

# Exploring Competitive Musical Creativity in Digital Composition Games

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## Abstract

This paper reports on two digital games being developed in an effort to explore real-time interactive composition in a competitive game setting. The games allow players of any experience level to exercise musical creativity via symbolic gameplay interactions with a stochastic music generation system, but critically depart from related media by positioning the player in contest with an opposing compositional agent. We address the context of these works, describe their game and music systems, and frame the two designs as contrasting explorations of competitive, game-based composition. We then identify key human-computer co-creative dialogues expected to emerge from player interaction with the games before discussing their wider implications for Musical Metacreation (MuMe). Our plans to formally evaluate the systems by gathering user perceptions of musical creativity, control, and competition are also outlined.

## 1. Introduction

Digital games and game technologies have garnered great attention as a novel platform for exploring musically creative applications. A lineage of game-based compositional praxis can be traced through the 18<sup>th</sup> Century dice games (Hedges 1978) and 20<sup>th</sup> Century “game pieces” of Zorn and Xenakis (Sluchin and Malt 2011). This practice now flourishes in a rich and growing landscape of interactive “sound toys” (Dolphin 2009; 2014), new interfaces for musical expression (Berthaut et al. 2011; Sa 2014), physical games and installations (Cera 2013; Bown and Ferguson 2016), and playful mobile apps (Kassabian and Jarman 2016). Two common themes unify this body of work: 1) the aim to provide casual access to music creation via playful interaction, and 2) the *avoidance* of competitive game elements such as conflict and defeat.

Our research aims to conceptualise an accessible digital game wherein a single player can exercise musical creativity in *contest* with an opposing compositional agent. We have developed two games, *EvoMusic* and *Chase*, to interrogate this notion. The game state persistently influences the sonic

outcome of a stochastic music generation system, allowing players to easily create music in real time by interacting with the gameworld. In turn, the rules and game logic are designed to encourage the music generation to follow its own creative trajectory, which the player then *contests* in an effort to realign the generated music with their musical goals. It is from this competitive interaction between the player and game system that the perception of an opposing compositional agent – and thus a more formal “composition game” – is suggested to emerge.

This paper outlines the context of the proposed composition games before unpacking how the design of their music and gameplay systems can contribute to the cultivation of a novel dialogue between player and computer: one that is both musically competitive and co-creative. We also discuss how the two works have been developed as contrasting implementations of this notion so that their juxtaposition might unearth new insights in an upcoming study evaluating user perceptions of musical creativity, control, and competition in such systems. We reflect on autonomy, interactivity and creativity within the composition games and outline the implications for future work. Video demonstrations of the games are available at:

- <https://youtu.be/pS-xG6bI8N8> (*EvoMusic*)
- <https://youtu.be/TjjKuIzusUc> (*Chase*)

## 2. Background & Conceptual Framework

We should first acknowledge the increasing use of automatic music generation in conventional game music contexts; that is, music designed to support emotional affect (Ekman 2014), immersion into a gameworld (van Elferen 2016), the auditory display of gameplay information (Ng and Nesbitt 2013), or narrative discourse (Summers 2016). Several researchers have explored generative music solutions to these aims (Brown 2012; Prechtel 2016; Scirea et al. 2016; Herremans and Chew 2017; Gillespie and Bown

2017), an initiative reflected by industry practitioners in the developmental *Melodrive* (Elmsley et al. 2017). Considering this high activity in the space of conventional game music, there are comparatively few explorations of generative music in the design of *music-based* games, particularly those that aim to elicit musical creativity in a *competitive* game setting.

We do not suggest a lack of interaction between gameplay and musical creativity, for which there are numerous examples. Participatory installations like *Urban Musical Game* (Cera 2013) and *Bowls* (Bown and Ferguson 2016) explore the sonification of existing physical games using networked audio devices as game props themselves. A host of device-bound designs similarly probe the nexus of play and musical creativity: Toshio Iwai's *Electroplankton* (2005), Brian Eno's *Bloom* (2008) and *Scape* (2012), Andrew Dolphin's collection of "sound toys" (2009; 2014), and even interactive app-albums like Björk's *Biophilia* (2011). Unifying these designs, however, is their avoidance or explicit rejection of a *competitive* game framework.

A notable exception to this trend can be found in *Sound Games 1 & 2* (Gimenes 2018), musically metacreative performances for multiple participants incorporating elements of both competition and scoring. There is also Marko Ciciliani's recent Gamified Audiovisual Performance and Performance Practice (GAPPP) project, which has produced works like *Tympanic Touch* (2017) to study the influence of competitive game systems on performer interaction and audience perception<sup>1</sup>. Both works invoke the more formal game spirit of Xenakis' *Duel* (1958) and *Strategie* (1962) by facilitating a scored musical "combat" with "points" and a victor (Sluchin and Malt 2011). And yet, the musically creative contest pursued by our research is in these cases predicated upon the interaction of multiple human agents in a formal performance setting. To our knowledge, there are no systems allowing a *single* player to engage in competitive musical creativity against the game system itself as an artificial compositional opponent.

It is this form of interaction what we hope to extract in developing *EvoMusic* and *Chase*: a uniquely compositional form of competitive gameplay between human and computer, contained to a single device. This presents several conceptual challenges. To begin, it is difficult to conceive of competitive composition-based gameplay that does not rely on social evaluation as a means of "scoring" the user's creative output or asserting a quantifiable "win" or "loss" outcome. While these elements are integral to the classical model of a "game" (Salen and Zimmerman 2003; Juul 2005), we suggest that a dynamic of musical contest can still be cultivated without a numerical score or victory condition by fostering the perception of an opposing compositional

agent through the careful design of game and music generation rules (discussed in Section 3).

This invites the further challenge of negotiating the issue of autonomy, interactivity, and creativity within our systems. While the games can be said to generate music autonomously once activated, the intended composition "game" emerges only at the point where the player interacts with this music generation. Interactivity, then, is clearly integral to our research aim, and yet so too is the player's perception of the system as an opposing agent capable of autonomously making creative musical decisions in contest with their own. Further to this, we do not present a music generation system that listens to or learns from the player. Rather, we aim to first investigate if a simple stochastic music generation system can be perceived by players as exhibiting creative behaviour when positioned in opposition to them within a game framework.

Our work rests on the critical perspective that potential MuMe systems are deemed "creative" as a function of how they are perceived by unbiased observers (Bodily and Ventura 2018). While we note a conflicting position arguing that creative behaviour cannot occur without reflection by the system itself (Agres et al. 2016), we have designed *EvoMusic* and *Chase* only as a preliminary experiment in user perceptions of musical creativity, control and competition within game settings. Our designs will be formally evaluated in an upcoming user study to test this position.

### 3. Original Works

This section details the design of *EvoMusic* and *Chase* as preliminary investigations of competitive, game-based musical creativity. We describe each work as an interactive system, addressing the musical constraints, game rules and interface of each before identifying how these elements contribute to the proposed construction of an opposing compositional agent.

#### 3.1 System Design

*EvoMusic* and *Chase* are each comprised of a game system and music system operating in direct communication. The game system is the central brain, serving as the point of player interaction and information display. It handles the game logic and directs the music generation system to respond to player actions and as control inputs. The game systems are built with Unity (*Unity Technologies*), a versatile 3D game engine popular with indie developers.

The music system is responsible for the generation and playback of musical content, but more conceptually for reflecting the player's compositional decisions. Basic stochastic strategies (e.g. first order markov chains, simple

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<sup>1</sup> <http://gapp.net/english/artandpapers.html>

generative grammars) are used to generate MIDI data in response to the game state. The MIDI data is then passed to VST plug-ins for playback. This output can also be captured as a WAV file to allow players to preserve a permanent artefact of their creativity. We have developed the music systems using the Max (*Cycling '74*) environment.

Interoperability between Max and Unity is achieved through Open Sound Control (OSC). We utilise a C# script from Thomas Frederick's *UnityOSC* project<sup>2</sup> to allow for the transmission of float or string values over a local network. This communication is to some extent bidirectional: while the music generation is hierarchically subservient to the game state, Unity is also required to respond to sonic events generated by Max to aid information display.

Critical to the works presented here is the player's perception of an opposing compositional agent. This perception is suggested to emerge from designing the game rules in such a way that the music generation moves inexorably towards some broad aesthetic outcome (e.g. harmonic cacophony), in turn affording the player a musical trajectory to "compose against". The specific conditions by which we hope to facilitate this interaction differ for each game and are outlined individually.

### 3.2 EvoMusic

*EvoMusic* is a 2D, point-and-click game inspired by the principles of mitosis and evolution. It enables players to exercise musical creativity by curating the growth of an evolving population of musical "cells". Each cell is assigned a discrete sonic event (e.g. a pitch, a percussion hit, a sound effect) which Max then organises into an open and evolving musical piece. The role of the player is to cast a judgement on the favourability of each sonic event and destroy any cells misaligned with their own compositional goals. Cells also grow over time, intermittently sounding their musical event until they grow large enough to divide into two new cells. One cell inherits the sonic event of the parent while the other is assigned a new event via a stochastic process. This provides novice users with a continually renewing stock of musical events to interact with, but also preserves any sonic features favoured by the player to allow for a shaping of compositional identity over the course of a game session.

There are six cell types in *EvoMusic*. A cell's type determines both its behaviour and the "class" of sonic event that may be assigned to it (see Figure 1). When a new cell is created, Max assigns it an unused sonic event of the appropriate class from a player-defined constraint. These constraints are selected in a pre-game menu where the player can also configure tempo, metre, cell types used, and the speed of cell growth (akin to "game difficulty"). The new event is added

to a pool of currently active events which Max then adopts as the parameters for real-time, stochastic music generation. Importantly, cells also "flash" whenever their assigned musical event is produced; this allows players to quickly decode the sonic identity of each cell and thus affect clearly identifiable sonic results (e.g. remove *this* sound).

Cell Type	Colour	Sonic Event Class
Melody	Yellow	Short, pitched notes
Harmony	Magenta	Long, pitched notes
Bass	Red	Low-register notes
Percussion	Green	Percussive layers
SFX	Cyan	Miscellaneous SFX samples
Destructive	Black	Dissonant synthesiser

Figure 1: Summary of Cell Types in *EvoMusic*.

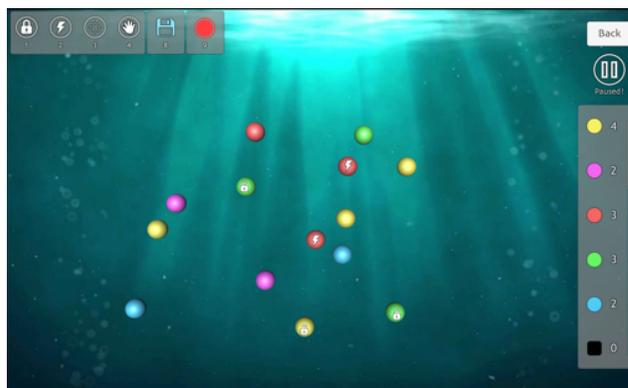


Figure 2: The interface of *EvoMusic* during gameplay

The competitive element of *EvoMusic* is multi-faceted. First, population growth is tied to an increasing chance that new sonic events will *not* conform to the initially chosen constraints. The player must actively contest this innate pull towards cacophony should they desire to preserve their ideal musical state, particularly given the population's exponential bifurcation. And yet, it is by this same growth mechanism that the player is offered new sonic material to preserve or discard at their discretion. Our aim is for the co-creative dialogue between player and system, in each moment of interaction, to exist in a transitory state between collaboration and competition.

We have also incorporated game elements that are more distinctly adversarial. For one, each cell division can result in the creation of a "Destructive" cell; these destroy any unprotected cells they collide with and so can disrupt the music if the player fails to remove them. The player is also afforded several tools to more broadly combat the system's compositional decisions: they can "lock" cells to slow growth and preserve favoured sonic content, "mutate" cells to hasten growth and sonic variety, or outright remove cells

<sup>2</sup> <http://thomasfredericks.github.io/UnityOSC/>

to suppress unfavoured sonic content (a staple of gameplay). Each of these actions consume “energy” – displayed on a bar to the right of the interface (see Figure 2) – which is only replenished by generating further music. The intention with such design elements to prevent the player from entirely overpowering the system’s musical contributions. We suggest that this balance may better cultivate the perception of an equal, gamified dialogue between compositional wills that variably collide or comply with one another.

### 3.3 Chase

*Chase* is a marked departure from *EvoMusic* in both its game framework and compositional control. The player is perpetually pursued by a red humanoid agent (see Figure 3) over a 3D gameworld comprised of four interconnected environments. The proximity of this “Red Man” to the player is scaled by Max and used to increase the tempo, velocity and rhythmic density of stochastically generated music in real-time. The metre and harmonic treatment of this music is determined by the Red Man’s current environment (see Figure 4). Having decoded this sonic relationship, the player navigates the gameworld’s varied objects and architecture to manipulate the Red Man’s position and exert creative control over the music.



Figure 3: The interface of *Chase* during gameplay.

Environment	Metre	Harmonic Treatment
Forest	4/4	Major
City	4/4	Harmonic Minor
Desert	3/4	Lydian-Dominant
Snow	3/4	Phrygian-Dominant

Figure 4: Musical treatment of environments in *Chase*.

The player loses “health” if the Red Man gets too close, eventually leading to their death and loss of the game. New musical layers accumulate as this occurs, though are removed if the player restores health by collecting heart-shaped tokens distributed throughout the gameworld. The result is a risk-reward dynamic where the music grows more interesting as the danger of losing increases. The player also

loses “stamina” as they sprint, which can only be recuperated by slowing down (and risking being caught). This provides a similar balancing mechanism to the energy bar in *EvoMusic*, preventing the player’s compositional control from overpowering that of the system.

The dynamic of compositional contest in *Chase* is conceptually similar to *EvoMusic*. The Red Man’s perpetual pursuit of the player inexorably pulls the music towards rhythmic saturation, which the player must variably resist or embrace to explore compositional outcomes. Several design elements aid the player in this, such as the numerical indication of proximity at the bottom of the interface (see Figure 3). The generated music also pans in accordance with the Red Man’s position. This functions as auditory information display (for locating the Red Man), but more significantly contributes to the impression that the music is emanating from the Red Man himself. The intention is to construct a more physical embodiment of a compositional opponent so that we may investigate its influence on player perceptions of the system as musically competitive and creative.

## 4. Discussion

*EvoMusic* and *Chase* are designed as contrasting explorations of competitive, game-based composition. *EvoMusic* affords atomized command over musical content at a granular level (e.g. removing individual notes and sounds). The larger co-creative system resembles a gamified genetic strategy with the player’s musical taste as the fitness function. In contrast, players in *Chase* harness a single interaction to broadly affect high-level musical characteristics such as harmonic treatment, rhythmic density, and general intensity (e.g. tempo, velocity). The compositional opponent is embodied as a literal hostile agent and the game can be definitively “lost”. Our intention with pursuing these contrasting designs is to enable their juxtaposition to reveal meaningful insights during a formal evaluation process.

Foremost, this formal evaluation will investigate if either approach more successfully elicits a perception of the game system as musically creative and competitive. Of further interest are player perceptions of their own creative agency within the system, particularly with regards to their sense of authorship over the resulting musical outcome. For instance, does the player believe that they are creating music, or simply “activating” music through arbitrary gameplay? We will gather open qualitative feedback alongside quantitative usability evaluations (using the “System Usability Scale”, Brooke 1996) and will also invite direct, open comparison between the game systems. The insights gained will help to chart the design space of competitive composition games and inform future works in other gamified MuMe and interactive composition contexts.

To reiterate, the generative music systems comprising *EvoMusic* and *Chase* do not listen to nor learn from the player’s compositional interactions. The musical trajectories against which the player competes – though inexorable and stochastic – are *static*, and so our systems would not be deemed creative by more discerning positions (Agres et al. 2016). However, their simplicity allows us to investigate if merely placing the system in musical contest with the player, within a game framework, is sufficient to instill the perception of an opposing creative agent before pursuing more complex designs. If successful, there is scope to consider competitive gamification in other MuMe contexts. *Musebots*, for instance, have seen an expansion of their original purpose as strictly autonomous ensembles towards human intervention and live collaboration (Brown et al. 2018). This opens new avenues for the potential application of MuMe systems to game-based environments.

At present, *EvoMusic* and *Chase* can be understood as gamified, co-creative software “partners” for single players of any musical experience level. They serve as an assistive compositional force by first generating musical materials and then providing the scope to creatively interact with them via game-based abstraction. Conversely, these same mechanisms also sustain a musically competitive framework: *EvoMusic*’s exponential growth provides a form of musically creative difficulty progression, and *Chase* ties the exploration of musical outcomes to a persistent risk-reward mechanic. The system’s musical contributions variably collide or comply with the player’s creative goals. What emerges is a novel human-computer co-creative dialogue that exists in each moment of interaction as a unique meld of collaboration and competition over a shared musical outcome.

## Conclusion

In this paper, we report on two digital games being developed to explore real-time interactive composition in competitive game settings. We address the context surrounding these games and discuss the design elements by which player perceptions of the systems as musically creative and competitive are suggested to emerge. As a key insight, the games expose a hybridized collaborative-competitive human-computer dialogue as one contribution of game design to MuMe and interactive composition.

Our future work will formally evaluate these positions in a user study examining perceptions of musical creativity, control, and competition. The games presented here, *EvoMusic* and *Chase*, have been juxtaposed so that this evaluation may more broadly chart the design space of competitive, game-based composition. The insights gained will inform any future efforts to gamify musically creative systems and will reflect more broadly on the notions of autonomy, interactivity, and creativity within such designs.

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