

METAGAMING:  
EXPERIMENTS WITH ART AND GAMES

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## Introduction

“My definition of metagame is broad. It is how a game interfaces with life.”

–Richard Garfield<sup>1</sup>

In the past two years I have created several works that share a common aesthetic approach of using games in their development. Upon examination these works exemplify my approach to interactivity and performance through the use of strategy, goal, play, and indeterminacy. I have finished five pieces and I am currently working on more that use games or game elements as fundamental structural components. The works vary greatly in their selection and usage of these elements, producing vastly different results. Even within the works themselves, iterations of the same pieces produce varying outcomes. Although they are varied, all of the compositions share a common aesthetic approach. In this thesis I methodically examine the compositional process involved in making these game art pieces, detailing their common and disparate characteristics as a function of their game elements.

Although it may seem obvious it is important to first discuss what exactly games are before detailing how I use them in my music and art. The definition of a game is actually a much more nebulous concept than it may appear to be. Games are distinctly part of the human experience, having been known to exist since at least 3000 BC. After centuries of development of many types and genres of games, the spectrum is quite wide ranging.<sup>2</sup>

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1. Richard Garfield. “Metagames” in *Horsemen of the Apocalypse: Essays on Roleplaying.*, ed. Jim Dietz. (Charleston: Jolly Roger Games, 2000).  
2. Irvin Finkel. *Ancient Board Games In Perspective.* (London: British Museum Press, 2007).

French sociologist Roger Caillois in his 1958 book *Les Jeux et Les Hommes* (Man, Play, and Games) defined games with six characteristics. First, a game is fun and light-hearted in character. Second, a game occurs in a specific time and place. Third, the outcome of the game is uncertain or unknowable. Fourth, playing and participation in the game is non-productive. Fifth, the activity is governed by an artificially imposed rule-set. Lastly, a game occurs in a kind of fictitious and different reality.<sup>3</sup>

Caillois' definition is broad and widely encompassing, having an obviously deeply thoughtful logic that defines classic games well. However, I argue it falls short in adequately defining all games, especially modern ones. The requirement that a game be fun and light-hearted seems almost absurd. Participants in a world championship chess match or a scrabble tournament would of course take the activity very seriously. The idea of a game occurring in a single time or place makes sense before the advent of the Internet. Today Massively Multiplayer Online Role Playing Games (MMORPG's) like the widely popular World of Warcraft are played by millions of players all over the world twenty four hours a day, seven days week.<sup>4</sup>

In his third requirement Caillois says games should be uncertain and that the outcome is unforeseeable. This defines the vast majority of games well, although the degree of uncertainty varies greatly from game to game. A horse race with several horses has much more uncertainty than a game of solitaire. The fourth characteristic requires games to be non-productive, which I take to mean, does not produce something of value other than the activity of playing the game. Educational games, such as a child's game that helps teach children about spelling or math could be said to produce a worthwhile

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3. Roger Caillois. *Man, Play and Games* (Chicago: University of Illinois Press, 2001).

4. Amanda Lenhart, Joseph Kahne, Ellen Middaugh, Alexandra Macgill, Chris Evans, and Jessica Vitak. "Teens, Video Games, and Civics". *Pew Internet and American Life Project*. 16 September 2008. <<http://www.pewinternet.org/Reports/2008/Teens-Video-Games-and-Civics.aspx>> (23 March 2009).

educational experience beyond the pure activity of the game itself.<sup>5</sup>

In his fifth qualification Caillois defines games as having an artificially imposed rule-set. What would a game be without rules? I find this to be one of the most compelling characteristics provided, although the artificiality of the rule-set again falls on a continuum ranging from the complete abstraction of the video game Tetris to the much more realistic rule-set of a combat sports match, such as Kick Boxing or Combat Sambo. Finally Caillois defines games as occurring in a false reality, a kind of pretend world with pretend rules self-imposed by the knowing participants, which leads me to the next definition to consider.

Classically a game of chess does exist in a dreamworld where bishops move diagonally, but Game Theory describes games in a much broader context, most often in the real world. Game Theory, a kind of applied mathematics, was originally developed to analyze competitions in which there are winners and losers, such as a game of Go, but is extrapolated to scenarios such as economics and biology. Furthermore, Game Theory has been extended to detail any kind of strategic situation with human or even non-human “players.”<sup>6</sup>

Game Theory provides very useful tools for defining game scenarios, such as zero-sum games, where one player's gains are balanced out by another player's losses, summing to zero and retaining a natural harmony of the components. With this definition, war, elections, and checkers could be said to be zero-sum games.<sup>7</sup> However there are also non-zero-sum games where there is not necessarily a direct balance between gains and losses. Some argue the economy and natural selection to be non-zero-sum games.<sup>8</sup> The

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5. Roger Caillois. *Man, Play and Games* (Chicago: University of Illinois Press, 2001).

6. Morton D. Davis. *Game Theory: A Nontechnical Introduction*. (New York: Dover Publications, 1970).

7. Ibid.

8. John Maynard Smith. *Evolution and the Theory of Games*. (Cambridge: Cambridge University Press, 1982).

importance here is that there is a game quality to almost any facet of interaction even where the participants are not wholly aware of their status in the “game.”

For my purposes though, I find Game Theory to be too broad for defining what I use when creating game art, but it is very helpful. I pull from both of these kinds of definitions of game in my artwork, the narrow and the broad. I find games to be compelling because they permeate our lives. They govern the world we live in and the events that unfold from day to day. Games are also a part of our more personal experiences because the spectra of game types is so broad.

Games are our entertainment when we are alone and as well as when we are with friends. From the game of cards or chess I play with my friends to playing *Half-Life 2* at home alone on my computer, games consume a large part of my free time. Games are sport as well, like professional soccer, boxing, or even chess. Games gain an air of importance and are followed by multitudes of people who aren't even participants when the competition surrounding them is fierce. They can be used as a teaching tool in education, or just as an exercise in strategy and deliberation. I also argue that games can be artistic and can certainly be a part of a work of art.

Is it justifiable to say that games can be artistic simply because they are so entwined with human experience? The fact that games have been a part of every culture for such a long period of time is in my opinion a very clear way to peer into the psyche of our species. Clearly, competition is an important part of our collective unconscious, but so are other game elements. We have a need for pastime and leisure and video games provide just such an escape to a world where life is simplified to a rule-set. Perhaps we have a need for self-imposed rules. The rules serve to simplify, categorize, and make into



patterns the interactions of the game experience, much as our brains seek to do the same to the world as we perceive it.

Games express our ideas about the world and desires for what we want it to be. This can be understood by looking at the way we play games and also in the way they are designed. Much like music or art, games reflect the time and the people who created them. Chess is as much a part of the pre-modernist cultures in Asia and Europe as *Super Mario Bros.* is for today.

It is for these reasons that games and art have had some interaction throughout history. The creation of well-figured chess sets and mahjong tiles is unquestionably artistic. Fine products show true craftsmanship and a sense of aesthetics. However, what I find most compelling in the integration of games and art has been more recent. The following is a small selection of five historic game art pieces that have influenced the way I think, create, and perform.

### **Selected Game Art Works**

*Reunion* was a performance lasting approximately five hours at Ryerson Polytechnic on March 5, 1968 in Toronto, Ontario, Canada. The performance was a realization of the work *0'0" No. 2* composed by John Cage, which is identical to the work *Solo for Voice 23* from Cage's *Song Books*. The event itself had no score, but was organized by John Cage. Participants included Lowell Cross, chess board preparation; Gordon Mumma, David Tudor, and David Behrman, electronics; and John Cage, Marcel Duchamp, and Alexina Duchamp, chess players. The electronic musicians created sound that was sent into a mixing system which was then routed and gated by the chess board.

Lowell Cross adapted a chess board with photo-resistors that detected piece position and movement. This data was used to control the gating, routing, spatialization, and amplification of the electronic musicians, as well as to control changes in oscilloscopic images displayed by several televisions.<sup>9</sup>

John Cage used this process as a way to let the chance elements of the electronic musicians be randomly mixed and manipulated, creating a unique real-time electronic music.<sup>10</sup> However, I find the idea of using a chess board in a live chess match to be the most compelling element of the performance. Although the music being produced was improvised and its elements mixed together in a way unintended by the electronic musicians, the governing structure of the piece was the strategy implemented by the two players.

Marcel Duchamp, Alexina Duchamp and John Cage engaged in a real-time game art performance using chess rules as structure and tactics as execution. Instead of gesture and musicality dominating the experiences of the performance and audience, pawn promotion, castling, and forks were the language of discourse. There was a direct correlation between piece movement and audio output which created an interconnectivity between the chess game and electronic music. This work greatly influenced my aesthetic approach to music and game art, serving as a classic example of bridging the two mediums.

Another of example of compelling game art again uses a chess set, but in a very different manner. Yoko Ono's *Play It By Trust* (1966) is a much more conceptual piece compared to the performance flare of Duchamp and Cage's *Reunion*. For *Play It By Trust*,

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9. Lowell Cross "Reunion: John Cage, Marcel Duchamp, Electronic Music and Chess", *Leonardo Music Journal* 9 (1996): 35-42.

10. Ibid.

Ono created an all white chess board that has all white pieces for both players. She supplies these instructions:

Play it for as long as you can remember  
who is your opponent and  
who is your own self.<sup>11</sup>

Clearly Yoko Ono is making a commentary on war, given heavier weight considering that the Vietnam War and Cold War were current events. The United States and Russia even used chess as part of the cultural competition between our two countries. This culminated in the famous world championship chess match between American Robert Fischer and Russian Boris Spassky. With the all white chess set, Yoko Ono turns the rules of chess on its ear, and forces the players to consider that they are in fact the same. If they wish to compete they must negotiate the rules and will over time lose track of the ownership of the particular pieces.<sup>12</sup>

Ono's use of chess made me consider games beyond their structural and strategic components. Now when I create game art I consider what it means to play the game itself, what it says about the participants involved and the ultimate goals of the game. Where *Reunion* speaks to my implementation of strategy, *Play It By Trust* encourages me to think about why it is that people even use strategy.

Another work that has played a large role in the formation of my approach to games and art is *Cobra* (1984) by John Zorn. This work doesn't use any electronics or even a pre-existing game. Here Zorn has created a complicated and obfuscated rule-set to govern an improvisation by a large pool of players. A prompter with an array of large cue cards is guided by the performers to control, shift, and change the improvisation through

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11. David Sheff. *All We Are Saying: The Last Major Interview with John Lennon and Yoko Ono*. (New York: St. Martin's Griffin, 2000).

12. Ibid.

a complex system of hand signals. There is even a built-in effort to overthrow the power of the prompter through rebellious guerrilla tactics.<sup>13</sup>

The score has never been published and Zorn has been consistently secretive about the specifics of the work, preferring to be a part of any “official” performance of the work. If you want to perform *Cobra* correctly Zorn must be a part of it. Even though there is a large mystery surrounding the specifics of the work, I have been fortunate enough to be a performer in several performances that although Zorn was not a part of, did have participants who have either performed with Zorn or worked closely with others who have. I have a copy of the cue card cheat sheet which has the images of the many different kinds of actions for the ensemble to take such as “runner,” “pool,” or “buddies.” Each cue has a corresponding hand signal. Also, there is a vague series of guerrilla tactics on the right side of the page.

The score has no other information aside from these esoteric codes. Fortunately I have worked with William Winant and Zeena Parkins, both longtime Zorn collaborators, who have given insight into the rule-set. The specifics are not important here, but what is important is how much I enjoyed being a part of such a secretive and obfuscated performance. The complex system is still in my opinion the most interesting and engaging system for guiding an improvisation that is both entertaining and challenging for the performers and the audience. The “game” is not really a game in the classical sense, but more in the celebration of rules and systems. The theatrics of the rules and performance quality of the hand signals and cue cards are what I am still trying to capture in my own work.

The three previous works I've mentioned occurred before home computers were

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13. John Zorn. *Cobra: John Zorn's Game Pieces, Vol. 2*. Tzadik Records, 2002. Cat. # 7335.

commonplace and well before the advent of the Internet. Because of this they all share a kind of classical approach to game art. It is now important to acknowledge my heritage as a youth from the era of video games. When I was five years old my father surprised my brother and me one Christmas with the best Christmas present and likely the most important one I've received in my life. He bought us a Commodore 64. Although I was young and had never seen a computer or even knew exactly what one did, I was immediately drawn to it. What I eventually figured out is that apparently you can use it to play games. I learned how to type the required phrases to load and play games like *BattleTech*, *Ultima*, and *Journey to the Center of the Earth*. I played those computer games for years and my father actually still has the computer in functioning condition.

Those games bring me a sense of nostalgia, but there are other games that have affected me in a deeper way. Like the older game art pieces, there are too many to name here, but I will describe two video games that I find to be undoubtedly artistic in their design and execution.

*Grim Fandango* (1998) is an adventure game created for the PC by the developer Lucas Arts. The lead designer, Tim Schafer, crafted a world that mixes Aztec mythology with Film Noir, and a visual style that fuses Dia De Los Muertos (the Day of the Dead) with Art Deco. The characters in the game exist in the land of the dead, having died previously in the land of the living. Their dead souls are trapped there until they make the journey to the Ninth Underworld. Sinners in their previous life have to make the trip on foot while those with a moral past can have access to faster transportation such as the Number Nine train which takes its passengers to the Ninth Underworld in four minutes instead of four years.<sup>14</sup>

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14. Lucas Arts. *Grim Fandango*, video game. Lead Design by Tim Schaefer. (San Francisco: Lucas Arts, 1998).

The main character, Manny Calavera, is someone who not only does not have the moral capital to travel swiftly to the Ninth Underworld, but he actually has a moral debt that has to be paid in a seemingly unending fashion. The player guides Manny through a long journey rife with conspiracy and murder (the dead die a type of second death) to an ultimate redemption. Manny eventually stops plotting to find his own way out and instead helps others who have been tricked out of their ticket to the Ninth. This act of sacrifice is what leads to his own release from the land of the dead.<sup>15</sup>

*Grim Fandango* is a game that does not have the most innovative game-play, and the graphics are quite dated by today's standards, but its world and engrossing story make it one of the most artistic video games ever made. This game, although a financial let down, was critically well received and has influenced game designers and myself to create something greater, something beyond simple puzzles and shooters.

Another game that is just as engrossing but in a completely different manner is *Shadow of the Colossus* (2005). Developed by Team Ico with lead designer Fumito Ueda, *Shadow of the Colossus* is a somber tone poem that unfolds slowly with a reserved quality. Where *Grim Fandango* could be described as larger than life with its bright color palette and wildly turning plot line, this game gives almost no direct information about the narrative and the vast majority of the game is without dialogue.

The game starts in a temple where you've brought a dead girl whom you learn could possibly be brought back to life by defeating several giant colossi. You travel through an empty land, save for some birds and the occasional small lizard, traveling on your horse and searching out the secret location of each of the 16 colossi.<sup>16</sup> Most

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15. Ibid.

16. Team Ico. *Shadow of the Colossus*, video game. Lead Design by Fumito Ueda and Kenji Kaido. (Tokyo: Sony Computer Entertainment, 2005).

adventure games would have hordes of enemies to fight, towns to travel to, and side quests to complete. Here there are silent beaches, dim forests, and barren cliff tops to explore. You wander a peaceful digital countryside, taking the time to enjoy the simple beauty of this waterfall or that interesting arrangement of rocks. The game encourages you and sometimes forces you to recognize the landscape as an important character.

Upon finally meeting a colossus it becomes immediately apparent that your small frame and humble short sword aren't going to be nearly enough to defeat these seemingly invincible juggernauts. Each failed jump and mis-timed dodge is accompanied by a perfectly clumsy fall. Climbing on the colossus is a momentous task and can only be sustained for a limited amount of time before you get tired. It is very clear that defeating a colossus is a daunting task that includes continuous failures and takes on average about 45 minutes for each colossus.<sup>17</sup>

This is just as important a characteristic of the game as the landscape. The main character, Wander, must try very hard to succeed and you experience every mistake he makes. It is his perseverance and obviously strong resolve to bring the dead girl back to life that keep him coming back after each defeat. This game showed me that a digital world can be just as important as dialogue; that movement, gesture and ambience are just as engaging as plot lines.

### **Game Art Theory**

At this point I think it would be helpful to consider some game art theory. This is the collection of my thoughts on the subject after almost two years of working in the medium. These topics have been formed by and inform my process of composition. There

17. Team Ico. *Shadow of the Colossus*, video game. Lead Design by Fumito Ueda and Kenji Kaido. (Tokyo: Sony Computer Entertainment, 2005).

is not an established language for game art analysis because there is not an organized game art movement, instead there are just creative minds who happen to use games. Most often these game artists wouldn't even consider themselves to be game artists. Instead, they perhaps view themselves as artists who used games in one or a few pieces. Another group are video game developers who put considerable thought into their video games. Experimental composers have also been known to use game elements. I liken this patchwork to the sound art movement, especially its historical connections. There are historical threads, but the artists do not consider themselves to be part of a specific genre or movement.

Possibly this state of affairs is because the use of games in art is simply a technique and not an aesthetic. I think this is true to a certain extent, however the common usage of a technique infuses some form of uniformity between all the works that share this technique. Game art is something I consider having a growing sense of connectivity between its creators, a slow and subtle realization. I think this especially true of video game designers. Regardless of its merits as a truly distinguished type of art, I think it would be useful to consider some terminology for discussing games in art. The following is a collection of categories that I use when analyzing or creating game art. Game Art works can share several combinations or omissions of these attributes.



## **Game Art Attributes Outline**

### Game Authorship Continuum:

found ↔ modified ↔ created

### Structural Integration:

Mapped–Game rules mapped as governing structures in the minutia of a work.

Functional–Games as metaphor, symbol, or concept.

Non-Functional–Games used for superficial aesthetic attributes.

### Audience Interaction:

Direct–The audience has direct interaction or a role in the game.

Indirect–The audience observes the performance of a game or is removed from the interaction.

Unknown–Audience or performer participation is hidden or obfuscated.

### Expression of Game Time:

Linear Time–Game time is expressed by moving from the past to the future.

Subcategories:

Real-Time–Time is actively unfolding.

Historic–Time is presented from a previously occurring event

Non-Linear–Game time is not expressed by moving from the past to the future and/or events are presented non-consecutively.

Non-Time elements–Game time is not experienced or is unchanging.

## Game Authorship

When a game is used in a piece of art or as a piece of art we must consider its authorship. That is, is this game created or found? This is not to say that games that are created by the artists themselves have more merit than those that are pre-existing, but as a first step to understanding the reasons or concepts behind the usage of the game, authorship should be determined. If a game has been created, was it created solely for one work or a series of works? Will the game have an independent existence away from the work of art?

If the game is found, or pre-existing, then we must consider several factors. First, what importance does that game have to the artist or culture that the artist is a part of? Is the implementation of the game purely mechanical or does the game somehow inform us about the intention of the artist's gesture in the usage of a game? It is indeed possible to use a found game with a minimal intention of expressing an idea simply through its appropriation.

Consider *Reunion*. The chessboard is used for its mechanical properties, but there are some ties to the performers. Marcel Duchamp was a chess master and John Cage would take lessons from him on occasion. Part of the reason chess was chosen for this reunion is because of its domestic connection between the performers—the same reason why televisions were used and why Marcel Duchamp smoked cigars while Alexina Duchamp and John Cage smoked cigarettes.<sup>18</sup> This usage of the game was important but I argue not as important as the purely mechanical properties of the game.

An argument could be made that there is then a third distinct category, modified

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18. Lowell Cross "Reunion: John Cage, Marcel Duchamp, Electronic Music and Chess", *Leonardo Music Journal* 9 (1996): 35-42.

games. Yoko Ono's *Play It By Trust* is a good example of modification. There are compelling reasons to consider it as an independent category of created and found games. The composition is greatly affected by the alteration, but there still remains association to the original. In my mind, though, it is more of a continuum. On one side is a completely individually authored game, on the other side is a found game with no alteration, and then in the middle is where I would argue most game art lies.

Most created games are just logical derivatives of previous games, which is especially true in the video game industry.<sup>19</sup> Consider the *Final Fantasy* series by Square Enix, which has twelve installments to date with a thirteenth due out this year (This is without considering games that aren't part of the direct canon but still bear the *Final Fantasy* moniker. When these are included the number totals almost thirty).<sup>20</sup> These games are not identical, but instead are evolutionary. When comparing recent installments to older ones, the gap appears large. However, if compared in succession, for instance from *Final Fantasy VII* to *Final Fantasy VIII*, the differences tend to be very minimal. The story line is new, and they have upgraded the graphics. There is a new magic system, you can now have more party members and combat has been revamped. Is this a created game or a found game? Is it a modification? It is somewhere between all of them on the continuum of authorship.

What makes this continuum more interesting is the strong and growing “mod scene” online. This large community is a group of video game enthusiasts who take pre-existing video games and modify their code or content. This can be something as small as adding new weapons, textures, and features to the game *S.T.A.L.K.E.R.* as in the

19. Edge Staff, “Dyack: Industry 'In Crisis' for Originality”, 19 June 2008, *Edge-Online* <<http://www.edge-online.com/news/dyack-industry-quotin-crisisquot-originality>> (25 March 2009).

20. Square Enix, *Square Enix North America*, 2009. <<http://www.square-enix.com/na/title/finalfantasy/>> (23 March 2009).

*S.T.A.L.K.E.R. Super Mod Pack*.<sup>21</sup> However, the most interesting and impressive examples are the full conversion mods. These are mods which replace almost every recognizable texture, weapon, and character model, creating essentially a new game from the game “engine.” These full conversions, like *Dystopia* for the Source engine, stretch the meaning of modification.<sup>22</sup> How much different is a full conversion mod by independent developers from another derivative game on the same game engine from the original developers? I argue not very much, and usually the distinction is that one is commercial and the other is free and unlicensed.

### **Structural Integration**

After game authorship we must consider how the game is integrated into the work or utilized in structure of the composition. I consider there to be at least three ways a game can be used in the structure of a piece of game art: mapped, functional, and non-functional. These three usages are always a part of any work, but how much they factor into its composition and reception differs from piece to piece. Briefly, mapped works use game elements as governing structures in the minutia of a work. Functional works use games as a metaphor, symbol, or concept. Non-functional works use games for their superficial aesthetic attributes.

The first structural category include games whose rules are used, or “mapped,” as an important organizational element. That is, the specific rule-set and therefore its implicit strategies become the dominant feature governing details and minutia. John Zorn's *Cobra* is a good example of a mapped game design. The complicated rule-set of

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21. Boinkmkr. *S.T.A.L.K.E.R Super Mod Pack*, 19 January 2009. <<http://www.moddb.com/mods/super-mod-pack>> (22 March, 2009).

22. Team Dystopia. *Dystopia. 2002-2009*. <<http://www.dystopia-game.com/>> (22 March 2009).

the game is the most important feature of the performance. The specific notes, timbres, and techniques used by the performers are for the most part freely improvised in the moment of execution. However their manipulation, organization, and repetition is governed by the workings of the game.<sup>23</sup>

A game's rule-set is important to consider when an artist decides to create a work and uses the rules as structure. Careful consideration should be given to the possibilities and limitations of the game. If a game is too simple, the number of possible outcomes and therefore the diversity of its expressions is low. This does not equate to bad art, just simple structure. This might be desired, but could become a limitation.

Imagine a game art piece where 9 individual images to be displayed on a television screen are tied to the 9 squares of a game of Tic-Tac-Toe. Whenever a player marks a corresponding “x” or “o” the most recent square marked causes the television to display the image associated with that square. No squares can be erased, and there cannot be squares marked that already have a mark. Because of the rules of Tic-Tac-Toe the formal structure of the piece is simple and the scope of possibilities is limited. The game starts with the maximum number of possible configurations and through the duration of its interaction the outcome becomes more deterministic. Again, simplicity is not a value assessment and does not mean that a game art piece using the Japanese game Go on a board with 361 possible locations is somehow a better work of art because of its inherent complexity. Perhaps the artist desires the deterministic quality of Tic-Tac-Toe. It could be that the artist has devised the sequence of images in a such a way in order to show the predestined quality of our lives and the illusion of choice.

Game creation in a mapped game piece is an important possibility to consider.

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23. John Zorn. *Cobra: John Zorn's Game Pieces, Vol. 2*. Tzadik Records, 2002. Cat. # 7335.

Should the game be created if there is not a found game that has the qualities the author desires? If I want to create a game piece that has a random quality, but do not wish to use dice, coins, or spinners, I might instead create a game. Instead of using dice I am compelled to use the direction that glass marbles roll when dropped from a height of three feet as the source of information. This could be for an aesthetic reason, I just like the visual of falling marbles for instance, or simply because I think that it is a rule-set more suited to the art that I'm creating.

The second game structuring method I present is the functional use of a game. That is, a game can be used as a symbol or concept, representative of a specific idea or expression. Instead of using the rule-set and strategies in a game an artist might decide to appropriate a game as a symbol or metaphor for something else. Playing the game might not be important or even occur at all. It might just be imagery from the game and not even the game itself that is depicted in the work.

The obvious example here is Yoko Ono's *Play It By Trust*. The work uses chess as a symbol for war, conflict, and struggle among people. She wants to illuminate that instead of focusing on our differences, we should consider how much we actually have in common.<sup>24</sup> What makes the piece so striking is the slight modification of the chess board and its profound implication. It seems obvious, but of course normally the board is black and white and the pieces are black and white. The two sides must battle each other. Our cultures have accepted that in cases such as war one side wins and another loses; we have differences and they aren't resolved, but the battles are decided. Through a slight modification to a found game Ono has created a functional art game.

It is possible to create a new game that is itself a symbol or its use is conceptual,

24. David Sheff. *All We Are Saying: The Last Major Interview with John Lennon and Yoko Ono*. (New York: St. Martin's Griffin, 2000).

instead of appropriating a found game. This newly created game will have to be clear in its goals if it is to be perceived as more than just a game, otherwise there is a risk of the intent becoming obscured and the observer would be left trying to make sense of game they've never seen being portrayed as art. However this is only an issue if the author intends the game's usage to be functional.

The last structuring technique for game art is the non-functional use of a game. As opposed to functional usage, non-functional game art does not try to express a conceptual idea explicitly from the usage of a game or game imagery. The artist's goal is not to cause the audience or observer to realize a previously unknown truth, but simply to gain the superficial and formal ties associated with that game. A common example of this technique is the usage of, or allusions to, 1980's era video games. Typically, 8-bit and 16-bit game sounds and imagery are procured for use in artwork from just about every genre such as music, film, and even modern video games.

Take for instance the video game *Strongbad's Totally Cool Game for Attractive People Episode 1: Homestar Ruiner* from Telltale Games and lead Designer Mark Darin. Within the house of the main character, Strong Bad, are many activities to engage in: listening to the radio, checking your e-mail, and yes, playing video games. The video game in Strong Bad's room is *Snake Boxer 5* which is very similar to a real video game called *Boxer* for the Atari 2600. In *Snake Boxer 5* you control a boxer who must literally box endless rounds of snakes in 8-bit graphics.<sup>25</sup> The purpose of *Snake Boxer 5* is not to raise awareness of animal cruelty towards snakes, but instead to try to channel the aesthetic quality and cultural ties of 1980's era video games. This is made even more interesting because the game *Snake Boxer 5* is a video game within a video game. Even

25. Telltale Games, *Strong Bad's Totally Cool Game for Attractive People*. Lead Design by Mark Darin. San Rafael: Telltale Games, 2008.

more, it is a newly created game, not a found game, and apparently the fifth installment in a non-existent series.

### **Audience Interaction**

So far I have described game art in relationship to the game's authorship and also how the game is used in the composition of a work. Now I think it is important to consider the observer's relationship to the game used in a work of game art. When a game art work is presented to an audience member or exhibition attendee their experience of the art work will vary greatly depending on how the game is presented and their relationship with said game.

I have labeled games where the audience has direct interaction or a role in the game as having a “direct relationship.” This group uses games that are open to be used by anyone who has access to the work, be it installed in a space or downloadable from the Internet. Direct game art lets the observer experience the game first hand allowing them to be a kind of hybrid between observer, performer, and composer. Their actions are often what determine the outcome of various parameters tied to the game, and therefore their choice is part of the composition and performance of the work.

Video games such as *Shadow of the Colossus* and *Grim Fandango* are clear examples of direct interaction. The audience participates in the control of the game through the use of a game controller or keyboard, governing the direct actions taken and therefore the specific ordering and unfolding of the events. The artists or designers decide the rules of the game, but the players decide how it is played. It is completely possible that a player of *Shadow of the Colossus* may decide that he or she enjoys the digital



environment so much that they don't even want to go kill any giant creatures. This is likely not the intended outcome of the interaction with the game, however it is possible because the developers made it possible.

When creating a direct art game it is important to consider how the audience will interact with your game and subsequently how tight the relationship is between the game and the intended creative output. When creating direct game art the design of the game should take into consideration how the audience might play the game. If freedom is given to the participants, more likely than not the participants will do something the designer did not think of or intend. This is not bad or good, but just a reality about interactivity.

For some games, like Yoko Ono's *Play It By Trust*, the game itself is the intended feedback given to the observer, so there is a maximal relationship between the two. This can become a problem when a game artist starts engaging in the mapping of data from the game to another medium, such as audio or video. Care must be taken so that intended gestural or structural connections in the game and output are understood by the observer. If this is not considered, unintended associations may be created or no associations will be created at all, leaving a work that is confusing. Of course if your goal is to create a confusing experience then this can be advantageous, constantly guiding the participants' attention somewhere else and then fooling them with another false relationship.

So, when creating a direct art game consider the options available. You could create a game, or use a found game. Creation of the game allows you to make something that is tailored towards the needs of your aesthetics and concepts. You can make your mapped relationships perfectly synchronized and design the look, sound, and feel of the game to your own taste. The trouble with created games, though, is that no one has

played it before. If the artist would like the game created to be played, the game must either be easy to learn in a relatively short amount of time or derivative of another game or game genre that is common enough that it can be played almost immediately by those familiar with its heritage. If the game is too difficult to learn, or unfamiliar to the participants, the artist risks losing the player's interest.

It may seem then that using a found game is an easy solution to the problem of game familiarity, but this is wholly dependent on the game selected. Chess is a game that has been used to great success because it is so common. Of course there are people who do not know how to play chess, but even they understand how it generally works. The game of poker would be another game that would be exoteric in its functionality. Of course uncommon games are not necessarily unusable, but care should be taken that the specific rules and mechanics are understood if the intent of the artwork is to remain clear.

The logical next category after direct interaction is indirect interaction. Unlike an installation or interactive computer program, indirect art games are not participated in directly by the audience. Instead the audience indirectly views the participation of the game by the performers or perhaps a historical documentation of a performance. If mapping of data occurs the relationship becomes harder to grasp than in direct participation. Often this means that the designer should make the relationship more clear. This however could lead to an output that is undesirable in its exaggerated congruity with the game, and perhaps the artist would like to create a more general sense of connectivity. In any case, whatever the aesthetic approach, thought should be given to the removal of the audience from interactivity.

As with direct art games, indirect art games must be considerate of game selection

or design in regards to rules. If the rule-set is intended to be understood, a short explanation of the rules in the form of program notes or brief announcement could benefit the experience greatly. If the game is familiar to the audience, then it is not important to mention the rules. *Reunion* is a great example of an indirect game art performance. There are performers of the game who engage in the game of chess, and the audience observes independently of the game and its outcome. The selection of chess means that the rule-set did not need to be explained so that even if an audience member didn't know the specifics of the game, they likely still understood the larger concepts involved, such as movement, piece elimination, and check mate. If John Cage and Marcel Duchamp were instead great enthusiasts of the Royal Game of Ur, then likely the experience would have been very different.

An interesting advantage of indirect game art is that an unfamiliar game can be selected or created without the need to teach the audience the specific rule-set. Therefore there is no need to account for a learning curve in its performance because the game is not directly played. Perhaps the specific rules are not especially important and thereby the audience is freed from having to learn an entire game just to enjoy a performance of a new and exotic game art piece.

Another possibility for indirect game art is the fixed medium game art work. In this category a work uses a game that has been played historically or not played at all, just alluded to. Because of this, no explanation is explicitly needed for the rule-set. It also allows for a freer usage of the game and its aesthetic. One example of a fixed medium “mapped” game art piece is the *distellamap* (2005) series by Ben Fry. In this interesting series Fry has extracted the code from Atari 2600 game cartridges and lists them

vertically in assembly language, a low level computer language.<sup>26</sup> Each time the code has a “go to,” a logical jump from one section of code to another, a curve is traced between the two sections.<sup>27</sup> This creates a visually complicated but evocative image of the literal logic and therefore low level rule-set of the video game.

A third category for interaction that is somewhat more amorphous in its definition is the unknown or hidden relationship. This category includes works where the game is played without the participant's knowledge or the rules are purposely obscured. In *Cobra* the participants are aware of the rules, however the audience is left attempting to formulate their own opinion about the musical and strategic relationships. It is even possible to have a game where the participants are unaware of the mechanics or have no knowledge that they are in fact playing a game. Right now I consider this technique to be less represented in the field of game art, however it is entirely possible to create a game art piece and have the outcome of the game be completely hidden from the participants.

The Christian Wolff piece *Play* from his *Prose Collection* (1969) is an example of an unknown game connection. There is an intricate set of instructions for the performers to follow, allowing for a controlled but dynamic form of interaction between the players. The rules govern the game but the audience is unaware of how the connection is made, or that there may even be a game being played.<sup>28</sup>

### **Expression of Game Time**

After game authorship, composition, and interaction, the last theoretical topic I will discuss is games as expressed in time. The experience an audience member has with

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26. Ben Fry. “distellamap”. 31 August 2005. <<http://benfry.com/distellamap/>> (23 March 2009).

27. Ibid.

28. Christian Wolff. “Play” in *Prose Collection*. Lebanon: Frog Peak Music, 1969.

game time can differ greatly between various works of game art. I consider there to be three large classes that game time can be grouped into: linear time, non-linear time, and non-time.

Game time that is expressed linearly moves from one point of time to another in a consistent and unidirectional fashion. This does not necessarily mean that game time is always moving from the past to the future as it is also possible to express linear retrograde game time. Within the class of linear time there are two subclasses, real-time and historic time. Real-time in games means that events are depicted as they occur. *Reunion, Play It By Trust, Cobra, Grim Fandango, and Shadow of the Colossus* are all examples of linear real-time game play. In each example the players interact with the game synchronously with passing time.

Linear historic time game play involves the presentation of events that have already transpired. The presentation is still linear and therefore unidirectional and consecutive, however its observation is after the fact. Because in reality we experience the arrow of time only flowing forward, retrograde time cannot be expressed in real-time. However it can be depicted historically. The presentation of a historic game could be in a fixed medium such as an audio recording or video presentation, but it could also be a part of a real-time performance or installation, as long as the game itself is historic. For instance, if I were to write a piece of music for piano where the rhythms were determined by a game of Mancala, the piece would be performed in real-time but the game time of the procedure used to compose the work would be historic.

In contrast to linear time, non-linear time is game time expressed either multi-directionally or non-consecutively. This technique is used often in other mediums such as

film, where the sequence of events presented are not ordered in a linear fashion, resulting in a fragmented narrative. I argue, though, that because of the interactive nature of games a distinction needs to be made when speaking of non-linear game time as opposed to non-linear narrative. Non-linear game time does not include games where time is depicted non-linearly through its narrative if the game is played linearly. This can be somewhat confusing so I will give the example of the video game *Assassin's Creed* (2007) from developer Ubisoft Montreal.

In *Assassin's Creed* the player takes the role of Desmond Miles, a bartender who is kidnapped and used as a test subject for an experimental machine termed “Animus.” Animus is used to recreate memories that are supposedly stored in a person's DNA. Desmond Miles' is forced to relive memories of Altaïr Ibn La-Ahad as a part of the Hashashiyin during the Third Crusade in 1191. Throughout the game Altaïr's memories are relived in a fragmentary fashion, broken apart and sometimes out of order, alongside Desmond Miles' modern day interactions with his captors.<sup>29</sup> Even though the narrative here is non-linear, the game is played in linear real-time.

To create a non-linear game time work based on *Assassin's Creed* I could create a video showing fragments of game-play out of order or non-consecutively. This would be non-linear game time because the game's time itself has been broken. This must also be distinguished from non-linear game-play, which is where a player does not encounter a fixed series of goals or events to experience. Instead the player is given either a branching tree of challenges or an array of options to choose from.

The third class of game time, non-time, specifies game art where game time is not experienced or expressed by the composer or audience. This means a game is not actually

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29. Ubisoft Montreal. *Assassin's Creed*, video game. Lead Design by Patrice Desilets. Montreal: Ubisoft, 2007.

played, only referenced or alluded to. Non-time can be used in either a performance, installation, or in a fixed medium as long as game time is never expressed. For instance, images of the pieces in a game of Risk could be used in a painting. The game would never be played by the painter or the audience, however a structural element of the game would be mapped to compose the work.

A more compelling example is the previously mentioned *distellamap* series by Ben Fry. The game is used as a structure for works of fixed medium visual art, where the logic of the code is mapped with curved lines. What makes this more interesting is that the video game was never actually played by Ben Fry in the composition of these works. The code was taken from Atari 2600 game cartridges, being a perfect expression of the “rules” of the game, without actual game play.

## Compositions

### ***Samurai Showdown: Hattori Hanzo vs. Genan Shiranui (2007) – duo for two performers, ROM emulation, and laptop.***

*Samurai Showdown* was the first game piece I wrote. It was my first semester attending Mills College and I was looking for an idea that I thought would be compelling and exciting. Previously I had been collaborating with my brother, Curtis McKinney, on a different game piece, however the scope was too large and we never finished it. The piece was to be a hybrid between a Robert Ashley style opera and a Japanese role playing video game (RPG). After composing a few small pieces of music and prototyping some game-play in a role playing game creation program we decided that it was much too large of an undertaking. Also, our focus was being guided towards other topics in our studies at Mills

College and the idea faded away.

After a few months I began having a small idea in the back of my mind coalesce and form slowly. I was still interested in the idea of using a video game in a piece of music but I was looking for a more manageable way to incorporate a game that would not take years to complete. I considered the different genres of video games. Role playing, real-time strategy, first person shooter, puzzle, adventure, simulation, and fighting games were options I considered. The fighting game genre is the category that I found to be the most intriguing. Fighting games are a genre of video game where two players are pitted against each other in some form of martial combat. Fighting games are fast and exciting. It was also the kind of game that could be enjoyed by players and an audience if presented well, like a boxing match. The controls are kinetic and real-time, which would lend themselves quite well to data mapping for a performance.

I had settled on the game genre; however, the task of creating a fighting game was still daunting. Development time would be cut considerably if we dispensed with the need for creating large amounts of content such as a written text and background mapping. Still, I didn't know how to code yet and I was not excited by the prospect using some form of stock fighting game generator. I believe it was my brother's idea to use a found game and discard its audio, completely replacing it with our own sound. If we appropriated a pre-existing game we would free ourselves from the labor of creating an entire fighting video game for a short piece of electronic music.

The question then was, which game? The genre has a long history since the first fighting games in the late 1970's and early 1980's, and therefore there was a large pool of available options. *Street Fighter II* (1991) was an obvious choice. It was the first fighting



game I had played on a regular basis and it has a colorful cast of characters, but my brother and I decided it was too popular, especially since many people would be familiar with its soundtrack. After many considerations we settled on the Neo-Geo classic *Samurai Showdown* (1993).

There are several reasons why we settled on *Samurai Showdown*. We decided we wanted to use a game from the 16-bit era of video games. This era is when the fighting game genre matured and many of the themes and game-play conventions were created. It was also nostalgic for us and our peers. *Samurai Showdown* was a classic but it didn't have the kind of popularity that *Street Fighter* had. The game was also gloriously violent and bloody, including dismemberment and sprays of blood on a regular basis.<sup>30</sup> This matched our aesthetic approach perfectly as we wanted to create an aggressive noise piece with the game.

Now that we had a game we needed to decide in a more concrete way how the control scheme would actually work. We decided that console emulation was the best solution, even though there is some controversy in the video game community regarding emulators. If we wanted to use an actual console for the game we would need to hack the hardware for two game controllers so that they would send information to both the video game console as well as our laptop which would produce the electronic music. This would be needlessly complicated. By using console emulation we were able to use normal USB video game controllers, using their output to simultaneously control the video game and our electronics.

After the initial pre-compositional decisions were made we started working on the

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30. Wood, Bill. "Hadoken! The History of Fighting Games", *Capcom-Unity*, 22 March 2009. <[http://www.capcom-unity.com/billwood/blog/2009/03/22/hadoken\\_the\\_history\\_of\\_fighting\\_games](http://www.capcom-unity.com/billwood/blog/2009/03/22/hadoken_the_history_of_fighting_games)> (22 March 2009).

actual music. Because we were going to be playing *Samurai Showdown* in real-time, each of us would be controlling the moves of a single character. Applying this model to our electronic sounds, we decided to divide the work between us by character. Each character's sounds would be generated and controlled by the player who adopted their role in the video game. We also decided that we should work on the sounds somewhat independently at first so that there would be an individual style to the two different characters.

To apply some of the theory from earlier, *Samurai Showdown* could be described as a mapped game art piece. The rules and actions in the game are what govern the large scale and small scale structure of the music. More specifically, the attacks that each player executes are mapped and a corresponding sound is generated from Max/MSP. My brother and I have since coined the term “one to one,” or 1:1, to describe these kinds of tight relationships between the game and output. *Samurai Showdown* also has indirect interaction with the audience. The piece is performed by two players while the audience listens and watches. An installation version was always considered but never completed. The piece uses a found game, *Samurai Showdown*, and game time is realized in real-time by the two players.

One interesting facet of using a fighting game's controls for data mapping is the concept of combinations. Because of the limited number of buttons on our USB game controllers we were only able to send the data of about 8 different buttons for use as attacks, and 4 buttons as directions of movement. Fortunately fighting games often use a series of combinations (complex button sequences that can be difficult to execute) that allow for a larger pool of possible moves with a limited array of buttons. Successful

performance of the sequences trigger more powerful attacks with more visually spectacular character animation. We also created louder, noisier, more complicated, and longer lasting coordinating sounds, increasing with an attack's power. Because of this a built-in scale was enforced by the game mechanics so that less powerful attacks occurred more often than more powerful combinations and their equivalent sounds. This also created a dramatic feel so that if a player's character discharged a devastating attack the music would become more frenetic, following the natural flow of the video game.

In fighting games the two characters in combat attack each other, inflicting damage which is mapped using health-bars. Health bars are rectangles at the top of the screen next to the coordinating character's name informing the players about how much life each character has left (see Appendix A). As soon as a character's health-bar is emptied he or she is defeated and the match is over. The health-bar provided another opportunity to map an aspect of the game's mechanics. However, as opposed to attacks, the health-bar provided information that was relevant over a longer period of time.

Using visual Jitter analysis of the screen we were able to screen-capture the size of each character's health bar and store it for use as modulation data in our Max/MSP patch. This provided another natural envelope of drama for the unfolding of the sounds. As a character inflicted more and more damage upon the other, the attacking character's sound pool would become noisier and more energetic. In this way a logical envelope was created so that as a match progressed and as more damage was delivered by the various attacks, the music would grow louder and more distorted.

After we finished the 1:1 sounds we experimented with a few run-throughs of the game piece. After listening to what we created we both agreed it needed a great deal of

improvement. The sound of the 1:1 sounds was interesting but it did not have enough length, often leaving large pockets of silence when neither character was attacking. The rate of attack was also slower than I had originally thought, which gave the music a sluggish quality.

To counteract this unfortunate turn of events we decided that each character, in addition to the large number of various attack sounds, should also have a background layer of sound. This layer was not directly tied to the attacks executed by the characters, allowing for a continuous output. Their background layers were tied to health-bar levels. The backgrounds were able to have their own rhythm and sequence of events while important variables in the background were modulated by health levels. The tempo of rhythmic sequences, range of frequencies, and depth of frequency modulation were all real-time modulated by the decreasing amount of health each character had.

The loose relationship of the background layers combined well with the tight relationship of the 1:1 sounds. A hybrid was created that was able to map the minutia of the game, attacks, and combinations. The larger scale form and continuity was also depicted with the background layers. Furthermore, the background layers were developed further across multiple matches. In *Samurai Showdown* fights are not over after one match. They are played to the best out of three matches. The background layers we created were designed so that they would not reset for each match, but instead develop further through all three. After some tweaking of the pace and sounds, the fight between Hattori Hanzo and Genan Shiranui was completed.

The piece was performable at this point, however we decided to embrace *Samurai Showdown's* built-in introduction and startup. The console boots and a selection screen

appears. The players must select that they wish to engage in player vs. player combat. Next a menu screen is shown, displaying the large number of characters to choose from. Our fight system was only cued to work with Hattori and Genan, however we enjoyed the ritual of fighter selection. A subtle low drone hung in the background while high “clink” sounds mapped the players movement through the list until each of us finally decided on a character for use in combat.

I now truly considered the piece to be finished. My idea of creating a fighting game noise work was complete. The first performance was at Thursday Night Special (TNS) at Mills College on November 15<sup>th</sup>, 2007. The match was competitive and dramatic, however in the end Curtis' Genan Shiranui was victorious in large part to his character's devastating roll/slash combination. I considered the performance to be a great success, however with the final composition seminar class concert approaching, we decided to start work on a second fight in the *Samurai Showdown* series.

The methodology was identical to the first, just with a different set of characters and sounds. We worked on the second fight as much as possible, but unfortunately the limited time proved to be too little to produce a product we were both proud of. We were still making changes to the fight during sound check but at the last minute decided to perform only one fight instead of two. To this day the fight is incomplete. The performance of *Hattori Hanzo vs. Genan Shiranui* was again a great success, and I feel it delivered on the hopes I had at its inception. The piece was loud, especially with the house system's massive subwoofers. There was drama and energy, and again a winner was crowned. Curtis' Genan for a second time defeated my Hattori Hanzo. I feel that piece is what made the other students at Mills remember Curtis and me for our music. To

this day I still get requests to do another fighting game piece.

***Koi Koi* (2008) – duo for two performers, Japanese hanafuda cards, and homemade ReacTable.**

I started working on *Koi Koi* with my brother in May, 2008, when my first year at Mills College had come to a close. It was an eventful and challenging year, yet rewarding. Over the course of the year I had written several pieces of music, started working in the field of sound art, learned how to program in SuperCollider, and performed on a regular basis including at Signal Flow 2008. At Signal Flow my brother and I performed our first large scale game piece, *Red King Snoring vs. The Octopus Knight*, a duo for magnetic chessboard and laptop. I had learned a great deal and my style and approach had changed drastically since I left my undergraduate program in Oklahoma. My brother and I decided that instead of resting over the summer, we would instead regroup and focus our efforts on our next big game piece.

We wanted to create something similar to our work with the game of Chess that used physical pieces with an electronic music performance. Many different genres of games were considered, however the idea of using a card game was the one I found most interesting. My brother and I had played card games for years since we were around 11 years old. The card games we played were not normal games such as Texas Hold 'Em or Spades. We were early players of a new type of card game called Collectible Card Games (CCG). In these games each deck was modular and designed by the players themselves instead of having one stock deck that is used for all game-play.

My brother and I considered using various card games such as *Magic: The Gathering*, *Pokemon: the Card Game*, *The Call of Cthulhu*, and *Deadlands*. We debated

about the games' different merits and the merits of CCG's as a whole. The cards from *The Call of Cthulhu* and *Deadlands* had an aesthetic quality that was attractive, but there were also cultural ties to the gaming community that my brother felt would be distracting to an audience. The decks were large and modular, which meant either a large work load for us to account for a large pool of cards or limiting the scope of the work and not taking advantage of the game's modularity. The cards were also expensive compared to other card games. When we wrote *Red King Snoring vs. the Octopus Knight*, Mills College awarded us with a grant to buy the specialized magnetic chessboard, however convincing an academic institution to fund the purchase of *Magic: The Gathering* cards with no special properties would likely not go over as well.

We did however find the idea of using attractive cards with a complex and intricate rule-set quite interesting. Instead of using a pre-existing card game we decided to design our own card game. After some thought, we chose to use occult themes based on the writings of the famed writer Aleister Crowley. We wrote a large document detailing the rule-set to the entire game including three decks with various card types such as summons, spells, astral planes, and battle. Following the occult theme we decided to obfuscate the rules and not print them on the cards or reveal them to the audience. Only mysterious symbols and pictures would indicate to us their usage in the game. To continue the theme of Magick (spelled with a "k" when used in the manner of Crowley) we wanted to create a table that could detect the the cards while hiding the mechanics from the audience.

After a few weeks of designing cards and game mechanics we decided to abandon the idea for something simpler and more concrete. The only concepts left over from the

previous work was that it would still be a card game and we would still use some form of table to detect the cards. We decided to go back to the idea of using a found game, although not a CCG. We searched through hundreds of card games on the Internet for any obscure or foreign card game that combined elements of chance, strategy, and aesthetic imagery. After a long search we discovered the Japanese hanafuda cards. We were specifically attracted to the game Koi Koi using the hanafuda cards, which fulfilled all the qualities we sought.

The game of Koi Koi is a good choice for this work because it is dynamic, stochastic, and skill-based. Even though the imagery is of birds and flowers, the game was used as a gambling game by the Yakuza, which are Japanese criminal organizations, and the card game was even banned in Japan for some time. Early in development we decided to use Koi Koi as the basis for a mapped and real-time game art performance. Like *Samurai Showdown*, the audience would have indirect interaction with the game, which for this particular game was beneficial. While Koi Koi is a popular game in Japan, in America it is obscure. Because of the indirect nature of our performance the audience does not have to be familiar with the rules of Koi Koi in order to enjoy our performance.

Now that we had finally decided on a game our next task was to create a system that could somehow detect the presence of certain cards and communicate that information to our laptop and ultimately the SuperCollider programming environment. My brother experimented with designing a bar code system. Using just digital pictures on a computer, he could analyze a series of black and white bars and successfully identify the correct ID for the picture using a simplified homemade encoding system. However, when we transferred the system to using paper printouts and a camera, the results were



not as impressive. Misidentification and non-recognition plagued the system which left us grasping for a new more precise methodology.

Through research we discovered the existence of the ReacTable software ReacTivision. The ReacTable was a new electronic instrument that used visual detection of several individual objects on a surface for use in modular synthesis. The instrument itself is expensive, but the designers generously made the basic visual detection engine available as a free download. The visual detection used by ReacTivision was more sophisticated than our bar code system, using a two-dimensional side-weighted fiducial system.<sup>31</sup> The versatility and accuracy of the ReacTivision software was remarkable, which left one less element for us to worry about.

Hanafuda cards are much smaller than what Americans normally use for playing cards. Their construction is made of hard paper and the card faces are ornate and attractive (see Appendix B). We glued printouts of the fiducial identifiers on the back of each card so our visual detection system could identify each card, and then we constructed the table system.

We found a wooden cabinet and spray painted the inside and outside black to reduce reflections. Next we purchased an infrared LED array to shine infrared light up through the transparent table, upon which the cards were placed, illuminating them from below without a noticeable light source. The hope was that we could hide as much of the detection process as possible from the audience. To complete the effect we purchased sheets of plexiglass, one red and one blue, that fit the size of the playing surface. When the blue and red sheets sat on top of each other it was impossible to see through to the inside of the box, though infrared could pass through and reflect off the back of the

31. Music Technology Group - Pompeu Fabra University, *ReacTivision*, 2003-2009 <<http://reactivision.sourceforge.net>> (25 March 2009).

hanafuda cards.

We needed a camera that could sense light in the infrared spectrum. We modified a Logitech web camera, taking it apart and extracting the small glass IR filter over the lens. We reconstructed the pieces and applied a visible light filter made from fully exposed film negatives at the end of a roll of film. The construction was done and testing commenced, checking the integrity of the visual detection for accuracy and consistency. The results were less than desirable. ReacTivision was highly accurate but the concessions we made to hide the detection and allocate it to the IR spectrum proved to be detrimental to the detection process. Detections occurred but often cards were not recognized or even worse, misinterpreted as other cards. Some changes were needed if the system was to ever become performance-worthy.

Part of the problem was the infrared light. Unlike the visible spectrum, infrared light has a small contrast range, so the difference between black and white was smaller. This, combined with the very small printouts on the back of the small hanafuda cards, made the system unusable. We decided that detection accuracy outweighed the importance of obscuring the detection process. First we replaced the detection system. We were allowed to borrow a much higher quality camera and swapped out the two layers of shaded plexiglass for a single layer of clear plexiglass. We replaced the infrared LED array with a less directional black light. The black light emitted near-ultraviolet light which is more diffuse and surprisingly appealing as it subtly emanated up from the table.

Finally, and begrudgingly, we replaced the original hanafuda cards. Although they were quite attractive and their diminutive size added a delicate quality to performance,

they were too small for consistency. We scanned all forty-eight cards and printed them out on thick card stock, with high quality images on the front and the coordinating fiducial on the back. The new system was much better. Detection was fast and accurate. The only problem was that our box was too shallow to allow a wide enough viewing field for the camera to accomplish a centralized play area of detection. This was annoying but manageable. The construction of the finalized box was completed literally the day before the premier of the piece.

Following the imagery of the cards we decided to create a noisy electronic piece that also incorporated some sampling of the sounds from various animals and scenes depicted on the cards. Since the game piece is mapped, we used the rules of the game to govern the structure of our music. Koi Koi is played at a measured pace, unlike the fast action of a fighting video game. We needed to design a system that would make sound somewhat independently of the minutia of the game, but would be guided and manipulated by the events of the card game.

The basic rules of Koi Koi are as follows: the goal of the game is to accumulate more points than your opponent, although originally it was played for money. There are forty-eight cards in a deck with 12 suits (one suit for each month of the year) with four cards for each suit. The deck is shuffled and eight cards are placed face up in the center of the play field between the two players. Eight cards are also dealt to each player. Play is initiated when the first player plays a card from his or her hand and attempts to match the card's suit with the suit of one of the cards on the table. If there is no matching suit the card is discarded and placed among the other cards on the table. Next, a card is taken from the top of the deck and checked for a match against the cards on the table; if there is

a match, the player takes the cards and puts them in a pool of possible combinations, or Yaku. Otherwise, the card is discarded to the table. Players take turns matching and discarding until the deck or either player's hand is depleted. When a player gets a Yaku, play is paused. The player with the combination may decide to continue playing for more points or to end the game, winning that round. The number of points a player receives is based on the particular Yaku they create with their pool of matched cards, with more complicated and rare combinations netting the most points.

The game offers a simple complexity that I think lends itself well to a musical structure. In order to represent the twelve suits we created 12 corresponding sound-generating sources in SuperCollider. When the first two cards (one from the hand, the second from the deck) are played for each participant, a corresponding oscillator sequence is generated: therefore, the game starts with a combination of four sound sources from the twelve suits with the possibility for duplicates. These initial oscillators greatly impacted the overall sound of the piece which meant that different versions of Koi can sound drastically different. One game might start with synthesized koto-like melodies paired with high pitch aliasing square waves, while another game might begin with dissonant sine wave clusters and recursive frequency modulation chains. This is a feature that we aimed for, and when the piece is performed we usually perform two or three different games in a row.

After the initial four cards are played, each subsequent card played that matches another card's suit adds a module to a growing effects chain manipulating the original four sources. The four chains (player one hand chain, player one deck chain, player two hand chain, and player two deck chain) are independent and develop separately from one

other. The initial goal for the piece was to create forty-eight different effects modules that could be chained together in any order, mirroring the forty-eight cards in the deck. However, time was not on our side, so we finished with around forty, and added some modified duplicates. Each game has its particular sequence of cards determined half of the time by a player's strategy and the other half by the chance order of the deck. This generative chain of effects mirrors the growing pool of matched cards each player collects, following the mechanics of the game rules.

Each of the individual modules were designed to have an independent character. There was some difficulty in their creation because a delicate balance had to be struck. We wanted each module inserted in an effects chain to alter the output in a clear manner. However, we didn't want each new module in the chain to obliterate the intelligibility of the previous modules as this would destroy the chain's evolution. Furthermore, we designed the modules to modulate independently over time so that they were not static. We hoped to create a continuously morphing and shifting column of sound that was semi-transparent and yet unique.

“Face” cards are independent of the module system. These are cards that have an ornate picture of animals or other depicted scenery instead of having flora printed on them. We decided that it would be interesting to represent these face cards with corresponding pre-recorded sampled sounds. Initially it was our goal to record as many of these sounds ourselves, all of them if possible. I decided to take my wife and two children along with my brother on an ill fated trip to the Oakland Zoo in August one afternoon with a shotgun microphone and flash recorder. Although the zoo was noisier than I had hoped, with the large number of loud children and extraneous mechanical sounds of

passing trains, I was still able to capture decent enough sound. However the animals themselves were quite lethargic in the heat of the sun and were largely silent.

Occasionally I caught some bird songs, but the other animals like the boars were not very cooperative with my recording session.

After the hopes of recording our own sounds were dashed, we decided to use what we could from our session, but also use sounds from other sources. Regardless of the original source, I am content with the effect created when one of the players matches a bird or boar, which sings in counterpoint with a synthetic sound source. These samples reflect the imagery of the cards, creating a connection between sound and image.

As modules and matches are collected, Yaku (combinations) are accrued by each player. Normally in a game of Koi Koi, only a few Yaku will be collected before the game is ended. To extend the length of the performance we decided to defer the end of the game until the deck or either hand was depleted. At first we planned on having specific Yaku sounds that would be triggered each time a combination is made. Instead we decided on changing the module chains in a more fundamental way by switching out the sound source at the start of each chain with corresponding sound matched to the suit of the Yaku cards.

Later in the development of this piece we decided to add a few directly correlated sounds to tighten up the apparent reaction of the sound system to the game as well as give an aural cue to important events in the game. We added subtle card recognition sounds that are triggered each time a card is laid down on the table and recognized by SuperCollider. This solves two problems. First, we don't have to always monitor the laptop screen to check if SuperCollider is correctly tracking the plays in a game. We are

now free to focus on the performance of the game and take attention away from the laptop. In my experience, too much attention given to a computer in a game piece performance can potentially give the sense that something has gone wrong with the system. Also, before we added the 1:1 sounds, when a card was discarded to the board no sound was triggered. This could be confusing for an audience member trying to understand the relationship between a game they've never seen played before and the audio output of our electronics. We didn't want to confuse people by having some cards make sound automatically while others didn't make any sound at all, perhaps again leading to the conclusion that something has gone wrong.

In order to accomplish this task I had to learn how to use SuperCollider much better. I had been avoiding this particular facet of object-oriented programming (OOP), however the time had come to learn how to code classes. Classes in OOP are a way to create efficient code that is dynamic and easily reusable. Instead of hard coding every instance of a particular chunk of code, a programmer could use an instance of a class that has its own particular instances of arguments and variables. This technique saves a great deal of development time and creates a more streamlined and easily understood code base.

Aside from programming classes for the linking system and module sequences, in order to make the whole system work correctly my brother and I had to program the core mechanics of the game logic in SuperCollider. After a long period of experimentation and failed attempts, we finally completed a working logic that was dynamic and fast. Our programming accounted for card recognition of all forty-eight cards, a matching system based on the twelve suits, turn-switching between players, card ownership, Yaku

collection, and every possible end game scenario. Shortly after this, the table construction was finished and we had ended our largest development cycle to date. We still go back to edit the piece each time its performed, fixing bugs, streamlining logic, and tweaking the sounds for an even better end result.

The development of *Koi Koi* was long and troubled, testing my resolve and the collaborative effort of my brother and me. The piece was projected to be about fifteen to twenty minutes long, although we have since increased our rate of play so that performances of *Koi Koi* now take about ten minutes. Although it was unfortunate for the two of us to spend so much development time on the project and only have ten minutes of music to show for it, I believe it was an immense learning process for us. The piece also speaks for itself. We succeeded in creating a truly dynamic work, and I'm still surprised by the combinations of sounds that are created each time it is played.

***Urchin* (2009) – interactive installation and standalone application.**

After working on *Koi Koi* during the the first half of the summer and preparing for a performance of *Red King Snoring vs. the Octopus Knight* for the 2008 Skronkathon at 21 Grand, I spent the last month of the summer break working on something for the upcoming Signal Flow 2009 festival months away in March. After creating four previous game art pieces and having had several performances, I had developed a kind of style as well as a reputation for making game art. I had a more defined idea of what game art is and how I would like to make it.

I had no initial notion of game art when I wrote *Samurai Showdown*. I was just interested in mixing two of my favorite things, music and video games. However,



through a year and a half of growth and development I began to think more about games and art. I feel that the performances of *Red King Snoring vs. the Octopus Knight* and *Koi Koi* were successful, however one question that would almost always be posed to me after a performance was if I could let someone else play with the system we made. Any time you have a game that is being performed, it seems the natural inclination is for people to want to participate instead of just observe. I feel that perhaps the purest form of game art is something that has direct interaction with the audience as opposed to indirect interaction. I don't think that means it is better or worse, however I believe it does fulfill a desire on the part of the audience to play the game instead of just watch.

Modern day culture is rife with interactivity. We don't just consume information, we create it through wikis, blogs, facebook.com updates, twitters, and every kind of imaginable specialized website for topics from Apple computer hacks, to *World War Z* fan sites. It is increasingly unusual to find a medium that is fixed, especially a digital one, so the normal inclination is to participate.

Because of this, in my opinion the video game is quickly becoming the most important new art form of the twenty-first century. The Pew Internet and American Life Project presented a survey (*Teens, Video Games, and Civics*) in fall of 2008 showing that 97% of 12-17 year olds play video games in one form or another.<sup>32</sup> Now I will be the first to say that not all video games are artistic. I don't think there is much artistry in a computerized version of solitaire. However, what exactly constitutes an artistic quality in this context is subjective. The topic itself is too large to discuss here, but I think it is important to recognize that the relationship between video games and art will continue to

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32. Amanda Lenhart, Joseph Kahne, Ellen Middaugh, Alexandra Macgill, Chris Evans, and Jessica Vitak. "Teens, Video Games, and Civics". *Pew Internet and American Life Project*. 16 September 2008. <<http://www.pewinternet.org/Reports/2008/Teens-Video-Games-and-Civics.aspx>> (23 March 2009).

strengthen as video games become more popular.

With that in mind I decided to try my hand at something that was more directly interactive with the audience. Although I did not intend to make a video game, I knew that I wanted to make some form of interactive installation that was directly engaging. In July my goal was simply to figure out how to code in the Processing visual programming environment. Processing is very similar to SuperCollider in several ways. It is a specialized language that is simplified with hard coded functionality that makes working in a specific medium quicker and easier to understand.

The first thing I did was work through some tutorials, slowly building my knowledge base. After some time I discovered how to create recursive visual structures which eventually led me in a completely unintended way to animating polygons. These early experiments were simple and meager, however they were the humble beginnings of *Urchin*. I learned how to use the mouse to move my odd spiraling object around and change its shape by altering the properties of the triangles that composed it.

Color, transparency, and shape were the only things I was working with initially. Eventually I started making shapes that I thought almost began to look like sea creatures. Sometimes they looked like the shell of a shellfish and often like an odd polygonal sea urchin. I am a huge fan of sea creatures so I immediately began thinking of ways I could accentuate the effect. I created a blue background and implemented some rough momentum to the shape's movement. Then I added small flashing dots that looked like some kind of photo-luminescent sea creature. The work began to take shape.

Once I felt like I had something worth keeping I started developing some sonic material in SuperCollider to use with the Processing application. The initial creations I

made were deep bell-like sounds that would strike at fixed intervals. I thought the music fit the mood of the visual application, but its lack of interactivity seemed out of place since the visuals were interactive.

I wanted to create an immersive interactive experience and so I again tried to create a better audio layer. To that end, I created something that used mouse input to change filter frequencies and delay times in an audio feedback loop. Impulses at 11 Hz and 13 Hz in the left and right speakers respectively initiated sound while the feedback and filters created a cascading noise. The result was much more aggressive in approach than my first attempt and was also responsive to input.

At this point I felt I had something that was a prototype and I decided to discontinue working on it for a while. My second year at Mills College had begun and I was gearing up for the League of Art Game Composers (LAG) concert where I would be performing *Koi Koi* at the Luggage Store Gallery in October, 2008. I decided to wait until the semester was over to develop my prototype any further.

In December, winter break started and I made the trip to Oklahoma to visit my mother. I had planned on finishing my applications to doctoral programs before I left, but unfortunately I didn't feel like I had a presentable enough product in *Urchin* to send as part of my portfolio. What was originally intended as a few days of polishing up the piece ended up consuming my break. I spent the majority of my time working on developing *Urchin* further and creating something that was much more interesting.

The shapes I was making in Processing were interesting to me, but I felt like there should be more variety to the overall style of their composition. I created code that would allow for different styles or modes that would take the same coordinate data and create

different types of shapes, allowing for more variety from the same basic data. I also created a layer cloning system so that if the player liked the appearance of a layer they could click on the “q” key and save it. Over time the player would construct a complicated shape with independently moving layers all around the same central point.

Next I decided to further develop the audio along the same lines as the visuals. Instead of just having one sound field, I created multiple sound modes that could be cycled through with the visuals. In this way, instead of having to decide on one way that the installation would sound, I could allow for more diversity. Keeping the old noise mode, I added what I'll call a liquid digital spawn: a sequence of electronic formant oscillator blips that are generated at variable rates, amplified with resonant filters, and fed into delays. Mouse control was again used to vary the amounts of feedback, filter frequency, and sequence tempo.

The next sonic mode was an attempt at creating generative melodies based on the rules of Javanese gamelan instruments. Two synths imitating sarons would follow a lower bass synth functioning like a slentem in a gamelan ensemble. Mouse clicks initiated new melodies and mouse pad location changed filter frequencies and delay times. The last mode was another attempt at the bell-like sounds I made during the summer, but this time I tweaked the sounds to be more like underwater harps and I allowed for some frequency control by the mouse. As the application deadline for doctoral programs was approaching on January 1<sup>st</sup>, I finished my second version of *Urchin*.

Upon returning home to Oakland I once again began working on *Urchin*. I felt like I had a much improved program over what I had before winter break, however it still felt incomplete. The interactivity was empty and pointless. It was interactive for the sake

of being interactive, which I don't think is bad, but in this instance it was not working. I felt like perhaps I should add some new structure to the system to make it more inspiring. The idea of adding some game elements to my design had crossed my mind before, but the details were always nebulous. What kind of game would it be? What would be the goal? Now I had an idea. I wouldn't try to make it a full on puzzle or platformer (video games where characters must jump between suspended platforms, such as *Super Mario Bros.*). Instead, I would just add some slight game elements that would take the modulations away from simple interaction and instead tie them to play.

I revamped the control scheme and took away the ability to accrue layers and change modes at will. Instead, I implemented a feeding system in the game. The urchin-esque object now sported a circular mouth that when guided over floating particles would read higher on an “algae meter” (see Appendix C). After so many algae were eaten a new layer would be generated and after much more algae were eaten modes would change. This small change alone made the game feel much more exciting to me. Suddenly there was a purpose: to swim around and eat. It was simple, but I liked it. There was no winning and you couldn't even die.

Creating the algae themselves was difficult. I had to learn Processing in a more deep and technical way than before and create a class that allowed each tiny particle to move independently, guided by the water, but at its own speed. I also had to create more realistic waves and momentum so that the underwater theme felt more convincing when steering the urchin around to eat algae. I also found the collision detection very challenging. I spent hours figuring out how to define boundaries for the urchin's mouth, but, more importantly, checking to see if any of the hundreds of generated algae roaming

around the screen were in the mouth.

Once I had created the algae and more sophisticated physics I felt the last real task left was creating some form of enemy. I had several ideas including an eel, poison algae, a jelly fish, or an octopus. Octopuses are my favorite animals so they were the clear front runner in my mind: however, knowing the limitations of my visual coding skills I didn't even attempt to create one. Poison algae seemed too easy, not to mention likely confusing. So I tried to make an eel.

I spent hours drawing and animating an eel. It would randomly swim from one side of the screen to the other and if the urchin touched it all the algae in the urchin's algae meter would disappear. Depressingly, I was not pleased with the results I was able to achieve. The eel looked decent, but the style was drastically different from the rest of the visuals. Everything was polygonal, yet stylized. The urchin, though simple, could create interesting patterns through layering. The eel, on the other hand, was just poorly drawn and the animation was embarrassing. I needed a different enemy that was more attractive.

Since the idea of an eel failed miserably, I decided instead to create a jellyfish. The jellyfish took all my effort to create, but I feel the end result well surpassed the eel. The jellyfish just floats along, unresponsive to the urchin. If the urchin mistakenly swims into the tentacles of the jelly fish then the urchin is stung and loses all of the algae in its algae meter. Occasionally when the jellyfish floats to the bottom half of the screen it will start swimming higher, which is its most threatening mode. At first I was unsure that this would be enough of a threat, but eventually I came to enjoy the calm nature of the game. The fact that the only enemy just floats along made a great deal of sense to me in a game

where you can't win.

With the creation and animation of the jellyfish complete I turned my attention to finalizing the audio. I created 1:1 sounds for each section, reinforcing the game mechanics. The jellyfish also “emitted” a little buzzing sound whenever it stung the urchin. Each time a new layer was created a sound was triggered. I added some finishing touches with a new splash screen and start-up chimes when the game begins. I am an incessant tweaker when it comes to electronic sounds, and I continued to change variables and parameter mappings up until the day of *Urchin's* premier at Signal Flow 2009.

Another important element that was completely reworked the week of the premier was the control interface for the game. The original prototype for *Urchin* used the keys “w”, “a”, “s”, and “d” for shape changing and mouse direction for movement. When the game was revamped in the winter time I decided to consolidate the controls to create a more fluid experience. Movement and shape changing were both controlled by mouse movement and cloning was triggered by a mouse click. This way everything could be simply executed with just one hand. This model, however, had to be changed when the game mechanics were introduced, so I removed everything but the mouse movement for testing purposes.

I used a USB game controller for the controls when *Urchin* was premiered at Signal Flow 2009. The installation received a great reception throughout Signal Flow with groups of people regularly surrounding and playing it for long periods of time. I was very pleased with how the game developed and was pleased that others were enthusiastic about it as well. After *Urchin* was set up for Signal Flow, the last task was to prepare the

software for Internet distribution. I had to once again recreate the controls. The old mouse controls worked well on a laptop touch pad, but unfortunately using a normal desktop mouse made it clunky and hard to use. I decided instead to use the arrow keys on the computer. This way the controls would be universal on any computer including Macintosh, PC, desktop, or laptop. It is interesting that after nine months of development the controls that were ultimately used were similar to the original controls.

With the controls in order, I created a standalone version using SuperCollider. Thankfully, Processing can create applications for multiple platforms, so it is very portable. SuperCollider on the other hand is OS X only, even though there is a PC port. I have not yet created a PC version of *Urchin* although I will soon. I want it to be available to anyone to download and play for free. Creating *Urchin* was challenging and rewarding. I have always wanted to create a game, and I feel that the purest form of game art has direct interaction. I plan on creating more direct real-time game art works, especially because I feel that experimental video games is a niche that needs to be filled.

## **Conclusion**

Game art, although somewhat disparate as a movement, is growing and developing. I believe that game art pieces are compelling and interesting works that speak to our minds and our subconscious as a species. Games have been an integral part of the human experience and are an important part of analyzing our collective goals, aspirations, and faults. I also think that because of the inclination for digital culture to be interactive, computers are the most promising field for the development of new game art work.

The potential is there to create immersive, thought provoking, and exciting art that



engages players in a way that is unlike any other medium. Unfortunately, like other industries, video games are run by money-hungry companies looking for profits. Publishers are especially egregious, encouraging infinite numbers of sequels to prevent themselves from having to take a chance by investing in original ideas. Because of the massive amount of money and development time it takes to create large video games, only the most popular genres will usually be created.<sup>33</sup> Fortunately there are independent developers, as well as the mod scene, who continue to push the boundaries of video games beyond goal-oriented button mashing and into a full fledged art form.

My first foray into interactive game art was exciting and difficult. I hope to become part of this fledgling art form as it develops and experiment with new narratives and interactivity that will give players something to think about. My hope is that the art I create will influence players and developers alike to think more about the games we make and what it is the games say about us.

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33. Edge Staff, "Dyack: Industry 'In Crisis' for Originality", 19 June 2008, *Edge-Online*  
<<http://www.edge-online.com/news/dyack-industry-quotin-crisisquot-originality>> (25 March 2009).

Appendix A



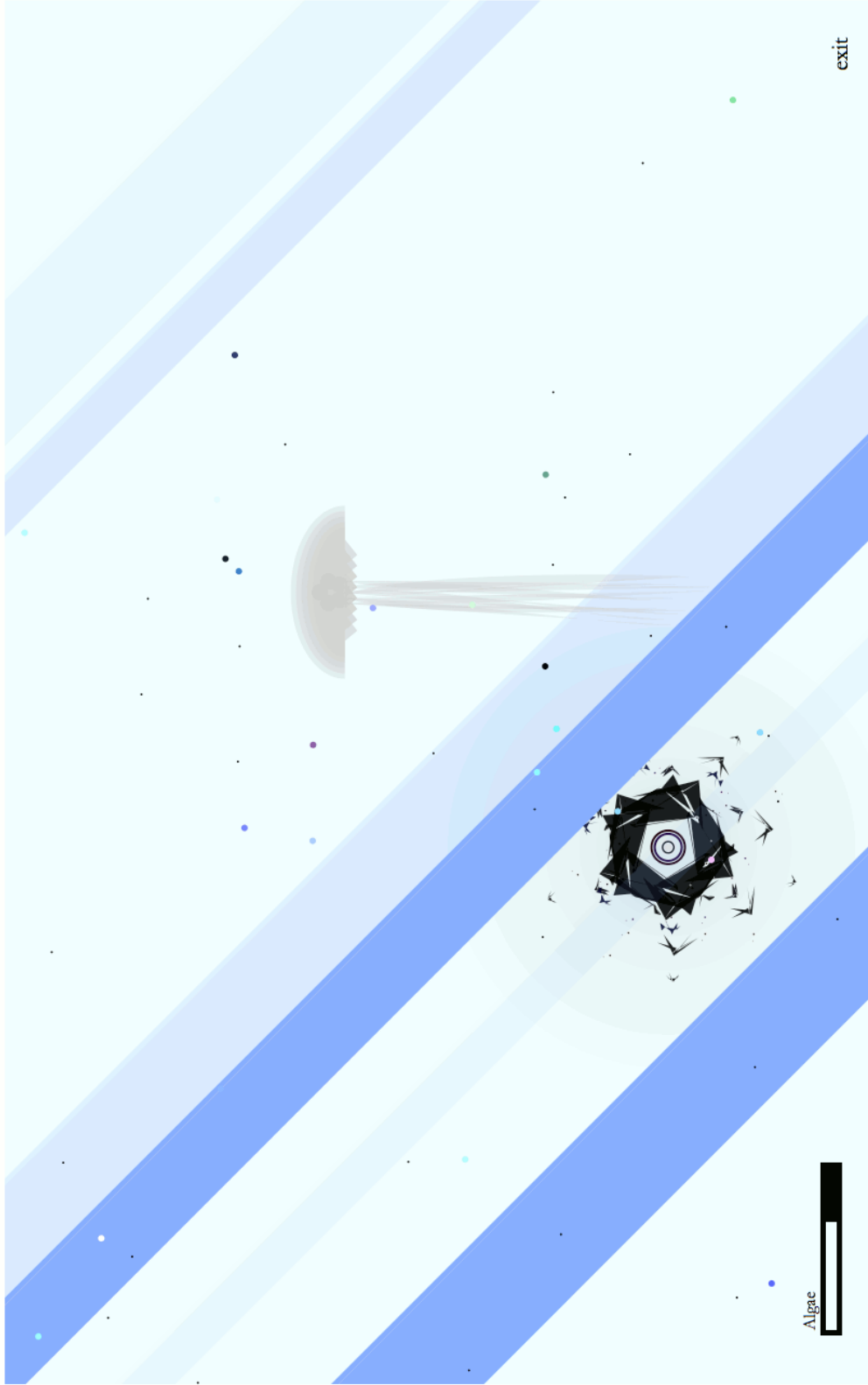
Screenshot of game play from Samurai Showdown

Appendix B



A selection of hanafuda cards

# Appendix C



Screenshot of game play from Urchin.



## Bibliography

- Boinkmkr. *S.T.A.L.K.E.R Super Mod Pack*, 19 January 2009.  
 <<http://www.moddb.com/mods/super-mod-pack>> (22 March, 2009).
- Caillois, Roger. *Man, Play and Games*. Chicago: University of Illinois Press, 2001.
- Cross, Lowell. "Reunion: John Cage, Marcel Duchamp, Electronic Music and Chess,"  
*Leonardo Music Journal* 9 (1996): 35-42.
- Davis, Morton D. *Game Theory: A Nontechnical Introduction*. New York: Dover  
 Publications, 1970.
- Edge Staff, "Dyack: Industry 'In Crisis' for Originality," 19 June 2008, *Edge-Online*  
 <<http://www.edge-online.com/news/dyack-industry-quotin-crisisquot-originality>>  
 (25 March 2009).
- Finkel, Irvin. *Ancient Board Games In Perspective*. London: British Museum Press,  
 2007.
- Fry, Ben. "distellamap." 31 August 2005. <<http://benfry.com/distellamap/>> (23 March  
 2009).
- Garfield, Richard. "Metagames" In *Horsemen of the Apocalypse: Essays on Roleplaying*.  
 Edited by Jim Dietz. Charleston: Jolly Roger Games, 2000.
- Lenhart , Amanda, Joseph Kahne, Ellen Middaugh, Alexandra Macgill, Chris Evans, and  
 Jessica Vitak. "Teens, Video Games, and Civics." *Pew Internet and American Life*  
*Project*. 16 September 2008. <<http://www.pewinternet.org/Reports/2008/Teens-Video-Games-and-Civics.aspx>> (23 March 2009).
- Lucas Arts. *Grim Fandango*, video game. Lead Design by Tim Schaefer. San Francisco:  
 Lucas Arts, 1998.

Music Technology Group - Pompeu Fabra University, *ReacTivision*, 2003-2009

<<http://reactivision.sourceforge.net/>> (25 March 2009).

Pritchett, James. *The Music of John Cage*. Cambridge: Cambridge University Press, 1996.

Sheff, David. *All We Are Saying: The Last Major Interview with John Lennon and Yoko Ono*. New York: St. Martin's Griffin, 2000.

Square Enix, *Square Enix North America*, 2009. <<http://www.square-enix.com/na/title/finalfantasy/>> (23 March 2009).

Smith, John Maynard. *Evolution and the Theory of Games*. Cambridge: Cambridge University Press, 1982.

Team Ico. *Shadow of the Colossus*, video game. Lead Design by Fumito Ueda and Kenji Kaido. Tokyo: Sony Computer Entertainment, 2005.

Team Dystopia. *Dystopia*. 2002-2009. <<http://www.dystopia-game.com/>> (22 March 2009).

Telltale Games, *Strong Bad's Totally Cool Game for Attractive People*, video game. Lead Design by Mark Darin. San Rafael: Telltale Games, 2008.

Ubisoft Montreal. *Assassin's Creed*, video game. Lead Design by Patrice Desilets. Montreal: Ubisoft, 2007.

Wood, Bill. "Hadoken! The History of Fighting Games," *Capcom-Unity*, 22 March 2009.

<[http://www.capcom-unity.com/billwood/blog/2009/03/22/hadoken\\_the\\_history\\_of\\_fighting\\_games](http://www.capcom-unity.com/billwood/blog/2009/03/22/hadoken_the_history_of_fighting_games)> (22 March 2009).

Wolff, Christian. "Play" in *Prose Collection*. Lebanon: Frog Peak Music, 1969.

Zorn, John. *Cobra: John Zorn's Game Pieces, Vol. 2*. Tzadik Records, 2002. Cat. # 7335.