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From *Battle Metris* to *Symbiotic Symphony*: A New Model for Musical Games

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ABSTRACT

Music and games have a rich history of interplay. Instrumental composers engage with the idea of game play as a way to serialise musical material, facilitate performer's real-time decision making and organise a particular theatricality in performance. On the other hand, electronic game developers typically use music as a motivational device in a game, and in more sophisticated games conceive the creation of sound and music as an artefact of game play.

Whilst both these types of works can exhibit a tremendous degree of complexity in the relationship between game play and music, this paper argues that the question – what does it mean to play a game and music at the same time? – is rarely addressed. Using Salen and Zimmerman's framework of game design theory, an analysis of instrumental works which are in some way based on game play is presented along with an analysis of electronic game environments designed to create music. This analysis reveals that these works are almost always based on a relationship of music and game play dependant on a superficial conception of either aspect: composers and game designers have not found a common language for navigating the simultaneous design of a game and its musical content.

We propose that a conflict between a player's sense of musicality and the natural competitiveness engendered by game play is an effective common language. A composer can design games in which a player's sense of musicality forms part of the game rules; games in which each game rule has an opposing musical rule, moderating a player's competitive instinct with their sense of musicality. The author's *Battle Metris* is discussed as a work in which a player's sense of game play shapes a musical experience.

Inverting this sonification of game play, we present an audio-controlled game under development in which a performer must moderate their sense of musicality in order to succeed in the game. Music performance is 'gamefied', that is, rather than turning game actions into musical events, musical performance is translated to game actions. Retaining the dichotomy between a player's sense of musicality and their desire to do well in the game, a unique set of conflicts provide the basis for a novel type of music improvisation.

Categories and Subject Descriptors

K.8.0 [Personal Computing]: General – *games*.

I.2.1 [Artificial Intelligence]: Applications and Expert Systems – *games*.

H.5.5 [Information Interfaces and Presentation]: Sound and Music Computing – *methodologies and techniques*.

General Terms

General, Computing Methodologies, Information Systems.

Keywords

Music composition and games, games and audio, game controllers, audio control, graphical/musical interface.

1. INTRODUCTION

Composers and game designers have created works which attempt to link game play and music. This is no accident, as there are a number of important similarities. Both musical compositions and games create a virtual world which invite and subjugate the participants; they are at once players and observers. In a game, players determine their own progression through its virtual world. However, in a musical composition, a composer pre-determines a musical trajectory over time, except where the composition involves musical decisions made by the player at the time of performance. Like improvised musical compositions, games create a familiar structure through which players can explore the unfamiliar.

In varying degrees, most attempts at linking music and games have been relatively singular; either the game or the music, by virtue of a simplistic implementation, is subservient to the other. The relationship is not sufficiently complex, at the level of game rules and the level of the nature of game play, to generate meaningful game play or musical expression. This is especially true of instrumental works which are in some way based on games; two of these are discussed in this paper.

Digital games provide an opportunity for the simultaneous design of a game and a music composition, and some artists, notably pix + delire, have built digital game and game-like environments for the performance of music. Their latest work, *fjjuu2* [1], especially, comes close to realising a game environment as a genuine mechanism for generating and performing live music. However, similar to other electronic 'music' games surveyed in the author's previous work [2], and briefly discussed here, these works fail to create a meaningful language between music and game play

despite the complexity of the translation of game actions and game states to music. Whilst these works are not always beholden to a superficial concept of either game play or music, nor have they attempted to create a cohesive vision which addresses, and harnesses the myriad of possibilities inherent in the interface between games and music.

The starting point for such a vision must be an understanding of game design theory equal to an understanding one has of music composition theory.

2. GAME DESIGN THEORY

An understanding of game design theory is necessary to create complex relationships between music and games. In *Rules of Play* [3], Salen and Zimmerman identify three primary *schemas* for understanding game design, *rules*, *play* and *culture*.

Rules refers to the formal design of a game, the essential logical and mathematical structures in the organisation of a game. *Play* and *culture* refer to a game's symbolism and its cultural context. Symbolism allows players to interact with a game's formal structure, and defines the nature of a player's relationship with other players; the game's cultural context imbues a game experience with extra meaning within a larger context, i.e. personal relationships outside of the game, whether the game has an audience etc. The *play* and *culture* schemas frame closely related themes and are referred to hereafter as a game's *representational universe*, as distinct from a game's formal structure.

The three schemas not only provide a framework for understanding game design, they can also be used to facilitate an analysis and a general categorisation of musical compositions that are either based on or inspired by games:

Rules

- Compositions in which music is determined by progression through a game; this can either be real-time or pre-processed.

Play

- Compositions in which the relationships between performers will in some way be coloured by extra-musical competition; the player's experience of the musical piece/game system is defined by both musicality and playfulness.

Culture

- Compositions in which the effectiveness of the performance requires the complicity of the audience; in such performances, an audience has the potential to become engaged by virtue of the fact that the musicians are performers and at the same time contestants in a game. The reaction of the audience may also affect how performers will perform the work. These compositions typically have titles which draw attention to their use of games, e.g. *Duel* and *Stratégie* (Iannis Xenakis); *match* (Mauricio Kagel).

The distinction between a games' formal structure and physical representation is often neglected in music compositions that are in some way based on games. There are only a small number of cases where a game's physical representation is an essential part of its formal structure; 'Connect 4', for example, is a game whose formal constraints are permanently altered each time a piece is physically landed.

The underlying structures inherent in a data source like a game are often lost when merely the visual representation is used to derive audio output. Also, a lack of understanding of a game's design, the intricacies of its formal structure and how it creates a game experience, will limit any attempt to make a genuinely musical game.

3. INSTRUMENTAL WORKS INCORPORATING GAMES

Composers including Wolfgang Mozart, Iannis Xenakis, John Cage, Mauricio Kagel, John Zorn and John White have incorporated game design in their works. However, while game design theory recognises "...a game is a set of parts that interrelate to form a whole" [3], musical works inspired by games typically don't engage with an entire game system; game features are appropriated selectively to suit a composer's style. In these compositions the relationship between performers will be coloured by extra-musical competition; the performer's experience of the musical piece/game system is defined by both musicality and playfulness.

Further, an audience has the potential to become engaged by virtue of the fact that the musicians are performers and at the same time contestants in a game. The reaction of the audience may also affect how performers will perform the work.

While these works engage the player's and audience with the idea of gaming, it is uncommon for a complex relationship to have been established between the music and a game. The physical representation and symbolism of the game usually contributes to the theatricality and efficacy of the performance.

3.1 John Cage *Reunion* (1968)

Reunion is the sonification of a live game of chess between John Cage and Marcel Duchamp [4], a well-known musical game performance. In *Reunion*, players' moves on a chess board are mapped to sounds through a set of light-dependant resistors mounted in each square. Cage hoped that "elegant games of chess could bring forth elegant musical structures" [4]. However, theatricality plays a large part in the performance; the success of the performance is dependant on the engagement of an audience by the playing of a game of chess. Ironically, it is for precisely this reason that the composition could not bring forth elegant music based on the formal structure of chess. Theatricality demands the game of chess be brought into the concert hall intact; the symbolism and physical representation must be retained. However, the physical realisation, the board game, is only a representation of the formal structure of chess, and in this way is no truer a representation of a chess game than, for example, a written record used to document a match.

Reunion attempts to tease out the underlying structures of chess using only the physical movement of chess pieces. A sonification of the text of a written record would be as effective a method; it may indeed be more effective, as the text codes used to represent pieces and moves contain more information than whether a board position is occupied or not. But theatricality demands the physical representation and symbolism of the board game; in *Reunion*, the musical progression is determined by the physical representation of chess, decoupled from the elegance of its formal structure.

3.2 Iannis Xenakis *Duel*(1959), *Stratégie*(1962)

Game theory was introduced into music by Xenakis in *Duel* (1959) and *Stratégie* (1962) [5]. These works are not based on any existing games; game theory is a branch of economics that concentrates on managing possible outcomes and conflicts which result from decision making when both parties operate on the basis of each party's self-interest [6].

In both works, game theory is used to create and manage conflict between two conductors, each in charge of an orchestra. Each conductor accumulates points, the allocation of which is determined by the progression of alternating musical deployments. Each conductor has six types of music which can be played; a *payoff matrix* details relative strengths of different musical passages. Xenakis also provides probability ratios for each conductor which guide them in devising a long-term strategy.

In this way, Xenakis manages a sophisticated determination of musical progression. His management of probabilities determines which musical passages are more likely to be played than others and his management of game theory determines which combinations are likely to be played together at any time. At the same time, he ensures that the balance between playing question-answer and adhering to strategy is determined by the conductors at the time of performance. It is an elegant game, and an elegant arrangement of musical material.

However, this is quite different from a musical game in which musical progression is determined by the resolution of a conflict between a performer's sense of musicality and the competitiveness generated by a game environment. Each conductor's musical deployment is the result of a purely tactical mindset. The musical passages in these works form the physical representation of the formal structure, but it has been ignored that, unlike a conventional game, the game 'pieces' – the musical passages – have an inherent value outside the game. For example, the symbolism chosen for chess does not encourage a player to favour moving one piece more than another, each piece is moved on a purely tactical basis. Imagine, though, a young girl who loves horses, and every time she has to move a chess piece would much rather move the horse than any other piece. She must resolve her love of horses with the move which is most strategic.

In *Duel* and *Stratégie*, a performer is not asked to truly consider the musical implications of a tactical decision; Xenakis, as composer, has determined the strengths of each passage despite each conductor having their own views on which passages are more musically favourable. In both works, the victory condition is the realisation of an 'ideal', partly inflexible strategy.

Xenakis' works have this 'victory condition' paradigm strongly in common with contemporary electronic games which are explicitly related to music and music performance. Xenakis has determined

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that a victorious game outcome is the desired result in his works; game developers have determined that *their* conception of an ideal 'music' performance is the goal.

4. Electronic 'Music' Games

In many electronic games music is used as part of the motivation, reward system or cultural attraction. Games like 'Amplitude', 'Frequency' and 'Taiko: Drum Master' attempt to enhance the degree of player immersion by engaging the player musically.



Figure 1. 'Taiko: Drum Master', the player must hit a drum controller when indicated by the visual cues; playing 'music' well wins the game

These games can be categorised in two ways:

- games in which a player must play music to win the game; and
- games in which the relationships between a game and the player is enhanced by the cultural resonance of the musical consequences of their play.

4.1 'Taiko: Drum Master' & 'Amplitude'

Both 'Taiko' and 'Amplitude' link a concept of musical success to success in a game. This is in part because their intention is to create a game system in which "[e]ach level dances around the outer limits of the player's abilities, seeking at every point to be hard enough just to be doable" [7]. This approach attempts to keep game play and musical interaction rewarding at all levels of play. However, it also makes it necessary for game developers to decide what constitutes musical success; by definition, this limits the capacity a player has to express personal musicality.

'Taiko: Drum Master', a screenshot of which is shown in Figure 1, is a game in which a player must play music in a mechanically conceived version of 'well' to win the game. It is played with a small replica of a Japanese Taiko drum; points are accumulated by performing the prompted drum stroke on cue. Interestingly, music does form a part of the formal structure of this game. As the timing of game events is driven by music, a player can engage with the rhythm and anticipate the timing of the strokes; the player 'feels' the music and uses this intuition to advantage over the game. Music, of course, forms a large part of the representational universe of this game; similar to the example of 'Connect 4' given in Section 2, the distinction is between the symbolism and formal structure in 'Taiko' is not clear.

In 'Amplitude', an example of the second category, music does not form a significant part of the game's formal structure as it does in 'Taiko'. A conventional game controller is used to activate musical sequences in a futuristic tunnel setting. While the process of remixing music is at the core of the formal structure of 'Amplitude', music does not significantly determine how a player plays the game. The victory condition in 'Amplitude' is the realisation of an 'ideal' performance which has been predetermined by the game's developers. In determining the obstacles to victory in the game, the developers have decided what constitutes a worthwhile musical result.

For a more comprehensive discussion on both instrumental works based on games and electronic music games, please see the author's Masters thesis [2].

4.2 Creating music based on game play

While musical compositions based on games suffer from a shallow understanding of the game on which they are based, electronic music games make no real attempt to understand what may constitute a genuinely musical experience. Generally, game developers determine particular musical outcomes desirable, and the game player must reach these conditions to succeed in the game.

Making music in this way has more in common with traditional musical instrument learning techniques which prescribe the level of technical attainment necessary to perform certain music. This can be likened to a pianist who, in order to express themselves coherently in a difficult piece like Rachmaninov's 2nd Piano Concerto, must be able to perform scales in thirds rapidly.

Linking the concept of musical success and success in a game tends to diminish a player's interaction with a game for musical production. One needs to focus less on the ability to press buttons (in a specific order) accurately and repeatedly, and more on possibilities for new musical experiences when interacting with a game system.

4.3 Systems for Specialised Interaction between Audio and Games

More specialised game systems have been created which use audio (musical or not) as an input and/or output. Games may combine audio with other technologies like haptic feedback [8], three-dimensional visual worlds and gesture (physical and musical) analysis; players are invited to control, or 'sculpt', audio output through the culturally accessible context of a game.

Typically, games which use audio as a discrete output method are developed cautiously; such a game will usually draw its rationale from a small set of universally palatable, and relatively achievable, concerns:

- Pedagogical – "[audio games] could provide a vehicle for the acquisition of skills, memory and concentration" [9, 10].
- Therapeutic – blind or partially-sighted players are empowered to enjoy game play in which success or immersion is not dependant on visual interaction [11].
- Social – participants must learn to co-operate with fellow participants in order to manage audio (and/or physical [12]) gestures which facilitate game actions

- Fun – engaging an audience and players with the novelty of either replacing visual feedback with audio, or controlling the progression of a game with audio [13, 14].

When these concerns form part of the primary or secondary objectives in a musical game, the potential for a musical outcome is invariably lessened. They make it too simple for a designer to view the game as a tool for another purpose rather than seeing the game experience as a rich source of musical potential in its own right.

A game is capable of the same experiential depths as a musical composition; a well-developed game is already a system for determining an aesthetic experience in its entirety. The structure of this experience can be analysed using game design theory, from which point music can then be built into the structure; music can be an inherent motivator in a game.

This shift of emphasis introduces the possibility for new music being created by combining a player's sense of game play with musicality. How this relationship can be realised in a concert context will be described in next section.

5. New Musical Games: *Metris* & *Battle Metris*

Based on 'Tetris', *Metris* associates musical responses with specific game actions. Music forms part of the formal structure in *Metris* by integrating an additional layer of rules into the existing rules of 'Tetris'. Additional rules in *Metris* are best described as a cybernetic system [3]; music production is designed to regulate a player's sense of competition as it is normally expressed in 'Tetris'. Music production also alters the player's experience of the game system which in turn is coloured by their style of game play.

Musical output is a direct result of game play; the organisation of pitch and timbre creates a *soundtrack*, something larger than the memory of individual events. Musical responses to events are crafted so that the sound is affected in different ways depending on the nature of the game event. Minor events affect the sound in a subtle, repeatable way, major events have a more dramatic effect on the entire sound design.

5.1 Music in *Metris*

Metris consists of four principle game actions and musical responses:

Landing a game piece

- When a game piece is landed, a synthesised bell strikes [15]. Bearing many similarities to Jean-Claude Risset's Bell [16], it is created by summing the output of 6 partials, each with its own relative amplitude, frequency and duration. The pitches are based on a just intonation scale derived from the frequency of the bell's partials, a different pitch is assigned to each figure.

Rotating a game piece

- When the player rotates a game piece, the fundamental partial of the bell previously struck is transposed above or below its current pitch by 3Hz. This creates beatings with the timbre and pitch of other bells which are still sounding.

Completing a row

- When the player removes a row of game pieces, 20 random sine tones are played over a range proportional to the number of rows removed. This causes the bell tones to interact with the sine tones, thereby destabilising them.

Modulation regions

- The *Metris* game screen consists of 20 rows divided into four subsections, each consisting of five rows. Each subsection defines a region of harmonic modulation. If a game piece lands somewhere within the lowest subsection, notes from the original scale will sound; if a game piece lands in a different subsection, pitches from another harmonic region will sound. Here, where just intonation tuning is involved, non-uniform interval sizes cause pitches to shift to positions not audible in the original (un-transposed) scale [17].

The music production system regulates the manner in which a player plays the game. Certain types of play are naturally discouraged by the rules; i.e. if a player lands game pieces too quickly, the soundtrack is overwhelmed.

Metris retains the formal structure and representational universe of Tetris, ensuring that a player is interacting with this game system in the same way they react to a standard game. The game experience is not simulated; the natural responses of a player are retained. However, part of the formal structure of *Metris* is defined by a player's musicality. Music is not simply a way in which a player may interact with a game's formal structure, as in 'Taiko: Drum Master', nor is it a goal-based motivator, as in 'Amplitude'.

In *Metris*, a player's musicality defines the exact nature of the formal structure; no 'ideal' musical product is insisted upon by the game's developers. The game system invites a player to interact musically with the other parts of the game's formal structure, allowing the possibility for new music to be created within the familiar structure of a game

5.2 Music as an intrinsic motivator

Battle Metris is a version of *Metris* adapted for two players. It is a game designed especially for concert performance; Figure 2 shows the performance set-up for APMC 2006, Adelaide, 12 July, 2006.

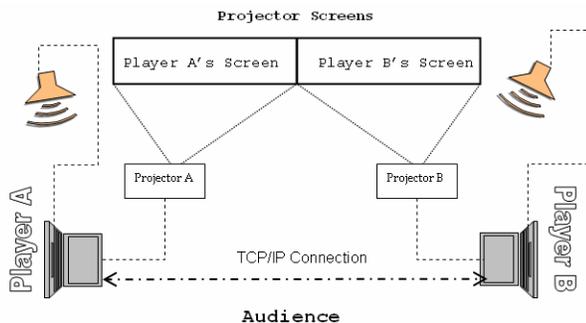


Figure 2. The performance set-up for *Battle Metris*. The two players sit facing each other at desks on the left and right hand sides of the stage, with their profile to the audience.

Unlike *Duel* and *Stratégie*, as described in Section 3, music is an intrinsic motivator in *Metris*; conflict is created between the player's sense of musicality and the competitive game context. In *Battle Metris*, additional motivations invoked by a concert performance context are built into the game's rules. The resulting game play and music is the dynamic resolution of this conflict; this dynamic resolution becomes the primary motivation in the game. It is an *implied rule* that the player's sense of musicality affects their game play.

Cultural and social contexts form a large part of the implicit rule base, as described by Salen and Zimmerman:

Implicit rules arise via cultural custom, tradition, and player experience. They directly link the formal and cultural aspects of a game, creating a bridge between the forms of authority that exist inside and outside of a game's space of play [3].

In *Battle Metris*, implied rules are one of three types of rules which define the formal essence of a game; the other two types of rules are *operational rules*, which are the "guidelines players require in order to play" [3], and the *constitutive rules*, which are the underlying formal structures that exist 'below the surface' of the rules presented to the players. Within the world created by the game, a concept which Huizinga refers to as the *magic circle*, a "temporary world within the ordinary world, dedicated to the performance of an act apart" [18], the authority of these rules holds sway.

In *Battle Metris*, as with *Metris*, the implied rules are created by the relationship between game play and music. Game play is regulated by positive and negative feedback systems.

5.3 Positive and negative feedback systems – a Cybernetic System

Games typically make use of *positive feedback* [19] systems for dramatic effect or to bring a game to conclusion. Positive feedback is built into the rules of *Battle Metris*; these are rules it inherits from Battle Tetris.

5.3.1 Positive and Negative Feedback in Game Play

When Player A removes two or more rows from the screen, the same number of rows appear at the bottom of their opponent B's screen; Player B is now closer to the end of the game while Player A is further from the end of the game. This is a positive feedback mechanism as it magnifies the success of Player A by also punishing Player B, making the game prone to ending quickly.

A *negative feedback* system is often used to counteract the effects of a positive feedback system. In both *Metris* (single-player) and *Battle Metris* (two-player), the music constitutes a large part of that negative feedback system. The music generated can only be understood in the context of these two feedback systems.

5.3.2 Music as Positive and Negative Feedback in *Metris*

Specific examples of negative feedback in *Metris* include:

- Long and dense bell tones discourage rapid and aggressive game play.

Each bell tone contains 7 partials and has a duration of 20 seconds; when it rings in rapid succession, it quickly overwhelms the texture of the soundtrack and the relationship between game play and music becomes obscured.

- As rows are removed from a player's screen, the player is rewarded with sound; the reward is related to the number of rows removed and the sound is richer in texture and dissonance as more rows are removed. This encourages players to react more slowly and thoughtfully, as they attempt to anticipate game circumstances that will remove several rows in a single game action.
- As a block is rotated on a player's screen it produces a pitch bend in the last played bell. Because the pitch bend focuses listening on a single moving fundamental within an otherwise stable sound texture, it discourages rapid play; if the texture is dense a pitch bend will have little effect.

Specific examples of positive feedback include:

- Different regions of harmonic modulation, as described in Section 5.1, correspond to visual placement of objects on the screen. More dissonant modulation results when the player lands an object in a higher row while more consonant modulation results from landing an object in a lower row. However, more dissonant modulation is associated with conditions that increase the likelihood of ending the game.
- The position of game pieces placed on the screen determines the next game piece, and therefore determines the next bell pitch selected. Although the capacity to select the next block seems neither a positive or negative form of feedback, experience has shown that the conflict between game play and production of sound is heightened by associating selection of visual objects with selection of pitch. This forces a player to rationalise the conflict between making an awkward move or never getting the desired sound outcome.

5.3.3 Music as Positive and Negative Feedback in Battle Metris

Battle Metris allows the game played by one player to alter the constraints placed on the other player; the music is a sonic realisation of the conflict between players. Each sound event has meaning in the magic circle of the performance: it represents a player's fortunes in the game and thus links both the players' and audience's perception of the game's progression.

When Player A stacks rows at the bottom of their opponent B's screen, Player B's soundtrack is altered. A signal created from the amplitude-modulated sum of the partials (the *AM signal*) is added to the audio mix.

The AM signal is implemented in *Battle Metris* by multiplying all the partials from each bell. However, the amplitude envelopes of the partials are ignored; a partial is included in the signal multiplication at full amplitude until it is due to end. As a bell sound is characterised equally by its amplitude envelopes and partial relationships, not implementing the envelopes creates a

significant distinction between the Japanese Temple Bell sounds and the AM signal.

The volume of the existing signal, the sum of the bells, is decreased to accommodate the volume of the AM signal, which is determined by the number of rows added. This creates a rich sound with sidebands of high and low frequencies. As the frequency of one of the sine tones slowly rises, these sidebands move in contrary motion to produce an effect reminiscent of the endless glissandi of Risset's implementation of a Shepard tone [20]. In the context of this game, the aural effect of the endless glissandi puts the player under pressure in a similar way to how a player responds to a count-down timer in a conventional electronic game.

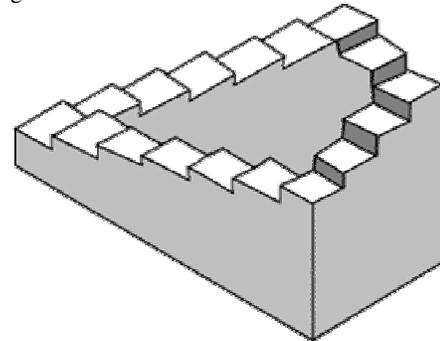


Figure 2: The Penrose Stairway, a visual equivalent of a Shepard tone. “An impossible figure in which a stairway in the shape of a square appears to circulate indefinitely while still possessing normal steps” [21]

Player B can only decrease the volume of the AM signal by removing rows whilst the dense sidebands in the AM signal set up beating patterns with the output of Player A's channel. This is sonically exciting for the audience and Player A; experience has shown it increases the level of stress in Player B, as their immediate focus shifts to reducing the level of the AM signal in their mix. The oppressiveness of the AM signal complements the addition of rows as a negative effect on Player B's performance.

Non-paradoxically, this addition to the music production rules in *Battle Metris* functions as both a positive and negative feedback mechanism.

Player A is rewarded in three ways when they remove a row: they are further from death, a new audio signal is available to play with, and Player B is closer to death. This is the positive feedback system. However, there is a maximum point to which Player A can punish Player B.

- Player B's mix is saturated by the AM signal after the addition of only five rows, if Player B does not remove any rows at this point, Player A ceases to receive a sonic reward for the punishment of Player B.
- If Player B does remove a row, it is added to the bottom of Player A's screen and Player B's mix becomes less dense, therefore because Player A is constantly vulnerable to attack from Player B, no matter how much Player B has been punished, there is significantly less incentive to continue punishing Player B after the point of AM signal saturation.

At the point where a sonic reward is no longer available to Player A it is tactical for them to prepare a defence against possible

attack rather than single-mindedly pursuing the punishment of Player B. This feature of *Battle Metris* encourages aggressive play until a certain point, then removes itself as an incentive; it acts as both a positive and negative feedback system.

5.3.4 Implied Rules and the Magic Circle in Battle Metris

In *Battle Metris*, music and musical performance become part of the magic circle of the game, while the performance context is part of its implied rules.

Stephen Sniderman, in his essay “Unwritten Rules”, looks at implied rules:

[Players] intuitively understand and respond to the ‘real-life’ context in which the game is being played – i.e. the social, cultural, economic, political, and moral consequences of the result (e.g. whether someone’s livelihood or self-esteem depends on the outcome) [22].

The ‘real-life context’ of *Battle Metris* is a concert performance. The relationship between the rules of the game and the social and cultural context completes the set of negative and positive feedback systems which comprise the competitive motivations in *Battle Metris*. The players’ resolution of this complex set of impulses, incentives and disincentives is their performance. What began as Tetris has now become *Battle Metris*, in which music is the intrinsic motivator. The players do not need explicit instruction on how to play a ‘piece’ as they would in a conventional i.e. composed work. It is not necessary to enunciate the implicit rules of the context; no formal codification of the nature of the improvisation is required. The players are intrinsically motivated to play together.

An implied rule at a concert may be the length of a performance; this rule can only be satisfied by explicit cooperation between the performers. Regardless of any notion of what constitutes the definition of a successful performance, a *Battle Metris* performance is always the combination of:

- Each player’s dynamic resolution of the conflict created by the positive and negative feedback mechanisms implemented in the music and built into the rules of the game; and
- The impact of the implied rules of a musical performance on this dynamic resolution.

Reiner Knizia, designer of the ‘Lord of the Rings’ board-game, recognises the importance of intrinsic motivation in a game, and provides an appropriate metaphor for *Battle Metris*:

The story starts with the hobbits leaving their home to venture into unknown lands. I decided that each player would represent a hobbit, aided by the good characters and peoples in Middle Earth. Of course their only chance was to cooperate. To do Tolkien’s masterpiece justice, the players would have to play together. But the rules could not simply demand cooperative play: the game system had to intrinsically motivate this type of play. [Italics mine] Even the most competitive players would soon realise that the game system threw so many dangers at the players that they would naturally have to support each other to maintain a strong front against their common enemy [23].

One may replace the world of Middle Earth with a performance venue, and the common enemy with the implied rules of *Battle Metris*; at this point the metaphor is complete. Each player retains

their own motivations: winning a game; playing music they like; playing the game well. But neither of them alone can satisfy the implied rule of a successful performance. While a successful performance is subjective, it may be defined in terms of the ‘magic circle’ of the game experience; participants and spectators may agree on implied and/or explicit rules which have meaning only within in the magic circle.

6. ‘Symbiotic Symphony’, an Audio-Controlled Game

Based on the principles demonstrated in *Battle Metris*, an electronic game, ‘Symbiotic Symphony’ is a game specifically designed to be played with a musical instrument.

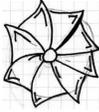
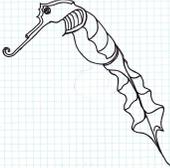
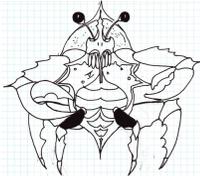
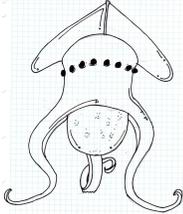
6.1 Game Behaviour

The graphical interface for ‘Symbiotic Symphony’ is a world of symbiotic relationships which employs the Game of Life Cellular Automata rule [24] to control the relationships between three different characters, Plankton, Crab and Octopus. The characters exist in a world filled with cellular activity generated by an implementation of the Game of Life algorithm. Based on an ecological metaphor, a new character is only introduced when there is a sufficient number of lower-level characters to support its existence. Characters gain energy when they pass through cellular activity.

When a new character is introduced, the game perspective zooms out to reveal a larger world which is inhabited by both the new and old characters. Characters and the size of the universes they inhabit are described in Table 1.

The game begins in a two-dimensional 160x160 cell world, the first level containing 16 Plankton characters in the state of lifeless husks. The second level is reached when all the Plankton characters are at 80% or higher of their maximum health; this level broadens to five Crab characters and a wider perspective; Crab characters may consume Plankton in order to enhance their strength. Similarly to the previous level, when all Crab characters are at 80% or higher of their maximum strength, the world perspective broadens again and two Octopi characters are introduced. At any point in the game, a player can zoom in to any level lower than the current one, i.e. if there are five Crabs, one of which has consumed a Plankton, it is possible to zoom in to the world of the Plankton. This allows a player to stimulate pod activity in the Plankton in order to increase its strength, and therefore, the strength of the Crab.

Table 1. Characters in Symbiotic Symphony

Name	Image	Description	Count	Size	World size
Pod/ Cell		Lowest level organism. Based on a traditional Cellular Automata cell, this character is either alive or dead and maintains a permanent grid position.	Depends on world size	1x1	Variable
Plankton		1 st level organism. Shrimp-like creature. Maximum health is reached at 50 live cells (20% of 324 cell area).	16	18x18	160x160
Crab		2 nd level organism. Maximum health is reached at 1,000 live cells (\approx 4% of 25,600 cell area).	5	160x160	400x400
Octopus		3 rd , and highest, level organism. Maximum health is reached at 3700 live cells (\approx 2.5% of 160,000 cell area).	2	400x400	1000x1000

Pod, or cell, activity is the essential life-giver to all organisms, any organism must have a reasonable percentage of live Pods within its bounds. As pods are stimulated inside a character, their movement against the enclosed lining will effect the direction of movement taken by the character in its environment. For example; if there is a lot of cellular activity inside the right extremity of the character, they will start to move in that direction. This is another manner in which a player is able to influence the movement and position of there character in order to maintain and encourage cellular activity.

Pod behaviour is determined by a combination of the Game of Life rules and player interception through musical performance. The musical interaction between a performer and the musical product of Pod behaviour pertaining to the rules of the Game of Life form the basis for musical interaction with this game.

6.2 Music in ‘Symbiotic Symphony’

6.2.1 Music Generated by the Game

‘Symbiotic Symphony’ generates music based on the Cellular activity inside the characters. Each character is chiefly a white-noise generator filtered through band pass filters whose band and Q value is determined by the Cartesian co-ordinates of the live cells inside the character. This has the natural consequence of generating noisier, more chaotic sound when a character is healthy (more of the noise is allowed to pass because there are more live cells, i.e. filters) and quieter, more melodic and soothing sound when a character is unhealthy. The stereo placement of the signal being generated by the object is determined by its horizontal

position, and the relative pitch of the band pass filters is determined by its vertical position.

This enforces a basic dichotomy between the pleasantness of the sonic product of the game when characters are unhealthy and the game playing urge to ensure they stay healthy.

6.2.2 Music Performance to Control the Game

A performer interacts with the game graphically and sonically. Of the two, the sonic interaction between the performer and the game is by far more important, as this is only way a performer can affect the game and the clearest way of informing the performer of the relative health states of different characters, even when they are out of the current screen perspective.

The principle way in which a performer may influence the game is to stimulate cellular activity in either: a region close to, or headed towards a character; and inside a character, near one of its boundaries in order to direct it towards external cellular activity.

A performer stimulates activity by playing notes at a certain amplitude and frequency, which stimulates cellular activity at an X/Y co-ordinate, respectively. This process is based on bit-masking techniques developed in the author’s ‘Egregious Game of Life’ application [2], which allows alternative types of mouse-based interaction with CA.

A further conflict is built into the rules which do not allow a performer to have played for more than 40 seconds every minute, this requires the performer to manage carefully the amount of time they spend stimulating activity in particular regions. This also

gives a natural rhythm to the music performance where it is anticipated that a performer will often run out of playing time before the minute is up and will have to compensate with greater activity at the beginning of the next minute.

7. Conclusion

Battle Metris represents a nexus between musicality and game play. Performance of the work involves musical outcomes focused on interaction between the tuning of bell partials and closely spaced pitches found in microtonal scales. These outcomes are controlled by algorithms initiated by the performer's game actions. So far, these actions have been limited to pressing keys on the terminal of a laptop computer. 'Symbiotic Symphony', however, introduces a performer to the game play equation. Through the use of a musical instrument as the controller, its inherent nature provides extended controlling parameters. A performer is given the opportunity, and the challenge, of squaring their own musical proclivities with the behaviours required to survive in the game.

The common language formed in the conflict between sense of musicality and game play is an essential part of both projects and ensures that design decisions that would otherwise be arbitrary have a stylistic consistency.

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