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Alternative Representations for Music Composition

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Abstract

Music teachers use standard notation and alternative representations of music in software programs to engage children in composition. However, there are benefits and limitations to these representations. This paper examines the relationship between children's internal representations of music and standard notation. In addition, this paper seeks to determine how alternative representations of music through music technology can enhance students' compositional abilities and concludes with a review of Impromptu*,* Hyperscore*,* GarageBand*, and the* O-Generator *that can be used for composition.*

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Music educators are increasingly interested in introducing students to music composition as a means to enhance musical understanding. In order to compose, teachers often expect children to represent musical ideas within the boundaries of standard notation, using classic, standard notation software programs such as those in the *Sibelius* or *Finale* product families (Williams & Webster, 2008). However, research suggests that there is a disconnect between what students hear and what students see in standard notation (Bamberger, 1996). When children are given the opportunity to notate music in their own way, their invented notations reveal that children hear music according to either small musical groupings or the larger metrical structure (Bamberger, 1991). If this is the case, our complex standard notation system may not be the best way to engage children in music composition, particularly in the early stages of their compositional thought.

Recent software programs enable students to compose without relying on standard printed "scores." Such programs have different interfaces that allow students to compose to varying levels of sophistication without the use of standard notation. The purpose of this paper is to examine the relationship between children's internal representations of music and standard notation, and to determine how alternative representations of music through alternative composition software can better present and often enhance students' compositional thinking. Three questions frame this paper: (a) what is the relationship between children's internal representations of music and the external representation of standard notation; (b) how might alternative representations of music (created with alternative music software) relate to children's internal representations of music and enable them to compose; and, (c) what are the limitations and implications of these alternative representations?

In this article, the term *external representations* includes attempts to capture musical structure in a visual form. A child's *internal representation* refers to his or her understanding of musical structure. *Standard notation* is the Western system of external representation that is found in traditional music scores (Read, 1974). Finally, *composition* will be defined as the ability to collect musical ideas into a personally meaningful framework that can be communicated to others through sound.

Children's Internal Representations of Music

Bransford, Brown, and Cocking (2000) state that "there is a good deal of evidence that learning is enhanced when teachers pay attention to the knowledge and beliefs that learners bring to learning a task, [and] use this knowledge as a starting point for new instruction" (p. 11). Therefore, if educators are to engage children in music composition, it is worthwhile to investigate their pre-existing knowledge. Children encounter a world full of music from TV shows to shopping malls to the latest music playing on their iPods. They hear and internalize music in various ways, sometimes passively, sometimes emotionally, or at other times, systematically. All of these encounters lead to internal representations of music. These representations include intuitive understandings of melody, rhythm, texture, and much more. Yet in school, if children are asked to represent their musical knowledge in a visual form, they often must conform to the isolated pitches and rhythms in standard notation.

Music education researchers have been interested in how students, when given a choice, represent music through invented notations. Researchers have found that young children (Barrett, 1997; Meske, 1987) and adults without musical training (Davidson, Scripp, & Welsh, 1988) go through an enactive stage of development in their notations, where images depict the most salient features of phrases and moments within the piece. The appearance of these notations varies greatly according to the assigned task. When teachers ask children to write down notation for music with familiar lyrics, they will often use images, icons, or pictures to convey the meaning of the words. However, when faced with unfamiliar melodies, they are more likely to develop discrete symbols or even borrow from other symbol systems (Barrett, 1999; Upitis, 1990). Invented notations also become more sophisticated and complex over time, showing signs of children's cognitive development and a keen awareness of the musical world around them (Bamberger, 1991; Barrett, 1997; Blair, 2008; Davidson & Scripp, 1986; Upitis, 1992).

Based on their broad musical understandings, Bamberger (1991) was particularly interested in how children group musical entities such as beat or pitch in their invented notations. Children were asked to write melodies such as *Twinkle, Twinkle Little Star* and simple rhythmic patterns in any manner that made sense to them. Bamberger had students notate rhythms using squiggly lines, stars, hearts, dashes, circles, and much more. Bamberger used these external representations as a means for understanding children's internal representations of music. She found two consistent differences in children's representations of music: (a) what children heard as being the same or different, and consequently, (b) how this influenced their understanding of boundaries within music (Bamberger, 1991). Children's representations were labeled *figural* if they focused on smaller note groupings known as motives and *formal* if their drawings focused on the larger musical structures such as the metrical pulse. Figure 1 represents the same rhythm, one as a figural representation and the other as a formal representation. Notice that in the figural drawing a student would represent three small pulses together as a rhythmic motive, while in the formal drawing a student would notate the third small circle as a larger beat to signify its being part of the metrical pulse (see Figure 2 for the representation in standard notation). Only over repeated listening and exploration with a teacher, could a child come to transform his or her internal representations of music from a figural to a formal understanding of musical structure and vice versa. Bamberger (1991) explains:

> …for the person who attends to the metric aspects of rhythm, figures remain unrecognized; for the person who attends to figures, the classification of events according to their duration remains inscrutable. As a result, for one to see/hear as another does, he must quite literally come to hear in a new way. (p. 29)

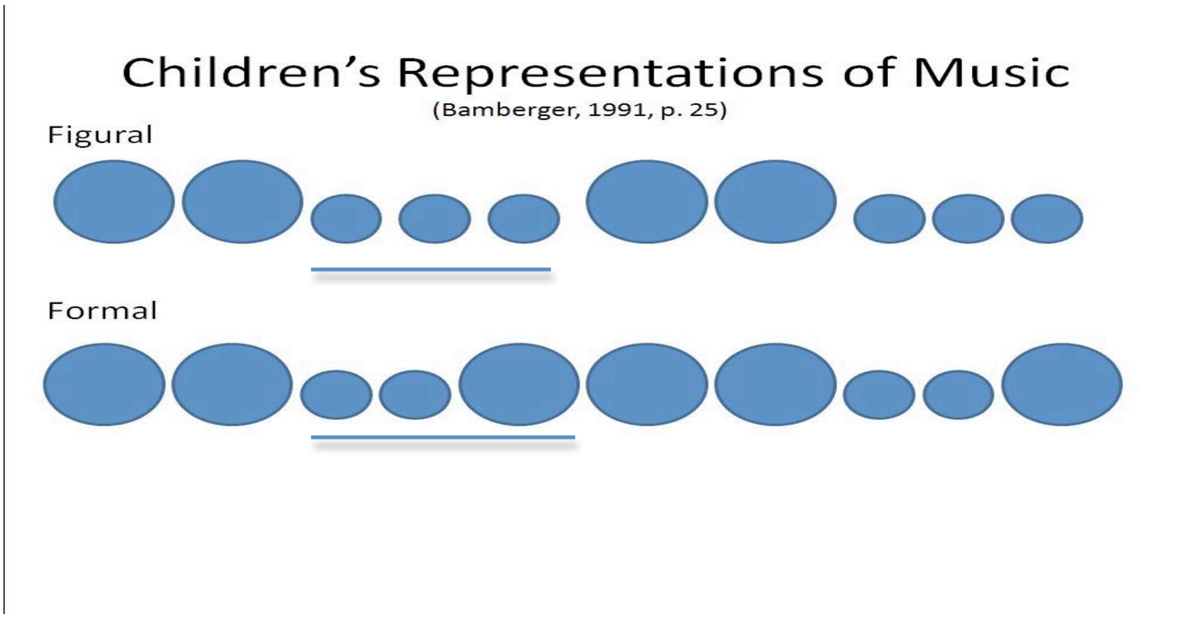

Figure 1. Children's Representations of Music.

Figure 2. Figure 1 represented in standard notation.

Helping a child to hear in new ways is a challenging scenario for any music teacher. These differing understandings of music are also evident as a teacher works one on one with a child. One student may have trouble accentuating the lulling pulse of a waltz, yet be able to perform a small fast rhythmic figure with accuracy, while another student may have no trouble emphasizing the movement of larger phrases, but struggle to capture a dotted rhythm. Each student is operating according to an internal representation system that helps him or her make sense of external representations of music whether seen or heard.

Preferences for internalizing musical structure are based on a child's mental schema. Anderson (2000) explains that "…schemas are not simply an extension of propositional representations. Rather, they are the ways of encoding regularities in categories, whether these categories are perceptual or propositional" (p. 155). Schemas include a generalization hierarchy and a parts hierarchy that help individuals categorize an item. The most general category for any item, known as the *isa,* links to other schemas according to its superset. The underlying attributes represent other categories or parts of the item. For example, a child may encounter a piece of music (the superset), be able to categorize it as a rock song (*isa*), and then consider its attributes such as instruments, tempo, and structure. However, as Bamberger (1991) pointed out, each child may continually focus on different parts of the musical structure. One child may be inclined to focus on the short riffs of the guitar, while another may focus on the structure of the chorus. Neither categorization is right or wrong, it is simply different from the other.

In discussing the importance of examining the structure of children's schemas, Lee (2007) explains "making connections across relevant schemata or clusters of schematic networks enhances the range of contexts and kinds of problems that one can tackle more efficiently" (p. 35). By understanding children's schema for categorizing music according to its musical structure, teachers can assist them in relating this information to composition and other musical skills. Through this understanding, teachers are also better equipped to provide relevant examples that may expand upon children's internal representations. Bamberger (1991) found that over time, a student can learn to focus on figural or formal aspects of musical structure simply by learning to hear similarities and differences of groupings within a basic melody. A change in understanding may happen in the classroom due to repeated practice at notating music, observing peers, or from questions that come from teachers or peers (Bamberger, 1999; Blair, 2008; Upitis, 1992). This broadened understanding of musical structure can then transfer to hearings of more complex pieces of music (Bamberger, 2000).

As one can see, children have obvious differences in their internal representations of music that warrant particular attention. As such, it is important to examine how these internal representations of musical structure align with standard notation. Standard notation is the external representation most commonly used in writing music and, because of this, is often assumed necessary in the teaching and learning of music composition. Therefore, it is worthwhile to review the attributes of standard notation, limitations of the system as related to children's internal representations, and examine children's natural inclinations toward music composition.

Implications of Standard Notation

When examining a piece of standard notation, one traditionally sees discrete symbols representing pitch and rhythm resting on the staff, which is divided by a meter. Each symbol stands for a small piece of musical information, and taken together, can convey complex melodic and harmonic information. This multifaceted semiotic system takes years for children to master. Yet despite its challenges, standard notation has fulfilled an important role in history enabling many to "construct, preserve, and communicate music and musical thought" (MacGregor, 1992, p. 21). Without it, our current society would never know the complexity of centuries of music that enrich our world to this day.

However, we should carefully consider how children are often introduced to and engage with standard notation. Early on, music educators initiate children into reading standard notation as they gingerly learn to play *Hot Cross Buns* and *Mary Had a Little Lamb* on a new instrument. Unfortunately, within this system students are forced to categorize their internal representations according to an external representation that has a complex and immediate interplay between small and large musical structures. This system may well be counterintuitive to how they naturally hear the music—at least in the early stages of musical understanding. When trying to learn the rule-bounded system of traditional notation, children who hear motives and small musical figures are particularly challenged by the discrete symbols in standard notation (Bamberger, 1996, p. 34). Therefore, what is heard and categorized in children's minds can be divorced from the page. In asking children to adapt to standard notation, music teachers discount children's understandings of music and place emphasis upon an external representation.

Norman (1981) warns against this type of approach, explaining that humans are not merely "symbol processing systems" (p. 3). While external representations are a method for communicating knowledge and even a means for understanding internal representations, they do not portray the multifaceted interaction between environment and culture on the internal representations of individuals. Norman (1981) believes it is important to observe the interaction of participants with external representations. He explains, "we need to have mental models of the people (and things) with which we interact, for communication depends strongly upon mental use of shared knowledge, shared understandings" (Normal, 1981, p. 282).

In order to understand how children interact with musical notation, music teachers can invite students to compose, and in doing so, come to understand how students hear the world around them. When children are able to share their compositions through invented notations or improvised performances, teachers will likely find a developmental trajectory that depicts increasingly sophisticated forms of musical knowledge (Bamberger, 1982; Davidson & Scripp, 1988; Swanwick & Tillman, 1986; Upitis, 1992). Children learn to incorporate and express musical ideas they hear in their environment (Swanwick & Tillman, 1986), and with effort, can move toward conveying their musical ideas with metric representations similar to those found in standard notation (Bamberger, 1982; Davidson & Scripp, 1988; Upitis, 1992).

Swanwick and Tillman (1986) developed a spiral model depicting the influence of children's musical environments on their compositions. Their model is particularly helpful in understanding the type of musical decisions students make when composing directly with sounds. The researchers examined the improvised compositions of toddlers through adolescents and found a trajectory of musical development. They defined seven stages of musical growth:

- sensory manipulative
- personal expressiveness
- vernacular
- speculative
- idiomatic
- symbolic
- systematic

(Swanwick & Tillman, 1986, p. 331).

In the sensory and manipulative stages, children simply explore musical sounds and instruments. During the personal expressiveness stage, they attempt to make musical statements with these sounds. As students mature, they translate their growing understanding of music in their environments to their compositions. During the vernacular stage, children attempt to group music in some metrical structure. They move on to challenging this structure and play with similarity and contrast in the speculative stage. In the idiomatic stage children adopt a personal style that builds upon their understanding of contrasts in musical structure, and often with more refinement, attempt to imitate popular music in their environment. For the few children that move on to the symbolic stage, pieces are then composed to take on personal meaning and expression. Finally, in the systematic stage, an individual develops to full musical maturity and is well able to manipulate musical structures according to his or her intent and knowledge of musical principles.

Swanwick and Tillman's (1986) developmental model provides us with a framework for understanding children's developing internal representations as they interact with their musical environment. Clearly, children apply and adapt music from their surroundings to their compositions with growing refinement and meaning. However, when teachers ask students to represent their musical ideas through an external representation, such as standard notation, teachers must be aware of the systems limitations. Bamberger (2000) suggests that as children write music, they need an opportunity for "sense-making" where there is "a kind of ongoing 'conversation' with (composer), listener, performer(s), and the piece as participants" (p. 1).

As music educators are now turning to alternative representational software programs to enable students to compose, it is important to examine them for their intuitive "sense-making" and developmental appropriateness. A review of these programs should consider the strengths and limitations of such software, whether or not new user interfaces speak to children's internal representations, and the ways in which music teachers can go about evaluating the power of these programs.

Guidelines for Evaluating Alternative Representations

A broad range of music software programs now exist that can facilitate students' ability to compose. Each program has a very different interface, inviting students to interact in the compositional process in a variety of ways. Wilensky and Papert (2010) define these alternative representations as "restructurations." A restructuration is "... a change from one structuration (representation) of a domain to another resulting from a change in representational infrastructure" (Wilensky & Papert, 2010, p. 2). Therefore, a restructuration is not a mild adjustment to standard notation, but instead a major alteration of symbolic representation. In addition, Wilensky and Papert provide useful guidelines for evaluating alternative representations. They include:

- Power properties
- Cognitive properties
- Affective properties
- Social properties
- Diversity properties

(Wilensky & Papert, 2010, p. 4).

We can examine the *power properties* of a restructuration by observing its ability to change and broaden a discipline. In this computer age, educators must consider the effects of technology on structural knowledge. In fact, Pea (1985) states, "…a primary role of computers is changing the tasks we do by reorganizing our mental function, not only by amplifying it" (p. 168). Therefore, as we consider alternative representations for composition, we will have to question how these restructurations change our understanding of music.

Cognitive properties are measured by judging the effectiveness of the alternative representation in relating to pre-existing knowledge and the building of new knowledge. As noted, children's internal representations of music are often detached from standard notation. In examining alternative representations of music we must continue to reflect upon children's musical knowledge. Jennings (2007) explains

> For the beginning composer, the value of using a computer-based notation system lies in the degree to which it can *reflect back* aspects of the musical materials in a manner that may be intuitively understood, while simultaneously making these materials available for *manipulation.* (p. 78)

Therefore, questions for consideration include: (a) does the alternative representation allow children to work with their figural and formal understandings of music; (b) is it flexible enough to meet students' developing knowledge of musical structure; and (c) does it provide ease of use in building new knowledge?

The *affective properties* of a restructuration are evaluated by examining students' interest in the new system. We must consider the motivational and engaging characteristics of the interface design and how it promotes excitement for music composition. These considerations can include whether or not the program has realistic sound effects and if the program connects students to one another or other musicians in a way that heightens a student's commitment to the compositional task.

Social properties of an alternative representation can be examined by how fast and widely distributed the representation has an effect. This concept should not be confused with power properties that broaden the discipline structurally. Instead, consideration of social properties can include how ideas "go viral" or how widely distributed and available music composition programs are in the market place.

Finally, *diversity properties* address how the restructuration engages children with different learning styles, cultures, genders, and overall background. Because music reflects cultural values and meanings, it is particularly important that alternative representations allow students to create music in many styles. In the US and UK, where student populations are diverse and composition is emphasized in the national standards, this is a very pertinent issue.

The following section includes discussion of features of alternative representations in four music software programs: *Impromptu, Hyperscore, GarageBand,* and the *O-Generator.* Wilensky and Papert's (2010) power, cognitive, affective, social, and diversity properties will serve as the basis for evaluating the alternative representations of these programs for their ability to develop children's musical understandings through composition, while also connecting to their pre-existing musical knowledge.

Composition Programs

Impromptu.

Power and cognitive properties. *Impromptu* is a program developed by Bamberger in conjunction with Armando Hernandez and a team from MIT. The program is meant to accompany Bamberger's (2000) project-based curriculum, *Developing Musical Intuitions. Impromptu* was derived from questions Bamberger developed while observing children with their invented notations. As a researcher and educator, she could not help but ask,

> Can we, for instance, find a way to give beginning students structurally meaningful entities to work with that match the more structurally meaningful perceptual objects that they are focusing on? Can we help students move smoothly and naturally among levels of structures, kinds of elements, and modes of representations—between musical figures, motives, gestures on one hand, and pitches, intervals, and time values that are their contents, on the other? (Bamberger, 1999, p. 68)

Bamberger's obvious motivation in designing *Impromptu* was to connect to children's pre-existing knowledge about musical structures. She also wanted to expand their listening skills. According to Bamberger, careful listening to music needs to come before composing since by allowing students “to actively explore and experiment with musical materials that progressively build on their intuitions, students come to understand, appreciate, and perhaps most importantly, come to care about compositions that previously passed them by” (p. 73).

Impromptu, when used in conjunction with Bamberger’s (2000) curriculum, takes a student through lessons and composition activities that explore melodic structure, rhythmic structure, pitch relations, theory, harmony, and polyphony. Children are first asked to reconstruct melodies or rhythmic patterns using “tuneblocks” that represent different portions of a song (Figure 3). In doing so, they explore smaller musical groupings, hearing what is the same or different, and through the lessons, parsing out information on pitch and rhythm. Under the “playrooms” option, each tuneblock can have four different representations. Two of the representations relate to a figural understanding of music, while the other two representations relate more to a formal understanding of music. The tuneblocks represent a range of rhythms in different meters, and pieces ranging from short folk songs to atonal melodies. Students can begin exploring composition by altering pitches and durations within the tuneblocks. This is done by changing the individual notes within an edit box. Students can also keep a tuneblock the same and use that familiar motive within a newly composed piece. The ability to easily see and change pitches, phrases, or sections of music is an important feature of the program. This allows students to hear “up and down the structural ladder” (Bamberger, 1996, p. 47). The curriculum is also aimed at making students aware of the varying levels of melodic and rhythmic structure within a piece to help them in their own compositions.

Affective, social, and diversity properties. The foundation of *Impromptu* is based on working from students’ pre-existing and developing musical knowledge in a way that helps them make sense of musical units ranging from pitch to rhythm, and harmony to meter. The folk songs are highly relevant to young children, and serve as excellent simple examples of different musical units for older children. However, in an age where so many musical styles and sophisticated sequence programs can create a range of musical sounds, *Impromptu* may not engage adolescents. Older students will likely want more freedom to manipulate tuneblocks within the program.

In examining Bamberger's curriculum, one can see a thorough and sequential introduction to all topics related to musical structure. The lessons and the language used throughout the book become quite sophisticated. Because of this, *Impromptu* could be used over the course of several years in a school curriculum. Teachers could adapt the software and curriculum to meet their needs and the needs of their students.

Impromptu is not a composition program per se, but a means for moving students toward composition. It is particularly useful in helping students' understand what is the same and different in music, while also constantly challenging them to hear and see music through a variety of representations. These research-based representations (Bamberger, 1991, 1996, 1999) offer many opportunities for children to understand musical concepts while exploring representations that make sense to them. In order to keep students engaged with the composition process, teachers might want to use *Impromptu* alongside more recent composition programs such as *Hyperscore* or *GarageBand.*

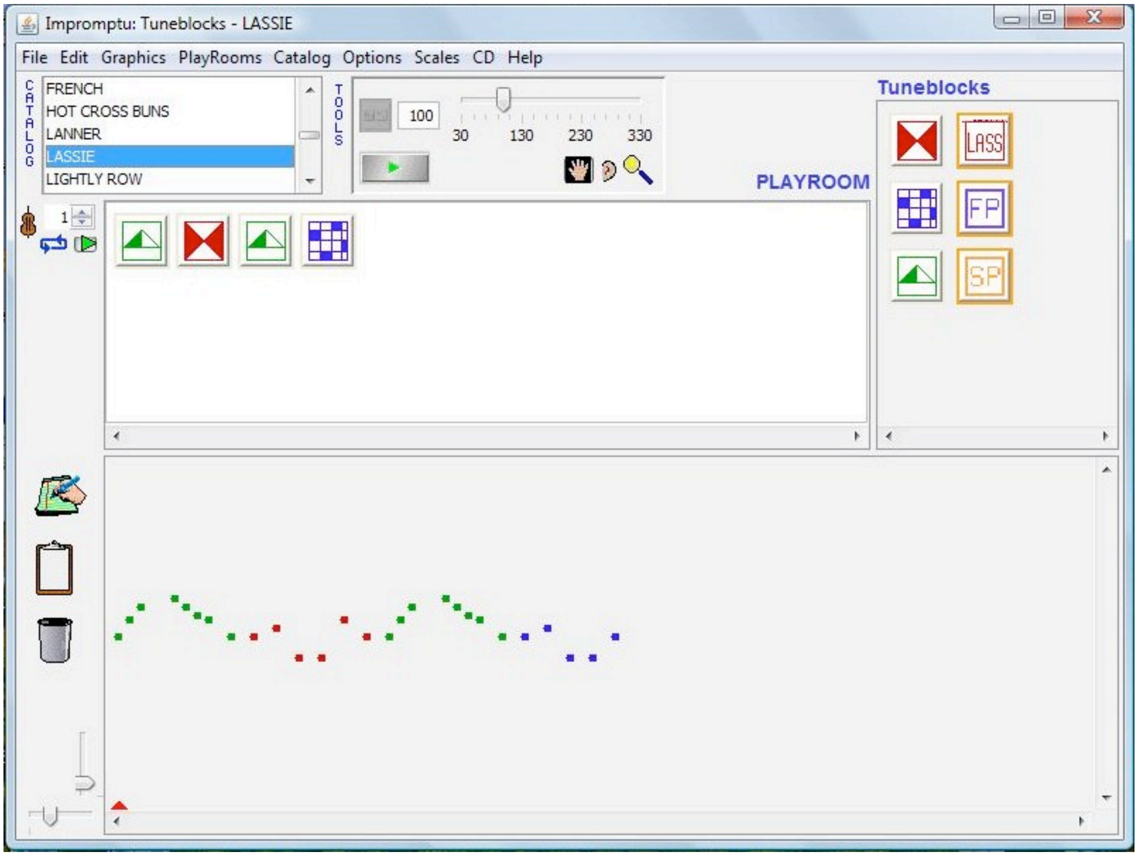

Figure 3. Impromptu

Hyperscore.

Power and cognitive properties. *Hyperscore* was developed by Tod Machover and a collaborative team at MIT. The program was designed so that "…anyone can perform two creative activities without musical training: compose short melodies and describe the large-scale shape of a piece" (Farbood, Pasztor, & Jennings, 2004, p. 5), and is available directly from the manufacture's webpage. *Hyperscore* uses children's drawings to develop sophisticated musical pieces (Figure 4). The horizontal axis represents time, while the vertical axis represents pitch. There are two primary windows through which students work. First, children develop motives in the small windows using color droplets of virtual paint. These motives are transferred to the large window in the middle of the screen. Drawing a straight line within the larger window will repeat a motive, and bending the line will sequence the motive with altered pitch. This allows for the development of sophisticated musical scores based strictly on drawn images. However, the image of the score can be printed in standard notation for other musicians to perform, giving children an opportunity to see music in more than one representation. The developers explain,

> The real power of the *Hyperscore* interface is the manner in which the software makes the composition task manageable by modularizing it. It's much easier for children and naïve composers to relate to the notion of making small bits of music and then assembling those bits of music into a larger work than it is to start with a completely unstructured task. (Farbood, et al., 2004, p. 53)

As one can see, the program is geared toward children's figural understandings of music, offering children a sequential view of their compositions without hindering their creativity with discrete symbols (Bamberger, 1991). It also broadens children's understanding of musical structures and empowers them to make advanced musical choices. If a child desires to add harmony, the program is so intuitive that it can supply a student with a harmonization in a range of musical styles.

Affective, social, and diversity properties. Coyne (2009) has witnessed the engaging and motivating effect of *Hyperscore* in his middle school general music classes. Coyne uses the program for composition, and has found that it is particularly accessible for students who are intimidated by standard notation, have learning disabilities, or simply lack musical training. Because the program easily enables students to compose, Coyne and his students have lively classroom discussions about formal musical elements such as pitch and rhythm within their pieces. He has also used the program to translate children's musical drawings into standard notation, inviting professional musicians to perform and critique his students' compositions.

The program's ability to notate children's compositions in standard notation has given students the opportunity to hear their music on major world stages. Under the *Toy Symphony Project,* students' works have been performed by major symphonies in Glasgow, Berlin, and Tokyo. This project makes collaboration between professional musicians and novice musicians a reality. The Toy Symphony project "serves to show children that they can create music, discover the potential of the symphony orchestra, absorb musical and technological principles…and, ultimately be an important part of a large-scale, professional production" (Toy Symphony, Vision, paragraph 2). In addition, the program allows students to collaborate on compositions with peers through the internet.

Hyperscore's strength lies in its flexible interface design that speaks to students' internal representations of music, and its ability to engage peers as well as other musicians in children's compositions. However, the interface is so engaging that if not carefully monitored, a student can become more focused on drawing visual images than building upon the musical structure itself (Jennings, 2007). However, *Hyperscore* is likely the closest software program to give students freedom in drawing their notations, resembling the invented notations that they might make on paper. *Hyperscore* also allows children to compose in multiple styles, although the sounds are not strong representations of acoustic or well-developed synthesized instruments. Therefore, while *Hyperscore* may work well for younger children, it may not engage all adolescents. *Hyperscore* may not work well for the teacher working with more experienced music students who want to delve deeply into different levels of musical structure. In such a case, the composition lessons and multiple levels of musical structure featured in *Impromptu* or *GarageBand* may be more appropriate.

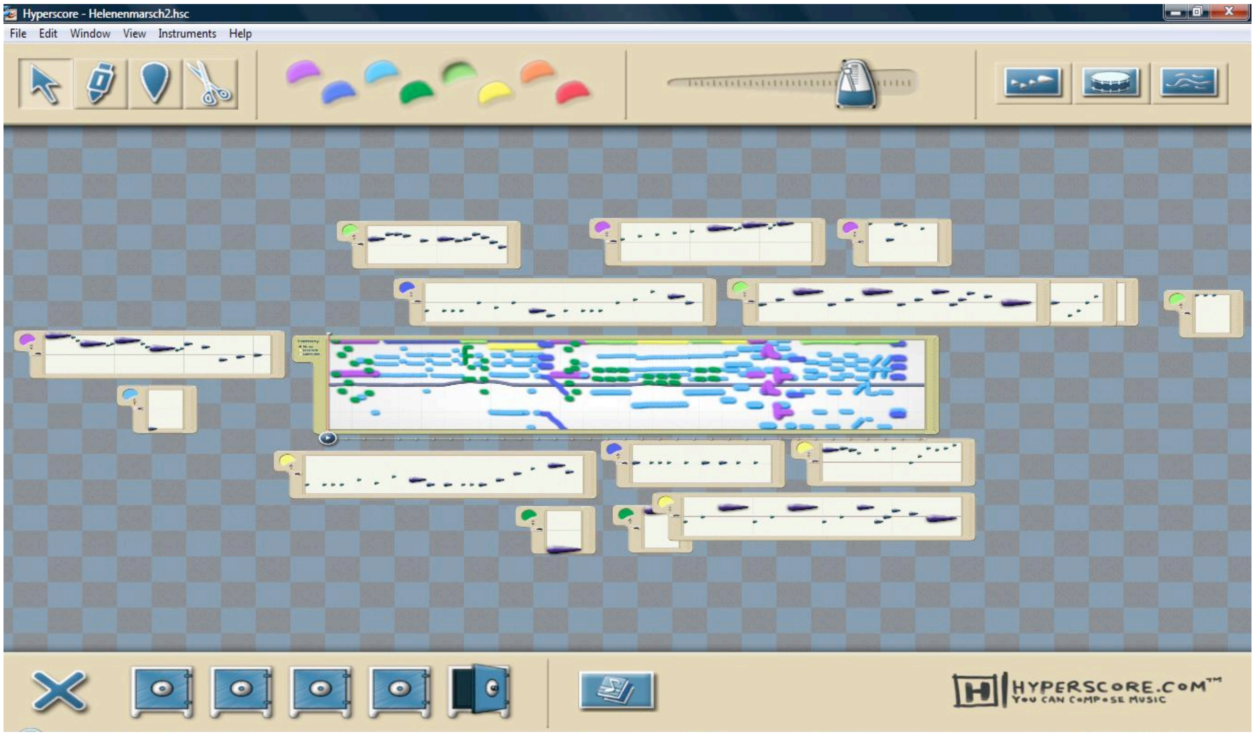

Figure 4. Hyperscore.

GarageBand.

Power and cognitive properties. *GarageBand* is one of the most widely distributed music sequencer and composition programs available. Because it is a standard feature on Mac computers, and readily available through iPhone and iPad applications, it has made a large impact on the field of music. The program is changing who composes and how composition is done.

GarageBand offers an array of composition possibilities for individuals of many differing ability levels. Like other sequencer programs, *GarageBand* allows musicians to record directly into the interface. A novice can compose using loops (repeated motives) or a MIDI keyboard, while an experienced musician can compose music using all of the notational features: loops, standard notation, and recorded clips (see Figure 5). Users can also create loops to be saved and used as needed.

The interface is designed with time on the horizontal axis, while the vertical axis displays the type of instrument in the score. Pitch is also within the vertical axis, but its representation is dependent upon the type of musical input device used. One can only distinguish movement of pitch if an individual uses the instruments available within *GarageBand*. As one will see, the MIDI inputs are represented by the cool electric piano and grooving bass part in figure 5. If an individual chooses, these parts can also be displayed in standard notation making the pitches obvious. *GarageBand* also addresses the issue of hearing and seeing music in unique groupings. Individuals can repeat, sequence, and transpose smaller groupings into larger frameworks with ease. All one has to do is simply click and drag a box to repeat a motive. This gives a figural learner an opportunity to sequence and expand smaller musical motives. The user then also has the option of editing the piece by mixing and manipulating individual instruments for nuanced effect.

Affective, social, and diversity properties. By simply searching the internet, one can find a plethora of songs posted to YouTube and other sites that were composed in *GarageBand.* While children have easy and quick access to the program in their private lives, it is important to consider how *GarageBand* can be effectively used for composition in schools. Bolton (2008) investigated the impact of a curriculum for music composition using *GarageBand* as his platform. However, Bolton did not directly work with students in the classroom. He was stationed in Australia, while working with fifth grade students in New Zealand. These students did not have a dedicated music teacher in the building. Instead, Bolton mentored students from afar using the powerful tools available in the program and the internet. The researcher developed a series of lessons allowing students to explore the sounds and features of *Garageband* while also covering the concepts of musical structure. For one particular student, who struggled with major behavioral and academic issues, Bolton found that the program and composition activities were extremely exciting and motivating. Overall, Bolton found that *GarageBand* is a powerful tool for the:

- Acquisition of compositional skill and knowledge.
- Ability to create increasingly innovative, interesting, and effective pieces.
- Development of positive self-concept about ability to compose.
- Enjoyment of the project's particular approach to compositional learning (Bolton, 2008, p. 50).

According to Wilensky and Papert's (2010) guidelines, *GarageBand* is a very strong program for its features, engagement, availability, and flexibility. The interface is more complicated than *Hyperscore*, which means that individuals need more time learning the representational design. The interface is also too complex to involve children younger than 8-9 years of age in the exploration of sound and structure. For younger children, programs such as *Hyperscore* may be more appropriate. However, *GarageBand* is an excellent program to consider because of the variety of notational representations, the ability for it to be both simple and complex, and its developmental appropriateness and flexibility in working with children of many different ages and ability levels (Bolton, 2008; Swanwick & Tillman, 1986). Also, because *GarageBand* offers different forms of representation with varying levels of detail, teachers could use the program similarly to *Impromptu* to develop lessons that investigate small and large musical structures.

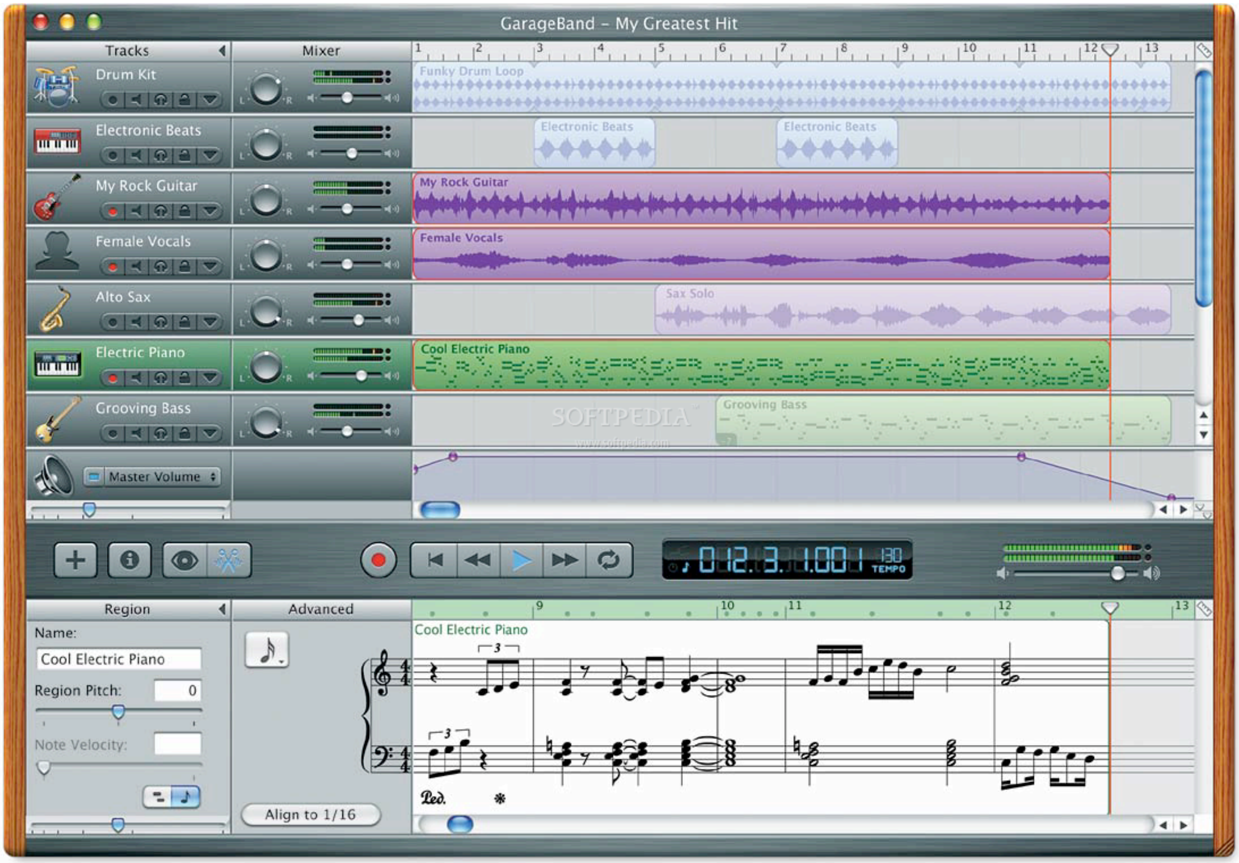

Figure 5. GarageBand.

The O-Generator.

Power and cognitive properties. The *O-Generator* composition program was designed in the UK to meet the composition standards of the *National Curriculum.* The *National Curriculum* lists composition as a means of achieving "integration of practice" and "creativity" within its key concepts (National Curriculum, 2010). Because composition is emphasized in the UK, many software programs are readily available for classroom use. However, this paper has focused on the *O-Generator* because of the implications of its unique interface design.

Criswell (2010) explains that the *O-Generator* "is a simple four track sequencer program that…makes it easier for a beginner to create their own music" (paragraph 2). The program is designed for users ages 10-16, and provides teachers with lesson plans that align with the

National Curriculum. The interface has no horizontal staves, but instead has a large dial in the middle of the screen that moves one revolution representing beats one, two, three, and four. In figure 6, one can see that the large dial is juxtaposed against 64 small circles at the bottom of the screen. The small circles represent each measure. The main objective is for students to compose back-up tracks to support lyrics they have written. Vocal parts must be written in a manner that fit dance style music. Characteristically, these melodies embody short motives that are easily repeated. Children are then encouraged to enter their rhythmic structure first on the two inner circles of the dial, the bass line on the third circle, and a guitar or vocal part on the outer circle. Once a measure is complete, a student can easily cut, copy, and paste it to other measures in the piece. Melodic instrument options are only for guitar and bass guitar and the pitch options are embedded in the beats around the dial. The *O-Generator* does not feature other musical styles, unless one purchases the latest version for African and Latin music known as the *O-Generator World Music* program. The *O-Generator* also does not output the music in standard notation. Rather, the goal is for students to create recordings that represent their work.

As one can see, the representation of music in *O-Generator* greatly differs from *Impromptu, Hyperscore*, and *Garageband*. A child who hears music figurally will see the sequence of music only one measure at a time. Students who grasp the concept of beat will be able to see the finite placement of time in one measure. This circular design places strong emphasis on quadruple meter, which is prevalent in dance music. London (2004) explains that a circular figure is actually an excellent way to represent meter, stating

> If meter is a stable, recurring pattern of attentional energy, it makes sense to represent this pattern with a circle, for in this way certain aspects of metrical structure will become apparent while at the same time freeing our representation of meter from any particular musical surface. (p. 64)

While the circular design may be a stabilizing feature for grouping music, the *O-Generator's* greatest strength is also its greatest weakness. The dial allows children to work with motives, but they are not able to visualize these motives in the context of the larger structure. In fact, students never see the overall structure of their composition, nor do they have any options for notating music in other ways.

Affective, social, and diversity properties. The *O-Generator* has expanded its efforts to reach a wider audience, offering iPhone and iPad applications for *O-Generator Acoustic, O-Generator Urban,* and *O-Generator Dance.* While the *O-Generator* is still not widely used in American music classrooms, teachers may find students soon using the apps in their free time and may therefore take interest in implementing this program in the classroom. It is clear that the program is geared toward a specific age group according to the musical styles offered. Developmentally, the program is engaging for many adolescents. The *O-Generator* enables them to compose music in relevant styles, and at the same time, develop a fairly polished recording without ever dealing with standard notation for capturing or translating those ideas to other representations. While this may be a contentious issue with many music educators, it is important to remember that this software may very well enable many adolescents, who would otherwise struggle with communicating musical ideas, to compose music up to an idiomatic level (Swanwick & Tillman, 1986). It provides them the means to imitate the popular music that is constantly in their environment.

The *O-Generator* can serve as a powerful classroom tool when composition is limited to certain genres and musical structures. It can easily engage beginning adolescent composers to even more advanced students. However, due to the *O-Generator's* circular interface, students are constrained to thinking about composition from a very strict metric standpoint, and do not develop their understanding of variations of meter or pitch. Because the *O-Generator* is so narrowly defined, it may not help students investigate and develop all of their musical knowledge. For that reason, if a teacher hopes to develop children's understanding of music based on their intuitive knowledge (Bamberger, 1991; Upitis 1992), the *O-Generator* may work best in conjunction with other music software such as *Impromptu* or *Hyperscore.*

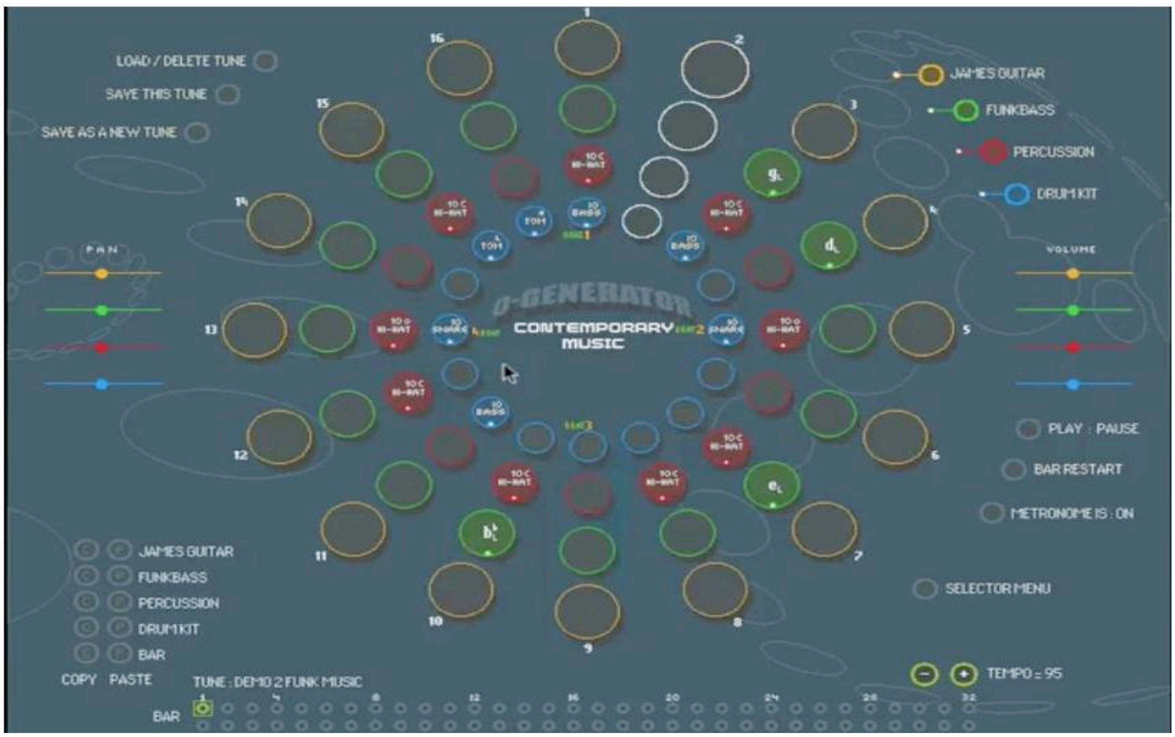

Figure 6. The O-Generator.

Conclusion

Cain (2004) asks "to what extent do these activities (composing, arranging, mixing using music technology) provide meaningful, educational encounters with music" (p. 218). He is not alone in asking this question. Many see technology changing musical interactions as we have known them, and therefore question the value of these tools. The interfaces displayed and described in this paper greatly differ from our understanding of standard notation and challenge existing notions of musical communication and interaction. Despite these changes, it may be wiser to ask questions regarding the goals of using alternative representations in technology for music composition.

One goal of music education should be to encourage composition as an ability to collect musical ideas into personally meaningful frameworks that can be communicated to others through sound. Therefore, like standard notation, alternative representations are a vehicle for engaging in composition. Alternative composition software programs offer powerful options to the complex semiotic system that has existed for centuries. Some alternative composition programs embody designs that are more intuitive to children's initial internal representations, flexible to children's developing musical knowledge, and engaging in their use. However, it is up to music teachers to carefully evaluate programs for their overall effectiveness.

Wilensky and Papert's (2010) guidelines provide a framework to help teachers make these decisions. Certainly, in an age of ever-changing technology, teachers should consider the power of these programs to transform who composes and how one composes. Teachers might want to start by investigating free and purchasable programs that students use to compose at home. Music teachers need to relate to how children are organizing musical knowledge for themselves and communicating those ideas to others. Educators should not only be attuned to the structural and social influences of composition programs, but also to the possible cognitive strengths and weaknesses of the representational designs. Strong educational tools can relate to and build upon children's pre-existing knowledge. While some programs may relate well to students' musical preferences and experiences in their musical environments (Swanwick & Tillman, 1986), their interface designs may not allow students to explore their intuitive understandings of small and large musical structures (Bamberger, 1996). It is up to educators to determine what level of structural detail they want students to engage in through the compositional process. Finally, Wilensky and Papert's (2010) guidelines also remind teachers that alternative representations should be assessed for how approachable, exciting, motivating, and applicable they are to a wide range of students. In the end, teachers need to make wise pedagogical choices based on who they teach, how they want to represent music, and how the design of the program will change interactions in their classrooms.

By using alternative representations of music in composition programs, we invite students of all ages and ability levels into a creative and interactive process that is changing the field. Up to recently, composition was reserved for only the most elite musicians. These alternative representations are helping redefine what composition is and who composes. While it is exciting to embrace this technology, teachers will continue to bear the responsibility for selecting composition programs that are well-designed and relevant to their students' needs and preferences. They also must be responsive and purposeful in integrating this technology in meaningful ways. However, the future looks full of possibility and if music educators will work to include and build upon the power of these alternative representations for composition.

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