# Games and Emotion

## How AI can bridge the gap between design and experience


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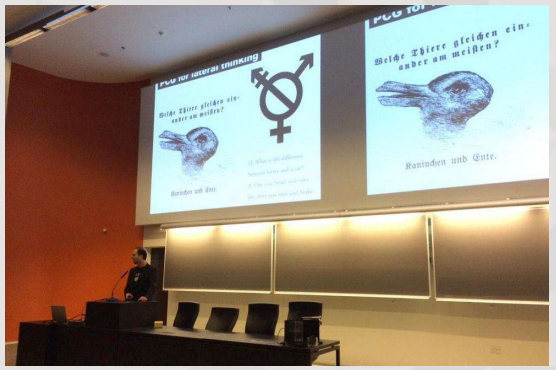
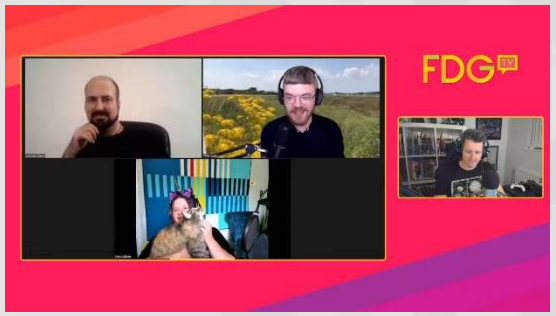
# Who am I?

- Senior Lecturer at the **Institute of Digital Games**, University of Malta.
- **Research** in procedural content generation, computer-aided game design, computational creativity.
- **Courses** for game dev, level design, content generation.
- **Passion** for RPGs and board games.
- More at http://antoniosliapis.com/

# Why am I here?

1. Designer intentions versus player experience
2. Player experience and emotion
3. Artificial Intelligence and (player) emotion models
4. Institute of Digital Games in this field (and beyond)

# Designer intentions versus player experience

How AI can bridge the gap between design and experience

# Game Design: art or science?




audio
visuals
narrative
level design
game design
gameplay
Nameless One - "Why have I lost my memory?"
Lothar - "It is a side effect of losing your mortality."
Nameless One - "I have lost my mortality? What do you mean?"
Lothar - "Your mortality - your soul, if you will, that which allows
live and die - is gone from you. It was stripped from you by
means, by the night hag Ravel Puzzlewell. Your mortality is the
your existence - when you find it, you will find your answers."
meless One - "Tell me about this Ravel."
ar - "Ravel Puzzlewell is an enigma, even among the night hags.
would call her barmy; others say she plays a deeper game than
see through. She is evil, through and through, making the fiend
e in the area seem positively divine when compared to her. Sh
the reach of men now, thank the powers, for she was mazed
y of Pain."
ed? How do I find her?"
did she die?"
My thanks. Farewell, Lothar."

# Design is divination

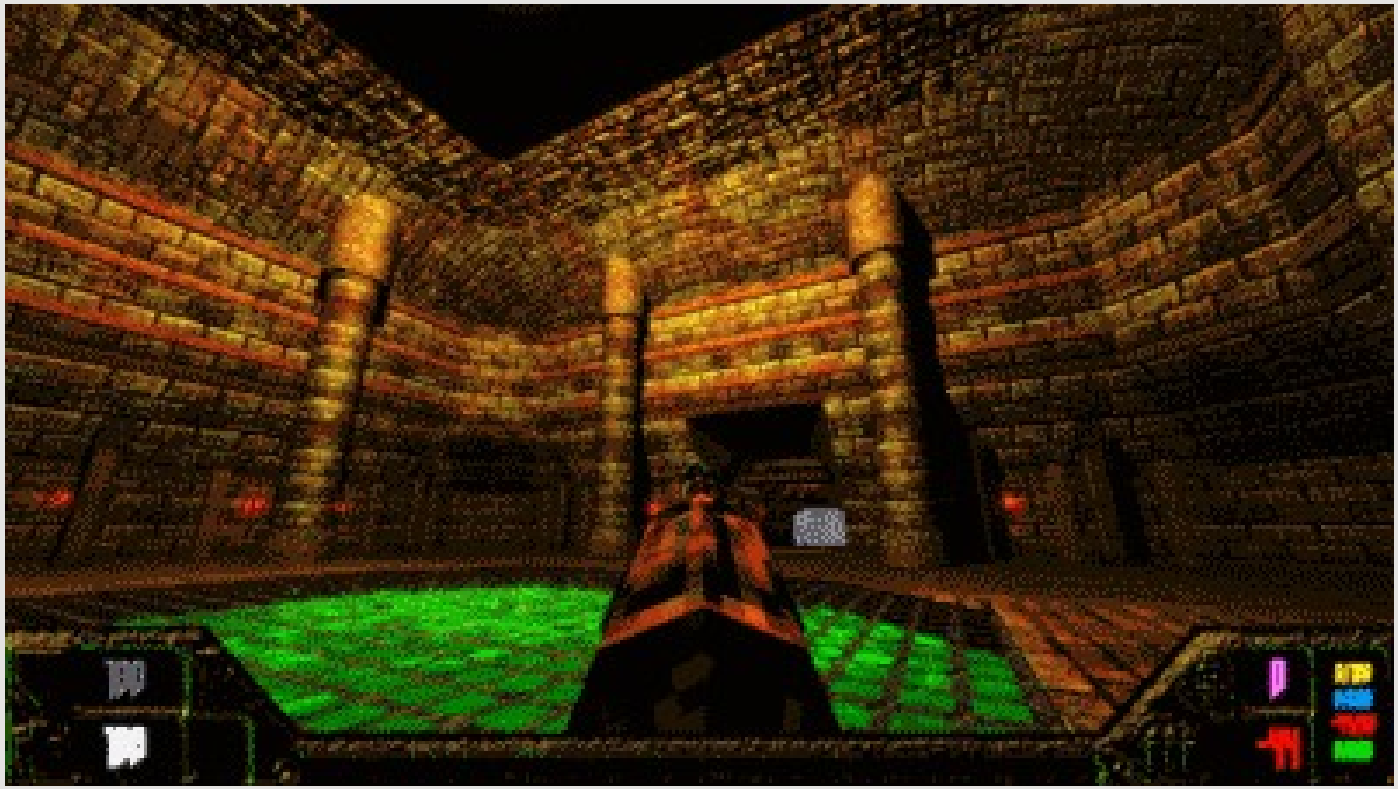
- You're trying to predict how someone will use your software
- Affordances & constraints
- Synthetic personas
- Testing & patching

# When design meets players…

- Players are **diverse** and unpredictable

# When design meets players…

- Players are **diverse** and unpredictable
- Players **ignore** or misunderstand mechanics



# When design meets players...

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- Players explicitly play **subversively**

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# When design meets players…

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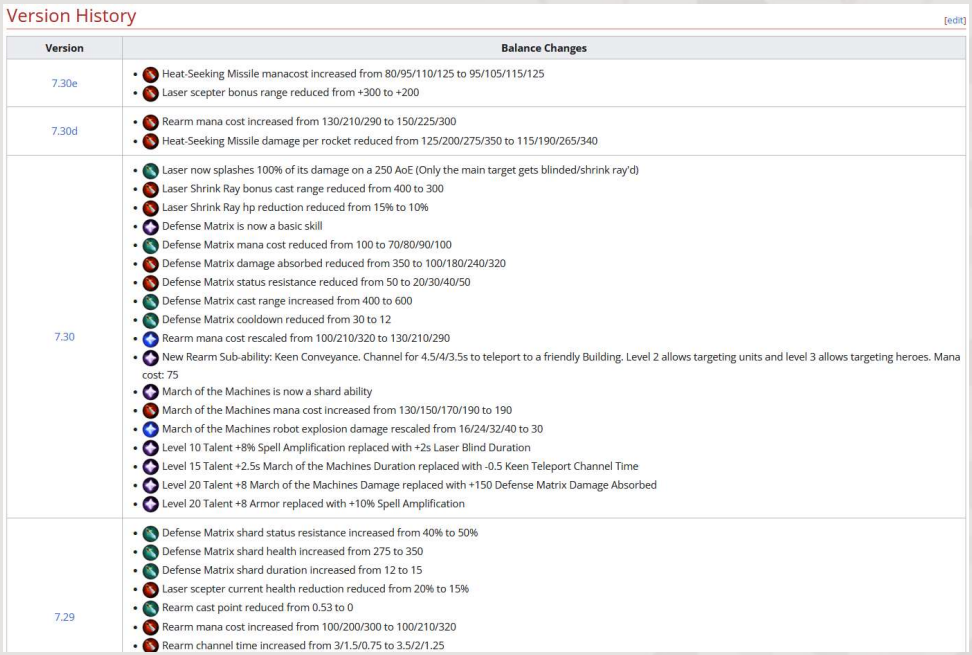
- Players explicitly play **subversively**
- Players play for their own* **challenges**
- Evolving **meta-game**

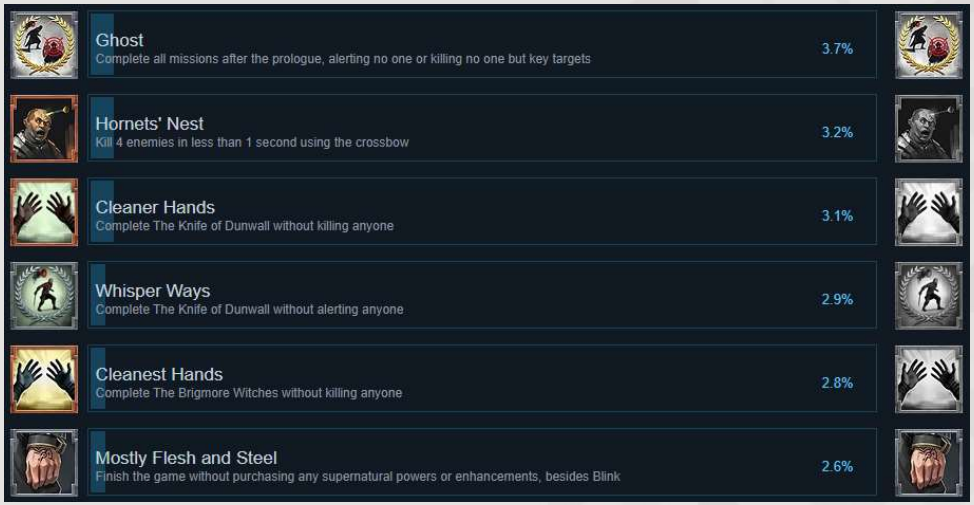

# Designers versus Players

- Designer strategies:
  - Blame the players
  - Patch/fix the game
  - Allow players to mod the game
  - Embrace/reward subversive play
  - Evolve the meta-game



Version History [edit]

| Version | Balance Changes |
|---|---|
| 7.30e | • Heat-Seeking Missile manacost increased from 80/95/110/125 to 95/105/115/125<br>• Laser scepter bonus range reduced from +300 to +200 |
| 7.30d | • Rearm mana cost increased from 130/210/290 to 150/225/300<br>• Heat-Seeking Missile damage per rocket reduced from 125/200/275/350 to 115/190/265/340 |
| 7.30 | • Laser now splashes 100% of its damage on a 250 AoE (Only the main target gets blinded/shrink ray'd)<br>• Laser Shrink Ray bonus cast range reduced from 400 to 300<br>• Laser Shrink Ray hp reduction reduced from 15% to 10%<br>• Defense Matrix is now a basic skill<br>• Defense Matrix mana cost reduced from 100 to 70/80/90/100<br>• Defense Matrix damage absorbed reduced from 350 to 100/180/240/320<br>• Defense Matrix status resistance reduced from 50 to 20/30/40/50<br>• Defense Matrix cast range increased from 400 to 600<br>• Defense Matrix cooldown reduced from 30 to 12<br>• Rearm mana cost rescaled from 100/210/320 to 130/210/290<br>• New Rearm Sub-ability: Keen Conveyance. Channel for 4.5/4/3.5s to teleport to a friendly Building. Level 2 allows targeting units and level 3 allows targeting heroes. Mana cost: 75<br>• March of the Machines is now a shard ability<br>• March of the Machines mana cost increased from 130/150/170/190 to 190<br>• March of the Machines robot explosion damage rescaled from 16/24/32/40 to 30<br>• Level 10 Talent +8% Spell Amplification replaced with +2s Laser Blind Duration<br>• Level 15 Talent +2.5s March of the Machines Duration replaced with -0.5 Keen Teleport Channel Time<br>• Level 20 Talent +8 March of the Machines Damage replaced with +150 Defense Matrix Damage Absorbed<br>• Level 20 Talent +8 Armor replaced with +10% Spell Amplification |
| 7.29 | • Defense Matrix shard status resistance increased from 40% to 50%<br>• Defense Matrix shard health increased from 275 to 350<br>• Defense Matrix shard duration increased from 12 to 15<br>• Laser scepter current health reduction reduced from 20% to 15%<br>• Rearm cast point reduced from 0.53 to 0<br>• Rearm mana cost increased from 100/200/300 to 100/210/320<br>• Rearm channel time increased from 3/1.5/0.75 to 3.5/2/1.25 |

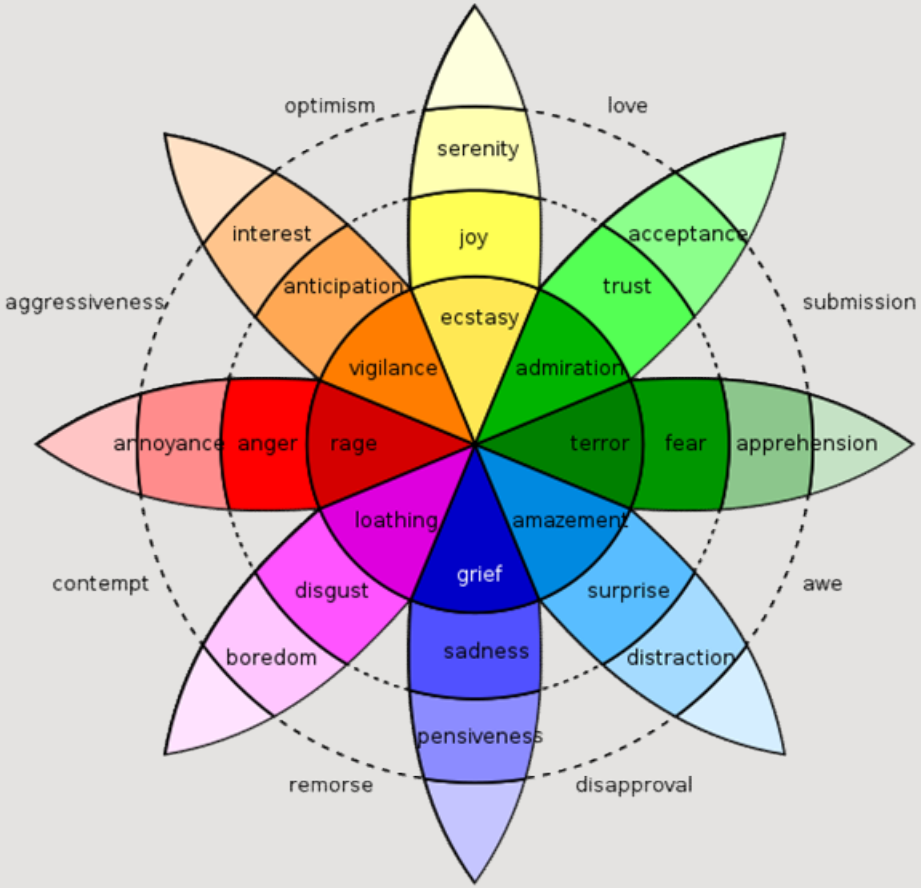


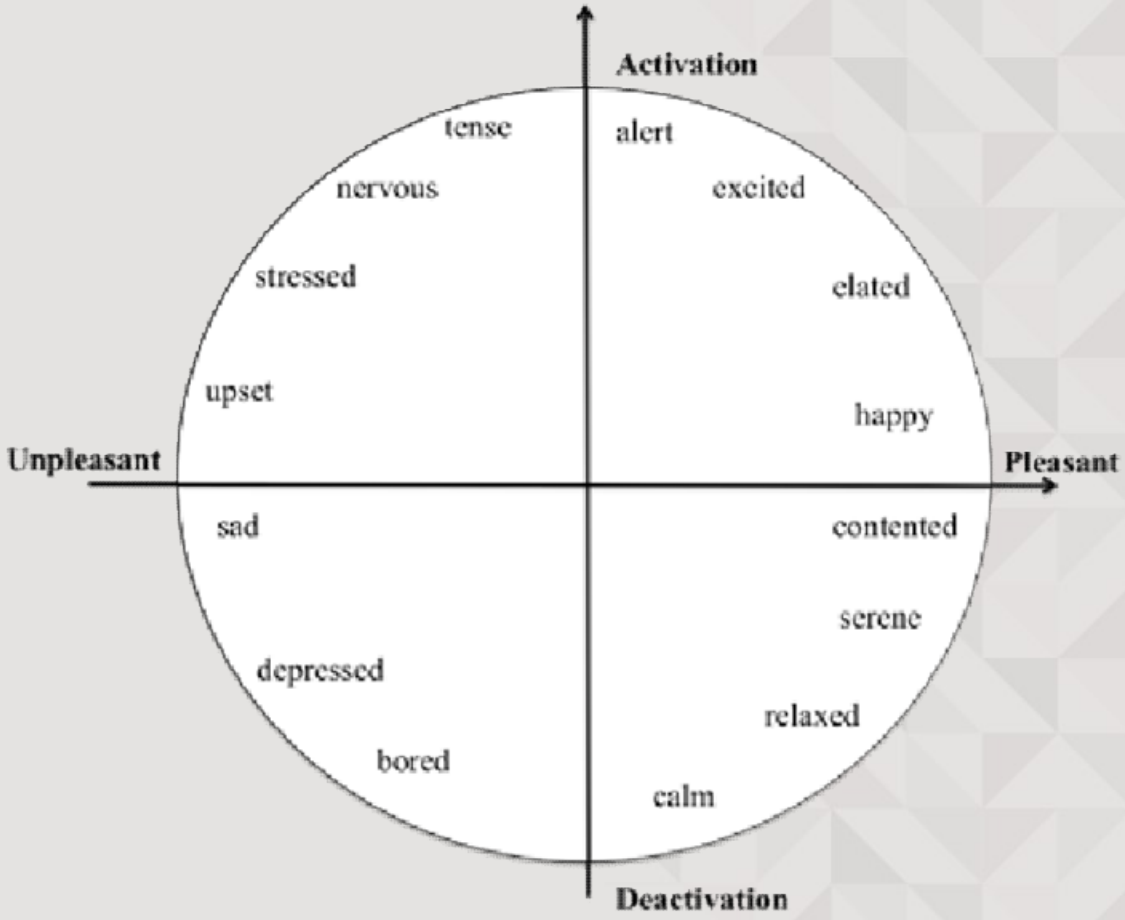
# Player experience and emotion

## How AI can bridge the gap between design and experience

# Playing games is emotional


# Emotion typologies

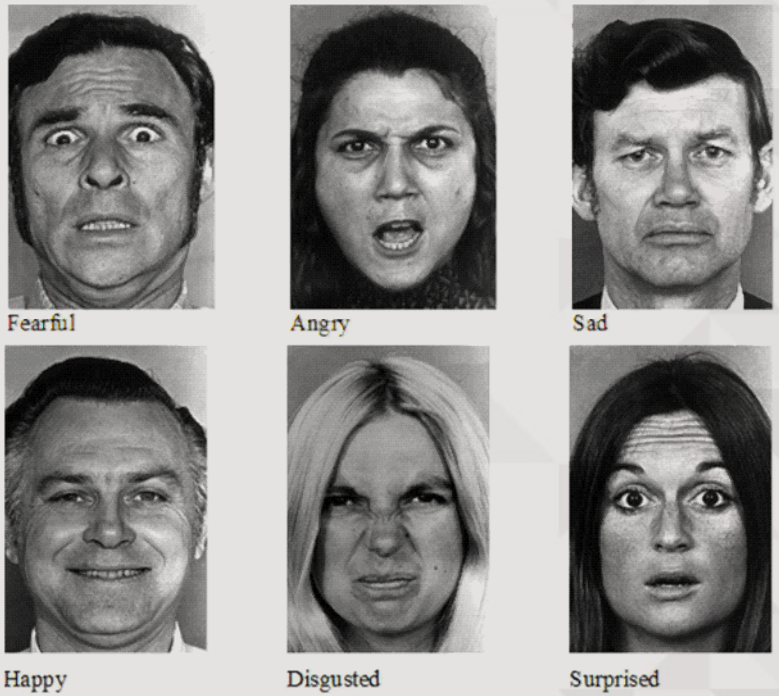



R. Plutchik, "Nature of emotions". American Scientist Vol. 89, No. 4, pp. 344-350, 2001.
J. A. Russell, “A circumplex model of affect.” Journal of personality and social psychology, vol. 39, no. 6, 1980

# Emotion manifestations

- Muscles
  - Facial expression
  - Posture
- Physiology
  - Heart rate
  - Skin conductance (sweat)
- Brain activity



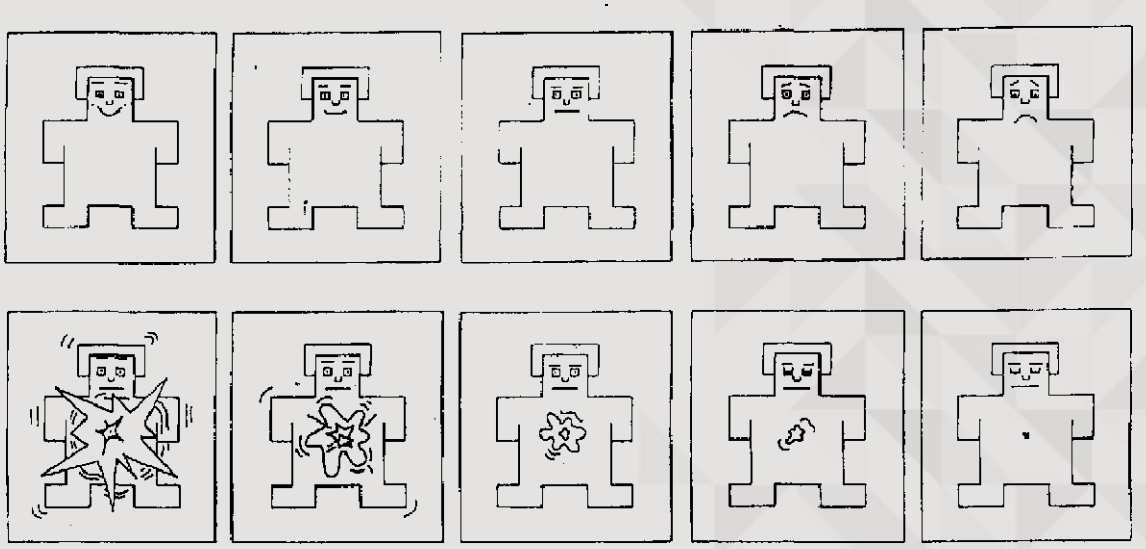

# Emotion annotation

How?

- Labels
- Manikins
- Comparisons (ranks)

Who?

- 1st person
- 3rd person




Bradley, M.M., & Lang, P.J. (1994). Measuring emotion: the Self-Assessment Manikin and the Semantic Differential. Journal of behavior therapy and experimental psychiatry, 25 1, 49-59 .
http://gifgif.media.mit.edu/

# Emotion annotation

When?

- Time-continuous
- Aggregated

Simulated recall

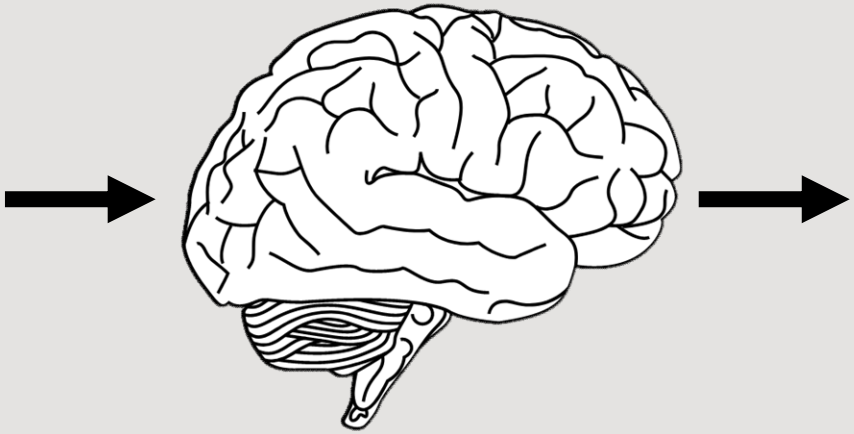

D. Melhart, A. Liapis and G. N. Yannakakis: "PAGAN: Video Affect Annotation Made Easy," in Proceedings of the International Conference on Affective Computing and Intelligent Interaction, 2019.

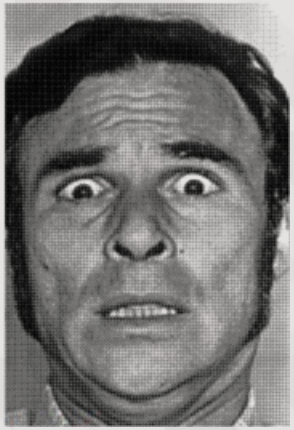
# Artificial Intelligence and (player) emotion models

How AI can bridge the gap between design and experience

# Human (Emotional) Intelligence

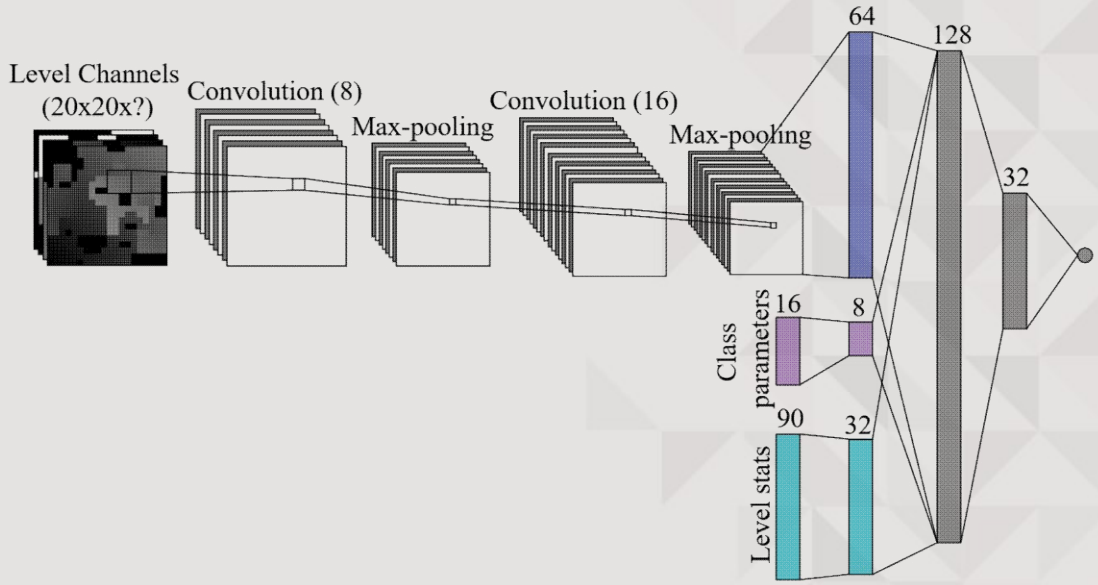
- Input (Video, music, game, grading)
- Output (Laughter/tears, Annotation)

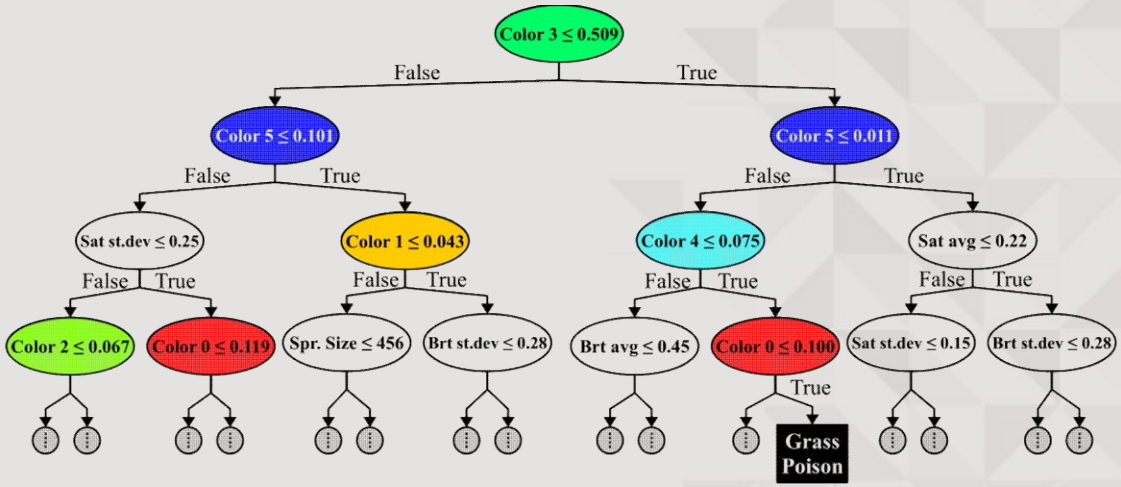




# Artificial Intelligence

- Predictive models
  - Learn I/O patterns on a **training** set
  - Predict output in a **test** set
- Methods
  - Deep learning
  - Decision Trees



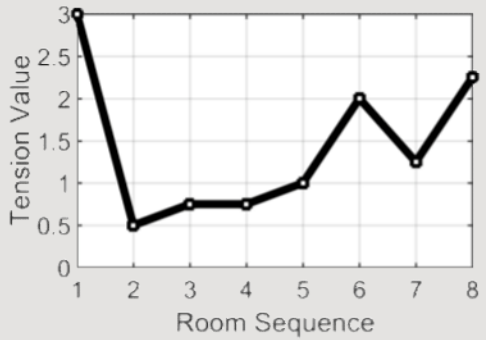
# In-game sounds and emotion

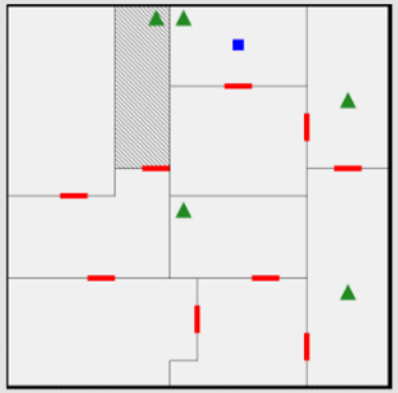
P. Lopes, A. Liapis and G. N. Yannakakis: "Modelling Affect for Horror Soundscapes,"
IEEE Transactions of Affective Computing, vol. 10, no 2, pp. 209-222, 2019.

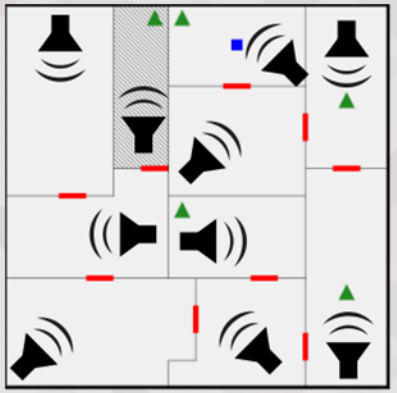
# In-game sounds and emotion

- **Sonancia:** complete horror game generation based on designer intent

Cliffhanger





Framing Information *Randomly Selected* → Tension Curve *Artificially Evolved* → Horror Game Level *Artificially Evolved* → Level Sonification *Deterministic*

P. Lopes, A. Liapis and G. N. Yannakakis: "Framing Tension for Game Generation," in Proceedings of the International Conference on Computational Creativity. 2016.

# In-game sounds and emotion

- Soundscapes were originally ranked based on the tension they elicit by the researcher.
- Hypothesis:
  - We can model the tension that a sound elicits based on crowdsourced data and audio features
  - We can look at original compositions (soundscapes) or filters applied to them

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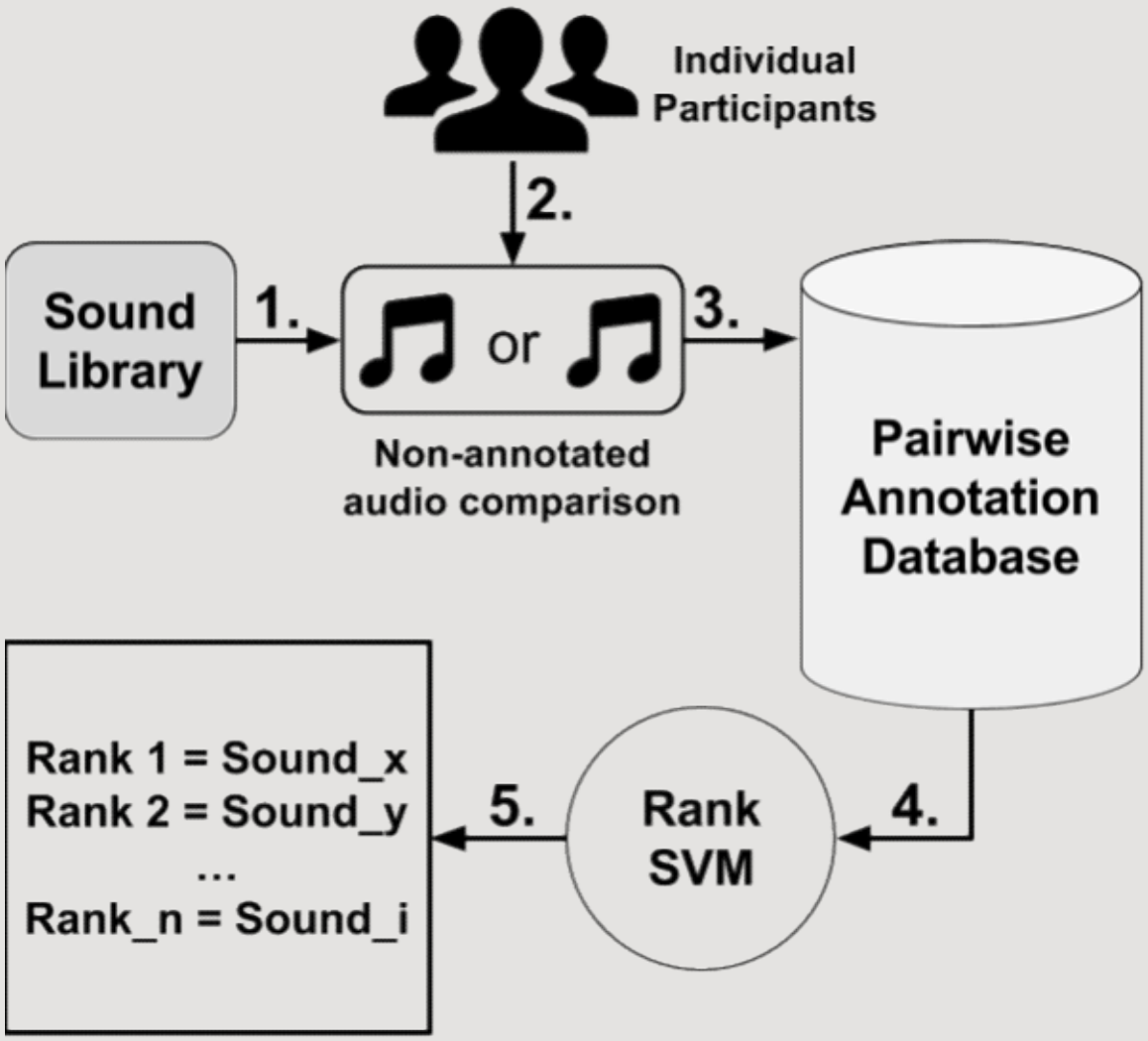
# In-game sounds and emotion

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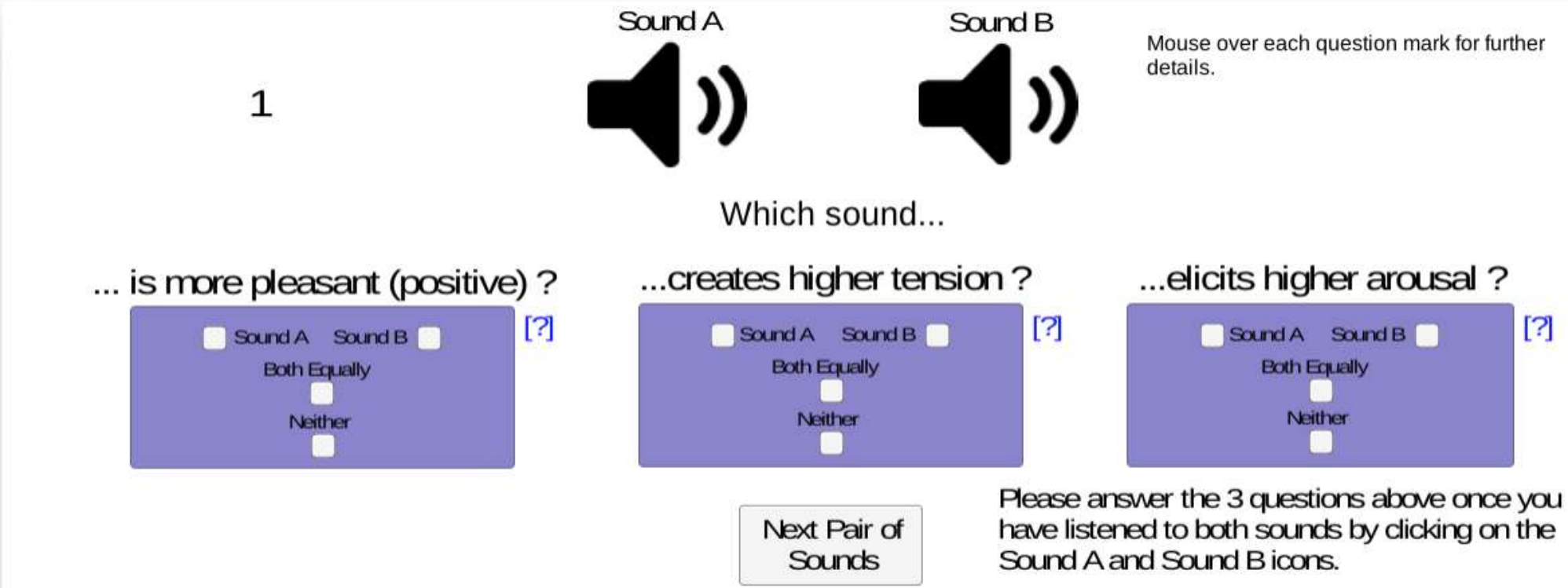
# In-game sounds and emotion

- Data collection: 4-alternate forced choice

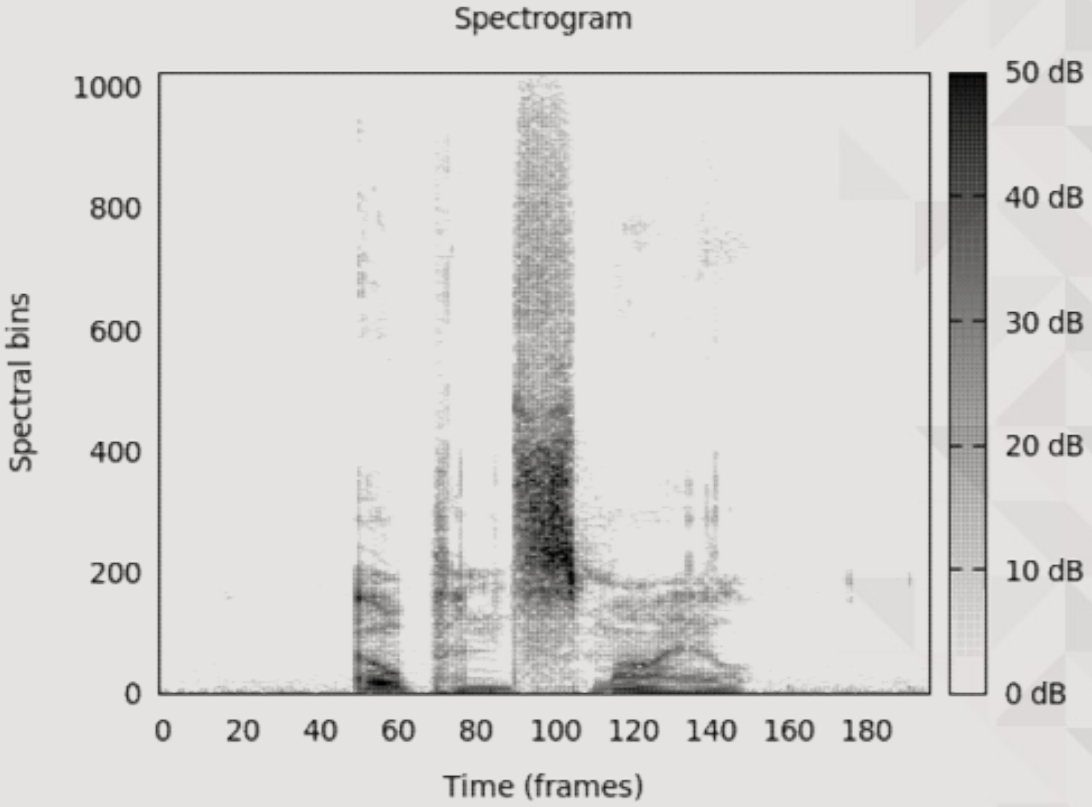
1009 rankings collected




P. Lopes, A. Liapis and G. N. Yannakakis: "Framing Tension for Game Generation," in Proceedings of the International Conference on Computational Creativity. 2016.

# In-game sounds and emotion

- Sounds: processed through the OpenSMILE audio feature extraction tool (384 features)

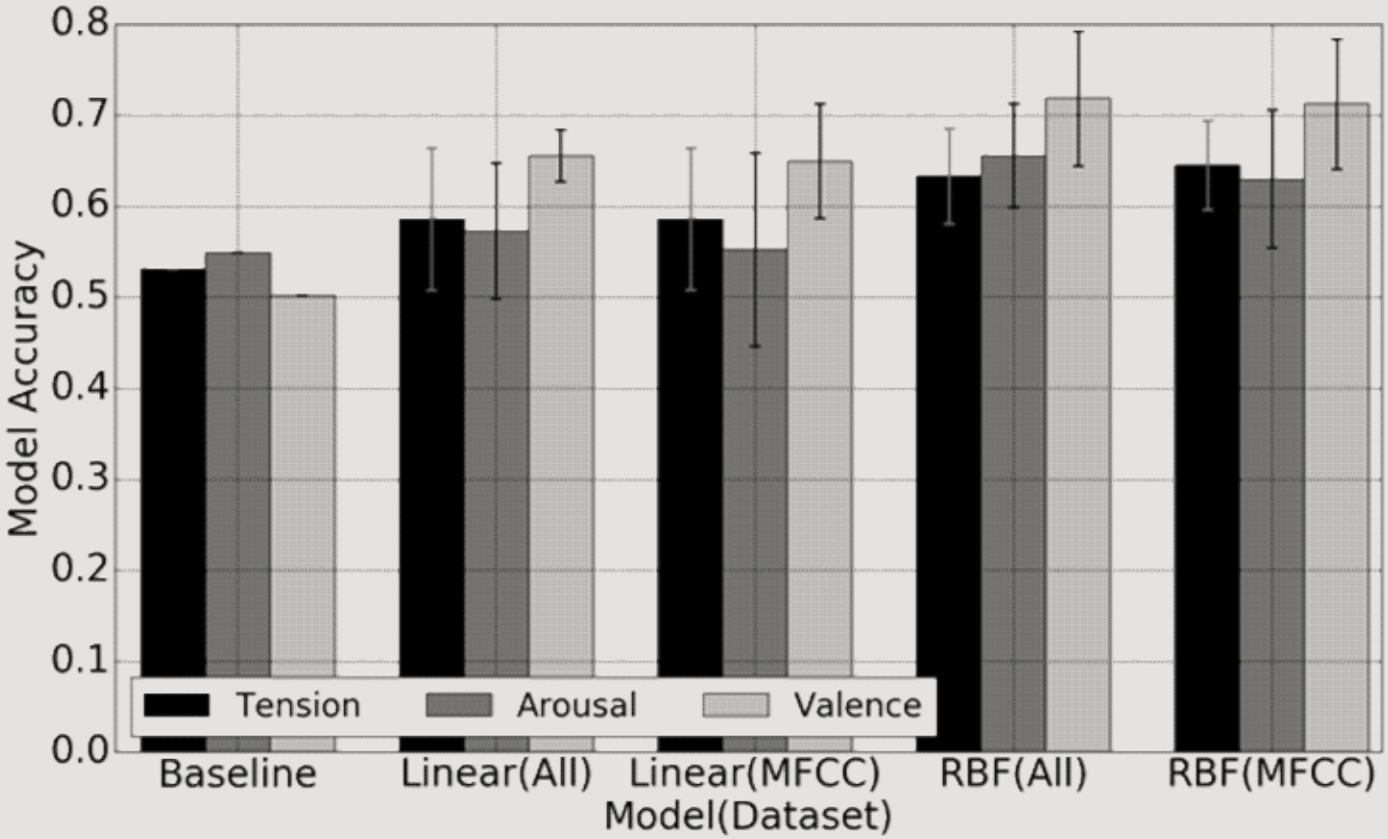



https://audeering.github.io/opensmile/

P. Lopes, A. Liapis and G. N. Yannakakis: "Framing Tension for Game Generation," in Proceedings of the International Conference on Computational Creativity. 2016.

# In-game sounds and emotion

- Training through RankSVM (SFS):




P. Lopes, A. Liapis and G. N. Yannakakis: "Framing Tension for Game Generation," in Proceedings of the International Conference on Computational Creativity. 2016.

# In-game sounds and emotion

- Applications:
  - Being able to choose sounds based on intended arousal/valence/tension *changes*, even among unseen sounds
  - Applying different filters to a soundbyte, and choosing the best one for a specific emotion (high/low valence etc.) among them
  - Generating completely new sounds based on intended affect.

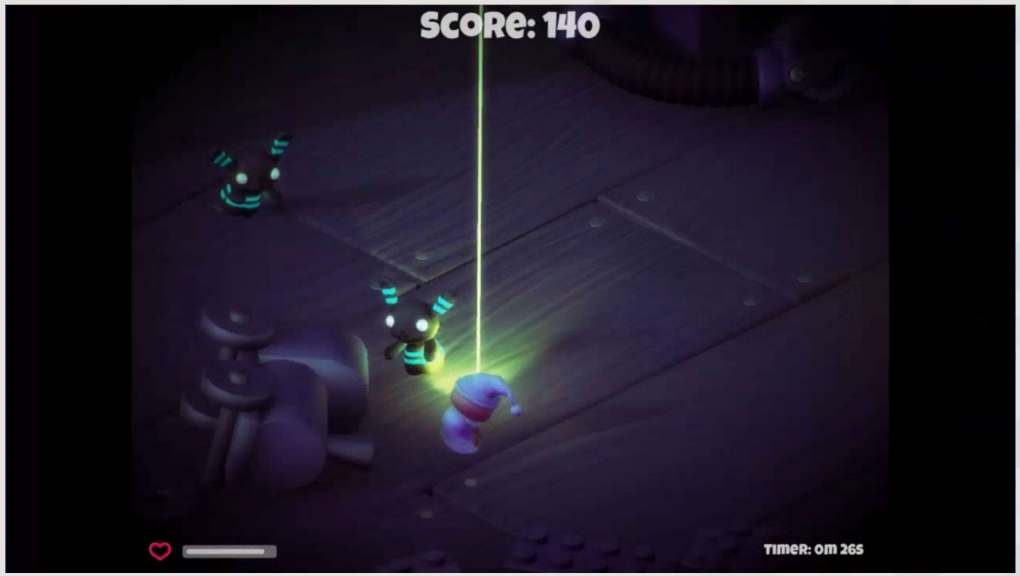
P. Lopes, A. Liapis and G. N. Yannakakis: "Framing Tension for Game Generation," in Proceedings of the International Conference on Computational Creativity. 2016.

# In-game visuals and emotion

K. Makantasis, A. Liapis and G. N. Yannakakis: "From Pixels to Affect: A Study on Games and Player Experience," in Proceedings of the International Conference on Affective Computing and Intelligent Interaction, 2019.

# In-game visuals and emotion

- Premise: gameplay footage can tell us about the emotions of the player(s) in it
- Interaction context is enough (no need for webcams or intrusive biosensors)

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# In-game visuals and emotion

- Data collection: **first-person real-time** annotation of **arousal** in post-play **video**

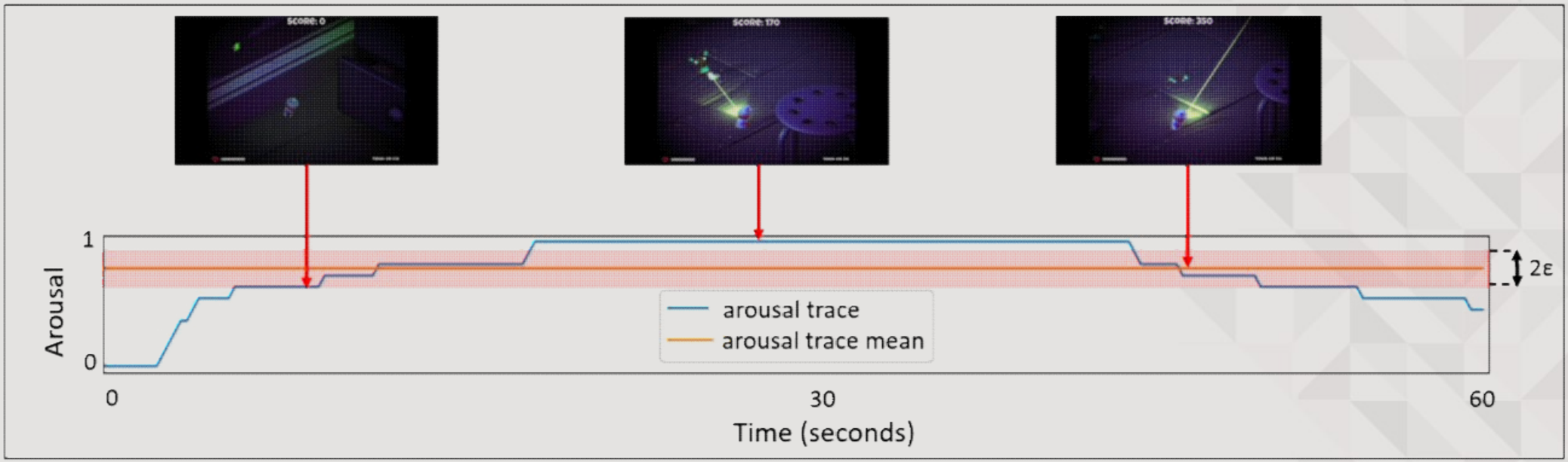
- First play…
- …then annotate (twice)

Participants: 25 players


D. Melhart, A. Liapis and G. N. Yannakakis: "PAGAN: Video Affect Annotation Made Easy," in Proceedings of the International Conference on Affective Computing and Intelligent Interaction, 2019.

# In-game visuals and emotion

- Annotation trace split into low arousal and high arousal, based on mean value
- Low and high relative to this trace

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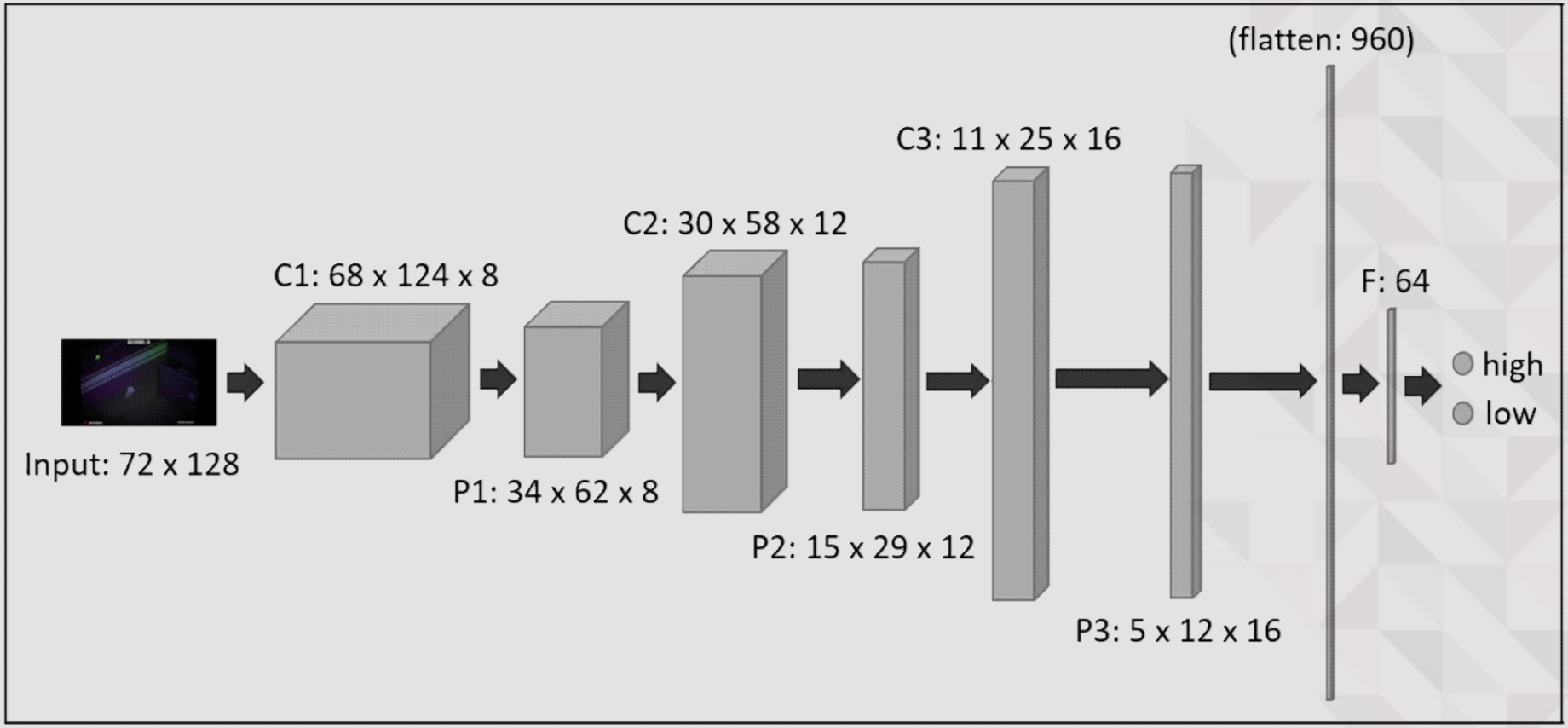
# In-game visuals and emotion

- Video frames turned to **grayscale**, **rescaled** and processed through a deep architecture

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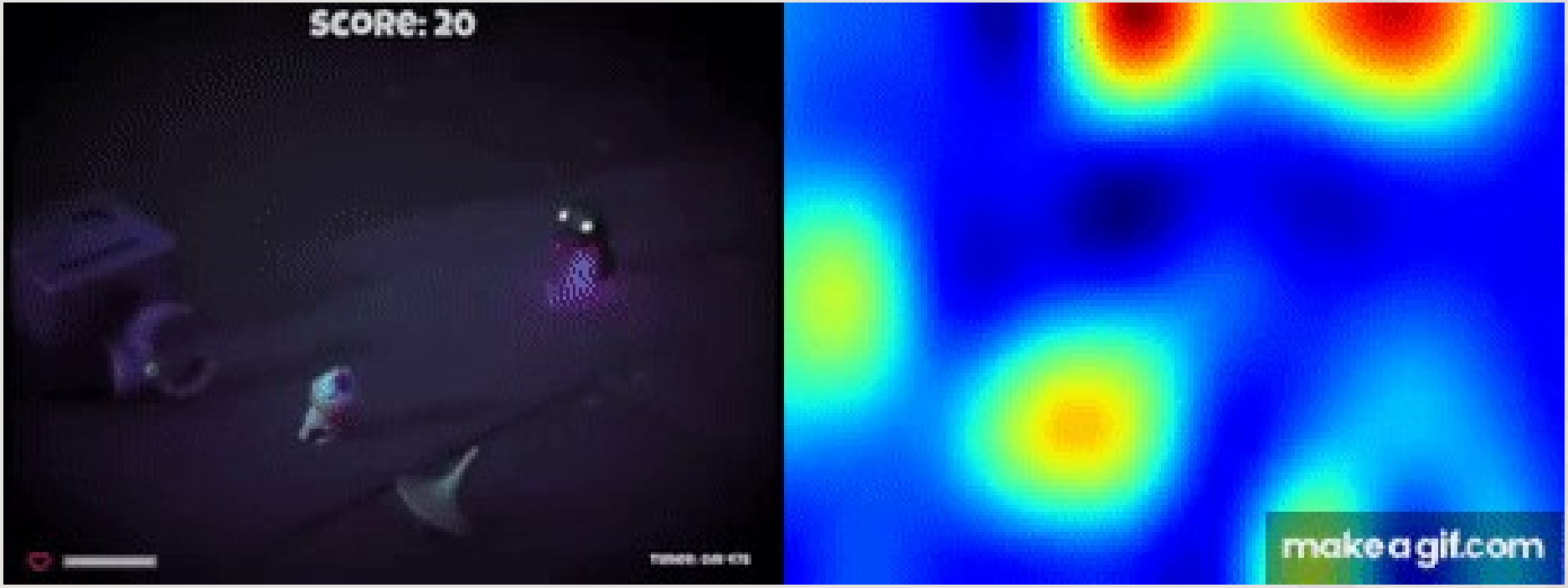
# In-game visuals and emotion

- Models based on frames, sequences or videos all reach class. accuracies ~77%

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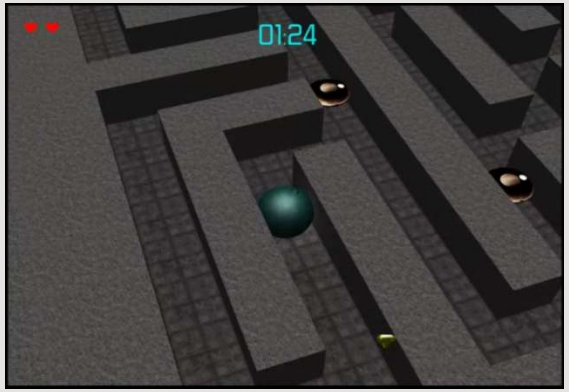
# In-game visuals and emotion

- Sequel: more games, more modalities

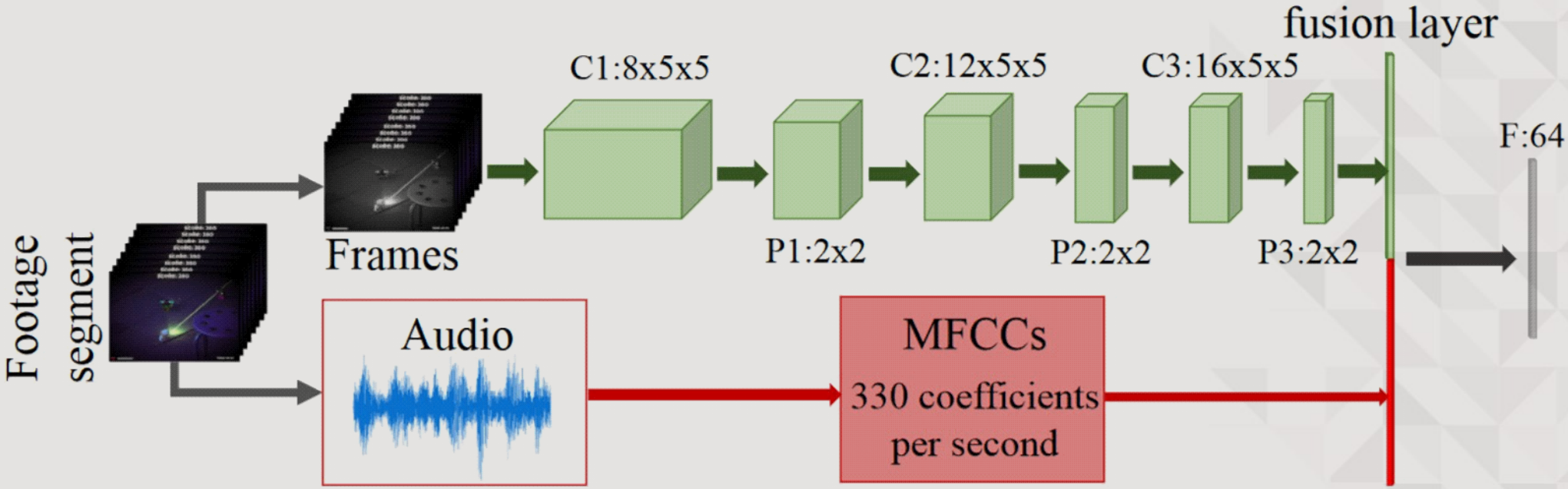





K. Makantasis, A. Liapis and G. N. Yannakakis: "The Pixels and Sounds of Emotion: General-Purpose Representations of Arousal in Games," in IEEE Transactions of Affective Computing, 2021 (accepted).

# In-game visuals and emotion

- Using visuals (grayscale frames), and audio (MFCCs) in a late fusion DL approach

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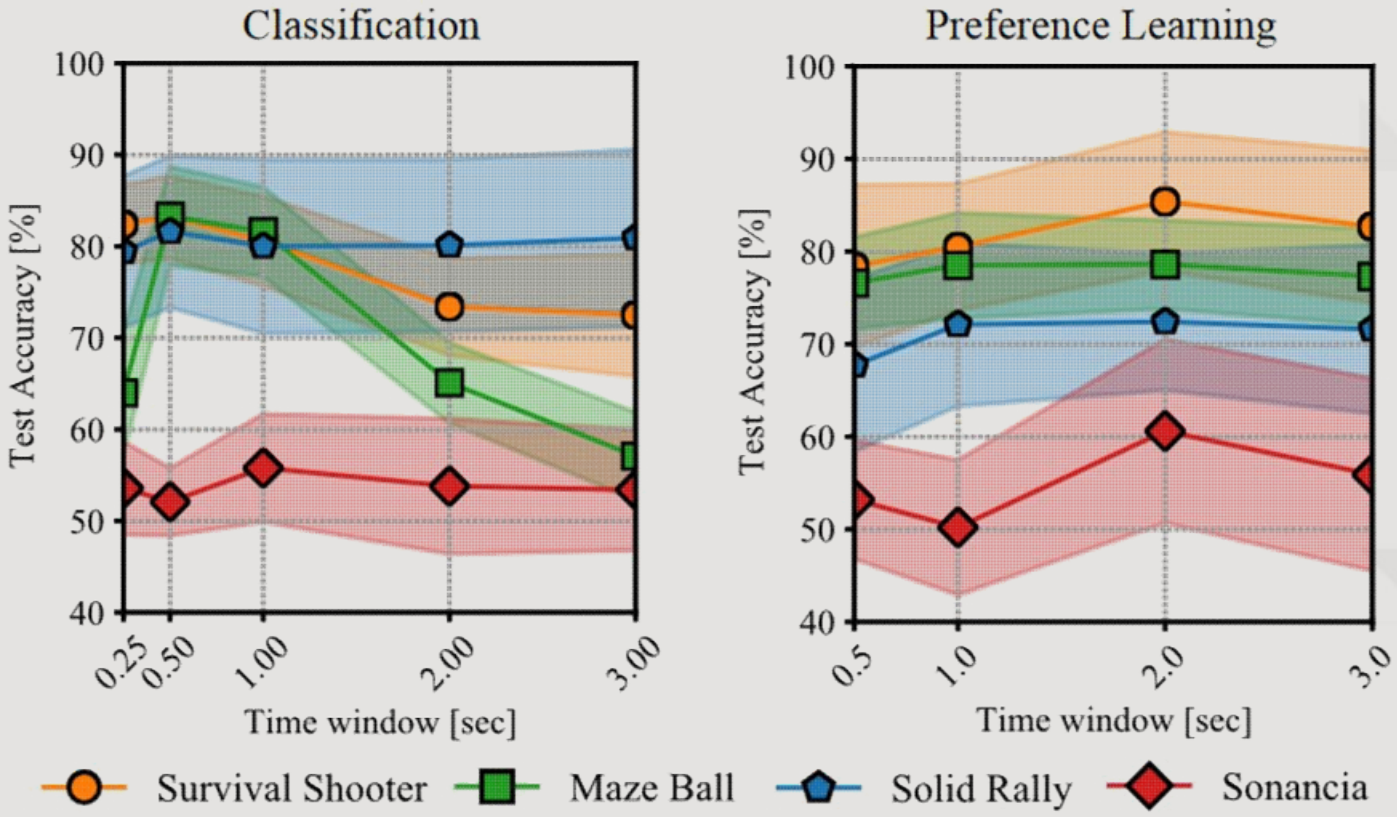
# In-game visuals and emotion

- Can reach high accuracies with audio + visual data in 3 games, but not Sonancia

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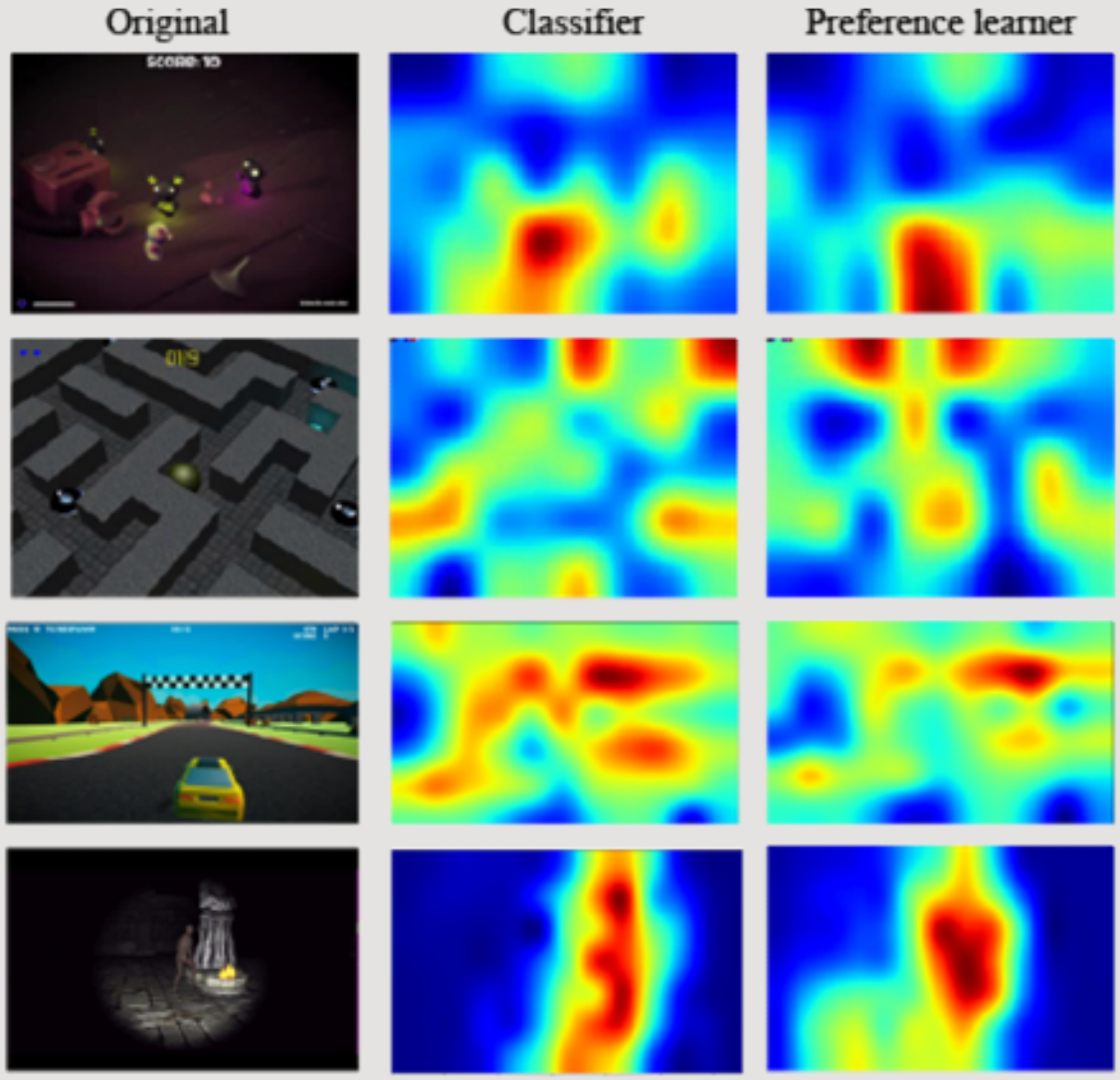
# In-game visuals and emotion

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# In-game visuals and emotion

- Applications:
  - Affect modelling without need for invasive hardware or software
  - GRAD-CAM visualizations can help designers identify visual stimuli that are triggers
  - Genre/style agnostic: possibly generalizable across games of similar visual style (?)

K. Makantasis, A. Liapis and G. N. Yannakakis: "The Pixels and Sounds of Emotion: General-Purpose Representations of Arousal in Games," in IEEE Transactions of Affective Computing, 2021 (accepted).

# Game levels and emotion

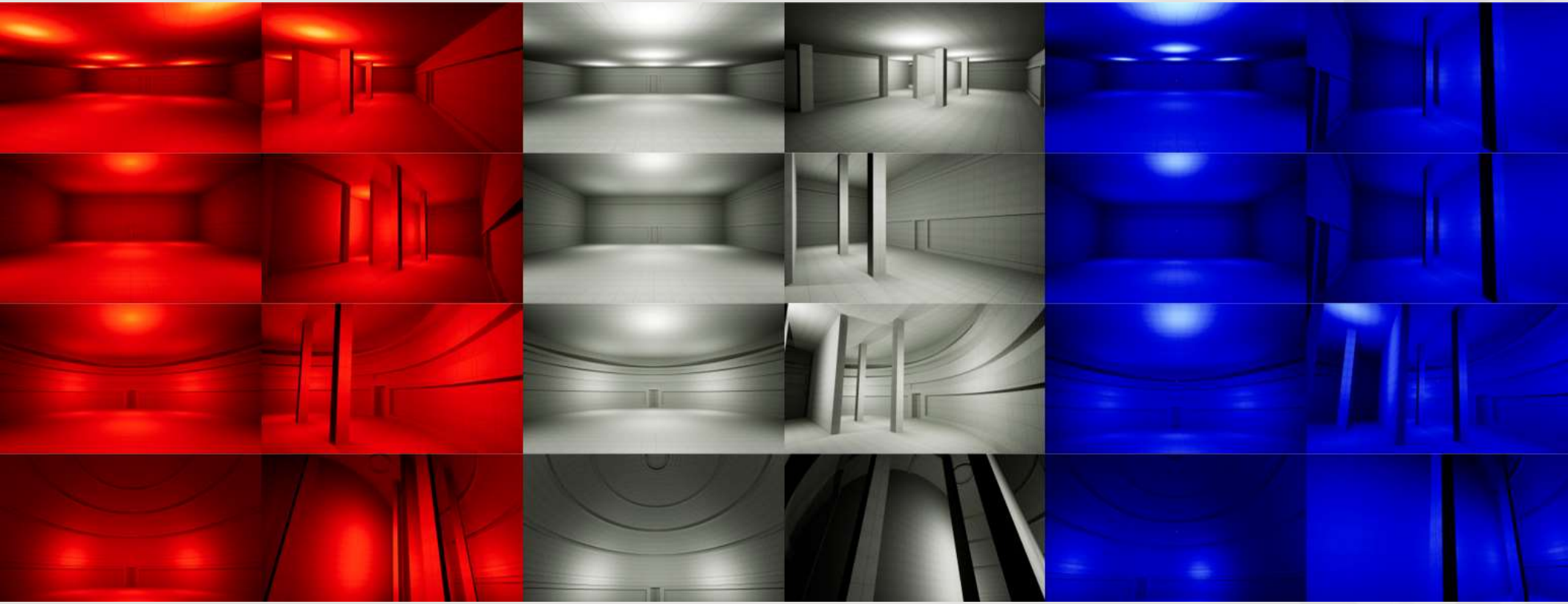
E. Xylakis, A. Liapis and G. N. Yannakakis: "Architectural Form and Affect: A Spatiotemporal Study of Arousal," in Proceedings of the IEEE International Conference on Affective Computing and Intelligent Interaction, 2021.

# Game levels and emotion

- Premise: spatial navigation & features or illumination of spaces impacts emotion

# Game levels and emotion

- Dataset: 24 rooms with changes in curvature, ceiling height, “noise”, illumination color



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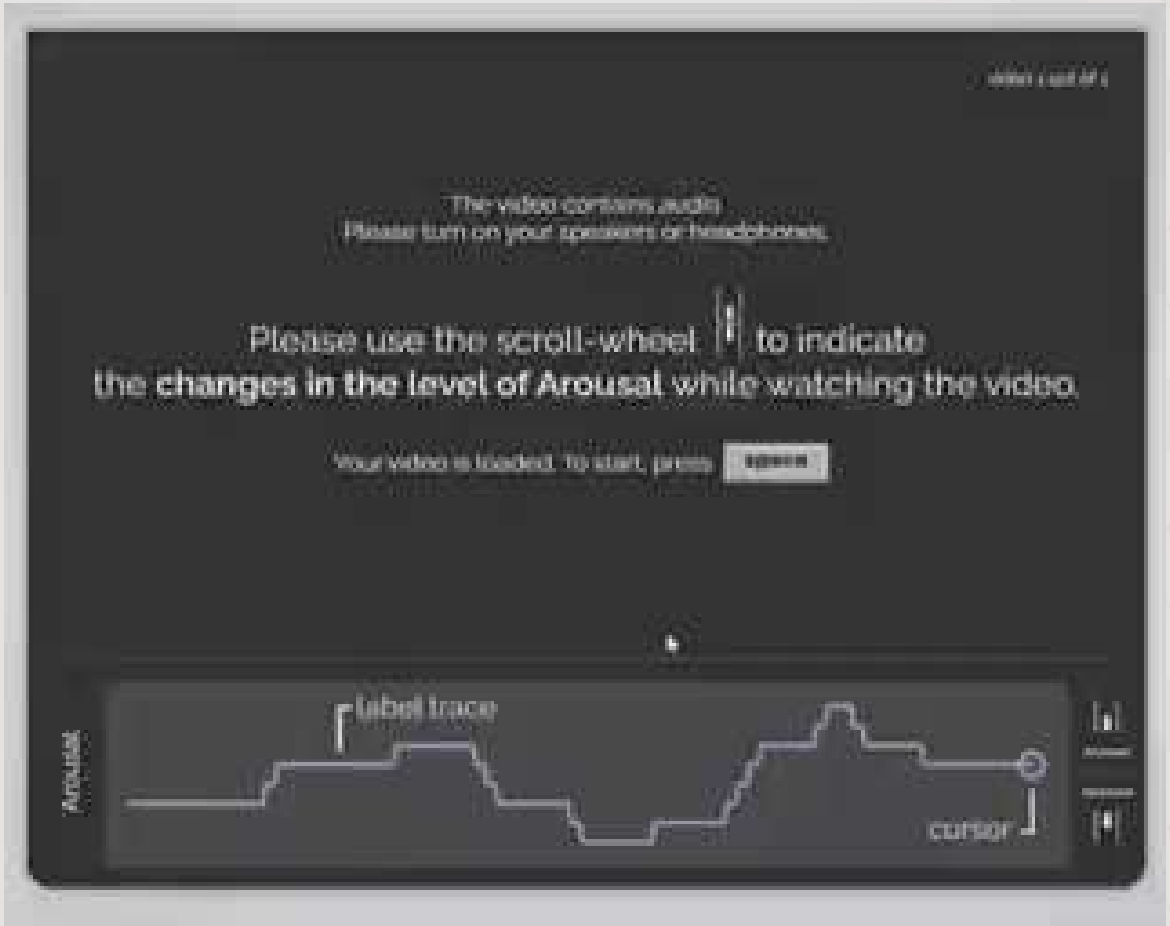
# Game levels and emotion

- Data collection: arousal in pre-recorded videos

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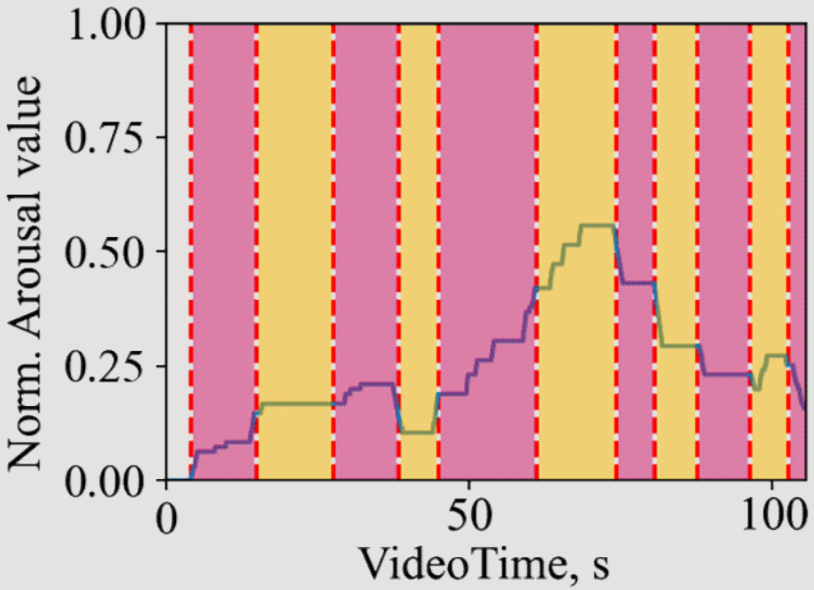
# Game levels and emotion

- Processing #1: changes between rooms
- How a feature changes between consecutive rooms versus how **mean arousal in these rooms changes**

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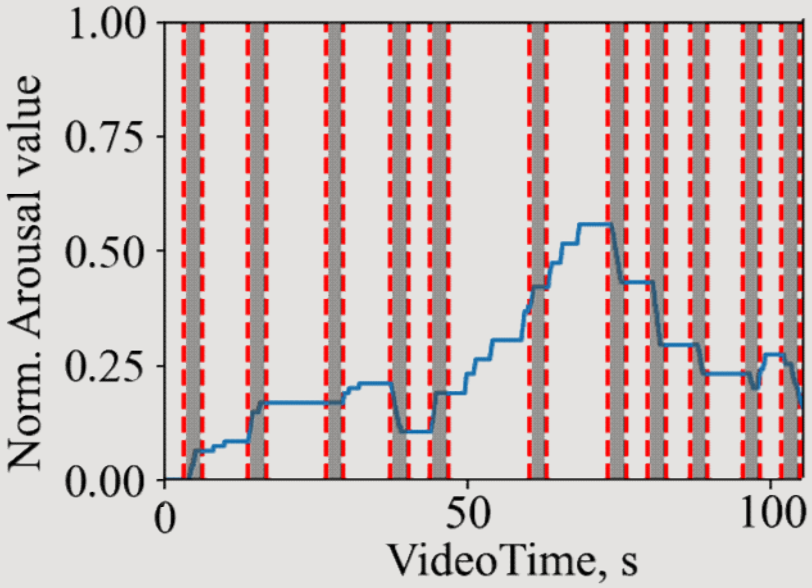
# Game levels and emotion

- Processing #2: changes during arrivals
- How a feature changes between new room and previous room versus how **arousal fluctuates when entering new room**




E. Xylakis, A. Liapis and G. N. Yannakakis: "Architectural Form and Affect: A Spatiotemporal Study of Arousal," in Proceedings of the IEEE International Conference on Affective Computing and Intelligent Interaction, 2021.

# Game levels and emotion

- Changes in “noise” (87%), curvature (75%) and color (59%) coincide with changes of arousal, when 2+ annotators agree.
- Applications:
  - Predict arousal progression in a premade architectural layout
  - Counter/exploit predicted changes in arousal with additional modalities (e.g. sounds)

E. Xylakis, A. Liapis and G. N. Yannakakis: "Architectural Form and Affect: A Spatiotemporal Study of Arousal," in Proceedings of the IEEE International Conference on Affective Computing and Intelligent Interaction, 2021.

# Gameplay metrics and emotion

D. Melhart, A. Liapis and G. N. Yannakakis: "Towards General Models of Player Experience: A Study Within Genres," in Proceedings of the IEEE Conference on Games, 2021.

# Gameplay metrics and emotion

- Premise: we can use summary gameplay metrics to predict high or low points of arousal...
  - within a game
  - across games

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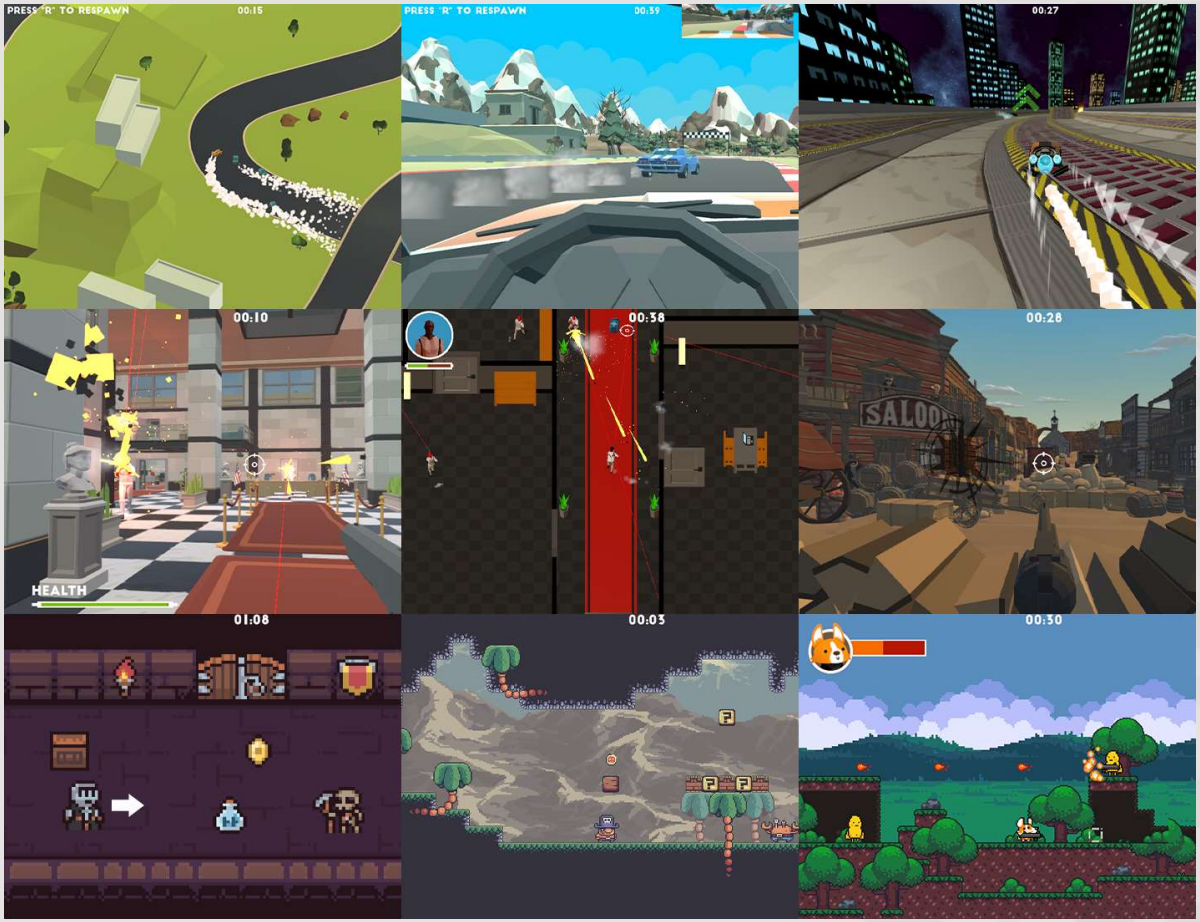
# Gameplay metrics and emotion

- Premise: we can use summary gameplay metrics to predict high or low points of arousal...
  - within a game
  - across games
- A step towards **general** player affect modelling
  - general models that work in unseen games
  - general gameplay metrics that work across games

D. Melhart, A. Liapis and G. N. Yannakakis: "Towards General Models of Player Experience: A Study Within Genres," in Proceedings of the IEEE Conference on Games, 2021.

# Gameplay metrics and emotion

- Dataset: 9 games with different controls/gameplay
- 3 genres:
  - **racing**
  - **shooter**
  - **platformer**
- Playtime: 2 mins




D. Melhart, A. Liapis and G. N. Yannakakis: "Towards General Models of Player Experience: A Study Within Genres," in Proceedings of the IEEE Conference on Games, 2021.

# Gameplay metrics and emotion

- Data collection: large Mturk campaign, 122 players*
- Play, then annotate arousal on video via RankTrace


D. Melhart, A. Liapis and G. N. Yannakakis: "Towards General Models of Player Experience: A Study Within Genres," in Proceedings of the IEEE Conference on Games, 2021.

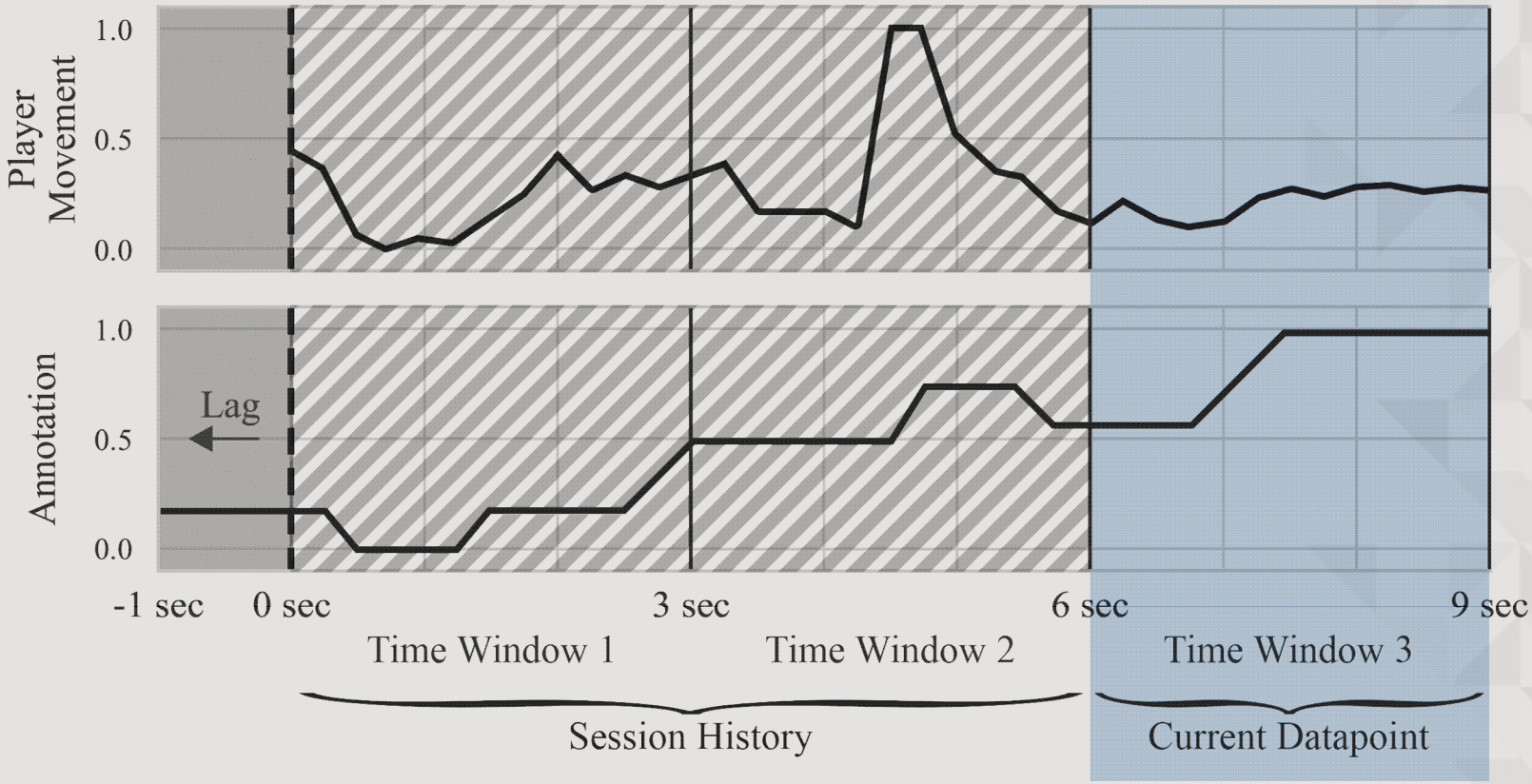
# Gameplay metrics and emotion

- Gameplay metrics:
  - **Specific**: 42 genre-specific features, may not be present in all games of the same genre.
  - **General**: 13 features common in all games
    - Time, score, player/object/bot activity, keypresses

D. Melhart, A. Liapis and G. N. Yannakakis: "Towards General Models of Player Experience: A Study Within Genres," in Proceedings of the IEEE Conference on Games, 2021.

# Gameplay metrics and emotion

- Comparing mean arousal in this time window with average mean arousal so far

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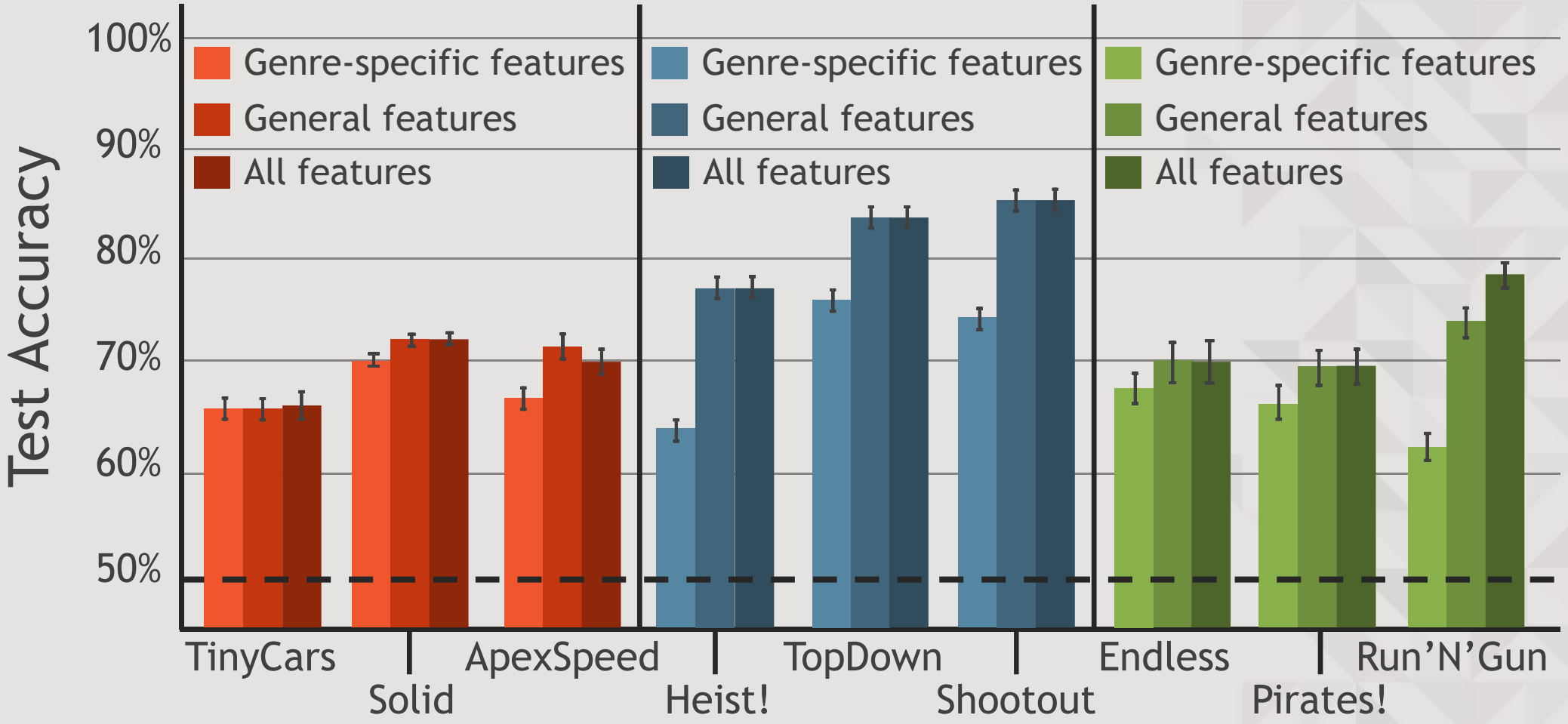
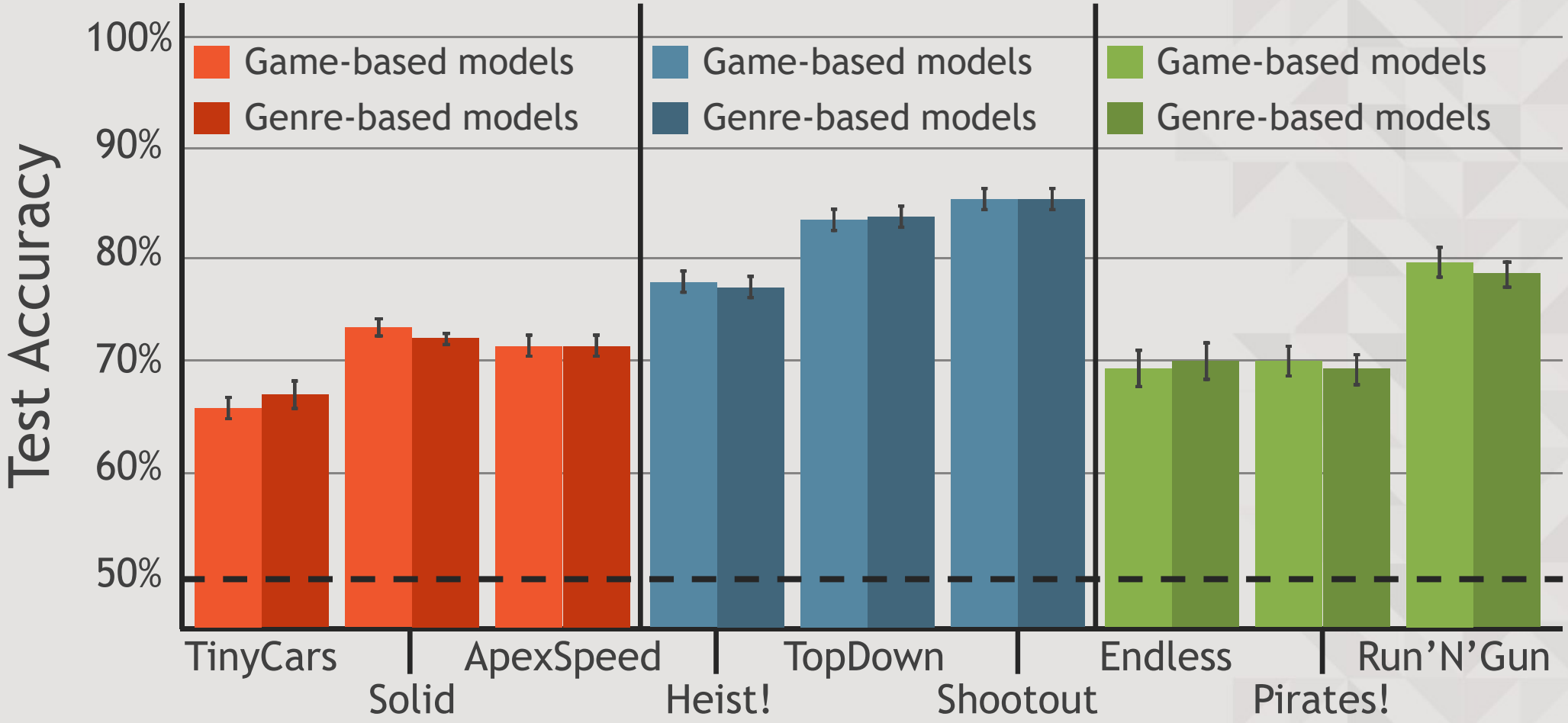
# Gameplay metrics and emotion

- Trained with Random Forests: General metrics work well within the same game



# Gameplay metrics and emotion

- Trained with Random Forests: General models trained on the other 2 games are quite accurate



# Gameplay metrics and emotion

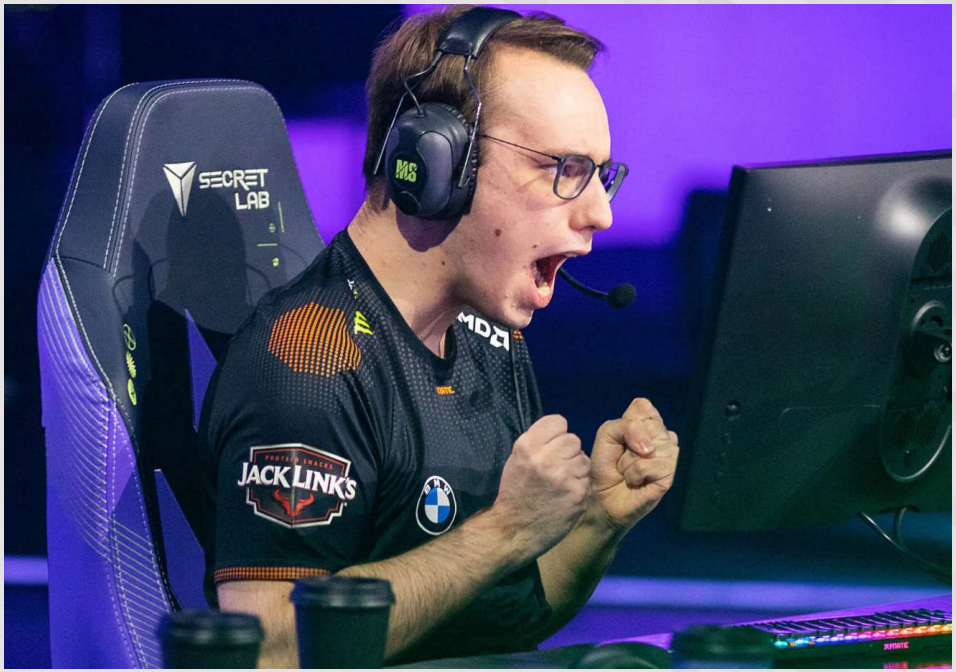
- Applications:
  - General “genre” arousal models: devs can predict arousal in a new game in development if they have (summary) gameplay metrics from past games in this genre
  - A step towards **general affect modeling**

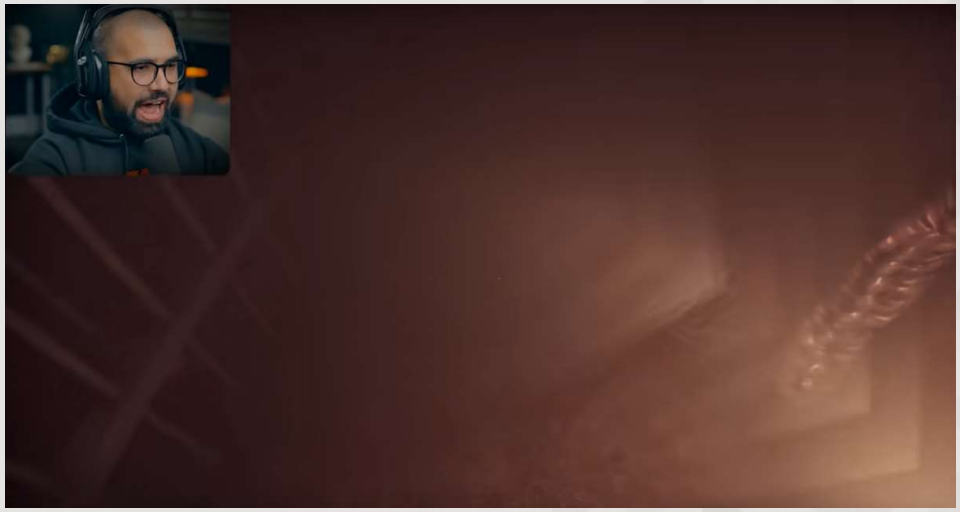
# Parting words

## How AI can bridge the gap between design and experience

# Games and Emotion

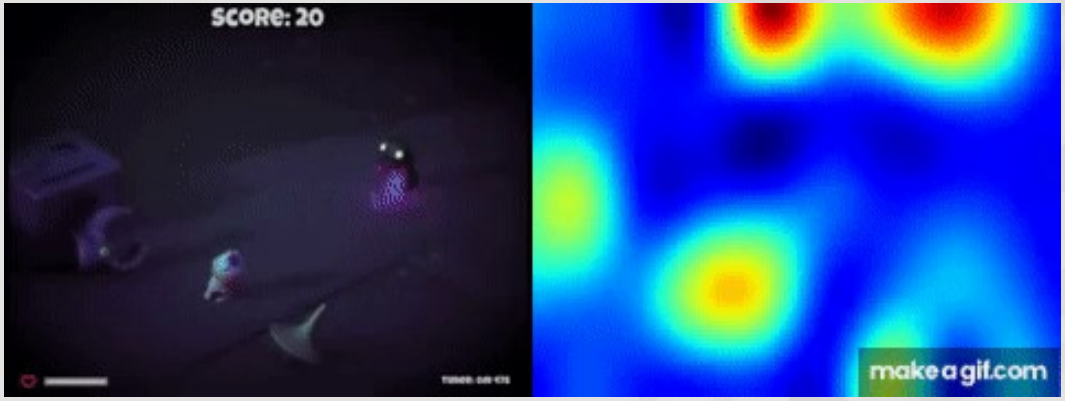
- Games can elicit powerful emotions
- Designers know (or should know) how to trigger such emotions
- Emotions during gameplay can be due to visuals, story, or gameplay intensity



# AI affect models and games

- AI can learn affect patterns from:
  - Game setup (colors, levels)
  - Gameplay (footage, metrics)
- This can help **general AI** and improve games!

# Thank you!