpone solving the Cube as many times as you see fit, but placing these detours within the larger developmental arc of this Second Phase, the Cube should find itself developing in the general direction of it's harmonious solved state.

Flash program manipulator:

Watch the conductor's Rubik's Cube very closely. For each move that the conductor makes on his Cube, mimic that move on the program's Cube. Try to observe and make these developmental changes as quickly as possible following the conductor's changes, but above all else be accurate.

Musicians:

Follow your square-face closely as it moves around the Cube, responding musically to each new position according to the following parameters. Always play at a *piano* dynamic level equally balanced with the other musicians.

When your square-face is in any position other than its Final Solved Position

On the side of the Cube that your square-face is temporarily positioned, you may find other square-faces of your color.

1. Determine the sum of the numbers found on these like-colored square-faces, including your own.

2. After you have determined this sum, count the same number of half-steps *above* your Resonant Pitch Class. You will arrive at your *Momentary Pitch Class*, or the pitch class that you are required to play at that moment. To facilitate this process, fill in and refer to the interval chart on your 'Performance Key' page.

3. Play any octave of this Momentary Pitch Class for the same number of seconds as the previously determined sum (if you play a wind instrument, it may be necessary to stop briefly to take a breath).

   An example:

   > You find yourself on a side with one other square-face of your same color (numbered 2, and lets say your own number is 1). The sum of your own number with this other like-colored square-face is 3, which equals 3 half-steps or a minor third. Count three half-steps above your own Resonant Pitch Class (which let's say is 'F#') and you will arrive at the pitch class 'A'. Now choose any octave 'A' and sustain it for 3 seconds (equal to the previously determined sum).

4. After you have finished the above process, stop for a short time and then play the same pitch as before (in the same octave) for the same duration. Repeat this step until your square face or other like-colored square-faces (located on your temporary side of the Cube) change position.

5. When your square-face or other like-colored square-faces (on your side of the Cube) change position, stop for a short time and then start again, reassessing your musical behavior according to the new configuration.

When your square-face is in its Final Solved Position

1. Play any octave of your Resonant Pitch Class while pulsing the note gently but noticeably (add emphasis; do not break the sustain of the note). Pulse the note a number of times equal to the sum of the numbers on your cubelet's two or three visible square-faces (refer to the Performance Key page to help you remember this number). Pulse at an even, constant rate, but be sure not to pulse at the same rate as any other musician (in the case that another musician is simultaneously sustaining and pulsing her own Resonant Pitch Class)

2. After you have finished the above process, stop for a short time and then play the same pitch as in step 1, with the same rate of pulse. Repeat this step until your square face moves out of its Final Solved Position.

3. When your square-face moves out of its Final Solved Position, stop for a short time and then start again, reassessing your musical behavior according to the new configuration.

When all the square-faces of your color are in their Final Solved Positions (when your side of the Cube is solved)

1. Oscillate between the different octaves of your Resonant Pitch Class at an even, constant rate (change notes every three seconds or less). All musicians in your group (assigned to square-faces of your color/side of the Cube) must change octaves at the same time, so you may need a designated leader to determine your rate of oscillation and to help cue the musicians. If another color/side of the Cube is solved, you and the musicians in your group must be careful not to oscillate at the same rate as them.

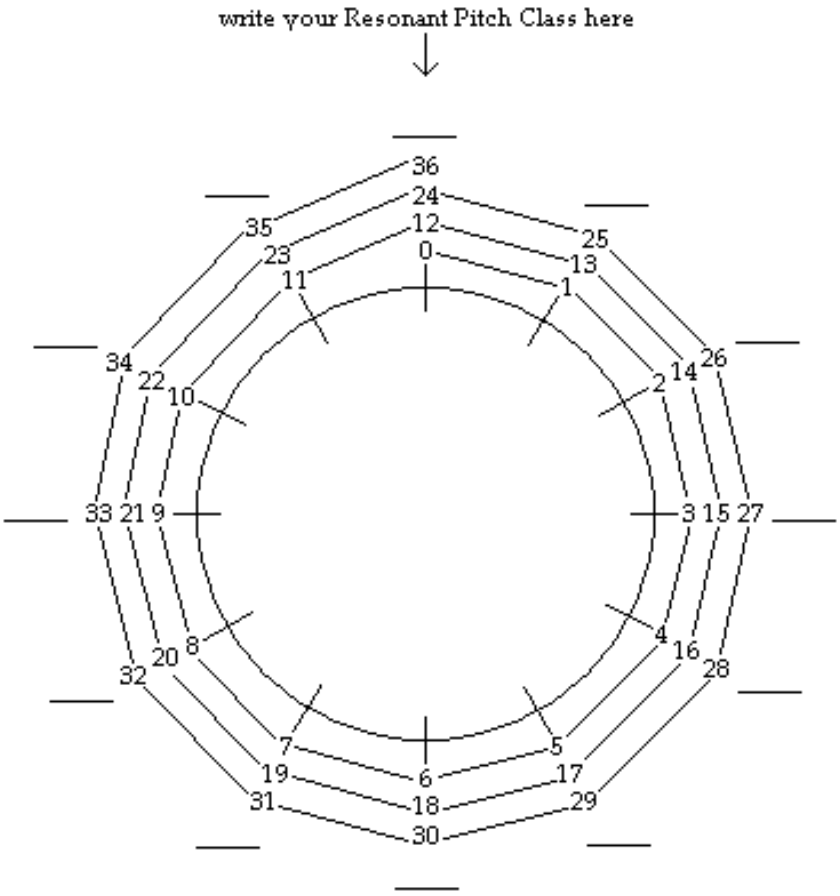
2. If a square-face moves out of its Final Solved Position, stop for a short time and then start again, reassessing your musical behavior according the new configuration.

Ending the Performance

When all square-faces of the Cube are in their Final Solved Positions (in other words, when the Cube is solved), the conductor stops altering the Cube and allows a short while (at least 30 seconds) for the musicians to musically realize the Cube's final state. To end the piece, the conductor hides the Rubik's Cube from the audience's vision (perhaps placing it back under a sheet), the program manipulator then minimizes the program on his computer screen and all musicians promptly stop playing.

Performance Key

Resonant Pitch Class = _____



Sum of the Numbers on your Cubelet = _____