Sound and music in serious games

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Sound and Music Technology,
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Recap

■ Sound and music for **interactivity** and **immersion** in games.

- Immersion: 3 different aspects of game immersion (Sander Huiberts)
    - 1- Being transported into the game world
    - 2- Absorption in the activity
    - 3- Identification with the situation or a character of the game
        - EMOTIONAL RESPONSE (GENERATING EMPATHY)
        - BRECVEMA model of emotion induction

- How to achieve interactive music? (Michael Sweet):
    - Method 1: Vertical Remixing (Layering)
    - Method 2: Horizontal Re-sequencing

Today

■ Main modules

  A. Sound and music for games

- Different functions of sound and music within games
- Challenges of interactivity and immersion

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
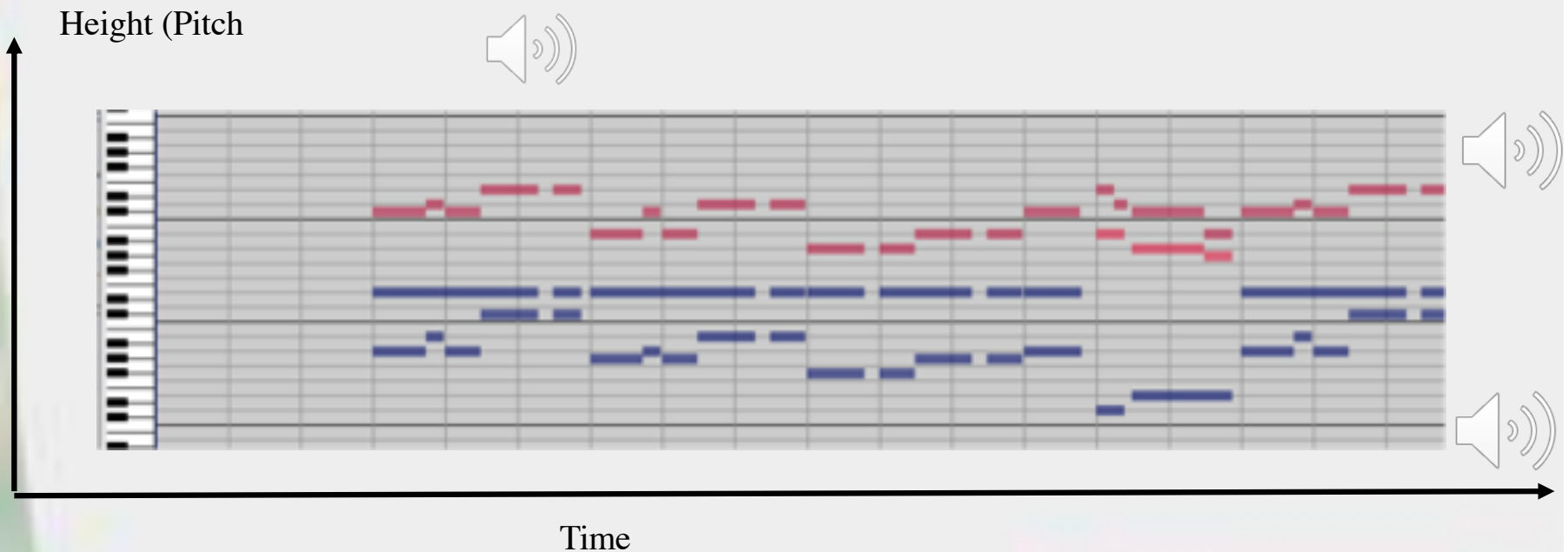
How to achieve interactive music?

■ Michael Sweet (Composer): Typical techniques

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Height (Pitch

Time

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

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

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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=9-JKJMnH8wM
- 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=C58TuhQPHNc
- ■ 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 whith 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

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
- does not lead to any "constant music in the background"
- 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)
The Game Audio Tutorial: A Practical Guide to Sound and Music for Interactive Games.

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

■ 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

■ widely used in film music, e.g. LOTR

■ Leitmotif of "The Fellowship" in different variations:

https://www.youtube.com/watch?v=3Q1RSn3h_84

Leitmotifs

■ Example Game: Final Fantasy 7

http://videogamemusicnerd.blogspot.nl/2012/11/analysis-final-fantasy-vii-leitmotifs.html

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

Summary

■ Music supporting interactivity in games
- Vertical Remixing (Layering)
- Horizontal Re-sequencing
- Leitmotifs
- Challenge: Automatic composition

Serious Games

Definition: Serious Games

Serious games are games that have other purposes than entertainment, such as:

- Education (children learn how to read, count, play musical instruments)
- Simulation gaming (firemen, rescue service)
- Health (wrist rehabilitation)
- Games with a purpose (science)

Games with a Purpose (GWAP)

… have a purpose to:

- Collect scientific data
- Outsource computation to humans that computers cannot do yet
- Collect the ground truth data for machine learning algorithms

Games with a Purpose: principles

- Humans are much better at some tasks than computers (common-sense knowledge, perception, vision)

- These tasks can be fun to solve
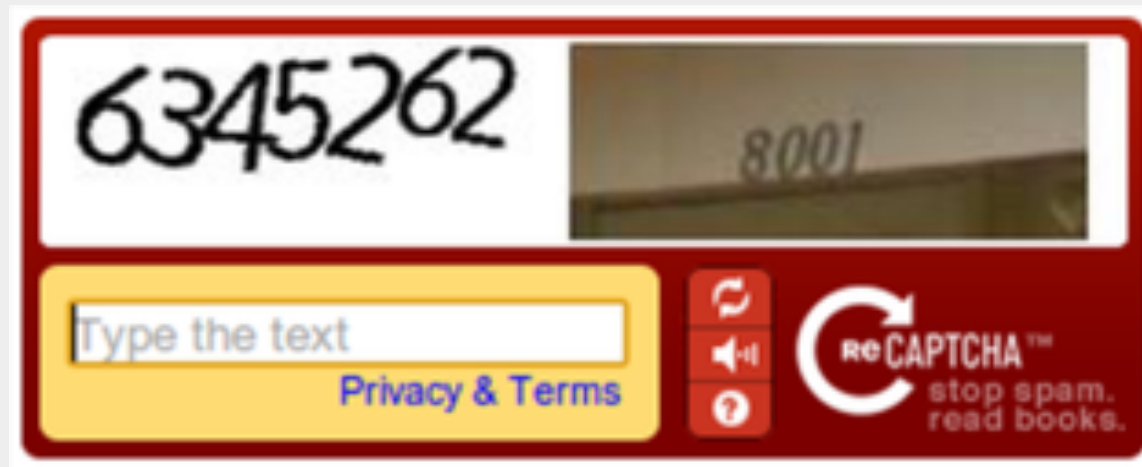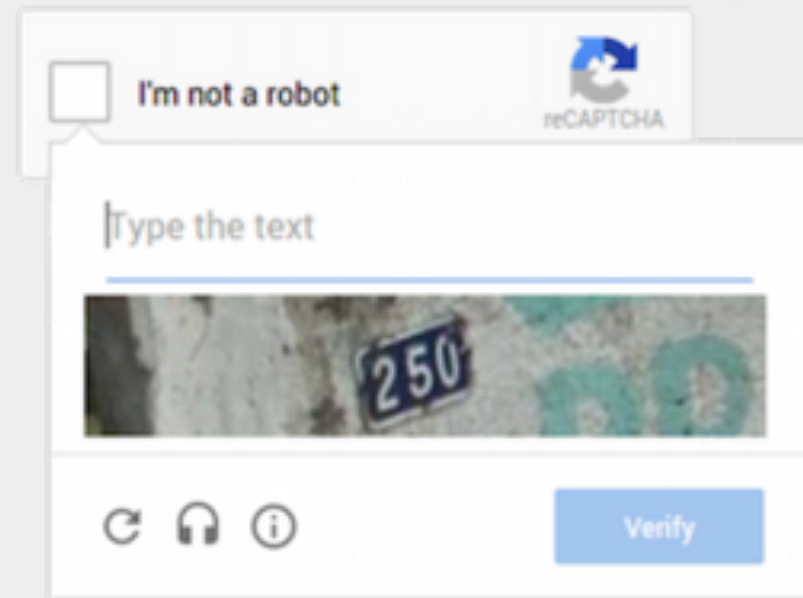
steamboat train, from New
this **morning** ran off the trac
New-London. Four cars plunge

morning upon

Type the text words:

reCAPTCHA™
stop spam.
read books.

I'm not a robot

reCAPTCHA

Type the text

250

Verify

6345262

8001

Type the text

Privacy & Terms

reCAPTCHA™
stop spam.
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ESP Game

ESP Game

Louis Van Ahn:

Google talk 2006

15 Million agreements
 with 75.000 players

Many people play over 20 hours a week

ESP Game

- 50 million agreements
- 200,000 players
- A lot of fun and devotion!

Players about ESP game

- "It's so much fun to guess what others think. You have to step outside of yourself to match"
- "When your view on the world is the same it gives a sense of connection that lovers would envy"
- "Strangely addictive"
- "Helps me learn English"

How about we apply ESP game to music?

How about we apply ESP game to music?

- Luis von Ahn $\rightarrow$ PhD Student Edith Law

How about we apply ESP game to music?

Tag a Tune

- Goal: enable music annotation with tags **which are less subjective** than those from social websites (e.g. last.fm)
- Method: randomly paired with a partner, both label short musical excerpts
- Question: Do you both listen to the same music? (after seeing each other's tags)

- Dataset created: Magnatagatune
  - ~25000 29s long music clips, each of them annotated with a combination of 188 tags

Tag	Count	Tag	Count
classical	37,781	no vocals	6,126
guitar	30,093	soft	5,642
piano	27,718	sitar	5,413
violin	19,525	no vocal	5,285
slow	18,485	classic	5,228
strings	17,484	male	5,216
rock	17,413	singing	5,059
techno	15,627	solo	5,047
opera	14,512	vocals	5,014
drums	13,667	cello	4,966
same	12,610	loud	4,957
flute	12,149	woman	4,321
fast	11,435	pop	4,213
diff	11,046	male vocal	3,951
electronic	10,333	choir	3,576
ambient	8,733	violins	3,454
beat	7,683	new age	3,390
yes	7,352	beats	3,387
harpsichord	7,261	no voice	3,252
indian	7,255	harp	3,172
female	7,071	voice	3,080
vocal	6,964	weird	3,056
no	6,659	instrumental	2,946
synth	6,530	dance	2,896
quiet	6,167	female vocal	2,873

Table 1. Head List: top 50 most frequently used tags

Law & Van Ahn (2009), Input-Agreement: A New Mechanism for Collecting Data Using Human Computation Games

Tag a Tune

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- Method: randomly paired with a partner, both label short musical excerpts
- Question: Do you both listen to the same music? (after seeing each other's tags)

- Used for evaluating algorithms that automatically tag music (ISMIR, 2009)
  - human players can correctly guess that the music are the same 93% of the times when paired against the **aggregate bot**, while only approximately 70% of the times when paired against an **algorithm bot**.

MoodSwings
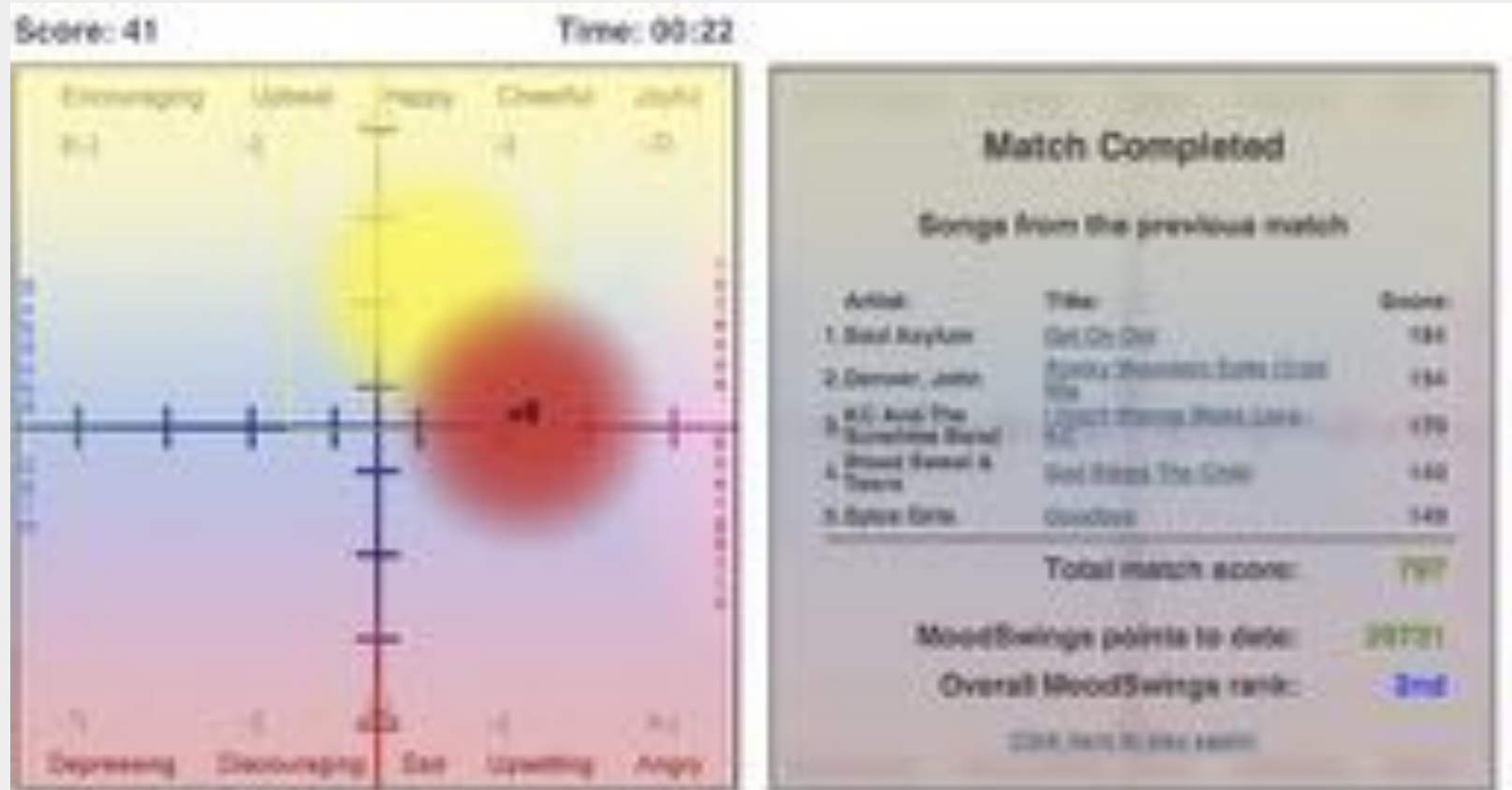
A music emotion labeling game
- Create automated solutions for labeling the emotional content of music

MoodSwings

Russel's Valence/Arousal Model

Russel (1980): Valence and Arousal

MoodSwings

Advantages:
- No hassle with tags
- Continuous values
- Can easily model changes over time
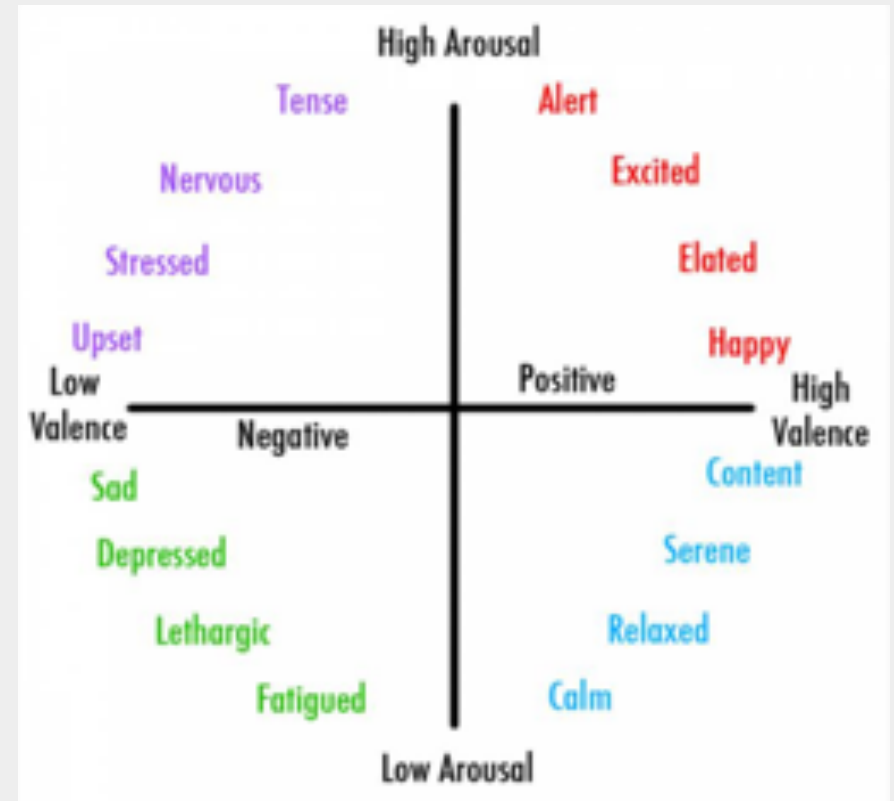
R. E. Thayer, *The Biopsychology of Mood and Arousal*. Oxford, U.K.: Oxford Univ. Press, 1989.

MoodSwings: Gameplay

1. The player's cursor blinks every second.
2. After 5 seconds, partner's cursor becomes visible.
3. The partner's cursor blinks once every 3 seconds.
4. The size of both cursors decreases.
5. At the end of each round, the player's score is presented.
6. At the end of the match, the artist-title list is presented.

MoodSwings: Scoring

■ Primary points:
  ➢ **Overlap between cursors**
  ➢ Accumulated when partner's cursor is visible.
■ Bonus points:
  ➢ **Convincing the partner**
  ➢ After staying stationary for at least 1 second, stationary player earns 5 points if partner moves towards
  ➢ May be collected each second.
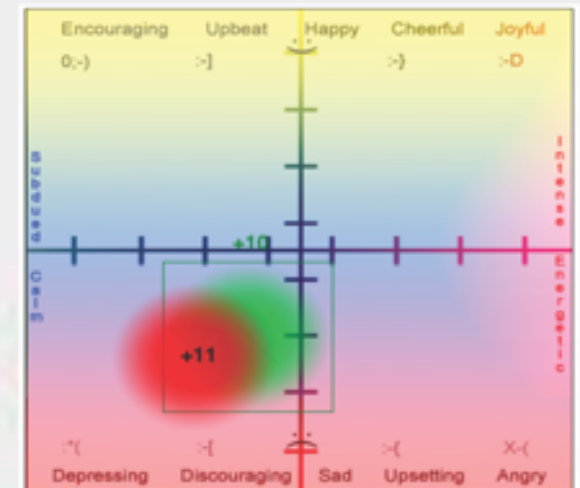
MoodSwings: Test phase

- Bias towards high valence and arousal
- Avoidance of extremes
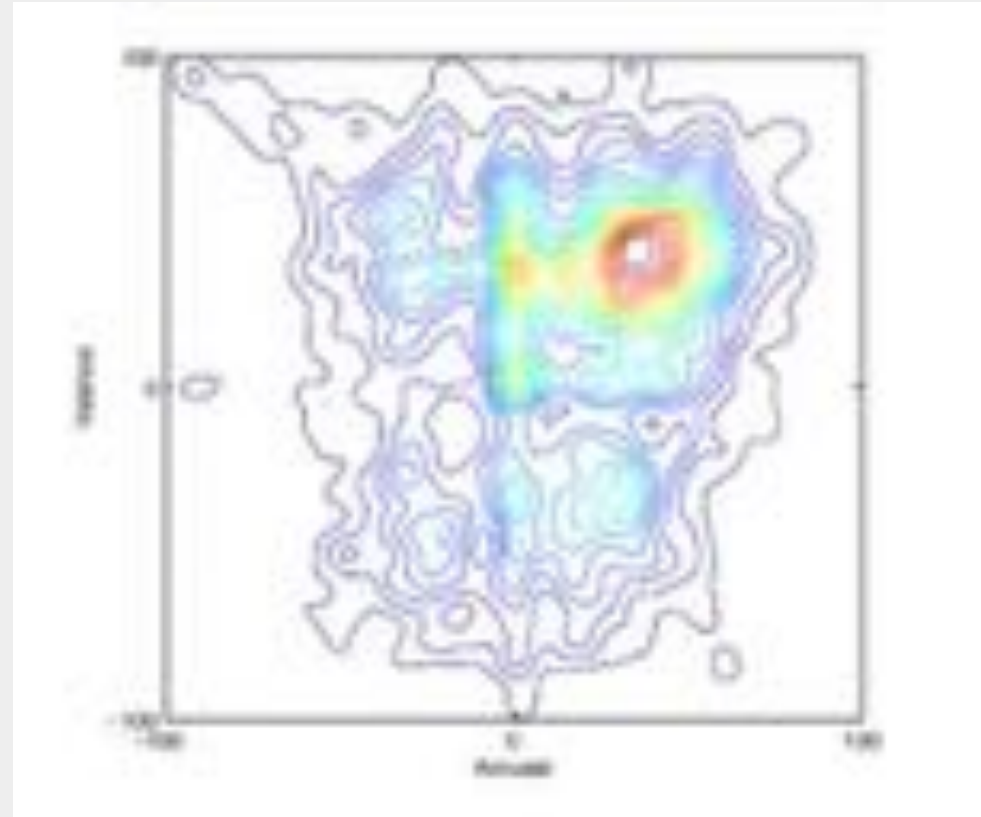
MoodSwings: Data analysis

Within two years:
- 5,177 games
- Over 150,000 valence-arousal labels
- 1,158 songs
- 16% coverage of all available songs

Gameplay scenarios:
- Two players
- Player vs AI
- Player vs Recorded

- Coldstart problem

MoodSwings: Data analysis

Analyzing Label vs Time
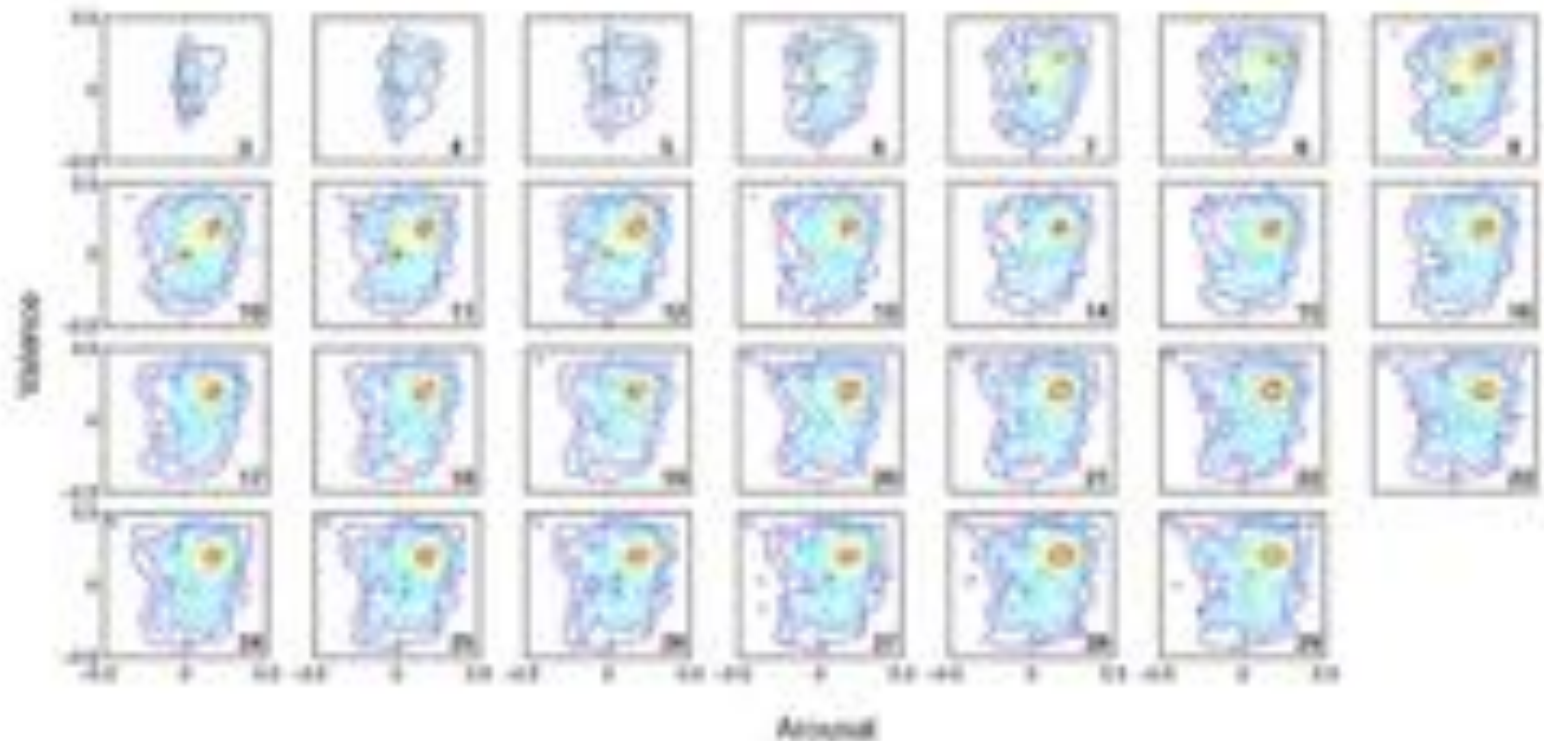
Most movements occur at the beginning

Game research in Utrecht...

Emotify: Student presentation

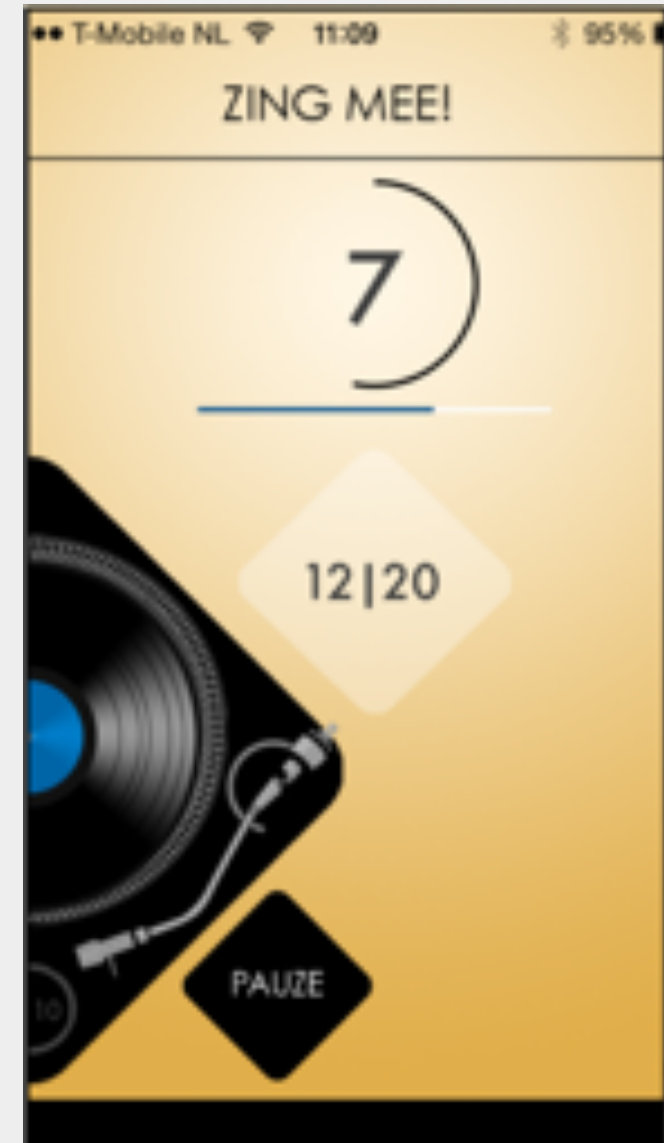

Challenge:
Expressed vs. *induced* emotion in music

Hooked

A song starts playing, usually from somewhere in the middle. The player has 15 s to decide whether they know the song.

Hooked

Once the player guesses,the music mutes for 3 s. While the sound is mutes, players *sing along* in their head. After 3 seconds, music starts playing again.

Hooked

Sometimes the music is what should be playing and sometimes it is a few seconds offset. Players who guess correctly win all the points at stake; players who fail lose the points.

The most recognizable song of all time …

… according to the Hooked game?

Design questions for musical GWAPs

- Where to get properly licensed (Creative Commons licensed?) music
- How to validate that answers are serious
- How to find balance between solving serious tasks and having fun

Serious games in health and rehabilitation

■ Motor rehabilitation: make the repetition less boring!
  ◼ Higher incentives to follow the rehabilitation program

■ In-between training for at-home-sessions

■ Music and time
  ◼ Different mental disorders linked with difficulties in processing time
  ◼ Language rehabilitation

Conclusion

■ Serious games for music exist in various facets

■ GWAP: collecting data for research on sound and music
  ■ Specifically for MIR

■ Serious games specifically for music education
  ■ What technolgical and musical knowledge is required for designing these games?
    • Example Chordify http://chordify.net/chords/kensington-home-again-official-video-kensingtonband
  ■ Creating new instruments, new forms of interaction
    • Ge Wang's Ocarina from Smule: https://www.youtube.com/watch?v=ol1b5mMeP7s#t=609s
  ■ Going to be increasingly important for health care