CCSE Games & XR

Dr Penny Kyburz

Games Research Group

ANU School of Computing

Acknowledgement of Country

Overview

01   Who am I?

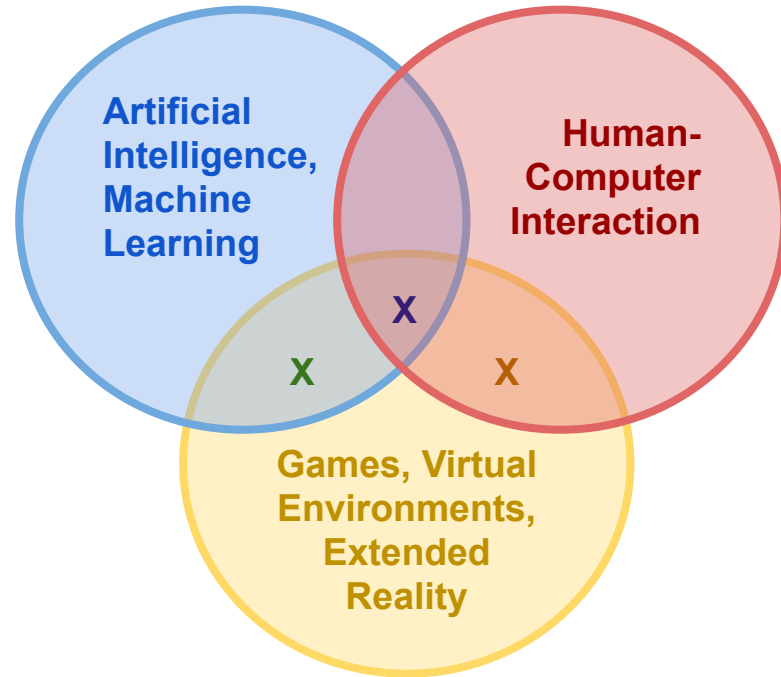# Video Games Research

I use video games to understand:

- humans,
- machines, and
- the world around us

I work at the intersection of:

Artificial Intelligence, Machine Learning

Human-Computer Interaction

Games, Virtual Environments, Extended Reality

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A Story

*(Australian Senate)

PhD (UQ)
(2005)
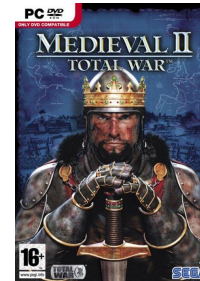
Industry
(2005-10)

QUT
(2011-3)

Indie
(2014-7)

*

ANU
(2018-?)

My Games

20 published games

- AAA / Indie
- >10 million players
- >$250M revenue
- Screen Aus/ACT
- 4 BAFTA noms
- Various awards
- Magazine covers
- Hundreds of articles
- Top/best lists

02   Games Research

My Research

Highlights

- ## GameFlow
  - ### >2700 citations
  - ### >200 applications
- ## Emergence in Games
- ## Active/Passive Screen Time

1. **Sweetser**, P. (2008) *Emergence in Games*. Hingham, MA: Charles River Media.
2. **Sweetser**, P. (2020) GameFlow 2020: 15 Years of a Model of Player Enjoyment. *32nd Australian Conference on Human-Computer Interaction (OzCHI '20)*, 705–711.
3. **Sweetser**, P., Johnson, D., Ozdowska, A. & Wyeth, P. (2012). Active versus Passive Screen Time for Young Children. *Australasian Journal of Early Childhood* 37 (4), 94-98.
4. **Sweetser**, P. & Wyeth, P. (2005) GameFlow: A Method for Evaluating Player Enjoyment in Games. *ACM Computers in Entertainment* 3 (3), 24 pages.
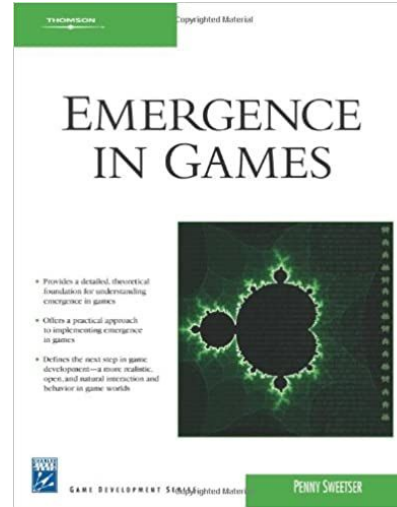
GAMEFLOW

Concentration (*6 criteria*)
Games should require concentration and the player should be able to concentrate on the game

Challenge (*4 criteria*)
Games should be sufficiently challenging and match the player's skill level

Player Skills (*7 criteria*)
Games must support player skill development and mastery

Control (*6 criteria*)
Players should feel a sense of control over their actions in the game

Clear Goals (*2 criteria*)
Games should provide the player with clear goals at appropriate times

Feedback (*3 criteria*)
Players must receive appropriate feedback at appropriate times

Immersion (*5 criteria*)
Players should experience deep but effortless involvement in the game

Social Interaction (*3 criteria*)
Games should support and create opportunities for social interaction

Project Students

- AI in games (RL, GANs, DL/ML) - StarCraft II, Atari
- Player modelling and adjustment (DDA, prediction)
- AI-driven game customisation
- Procedural generation / co-creation of game content
- Game review analysis and recommendation (NLP)
- Player experience (VR, persuasion, GameFlow)
- Human-machine teaming in games and XR
- Narrative and storytelling
- Gameful and game design

Student Publications

- Bian, P, Liu, L., & **Sweetser**, P. (2021) Detecting Spam Game Reviews on Steam with a Semi-Supervised Approach. *Conference on the Foundations of Digital Games (FDG 2021)*. [*Honorable Mention award*]

- Ip, I., & **Sweetser**, P. (2021) Investigating VR Game Player Experience via Remote Experimentation using the Player Experience Inventory. *Australian Conference on Human-Computer Interaction (OzCHI '21)*.

- Ip, I., & **Sweetser**, P. (2021) Investigating VR Game Player Experience via Remote Experimentation using the Player Experience Inventory. *ACM SIGCHI annual symposium on Computer-human interaction in play (CHI PLAY 2021)*.

- Chen, Y., Aitchison, M. & **Sweetser**, P. (2020) Improving StarCraft II Player League Prediction with Spending Quotient. *Australian Joint Conference on Artificial Intelligence (AI2020)*, 256-268.

- Gellel, A. & **Sweetser**, P. (2020) A Hybrid Approach to Procedural Generation of Roguelike Video Game Levels. *Conference on the Foundations of Digital Games (FDG 2020)*, 10 pages.

- Hao, D., **Sweetser**, P. & Aitchison, M. (2020) Designing Curriculum for Deep Reinforcement Learning in StarCraft II. *Australian Joint Conference on Artificial Intelligence (AI2020)*, 243-255.

- Jeffrey, R., Bian, P., Ji, F. & **Sweetser**, P. (2020) The Wisdom of the Gaming Crowd. *ACM SIGCHI annual symposium on Computer-human interaction in play (CHI PLAY 2020)*, 272-276.

- Jiang, Z. & **Sweetser**, P. (2021) GAN-Assisted YUV Pixel Art Generation. *Australian Joint Conference on Artificial Intelligence (AI2021)*.

- **Sweetser**, P. & Rogalewicz, Z. (2020) Affording Enjoyment in VR Games: Possibilities, Pitfalls, and Perfection. *32nd Australian Conference on Human-Computer Interaction (OzCHI '20)*, 55-64.

- **Sweetser**, P., Rogalewicz, Z. & Li, Q. (2019) Understanding Enjoyment in VR Games with GameFlow. Proceedings of VRST '19: *25th ACM Symposium on Virtual Reality Software and Technology (VRST '19)*, 2 pages.

PhD Students

ANU Games Group

7 PhD Students

PhD Projects

- Learning Long-Horizons in Episodic Time-Limited Markov Decision Processes (Mr Matthew Aitchison, 2019-)

- Playing to Advocate Climate Change: Harnessing the Power of Video Games to Influence Attitudes Towards Climate Crisis (Ms Mahsuum Daiiani, 2020-)

- Interpretable Recommendation for Video Games by Learning Key Features from Users' Reviews and Ratings (Ms Lei Liu, 2020-)

- Developing cross-media franchises: an approach to creating and ethically monetising cross-medium narrative projects across multiple platforms (Mr Andrew Smith, 2020-, P/T)

- Facilitating collaborative teamwork in multiplayer online battle arena games: shared cognition and team performance (Ms Yufei Cao, 2021-)

- Patient-Tailored Exergames for the Management of Parkinson's Disease (Ms Michelle Adiwangsa, 2021-)

- Mixed Reality for Enhancing Distributed Human-Machine Teaming (DST project, commencing 2021/2)

03

Games & XR

Games Industry

Who here

Plays games?

Would like to make games?

Has made their own games?

Games Industry

Worldwide industry worth $159 Billion/year

Australian sales $3.4 Billion / year

Digital Australia 2020

2/3 Australians play video games

9/10 households have a games device

47% of game players are female

Average age of players is 34 years

Games Industry

Video Games are

Fun

Art

Storytelling

Culture

Social experiences

Skill development

Training, education, rehab, therapy

Games Industry

Games Careers

Designer

Programmer

Artist

Animator

Producer

Quality Assurance

Games Design

What is games design?

What is the role of a games designer?

What does a game designer do?

Games Design

Games Design

A coherent set of rules that formalise a game's content in such a way that it facilitates appropriate gameplay, in order to achieve the game's fundamental goals.

Games Designer

A person who determines the rules by which a game is formulated, in order to achieve the goals for which it was created.

Games Design

Roles / Jobs

Creative Director, Design Director, Lead Designer, Gameplay/Systems Designer, Cinematic/Combat/Balance/Multiplayer, Level Designer, Writer/Narrative Designer

Tasks

Writing, Story/character creation, Level design, Scripting, Features/mechanics, Systems design,

Tuning/balancing, Playtesting, Interface design/mock-ups, Community management, Internal/public relations, Coordinating/managing

Games Design

Medieval II: Total War

Help system, Tutorial, Scripting, Campaign systems, Campaign story/events, Interfaces Tools, User testing, PR/Pitching

XCOM

AI design, Training system, User testing, Multiplayer systems, Metrics system, Campaign system, Base design, Interface design, Research/upgrades

Games

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Play and Games

Video Games

Motivation and Flow

Gamification

Serious Games

Photo by eleonora on Unsplash

Play - Animals

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Play comes naturally to animals of a certain level of intelligence

For example, pets are very playful

    Easy to start playing a game based on simple, understandable rules

    Catch the ball, retrieve the stick, my hand is prey, obstacle course

Play - Animals

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Young animals are particularly playful

Almost anything in their environment is an excuse to initiate gameplay

Without anyone teaching the animal how to engage in this behaviour

Play is fundamental to development and survival

Young animals refine skills that are necessary to hunt, fight, mate, hide and many other activities that are key to survival as an adult

Play - Games

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Games provide a safe context in which these lessons can be learned through play

Gameplay teaches skills that are important and necessary in order to survive in real life

Animals are capable of grasping abstract concepts like games or make-believe

Play - Games

– – –

Games involve accepting imposed boundaries and rules to your behaviour

    Need to understand that the gameplay experience is an artificial one

    Need to understand that games are an abstract construct, governed by a set of formalised rules

    Need to understand difference between rules that govern reality and those that govern the make-believe world

Also crucial to the enjoyment of film, literature, art, music

Play - Games

– – –

Good games are rewarding

  Engaging in gameplay is enjoyable, something you want to do

Playing games makes us feel good

  Chemicals are released into our blood when we play games

  Learning is necessary to the survival of the species

  Learning is a drug

Fun from games arises out of mastery and comprehension

  The act of solving puzzles makes games fun

Play - Humans

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Humans can engage in far more complex games than animals

Humans are very good at speaking the language of games

> People all over the world play games in which the rules are easy and intuitively understood

Humans have a universal gameplay grammar

> We can play games with people who speak different languages, have different cultures, and we haven't met

> We can play games with animals from different species

Video Games

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Traditional play is about teaching skills and testing the player's proficiency

It is rewarding to master a task or be good at something

Video games:

Teach motor skills, mental skills, skills of reasoning, and so on

Allow us to put those skills to the test in a controlled manner

A good game strikes a balance between:

Teaching these skills, and

Providing the player with an enjoyable test-bed in which to try them out

Games and Play

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Games are rule-bound activities with goals and at least one player who tries to fulfil the goals

Games are a form of play with structure

"paidia" and "ludus" for playing and gaming (Caillois)

> Two poles of play activities
>
> Paidia - uncontrolled, free-form, improvisational
>
> Ludus - restricted, structured, goal-focused

Intrinsic Motivation and Flow

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Intrinsic Motivation: doing something is inherently interesting/enjoyable

Extrinsic Motivation: doing something leads to a separable outcome

Self-Determination Theory (SDT) explains motivation based on innate psychological needs for competence, autonomy, and relatedness

Rewards can be experienced to be more or less controlling

Flow is an experience "so gratifying that people are willing to do it for its own sake, with little concern for what they will get out of it, even when it is difficult or dangerous"

Games and Gamification

– – –

Games are an autotelic experience with motivational pull

Gamification is the design strategy of using game design elements in non-game contexts

Selection and usage of the game design elements is key

Play is central to games. Rules and goals alone do not make a game

Reward-based gamification: points, levels, leaderboards, achievements

Meaningful gamification: using game design elements to help build intrinsic motivation and meaning in non-game settings

Serious Games

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Games with a purpose (beyond entertainment)

A game rather than a gamified application

Many games for education and training

Others - health, exercise, science, persuasion

Examples - Microsoft Flight Simulator, Duolingo, Minecraft, World Without Oil, FoldIt, IBM City One

XR

– – –

Virtual Reality

VR Games

Augmented Reality

Haptics

Brain-Computer Interface

Virtual Reality

– – –

1970s - "the illusion of participation in a synthetic environment rather than external observation of such an environment" (Gigante 1993)

Goal to create experiences that "feel real"

Images are displayed stereoscopically - VR headsets

    Audio and haptics also important

Photo by Giu Vicente on Unsplash

Virtual Reality

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Presence - "being there"

    (Slater and Wilbur, 1997)

Fidelity - true / exact

Different perspectives

    1st/3rd person, world

Head-mounted displays, Cybersickness

Assumptions: Higher fidelity is better for learning/training

Virtual Reality

– – –

Research and Design Considerations

Learning/training, health applications

Remote operations, travel, tourism

Presence, comfort, veracity, verisimilitude

Navigation, interactions, movement

Collaboration, communication

Tools - Unity, Unreal

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VR Games

Sweetser, P. & Rogalewicz, Z. (2020) Affording Enjoyment in VR Games: Possibilities, Pitfalls, and Perfection. *32nd Australian Conference on Human-Computer Interaction (OzCHI '20)*, 55-64.

Superhot and *Superhot VR*   *Skyrim* and *Skyrim VR*

Aim: Understand affordances and inhibitors of enjoyment in VR video games

Approach: apply the GameFlow model to review and analyse VR and non-VR versions of the same games to identify differences in enjoyment in VR games

VR Games

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VR affords more control and easier interaction with a more direct connection between physical and virtual movements and actions

- But disconnect between actions and expected feedback can be jarring (e.g., archery in *Skyrim VR*, throwing in *Superhot VR*)
- Players need higher veracity feedback in VR games to meet expectations and to feel effective in their actions

VR games can afford increased emotional and visceral immersion

- Physically performing actions and being present in the world

Increased immersion can come at the cost of a loss of sense of control

- Limited in ability to freely move around both VR games
- Perceived inaccuracies, limited input mechanisms

VR games, even complete and extensive games like Skyrim VR, can feel "more like a tech demo than a full experience"

VR Games

Comfort

We defined Comfort as how comfortable a player feels while playing a VR game, with respect to physical issues such as play space, body position and movement, and cyber sickness

Comfort was identified to be a key enabler or inhibitor of player enjoyment in VR games

- Cybersickness, standing/sitting, play space size/use, player control

Games should afford players to feel physically comfortable while playing.
Games should afford different players to control their level of comfort.
Games should afford players to feel comfortable in their play space.
Games should afford players to feel comfortable with their body position throughout play.
Games should afford players to feel comfortable with their movements.
Games should afford players to minimise feelings of nausea.

Augmented Reality

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Pokémon Go - mobile-based AR

AR application history and areas

Head-up displays (HUDs)

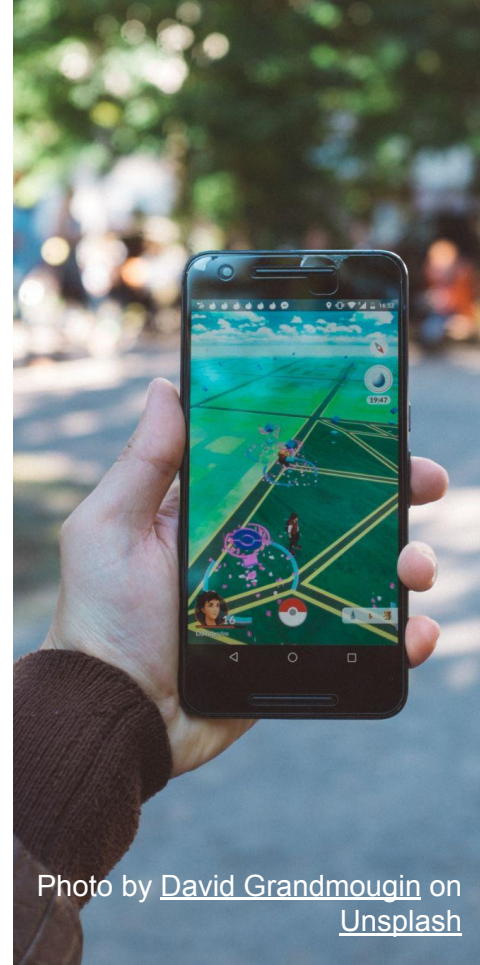AR headsets and glasses

Research and Design Considerations

Photo by David Grandmougin on Unsplash

Haptic Interfaces

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Tactile feedback - vibration and force

Vibrotactile feedback

Ultrahaptics - https://www.ultraleap.com/

Exoskeletons

Sharp et al. Figure 7.22

Sharp et al. Figure 7.21

Brain-Computer Interfaces

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Communication pathway between brain and device

Detects changes in neural functioning

BCI research and applications

BCI and games

Source: Emotiv

Questions?

Extended Reality
Games design
Games industry
Jobs and skills
Research projects
Student projects

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