Games: Sound and music for Interactivity and Immersion

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Today

Main modules

A. Sound and music for games
   • Different functions of sound and music in games (recap)
   • Challenges of interactivity and immersion
   • Music and emotion
Recapitulation last lecture

Functions of sound and music in film and games

Annabel Cohen (1999) for film: e.g.
- Provides continuity between shots
- Induces mood
- ...

Additional function for games
- Support interactive aspects of the game play
Recapitulation last lecture

- Dual nature of games:
  - Virtual world
    - Sound and music: support reality status of the game world (such as supporting sense of presence)
  - User system
    - Sound and music: important part of usability system, needs to be informational and communicative

- Challenge for music and sound design for games: combination of the two functions
Game audio typologies

- Recapitulation film music: diegetic vs. ?
  - What was it about?
Game audio typologies

- Recapitulation film music: diegetic vs. non- (extra-) diegetic
  - Diegetic sound: originates from a source existing within the film or game world
  - Extradiegetic: no connection to an actual source within the film or game world

- Application to games (Jørgensen, 2009): diegetic vs. ?
  - difference to extradiegetic in film?
Game audio typologies

- Recapitulation film music: diegetic vs. non- (extra-) diegetic
  - Diegetic sound: originates from a source existing with the film or game world
  - Extradiegetic: no connection to an actual source within the film or game world

- Application to games (Jørgensen, 2009): diegetic vs. transdiegetic
  - Extradiegetic: can provide game player with information that changes players’ actions, which in turn can change the game world (therefore “transdiegetic”)

Recapitulation: IEZA model

- Huiberts & van Tol (2008)
- Conceptual design tool for game and audio design students at HKU
- Applies to game audio during the interactive game play
IEZA model: two functionalities

- two main perspectives on the expression of in-game audio aimed at the player's experience:
  - Audio used for **optimizing** game play: helping the player to play the game by providing necessary gameplay information; serves usability
  - Audio used for **dynamizing** game play: making the gameplay experience more intense and thrilling
Today

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Important historic milestones
(according to Jørgensen, 2009)

- First Nintendo console
  - storage: primary concern for computer games
  - sound: only small amount of storage space
  - only a few sounds could be played simultaneously, **usability functions became prioritized**
  - Nintendo’s classic Super Mario Bros. games: use of sound for response and urgency purposes

- Stereo introduced in 1980s
  - new functionalities: sound and music with high precision compared to real world sounds

- 1990s: sound cards could produce CD quality sound
  - auditory focus on creating believable virtual environments
  - new uses of game audio beside the usability function, connected to **orientation** and the sense of presence.
Important historic milestones
(according to Jørgensen, 2009)

- Towards modern times:
- inclusion of CD-ROM allowed heavier applications with more sound and graphics
- functionality, fidelity, sense of presence, atmosphere still important, but came to merge with the use of sound for usability purposes
- E.g. games utilized stereo speakers to create the sense of three-dimensionality in games by making the sound move from one speaker to the other
- E.g. true surround systems which allowed the positioning of different channel speakers around the player in real space
An important drawback

<table>
<thead>
<tr>
<th>musical content</th>
<th>example</th>
<th>compare image</th>
<th>compare text</th>
<th>structur e</th>
<th>convert to above</th>
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<tbody>
<tr>
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<td><img src="image.png" alt="Waveform" /></td>
<td>level 1: primitive features</td>
<td>speech</td>
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<tr>
<td>Time-stamped events (MIDI)</td>
<td><img src="image.png" alt="MIDI" /></td>
<td>level 2: objects</td>
<td>text</td>
<td>little</td>
<td>easy</td>
<td>fairly hard (OK job)</td>
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<tr>
<td>Music notation (Finale, Sibelius, MusicXML)</td>
<td><img src="image.png" alt="Score" /></td>
<td>level 2: compound objects</td>
<td>text + markup</td>
<td>much</td>
<td>easy (OK job)</td>
<td>-</td>
</tr>
</tbody>
</table>
An important drawback

- Greater level of interactivity requires more flexibility of music; a more granular (note) level control over the music necessary.

- Composers work with MIDI sequencers and a sampling engine; by rendering out to a wav file, we are essentially creating the “one-track-orchestra” (every possible variation requires to render out a separate file).

Stevens and Reybold (2013): Game audio tutorial
Challenges for Interactivity

- In a surprising discussion, Sony's Jason Page admitted that the future of video game music may be based in technology that's considered antiquated by most: MIDI. Many developers have been moving away from MIDI to pre-recorded, orchestrated background music, but in the process, the interactivity of game music has been sacrificed.

- The incredible processing power of the next-generation consoles has changed the rules of MIDI ... MIDI samples used by consoles can be just as good, if not better, than the samples used on dedicated synthesizers. Because MIDI loads in real-time, it retains the interactivity that composers like Koji Kondo would need, and it would allow games to load more quickly.

Challenges for Interactivity

- adaptive music (Brandon 2004, Whitmore 2003) - technique to make music change according to the player’s behavior and actions in game.
Forms of Interactivity
(Michael Liebe, 2013)

- **Linear music**
  - firmly coupled to certain game-immanent elements
  - cannot be influenced by players
  - Examples: soundtracks

- **Reactive music**
  - music is directly connected to actions of the players
  - triggered by specific actions (e.g. location change, begin a fight ...)
  - Often in role-playing
  - Example of entirely driven by player: Elektroplankton
    https://www.youtube.com/watch?v=ttFoK8BTXM4

- **Proactive music**
  - prompts the players to undertake a specific action when it is played
  - Dance Dance Revolution: players follow rhythmic patterns
    https://www.youtube.com/watch?v=NqD-B8t_6us#t=100s
How to achieve interactive music?

- Michael Sweet (Composer): Typical techniques
- Method 1: Vertical Remixing (Layering)
- Method 2: Horizontal Re-sequencing

based on pre-composed stems of music to create interactivity
How to achieve interactive music?

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How to achieve interactive music?

- Michael Sweet (Composer): Typical techniques

- Method 1: Vertical Remixing (Layering)
- Method 2: Horizontal Re-sequencing
  - Cross-fading
  - Phrase-branching
  - Musical demarcation branching
  - Bridge transition
  - Stinger-based sequencing
How to achieve interactive music?

Michael Sweet, Composer

- **Method 1: Vertical Remixing (Layering)**
  - break a music cue into two or more musical layers (e.g. instruments)
  - control-inputs: which game events trigger the layers to enter and exit?
  - the more layers, the greater the diversity
  - often just two layers used
  - length, tempo, and harmonic framework the same

- Example: Fall out New Vegas
  [https://www.youtube.com/watch?v=JR38Yn9qxkQ](https://www.youtube.com/watch?v=JR38Yn9qxkQ)
How to achieve interactive music?

Michael Sweet, Composer

- Method 1: Vertical Remixing (Layering)
- Advantages:
  - Immediate changes to music based on a game event
  - Less impactful than switching to an entirely new music cue, (change is more subtle)
- Disadvantages:
  - Musical phrases easily interrupted (e.g. melody is faded in or out in the middle of a phrase)
  - fading in or out layers can sound non-musical
  - No change in tempo or harmonic structure possible
How to achieve interactive music?

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- When used:
  - when state changes from one state to another shorter than 30 seconds
  - puzzles within game: Completion of each phase of the puzzle might bring in a new layer of the music indicating to the player that he’s progressing
How to achieve interactive music?

Michael Sweet, Composer

Method 2: Horizontal Re-sequencing

Cross-fading

- one music cue fades out while another music cue fades up
- Example: World of Warcraft https://www.youtube.com/watch?v=9JKJMcH8wM
- Advantages
  - Easy to compose and implement into a game.
  - Immediate changes to the music based on a game event.
  - Ability to completely change the tempo, harmony, instrumentation, or melody instantly based on a game event
- Disadvantages
  - The least musical of all adaptive techniques (changes abrupt)
  - Musical phrases are often interrupted in the middle of a phrase.
  - No accounting for the tempo or key changes when switching from one musical cue to another.
- When used
  - Very often (is simple)
  - bad method to use if the cues switch more often than 30 seconds because of the constant interruption to the player
How to achieve interactive music?

Michael Sweet, Composer

Method 2: Horizontal Re-sequencing

Phrase-branching

- waits for the current musical phrase to end before playing the next musical cue; https://www.youtube.com/watch?v=C58TuHQP4Hc

Advantages

- Most musical of all the horizontal re-sequencing techniques, never interrupts a musical phrase.
- Ability to change tempo, harmony, instrumentation or melody in the next phrase based on a game event.

Disadvantages

- Non-immediate musical change because the music change will wait until the end of the current phrase which is dependent on the length of the phrases.
- Can be more disruptive to the player in terms of musical changes than vertical remixing.

When used

- suited for styles/genres with shorter phrase lengths such as rock and techno; longer phrase lengths will delay the entrance of the next music cue.
How to achieve interactive music?

Michael Sweet, Composer

- Method 2: Horizontal Re-sequencing
  - Musical demarcation branching
    - Allows music cue to switch at a musical demarcation point such as a beat, or measure

![Musical notation image]
How to achieve interactive music?

Michael Sweet, Composer

Method 2: Horizontal Re-sequencing

Musical demarcation branching

- Allows music cue to switch at a musical demarcation point such as a beat, or measure
- Advantages
  - More musical than cross-fading.
  - Faster changes than phrase branching.
  - Ability to change tempo, harmony, instrumentation or melody in the musical demarcation point based on a game event.
- Disadvantages
  - Non-immediate musical change because the music change will wait until the next demarcation point.
  - Musical phrases can be interrupted.
  - Can be more disruptive to the player in terms of musical changes than vertical remixing.

Example: https://www.youtube.com/watch?v=oMVeDBq6H24
How to achieve interactive music?

Michael Sweet, Composer

■ Method 2: Horizontal Re-sequencing
  ■ Bridge transition
    • short musical cues used to connect one musical cue with another for more seamless transitions

Musical Bridge:
http://www.youtube.com/watch?v=hE_qOY5GkH0&t=1m22s
How to achieve interactive music?

Michael Sweet, Composer

Method 2: Horizontal Re-sequencing

Bridge transition

- short musical cues used to connect one musical cue with another for more seamless transitions

- Advantages
  - Ability to link to disparate music cues in terms of tempo, harmony, and instrumentation.
  - Ability to change tempo, harmony, instrumentation or melody based on a game event.

- Disadvantages
  - Musical phrases can be interrupted.
  - The length of the bridge transition pushes the beginning of the next cue later making it more difficult to do another change until after the next cue begins.
  - Can be more disruptive to the player in terms of musical changes than vertical remixing.
  - If the same bridge transition is heard frequently, it can be repetitive to the player.

Example: https://www.youtube.com/watch?v=jZqaEZjxqLo
How to achieve interactive music?

Michael Sweet, Composer

Method 2: Horizontal Re-sequencing

Stinger-based sequencing
- a series of stingers which are played back based on game events
- player triggers these stingers individually based on game events
- Stingers may overlap
- do not have a connecting rhythmic framework, are composed primarily of crescendos and accents with silence in-between
- Advantages
  - Stingers are usually separated by silence, so they tend to work well musically together.
  - Immediate punctuation of a game event.
  - Ability to link to disparate music cues in terms of tempo, harmony, and instrumentation.
- Disadvantages
  - No tempo map or rhythmic framework linking the music together, e.g. can feel like disparate elements.
  - Can feel close to the film scoring cliche ‘Mickey-Mousing’.
  - Phrase lengths are heavily dependent on how the game is dramatically scripted. Example:

Example: https://www.youtube.com/watch?v=djI3FFM6oVM
How to achieve interactive music?

Michael Sweet, Composer

Writing interactive music

http://interactivemusicbook.com/wp/

Other example

Stevens & Reybold (2013)
Another example for interactivity

- **adaptive music** (Brandon 2004, Whitmore 2003)
  - technique to make music change according to the player’s behavior and actions in game.

- One technique to achieve that: **leitmotifs**
Leitmotifs

- Music is extremely repetitive

  - Famous example

  http://philomel.com/asa156th/mp3/Sound_Demo_1.mp3

  http://philomel.com/asa156th/mp3/Sound_Demo_2.mp3
Leitmotifs

- Music is extremely repetitive

- Famous example: Diana Deutsch’s “Speech to Song Elusion”; for more information check out:

  http://deutsch.ucsd.edu/psychology/pages.php?i=212

sometimes behave so strangely
Leitmotifs

- Music is extremely repetitive
  - Convenient for automatic composition, example
    - http://tonematrix.audiotoool.com
  - Used for loops in games, but no interactivity
Leitmotifs

- Music makes use of non-literal repetition, called *variation*

  http://www.youtube.com/watch?v=SKMVLKmgxAw

  http://www.youtube.com/watch?v=QYrZZ6zhSs
Leitmotifs

Leitmotif:

- attached to a person, object, place, idea, state of mind, supernatural force or any other ingredient in a dramatic work

- a theme, or other coherent musical idea, clearly defined so as to retain its identity if modified on subsequent appearances

Grove Music Online
Leitmotifs
Leitmotifs

The inventor: Richard Wagner
Leitmotifs

http://ringcycle.metoperafamily.org/leitmotifs
Leitmotifs

- widely used in film music, e.g. LOTR
- Leitmotif of “The Fellowship” in different variations:

https://www.youtube.com/watch?v=x0Z6zZceto&list=PLHmmG49wjXiCFYH51mCtmBHDwB6REeij9&index=3
Leitmotifs

Example Game: Final Fantasy 7

Leitmotifs

- Leitmotif challenge: how to do this automatically such that music adapts to player’s actions?
  - Experimentation project
  - Automatic leitmotif generation
  - Challenging: not every motif is suitable for each algorithm
  - Challenging: aesthetic value
Main modules

A. Sound and music for games
   - Different functions of sound and music in games (recap)
   - Challenges of interactivity and immersion
   - Music and Emotion
no generally accepted definition of term *immersion*, instead different descriptions in literature, e.g.

- the experience of losing a sense of embodiment in the present whilst concentrating on a mediated environment
- losing track of immediate physical surroundings
- being transported into the game world
- being absorbed in the activity
- being identified with the situation or a character of the game

Huiberts (2010), p. 36
Immersion: some systematic aspects by Sander Huiberts

- Sander Huiberts, PhD

Three basic aspects of game immersion
- 1- Being transported into the game world
- 2- Absorption in the activity
- 3- Identification with the situation or a character of the game
Immersion:
some systematic aspects by Sander Huiberts

Sander Huiberts, PhD

Three basic aspects of game immersion

1- Being transported into the game world
   - e.g. sensory features stimulate the feeling of being there

2- Absorption in the activity
   - e.g. challenge-based immersion

3- Identification with the situation or a character of the game
   - e.g. imaginative immersion
   - e.g. emotional responses: increasing the empathy through specific mood
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   • e.g. imaginative immersion
   • e.g. emotional responses: increasing the empathy through specific mood
Strong experiences related to music

Empirical study by Gabrielsson & Wik (2003)
- 900 people reporting on strong experiences of music

But it was not until the second half of the performance that the mystery and the power (4.7) really gripped me (4.3). I was filled by an enormous warmth and heat (2.1). I really swallowed all the notes (2.3) that were streaming out in the air, not a single note, effect or sequence missed my hungry ears (3.7). The music became so distinct (3.7). I was captivated by each of the instruments and what they had to offer me (3.7). Nothing else existed (4.1)!

Someone listening to a band playing Finnish tango in a pub
Strong experiences related to music

This is the first time that I am so involved in the music (4.4). I feel how the base comes in from the ground via the soles of my feet, continues up through my calves, thighs, the spine (3.3) and I am filled by the music (2.3). Boundaries are wiped out. I am one with the universe (6.2). The music dissolves all boundaries, just like what I have understood it means to be psychotic (4.5, 6.2). When they play my favourite tune “Learning to fly” tears begin trickling (2.1). I have always thought that it is ridiculous when girls howled at the Beatles (4.5). Now I am in the same situation myself, albeit not so hysterical — No, I am standing there very calm (5.2), rocking in time with the music (2.2), feeling whole (4.2, 7.1) and just letting tears trickle down my cheeks (2.1).

Someone listening to Pink Floyd in a concert
Empirical study by Gabrielsson & Wik (2003)

- 900 people reporting on strong experiences of music

- complete absorption
- one did not think about where one was or for how long this would last
- I was totally caught in the experience
- everything around me did not exist
- time and space ceased to exist
- I dreamed myself away

Strong experiences related to music
How can we create music for games...

... that induces these strong experiences and contributes to immersive experience of games?
Challenge

How is music inducing these experiences and emotions?

What do we know from the scientific perspective?
• Juslin & Vjästfåll (2008); Juslin, Harmat, Eerola (2013)
How is emotion induced?

- (1) brain stem reflex
- (2) rhythmic entrainment
- (3) evaluative conditioning
- (4) contagion
- (5) visual imagery
- (6) episodic memory
- (7) musical expectancy
- (8) aesthetic judgment

BRECVEMA
BRECVEMA

■ (1) brain stem reflex
  ■ hard-wired attention response
  ■ acoustic features (e.g. extrem loudness or speed)
  ■ Prepares body to react
  ■ quick and automatic
BRECHEMA

(2) rhythmic entrainment

Adjustment of internal body rhythm to external rhythm in music
BRECVEMA

(3) evaluative conditioning
- Certain music associated with certain events
- Memory plays important role
- Conditioned association
(4) Contagion

- listener perceives the emotional expression of the music, and then “mimics” this expression internally
- Induction of the same emotion
(6) Episodic memory

- an emotion is induced in a listener because the music evokes a memory of a particular event in the listener’s life
- “Darling, they are playing our tune”
BREC VEMA

(7) Musical expectancy

emotion is induced because a specific feature of the music violates, delays, or confirms the listener’s expectations about the continuation of the music
(8) Aesthetic judgment

subjective evaluation of the aesthetic value of the music based on an individual set of weighted criteria
Examples in game music

- (1) brain stem reflex
- (2) rhythmic entrainment
- (3) evaluative conditioning
- (4) contagion
- (5) visual imagery
- (6) episodic memory
- (7) musical expectancy
- (8) aesthetic judgment
Summary of important points

- Challenges for interactivity and immersion
  - How to achieve interactive music?
- Leitmotifs
- Emotion and immersion
- BRECVEMA-model on emotion
Literature

- Gabrielsson & Wik (2003), Strong experiences related to music, Musicae Scientiae, Vol. 7, No. 2.


- New Grove Online: Leitmotif

- Michael Sweet: Writing interactive music
  - [http://interactivemusicbook.com/wp/](http://interactivemusicbook.com/wp/)