Interpretive Challenges in Learning Brian Ferneyhough's Bone Alphabet

The learning and interpretation of percussion music often begins with the selection of instruments, the analysis of the score, and perhaps historical or contextual research about the composer or the work presented. Brian Ferenyhough's *Bone Alphabet* poses an extended approach, where the interpretation of the score requires a parallel interpretative context of oneself and how they perceive high levels of complexity. *Bone Alphabet* is scored for seven percussion instruments that are chosen by the performer. Materials can consist of metal, wood, or skin and no two adjacent instruments can be of the same material. Each instrument should be arranged from low to high and collectively have similar attack and decay characteristics.

Ferenyhough's musical language provokes fear in many performers. His rhythmical structures alone are so extremely complex that one single measure may take several hours to fully understand. The relationship between meter and tempo are also areas for analysis, for example *Fanfare for Klaus Huber* uses time signatures such as 2/20, 1/10, and 3/12 to express relative changes in tempo. In *Bone Alphabet*, texture and voicing are joined through rhythmical

lines that function quasi-harmonically at times where certain polyrhythmic figures are used both as progressive and iterative devices that resonate in ratio to each other. For example in a measure with a time signature of 4/8 and a tempo of eighth note equals 54 beats per minute, seven thirty-second notes iterated in the space of eight thirty-second notes would take place at 47.25 bpm as opposed to 54 bpm. This is very similar to harmonic ratios of 3:2 (ex. An A is 440hz and an E or perfect fifth above is 660hz, a ratio of 3:2) or 2:1 (an octave) of Western tonality but extended much like La Monte Young's tuning system of 17:16, 29:28, etc in *Well Tuned Piano*. These ratios or relationships are unified by iterative figures that create micro-structures within a measure that are layered upon other iterative passages. It can be most accurately expressed as harmonic rhythm and can even be heard as consonant or dissonant.

Structure and form in *Bone Alphabet* are derived from thirteen areas of material that are segmented and variegated based on the composer's aesthetic decisions. These are called by Ferneryhough "comportmental areas" and provide a macro-structure that dictates form, of which ultimately is guided by material that travels between stable and unstable rhythmic texture. (Ferneyhough, 1992)

As a result *Bone Alphabet* is a piece of dramatic contrasts. When listening the piece never remains on a consonant rhythm (rhythm that is of a clean ratio, 2:1, 3:2) for more than a few seconds. Though the piece still has a strong sense of direction. In many ways, the consonant areas magnetize the directionality, giving the formalized structure a notion of polarity.

It is the micro-structural and macro-structural details that make this piece so difficult to absorb. Ferneyhough's language is hyper-detailed and cannot be interpreted without first understanding the function of that detail in its individual, and group manifestations. Strategy and impression lend a great hand to learning this piece, however, a performer also needs tools in which to satiate their appreciation and comprehension. The challenges that this piece presents begin with: the understanding and execution of complex rhythmic structures, the process of refining and ameliorating the hyper-detail of dynamics and voicing, establishing a clear concept of how the material is distributed and phrased, and the overall complacency with the formal trajectory. This high level of interpretation is extended by adjectival labeling, instrument choice, physical gestures, and establishing the roles and contexts in which all these concepts collaborate.

Together these sets of challenges will be further explored, defined and analyzed over the course of this essay.

Understanding the Musical Structures

The large formal structure of *Bone Alphabet* is dictated by the thirteen areas of material, that are further subdivided by changes of tempo, addition of ornamentation, and the number of voices. All thirteen large areas have a unique behavior that binds each of the subdivisions. It is known that Ferneyhough composed each section from 1 to 13 in its entirety before their redistribution. After the redistribution of the material, the piece consists of forty-six phrases that are notated by two vertical lines across the staff, and marked by the previous sudivision criterion and descriptive adjectives, such as *comodo, intransigente, brutale,* etc. The result is "areas of sudden sharp contrast and direction." (Ferneyhough, 1992) Below is a table that shows the characteristics of each of the thirteen comportmental areas. The words that are surround by brackets are simplifications of the entire phrase character. Note that this table may not be the exact grouping of Ferneyhough's original thirteen structures, but given each phrase's characteristics this table shows thirteen cohesive areas of

composition. Exact details of this process have not been thoroughly revealed by the composer.

Area #	Characteristics	Phrase #
1	Interative figures, two voices, patterns in both voices, synchronous [Aggressive]	1, 4, 8, 11, 17, 23
2	Clear rhythmic motive that binds voices, four voices [Free]	2, 6, 31
3	Iterative, rolls, varys between iterative and freer patters, three or four voices [Expressive]	3
4	Non-iterative, common use of rhythmic or instrumental motives, two voices [Melodic/Thematic]	5, 13, 36, 38, 41, 43
5	Narrow instrumentation, quiet and reflective, trills and rolls, two voices [agitated reflection]	7, 18, 22, 25, 35
6	Florid Melodic, complex speed ratio, one voice [sinuous, virtuosic]	9, 14, 29, 40
7	Loud violent figures to sudden rolls or trills, four voices [Release]	10, 16, 33
8	Asynchronous, quiet to brutally loud, brief moments of iteration, four voices [Dramatic}	12, 19, 21, 26, 39, 42
9	Iterative figures, non-melodic, two voices [contrasting stability]	15, 20, 24, 27, 30, 32, 34
10	Very loud, brief moments of rest, iterative figure with changing tempo, one voice [brutal	28
11	Simultaneous instruments (up to four at one time) as one voice, quiet to violent, moments of rest, three voices [intraspective]	37, 45
12	Loud, iterative, speed expressed in nested tuplet [cathartic]	44
13	Grace notes without principle notes, quiet, zero voices [ghost-like]	46

An analysis of these areas gives a firm understanding of Ferneyhough's musical language. Area one, a segment of which is shown in figure 1 (mm. 1-2 and 4), has only two voices and is chosen as an expository statement.

Figure 1 - measures 1, 2 and 4. Area one

The rhythm is harmonic, where the top line represents a consonant rhythm and the bottom line proposes a dissonant contrast. Moments of linearity, mostly vertical, as suggested by the bottom voice's fifth note in mm. 1 allow a brief resolution as well as show in time the speed ratio between voices. Through repetition and dynamic contrast

each gesture progresses towards a cadence and gives the phrase a sense of segregation.

Rhythmic lines in area one are generally constructed by using symmetry, and cycles. Figure 2, mm. 34-35, in the first measure each voice is mirrored both in rhythm and instrumentation.

Figure 2 - measure 34 and 35. Area one

In measure 35 the bottom line's instrumentation is reversed at the midpoint of the bar, which is slightly accentuated by the hairpin dynamic envelope and the top voice providing accents on higher pitched instruments. In measure 4, the bottom voice uses a three-note cycle, either a dotted sixteenth, two thirty-seconds, or a sixteenth combined within a 7:4 ratio.

Area two, figure 3 (mm. 5, 6 and 9) consists of vectoral phrases of dissonant rhythm. These ratios are very close to 1:1 and pull each line either slightly

towards or away consonance giving the line a sense of insouciant linearity.

Figure 3 - measures 5, 6 and 9. Area two

This area yields the vectoral structure's freedom and can be played with more capricious and open phrasing. Measure 9 is a cogent example of this rhythmic polarity. Each voice is iterated on one or two instruments, is horizontally linear, and extends a broad dynamic range. Separated, each voice will sound displaced but together appear united as one phrase. In measures 5 and 6 the 6:7 figures become a binding 'pulse' that blends into the linear motion and disjunct speed variations. This may be for Ferneyhough an implied mode of phrasing or perhaps a more precise notation of natural musical expression.

Area three, figure 4 (mm. 11 and 16), behaves much differently than any other area. It seems to be the only instance of its kind and has two clear divisions.

Figure 4 - measure 11 and 16. Area three

The first half, shown in mm. 11, uses rolls and repetitive figures as an adhesive to the three or four other voices that furtively combine with the fundamental rhythm. The rolls are then in the second half isolated and brought into focus as the rhythm is blurred. Instead what appears are rich sonorities as the rolls often alternate between adjacent instruments which are punctuated by sharp accented single notes as in measure 16.

Area 4 and 9, figures 5 and 6 (mm. 20, 56-57), are instances of using iterative and motivic figures.

Figure 5 - measure 20-22. Area four

Area 4 uses a three-note motive that always occurs on the same instruments, in the same order (as seen in mm. 20) but at different speeds. This treatment of motive is common throughout area 4 phrases and is a parallel idea to iteration, but is not always recognizable when heard in context. Area 9 is perhaps an extension of area 1, where both use two voiced iterative figures, however, the patterns in area 9 are often asymmetrical and also involve more complex rhythmic ratios like 9:7, 13:8, etc.

Figure 6 - measures 56 and 57. Area nine

In figure 7 (mm. 24 and 66), area 5, there is a convergence of two voices on one instrument. Focused energy brings attention to one particular timbre and one means of development to each voice.

Figure 7 - measures 24 and 66. Area five

The performer must realize this situation in some capacity where both voices speak separately. A similar mode is present in example 8 (mm. 27). Here there is only one voice that concentrates on the velocity of a single line. Each phrase or, segment of a phrase, is accented with mordents or repeated notes.

Figure 8 - measure 27. Area six

It is melodic and sinuous and probably the most contrasting material in the piece. Despite the linearity of the material it can sound quite dense with the upper and lower mordent trills expressed throughout. Like area 5, its

simplicity acts as a formal nucleus. From stability comes instability, and these sections have tendencies toward the middle. Their rhythmic characters are not as sturdy as area 1, but their textural components are just as strong and insistent. Essentially they reverse the association of rhythm and stability as seen before, and replace this with timbre and monophony. In area 5, the timbral spectrum is diminished and the listener can give their attention to this aspect. The same can be accounted for area 6, where instead of timbre, line is developed which offers a firm ground of stability.

A stark contrast to this would be areas 7 and 8, figure 9 and 10 (mm. 33 and 42), that project high levels of instability and complexity. Area 7 tends to portray a resonance that is ignited by a dense array of dissonance that extinguishes into a serene layering of trills and rolls.

Figure 9 - measure 33. Area seven

These sections provide the extreme ends of character expression in *Bone Alphabet.* Parallel to this idea, area 8 includes the most complex musical details in the piece. Shown in figure 10, this area can have up to four voices acting at once.

Figure 10 - measure 42. Area eight

Often built from nested tuplets, the rhythms are based around brief moments of symmetry woven into the texture. These 'motivic binders', one figure being the thirty-second note triplet figure in figure 10, are not always heard but bind the layers structurally. Both areas provide the greatest formal instability, and are always followed with brief periods of stable material, such as areas 1,3, or 9.

This flux often happens abruptly and allows dissonant material to resolve without transition.

The most exemplary formally constructive areas of the piece occur in areas 10, 12 and 13, figure 11,12,13 (mm. 98-99, 152, 158). These areas act in setting a large structure by creating the largest amount of change. Even with pauses and silences marking sections and phrases, there is no sense of larger formal processes through the segmented construction of the piece. Area 10 is the first moment where space is perceived intentionally.

Figure 11 - measures 98 and 99. Area ten

Stability is regained and punctuated by an extremely loud dynamic level. Groupings of dyads set at different speeds ultimately diminish the previous complexity into the simplest of qualities and magnifies the overall formal

trajectory. This moment occurs approximately two thirds of the way into the piece and gives the listener an opportunity to reflect on the previous material. A similar effect happens at mm. 152.

Figure 12 - measure 152. Area twelve

Again, a violent iteration of a four note pattern that is divided every nine notes and symmetrical. A gesture of this kind perhaps predicts the ending of the piece, shown in mm. 158, where the completely opposite reaction is posed.

Figure 13 - measure 158. Area thirteen

Here there are no voices, only grace notes that mysteriously shape the outline of the rests they precede. Almost silent, the phrase is without any rhythmic clarity and appears ghost-like, completely in contrast to the entire piece. These three areas give shape to the form and provide an antecedent to the harmonic rhythm of the ten constituent areas. Using this contrast the fluidity of movement between stable and unstable material is dramatically strengthened.

Learning Rhythmic Polyphony

The polyphonic voicing of rhythm in *Bone Alphabet* is the most troubling detail in the piece. One must first begin with a strategy of how to execute multiple ratios accurately and musically but avoiding hours of mathematical and linear analysis. The piece is too complex to guess at where a note exists in time, but is also too virtuosic and beautifully constructed to practice relentless rhythmic precision. Ultimately a comprise must be made. Beginning with a careful realization of a parent voice provides a framework for the remaining voices. A parent voice is a dominant voice that binds the other voices in time. For example, in mm. 11 (figure 4), the lowest voice inherently becomes the parent voice because it is repetitive and the most stable. The other voices can be placed in proportion

to the parent layer and refined by listening to a particular voice individually apart from the parent voice. Measure 9, figure 3, however becomes more difficult. A parent voice is not clearly established, and the multiple ratios combined provide an extremely complex rhythmic summation. In this situation choosing a parent voice is a migratory process. The parent voice can move to a different voice within the measure. For example, the initial parent voice in measure 9 is the highest voice in the ratio of 6:5 and is immediately passed to the lowest voice in the ratio of 5:4 and later 8:7. In situations like this moving the parent voice requires an abrupt change in ratio and takes practice to accurately obtain the correct speed of the particular parent voice.

This strategy works most often by trusting the composer's notation. Ferneyhough has taken considerable effort to place each note in proportion to its neighbor. By learning the correct speed of the parent voice the remaining voices should theoretically align properly. This is most apparent to the performer in the first measure, figure 1, where the top voice is easily understood and sight readable, but the bottom voice elicits confusion. Where each note is placed precisely is unknown without the aid of a graph or other device and reveals the ultimate

weakness of using a parent voice. The ear can hear each voice when played together but not individually. One rather hears a summation, or resultant rhythm. This is most common in dissonant rhythmic passages where the addition of layers creates a corrugated texture. Small changes of density create wrinkles within a measure that are constructed of complex layering of ratios but perceived as one viable unit. Separation of voices in this case is impossible to hear unless a voice is placed on a specific set of instruments. For figure in mm. 42, example 10, the top voice is most apparently heard through the texture because the instruments are pitched higher and the rhythm is more compressed.

However, not all rhythms in this piece are polyphonic. Monophonic lines are normally expressed using variegated speed changes as shown in mm. 27, figure 8. The speed changes happen quickly without transition, a micro-structure that is also present in the macro-structure. These changes can only be practiced in relation to each other, a metronome could be used to obtain the proper speed, but almost becomes useless when in context of the entire phrase. Instead a good understanding of each ratio relationship will satisfy the progression of the phrase. Material of this sort is a locution of rhythmic energy.

Much like the pentameter of speech is augmented to inflect meaning, here the undulation of rhythmic speed provides shape and an implied sense of phrasing.

Perfect execution is perhaps not the goal in interpreting *Bone Alphabet*. However, proportional execution is the preferable substitute. Using these devices allows for the accuracy and freedom of interpreting rhythms of this kind and does not detract from the learning process that can at times lend itself to be frustrating and disagreeable.

Interpretive Contexts

Adjectival Labels

The most equivocal devices used in *Bone Alphabet* are adjectival labels that correspond to phrases and sections. These include such words as: *rigoroso, capriccioso, in modo analitico, violentissimo, comodo, piacevole,* and *convulsivo*, naming only a fraction of the unique terms. Labeling of this nature is a curious practice. How is one supposed to interpret such a specific word to such complex material? The very opening phrase, marked *rigoroso as in* figure 1, obviously calls for a rigorous impression when playing the music. However, another question is posed as to what about this music is to be rigorous. Perhaps it is

the rhythm, or the dynamic articulation. It may refer to the motion between measures or the exaggeration of horizontal contour. To what Ferneyhough is pointing at is not specifically known and is left to the performer to decide.

A germane approach would include the distinction of these adjectives to the listener, where one could potentially recognize such intricate characterization. Perhaps that is not possible except only for notable cases like *violentissimo,* or even, *piacevole.* Although, it may not be imperative in the context of the piece to attempt a one to one resemblance of a word. Possibly these labels could serve as contexts in which to approach the music, or a way of filtering the information. For example, the second phrase of the piece is marked *capriccioso* which represents a certain amount of freedom in interpreting this phrase. How much freedom is not revealed, but through the notation one could assume that there is no freedom whatsoever, and may balk at an attempt of applying any. At that same notion, the music may evoke a freer handling of details such as in mm. 6 (figure 3) the one roll in the bottom voices can be gracefully accentuated, the accents could become a separate voice, or the precise articulation markings could be very poignant. The vectorial progression

of the phrase moves so eloquently that too much displacement of the rhythm may not be necessary, but rather built-in as notated. Such handling may not be heard by one as capricious or free, but the manifestation of that feeling would still be imbedded in the performance.

The abstract adjectival labels provide, in a certain manner, a lens in which to approach the phrase. As seen in the previous description of the language, or alphabet, of Ferneyhough, the music is concrete. However, the interpretation is not, and by using these abstractions he allows the interpreter a way of voicing their reactions to this language and results in a pleasingly mercurial performance practice. Figure 5 (mm. 20-22) is a good model of an abstract label. Marked *comodo*, translates to *comfortable* or *convenient*, the phrase is by no means comfortable to play, neither is it comforting to hear. An allegorical representation is not necessary. It may refer to establishing the three-note motive, triplet figures, as a voice that has a cadence, which is an idea that would be comfortable to a listener of canonic Western music. This cadence is developed by the harmonic progression of the speed ratio between triplet figures and 'resolved' by the very last gesture of the phrase, which consists of a rapid, symmetrical cluster, in the time of 9:7. It even sounds

similar to a traditional half cadence as the very last note of the 9:7 cluster almost yearns to resolve to the very highest instrument in the next segment of the phrase.

These terms, or abstractions, are part of the ongoing progression of stable and unstable material in *Bone Alphabet*. Mention a priori, any moment of dissonance or instability is subjugated by an opposing moment of stability. This is same for the adjectival labels. Where some are referable abstractions, others clearly delineate their character. This is quite obvious with labels such as *brutale, violentissimo and convulsivo*. Figure 7 shows *convulsive* material, which dissipates to *calm and attached* material. These terms have no other direction in which to progress. A similar idea with figure 11, a formal 'beacon' can only be installed with force. The material is there to mark that moment relative in time. Other terms like *meccànico* and *piacevole* provide precise representative characterizations. These help stabilize the formal qualities of the piece as well as provide an interpretive context.

Physical Gestures

The corporeality of *Bone Alphabet* is throughout a choreography of the energy used to manipulate the music and

details in the score. Ferneyhough mentions "comportmental areas" in his notes as the musical substance of the piece. (Ferneyhough, 1992) Comportment inherently refers to movement, and is often associated in dance with the motion of the body. This perhaps implies a natural physicality when interpreting the piece. Not to be confused with contrived motions, motions that are not associated with the natural movement of performance, in reference to hands or arms recklessly moving through the air, or head swells and bobs that only remove the musical context of the piece. This physicality is a translational process, where the body releases stored energy, as interpreted from the score, to ignite the instruments in tandem with the positioning of the torso, arms, and hands.

Extended even further, the body may provide a context in which to approach the adjectival labels. In order to imply something is brutal or violent then the body must convince one of that message. This may derive from the manner in which the performer strikes the instruments and their position in front, or behind, the set-up. A stroke may originate from the shoulder or upper back and remain stiff and inflexible to enforce a violent motion. A 'playful' motion may include an appropriately exaggerated movement between instruments or a cultivation of the

intrinsic motions associated with 'playful' sections of the music. When given the term *danzando* the performer can decide if they want to include that expression in their movement. Although difficult, it may be interesting to see a 'dancing' representation in relation to the music. Probably the most visually associative, *danzando* may not have to be concretely representational. When dancing the body moves, most often, with the music, in rhythmic harmony. Perhaps the most natural way of physically conveying this notion is to allow the body to move idiosyncratically to the music. Not to contrive motion, but to allow sways, lunges, twist, etc. to freely evolve and progress with the music.

Apart from this type of behavior, the body is also involved with micro detailing of particular phrases and the macro detailing of formal 'beacons'. One aspect of the written score is the inclusion of simultaneous multiple voices. As mentioned earlier, when executing complex systems of rhythmic layers there is a perceived summation of the subsequent voices. The body, when used appropriately, can separate these voices and reveal their placement in space. They may hear the additive mix, but they can see the physical division. This could apply almost at any point within the piece and would be best used

to showcase a particular voice of significance by separating the hands, using the same mallet, or providing the same motion. Formal aspects could also be accentuated through body placement in relation to the set-up. One could stand at the polar ends for particular moments, given this is where it is best to strike the instruments, or even move in front of the set-up (if necessary), or circle around to play a particular passage. Areas 10, 12, and 13 could be visually distended, or corporeal by associating an angular, or linear placement within the set-up. Using the body to individualize phrases or sections is an adjunct to the performance interpretation and provides a physical basis in which to energize particular material.

Expanding Pedagogical and Interpretive Processes with Technology

Pedagogical Processes

Technology's role in performance is no longer limited to electro-acoustic works, but can be used as a tool for learning and interpreting complex musical structures. *Bone Alphabet* appropriately falls into this category of complexity. Performers are often coy to works of such sophistication and usually have abject reactions to

notation such as Fernyehough's. Learning *Bone Alphabet* is by no means a simple process, but does not have to be overly cerebral as well. Over the past year, I have been researching ways in which to use computer and hardware technology to assist the pedagogical processes of *Bone Alphabet.*

The first stage of this project was to find a viable method of collecting performance data and to design an interface in which this data could be analyzed by the performer. Using *Pure Data* (Pd) software, an application was designed to analyze signal input from seven contact microphones each attached to one of the seven instruments. (*Pure Data,* Puckette) The input was read by the computer and displayed the information in a separate window. If an attack was heard, a dot would appear over a rhythmic matrix, defined by tempo, similar to the notation in the score. (see figure 14) This allowed the performer to see the vertical alignment of each note in relation to the global speed of the performance.

What this first stage was lacking was a means for comparison. The data was not a practical interface to distinguish the accuracy of a performance. The second stage of research attempted to connect the performance input with a computer sequence of the rhythmic layers. By

using the ear as a learning tool, the sequencer could diminish the complexity by providing an interface where a performer listens to an audio realization of all voices simultaneously, or individually, and is given options to change tempo, and choose from fifteen samples that closely reflected their instrument choice. This gave the user a computerized interpretation of any measure that could be used as an aural 'pocket guide' during practice.

The user interface of the sequencer has two parts, the graphical control interface and a text file. The graphical interface uses buttons, sliders and toggle boxes that are native to Pd. The user can: select a measure they have sequenced, adjust the tempo of a measure, mute specific voices of a measure, select the instrument samples that resemble their set-up, and control the volume/playback of the sequence.

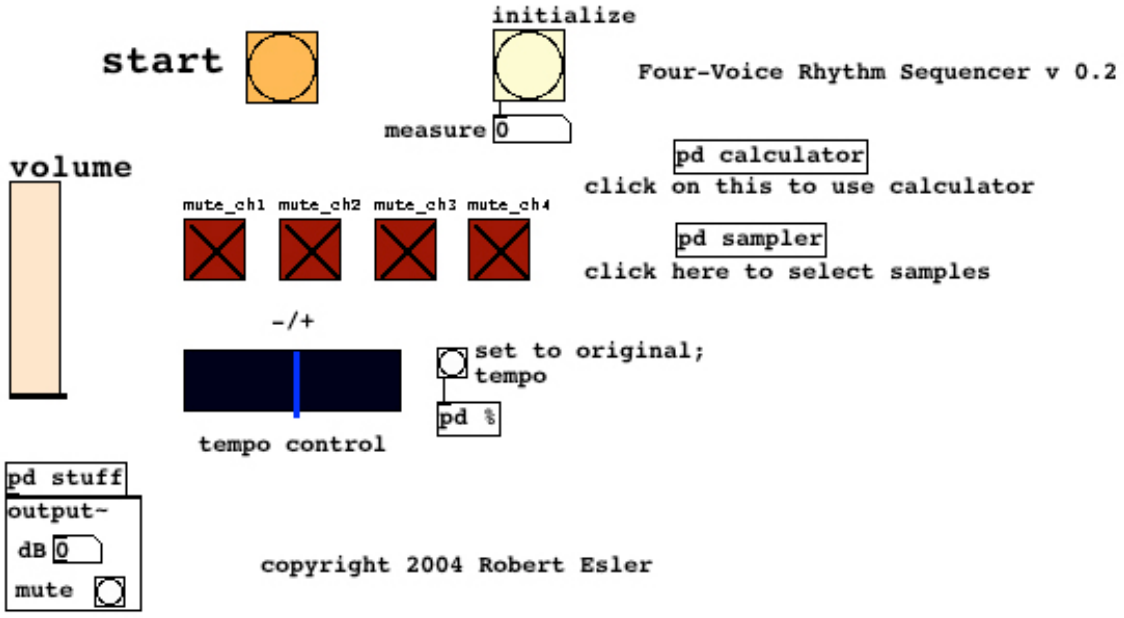

Figure 14 - Pd interface for sequencing Bone Alphabet

The text file uses a simple language, implementing numbers, that tell the application what instrument to play and at what time. A sample looks like:

```
1                       (this line is the first rhythmical unit)
voice4 0 1 1 1 1 1 1 1 1 1 1 8;(this line is the sequence for voice
four)
tempo4 854;   (this line is the tempo of the sequence for voice four)
2                                              (etc...)
voice4 0 4 4 4 4 4 4 5 5 0 0 5 8;
tempo4 213.3;
3
voice4 0 4 4 4 0 0 0 0 0 0 7 7 7 7 3 9;
tempo4 950.2;
4
```

Each number, on a single line, is a divider to help you separate a rhythmical unit from the measure. A rhythmical unit in this program is anything that is part of the same speed. For example if you have a quintuplet and four sixteenth notes at quarter note equals 120bpm, then the quintuplet is the first rhythmical unit and the sixteenths are the second, etc. This would look like:

```
1
voice4 0 1 3 1 3 1 8;
tempo4 150;
2
voice4 0 1 4 6 7 9;
tempo4 120;
```

This program uses speed changes, or speed relationships, to account for changes in rhythm. That is all that rhythm is essentially. Numbers 1-7 represent the instrument number in the score, 0 is a rest within a rhythmical unit, 8 is the indication to continue to the next rhythmical unit and 9 signals a stop cue. The tempo relationships can be calculated through a sub-program of the sequencer to reduce the amount of time and calculations.

Once this language is understood, sequencing complicated polyrhythmic voices is quite simple and fast. This program is an alternative to commercial sequencing software, which is usually designed for notation and MIDI applications. Complex rhythms are not easily realized using these programs nor is their interface designed for *Bone Alphabet* users.

Originally the computer and performance data were going to be displayed simultaneously to give the performer a comparison to the computer's realization. However, it proved to be less useful since there was no feedback. A musician will naturally execute certain figures out of phase with an exact replication. It was too hard to

distinguish errors from idiomatic discrepancies. Therefore, the sequencer became an aural tool and a way to check tempo and alignment during practice.

Future work on this project would begin with finding a better user input interface other than a text file. Perhaps even abandoning the language shown above and imitating a quasi-tablature such as:

```
_______|________|_______|_______||3/4 8=56 (time sig./tempo)
voice 1 1---3-5- 2-3---1 ------7||7:4/16;(rhythmic ratios per unit)
voice 2 ---4---- -----5---6—1 --||7:4/16;12:17/32;2:3/32;
voice 3 7--- 4----- 664---- ----||4:3/32;6:6/16;7:4/32;4:4/64
_____________________________||
```

or perhaps even create a more robust GUI where the performer can generate the text files through a friendlier interface. The text file system, as it works now, must have a separate text file for every voice in a measure and be placed within a hierarchical file system. Without a good understanding of this system a user may become frustrated and stop using the application all together.

Another future, and more complex, evolution would be developing a comparison method between sequenced data and performance data. The process would measure time differences between notes and base them on the input information of the sequence. Since the sequence has information for each rhythmical unit, the program can count the number of notes in the performance data, examine the

spaces between notes and asses whether it is within the limits of acceptable error based on the absolute computer realization. For example, if the performer played the very first measure of *Bone Alphabet* it could compare the spacing of the top voice, within a reasonable margin of error, with the computer realization and perhaps reveal any inconsistencies or compression of rhythm. Within that process it would be able to show any vertical misalignment between voices.

These features could enhance the learning of complex rhythm and give the performer intimate feedback about their technical performance. Knowing full on that technique should not replace interpretation, this tool would be used only to evaluate ones progress in understanding the rhythmic matrices of Brian Ferneyhough. Once the musical language is absorbed the application would become a way of fine tuning problematic areas. It is a preliminary device for learning the material, and an adjunct tool for deciphering complex rhythmic patterns.

Interpretive Contexts

Learning *Bone Alphabet* is a challenge in itself in which technology has shown to take a pragmatic role. However, interpreting the piece would seem to step outside this context but with the intentions of using physical gesture as a means of expressing adjectival stimuli, form and even polyrhythmic independence, technology can serve as a tool in studying the physical behavior of ones body during performance.

Motion capture has recently become a formidable tool in analyzing movement in a three dimensional space. Within the musical field, this technology has been used for many different applications some of which include: analyzing the gestures of conductors, movement tracking in conjunction with performers and dancers, musical therapy and a method for controlling any real-time data structure (most often graphical animation). Research is already being done at Arizona State University studying the movement of dancers to collect an "alphabet of motion" to study gestures and higher order movements. (Kahol, p.14) With the balletic movement inherent in *Bone Alphabet* it could be beneficial for a performer to study how their body reacts to the instructions of the score. For example, at mm 98-101 (partly shown in figure 11), the section is marked *brutale*

(brutal), which could manifest a particularized motion from the body as mentioned earlier. To see a computerized model of ones body performing *brutale* without hearing (or even while hearing) playback could help cultivate the minutiae of that individualized movement. Understanding how ones own body can be manipulated to release energy can be a valuable interpretive tool.

People have conducted this same type of study with regular video cameras, which can also reveal idiosyncratic motion. However, motion capture can refine the details of a gesture, giving the performer a better means of executing the same gesture during performance, ultimately adding a third dimension to performance practice study.

None of this research has taken place and is presented only in theory, however, these ideas may foster later developments of performance study. Performers are already doing just fine, and the introduction of technology may confuse and frighten some. These tools are not meant to ameliorate a disabled art form, but to bring a new perspective on an already thriving means of human expression. Further technological development in this area could provide new media for performance, new methods of interaction, fresh perspectives on interpretation and different approaches for pedagogical feedback.

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