HCI & Games Research
An Overview

Rogelio E. Cardona-Rivera, Ph.D.
Assistant Professor and Director, QED Lab
School of Computing, Entertainment Arts & Engineering
University of Utah
rogelio@cs.utah.edu
@recardona
The dominant research questions in this field have yet to be defined.

It is an exciting time to get involved with games research!
What’s in a Game?

game /gæm/ n. (pl. -games) a series of rules that involves a structured conflict representing a subset of the world.

{"<start>" : "<template>",

"<template>" :  
"<object> in which players <engagement>. 
| <object> that involves <characteristics>. 
| <object> <constraints>. 
| <object> characterized by <relationship>.",

"<object>" : 
...
}
An Operational Definition

A game is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome.

–Eric Zimmerman and Katie Salen, Rules of Play
HCI & Games Research: An Overview

• Past: Understanding Player & Game
• Present: A Fragmented Field
• Future: The Science of Game Design
HCI & Games Research: An Overview

- Past: Understanding Player & Game
• Piaget’s (1962) *Play, dreams, and imitation in childhood*
  • Child development involves schema building
  • Play environments lead to richer schemas
Understanding Player & Game

- Malone’s (1981) *Heuristics for designing enjoyable user interfaces*
  - Challenge
  - Fantasy
  - Curiosity

<table>
<thead>
<tr>
<th>Table 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heuristics for Designing Enjoyable User Interfaces</td>
</tr>
</tbody>
</table>

I. Challenge

A. *Goal.* Is there a clear goal in the activity? Does the interface provide performance feedback about how close the user is to achieving the goal?

B. *Uncertain outcome.* Is the outcome of reaching the goal uncertain?

1. Does the activity have a variable difficulty level? For example, does the interface have successive layers of complexity?
2. Does the activity have multiple level goals? For example, does the interface include score-keeping?

II. Fantasy

A. Does the interface embody emotionally appealing fantasies?

B. Does the interface embody metaphors with physical or other systems that the user already understands?

III. Curiosity

A. Does the activity provide an optimal level of informational complexity?
Understanding Player & Game

• Bartle’s (1996) *Players Who Suit MUDs*
  ▾ Different players value challenge, fantasy, curiosity differently
Bartle’s (1996) *Players Who Suit MUDs*

- Different players value challenge, fantasy, curiosity differently
- Tradeoffs for experience
Understanding Player & Game

- Hunicke, LeBlanc, and Zubek’s (2004) MDA
  - Mechanics
  - Dynamics
  - Aesthetics
- The indirect-design problem

The MDA framework formalizes the consumption of games by breaking them into their distinct components:

- Rules → System → “Fun”

...and establishing their design counterparts:

- Mechanics → Dynamics → Aesthetics

The designer and player each have a different perspective.
HCI & Games Research: An Overview

• Past: Understanding Player & Game
• Present: A Fragmented Field
Human-Computer Interaction v. Player-Computer Interaction

- Lazzaro’s (2008) 
  *Gameplay Experience Goals*

  ▶ HCI
  - Task Completion
  - Reduce Error
  - External Reward
  - “Intuitive”
  - Reduce Workload

  ▶ PCI
  - Entertainment
  - Fun-to-beat obstacles
  - Intrinsic Reward
  - New Things to Learn
  - Increase Workload
A Fragmented Field

• Carter et al.’s (2014) Paradigms of Games Research in HCI
A Fragmented Field

• Carter et al.’s (2014) *Paradigms of Games Research in HCI*
A Fragmented Field

- Carter et al.’s (2014) *Paradigms of Games Research in HCI*

In order to identify the relevant papers for this literature review, we used the following Boolean search string in the ACM Digital Library:

```
((Title:game*) or (Title:gaming*) or (Title:play*) or (Abstract:game*) or (Abstract:gaming*) or (Abstract:play*)) and (PublicationTitle:SIGCHI Conference on Human Factors in Computing Systems) and (PublishedAs:proceeding)
```
A Fragmented Field

- Carter et al.’s (2014) *Paradigms of Games Research in HCI*

  - Operative
A Fragmented Field

• Carter et al.’s (2014) *Paradigms of Games Research in HCI*
  ▸ Operative
  ▸ Epistemological

A Fragmented Field

- Carter et al.’s (2014) *Paradigms of Games Research in HCI*
  - Operative
  - Epistemological
  - Ontological

Domínguez et al.’s *Mimesis Effect* in CHI2016
A Fragmented Field

- Carter et al.’s (2014) *Paradigms of Games Research in HCI*
  - Operative
  - Epistemological
  - Ontological
  - Practice

Twitch Plays Pokémon

<table>
<thead>
<tr>
<th>Pokémon Red</th>
<th>12 February 2014</th>
<th>1 March 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>16 days, 9 hours, 55 minutes, 4 seconds</td>
<td></td>
</tr>
</tbody>
</table>
A Fragmented Field

- Carter et al.’s (2014) *Paradigms of Games Research in HCI*
  - Operative
  - Epistemological
  - Ontological
  - Practice

Instrumentalize games and play for other non-games work
A Fragmented Field

• Carter et al.’s (2014) *Paradigms of Games Research in HCI*
  • Operative
  • Epistemological
    • Ontological
    • Practice

Interested in games and play as disciplines in their own right
Ontological v. Practical Games Research

- Nacke *et al.*’s (2014) *Methods for Evaluating Gameplay Experience*

*Figure 1.* Three methodological frames of gameplay experience in the game development process. For example, game system experience methods are concerned with functional testing of the game; player experience methods ideally use sensor technology (or usability and playtesting) to assess emotion and enable player-game interaction, and finally logging metrics methods (among others) enable assessing game context experience.
Ontological v. Practical Games Research

• Nacke et al.’s (2014) Methods for Evaluating Gameplay Experience
  ▶ Psychophysiological Player Testing (e.g. EDA, EEG)
  ▶ Eye Tracking
  ▶ Persona / Player Modeling
  ▶ Game Metrics Behavior Assessment
  ▶ Rapid Iterative Testing and Evaluation
Ontological v. Practical Games Research

- Nacke et al.’s (2014) *Methods for Evaluating Gameplay Experience*
  - Ethnography
  - Cultural Debugging
  - Playability Heuristics
  - Qualitative Interviews and Questionnaires
  - Multiplayer (social) Game Metrics
A Fragmented Field

• Carter et al.’s (2014) *Paradigms of Games Research in HCI*
  ▶ Operative
  ▶ Epistemological
  ▶ Ontological
  ▶ Practice
HCI & Games Research: An Overview

• Past: Understanding Player & Game
• Present: A Fragmented Field
• Future: The Science of Game Design
A Science of Game Design is Needed

Gamification

Science discovery

Training simulations

Procedural rhetoric

- Games are a Significant Engineering Challenge™
- Advances in technology create more problems
- Research should target both artifact and person
Games are a Significant Engineering Challenge™

• Costly
• Difficult
• Poorly understood
Cost of Most Expensive Games per Year

- 2011: $200M (Star Wars: The Old Republic)
- 2012: $105M (Max Payne 3)
- 2013: $137M (Grand Theft Auto V)
- 2014: $140M (Destiny)
- 2015: $80M (MGSV)
- 2016: $124M (Star Citizen)
Time to develop those games

- 2011: Star Wars: The Old Republic
- 2012: Max Payne 3
- 2013: Grand Theft Auto V
- 2014: Destiny
- 2015: Metal Gear Solid V
- 2016: (Note: 5 Years)

Years to develop:
- Star Wars: The Old Republic: 3 Years
- Max Payne 3: 3 Years
- Grand Theft Auto V: 4 Years
- Destiny: 4 Years
- Metal Gear Solid V: 3 Years
- (Note: 5 Years)
Authorial Combinatorics Problem

• Bruckman’s (1990) *The Combinatorics of Storytelling: Mystery Train Interactive*
  - Content authoring increases exponentially with player choice
12 full-time writers + 3 years
= 200,000 lines of dialogue
(approx. 1,000,000 words)

(1,094,170 words)
Factors Influencing the Decision to Buy a Game

- Similarity: 9%
- Sequel: 9%
- Word of mouth: 11%
- Graphics: 12%
- Interesting Story: 16%
- Price: 21%
- Other: 22%

Essential Facts About the Computer & Video Game Industry (Entertainment Software Association, 2016)
Engineering Successful Games

Google search for "how do you make a successful game"

Gamasutra - Guidelines for Developing Successful Games
When you set out to develop a PC game, your potential market is basically everyone on Earth who owns a PC. Once you begin making decisions about your.

How to Make a Successful Game: 9 Steps (with Pictures) - wikiHow
www.wikihow.com/... Video Games > Video Game Creation

This Is The Formula For Creating An Insanely Successful Mobile Game
www.forbes.com/.../this-is-the-formula-for-creating-an-insanely-successful-mobile-ga...
Engineering Successful Games

Gamasutra - Guidelines for Developing Successful Games
When you set out to develop a PC game, your potential market is basically everyone on Earth who owns a PC. Once you begin making decisions about your.

How to Make a Successful Game: 9 Steps (with Pictures) - wikiHow
www.wikihow.com › ... › Video Games › Video Game Creation

This Is The Formula For Creating An Insanely Successful Mobile Game
www.forbes.com/.../this-is-the-formula-for-creating-an-insanely-successful-mobile-ga...
Cowboys, Ankle Sprains, and Keepers of Quality: How Is Video Game Development Different from Software Development?

Emerson Murphy-Hill  
North Carolina State University  
Raleigh, North Carolina, U.S.  
emerson@csc.ncsu.edu

Thomas Zimmermann and Nachiappan Nagappan  
Microsoft Research  
Redmond, Washington, U.S.  
{tzimmer,nachin}@microsoft.com
There’s a lot of hacks and kludges to get things working… I’m sure you would find tons of duplication of effort, definitely. I’ve been an audio programmer on [X] different games and I’ve written [X] different audio engines.

Cowboys, Ankle Sprains, and Keepers of Quality: How Is Video Game Development Different from Software Development?

Emerson Murphy-Hill  
North Carolina State University  
Raleigh, North Carolina, U.S.  
emerson@csc.ncsu.edu

Thomas Zimmermann and Nachiappan Nagappan  
Microsoft Research  
Redmond, Washington, U.S.  
{tzimmer,nachin}@microsoft.com
Procedural content generation

- Artificial intelligence for game content creation
Meaningless Procedural Content Generation

- No Man’s Sky can generate $1.8 \times 10^{19}$ Planets

The effect is dizzying. But it wasn’t enough. After three years of hype, it took just a few hours for players to start complaining that the game was boring or was missing features they had seen in early trailers. Many asked for refunds. What went wrong?

To answer why No Man’s Sky fails, we can look at how it misses the target of human exceptionalism. The technology here is impressive, beautiful, and sometimes unforgettable. That tech's basic template, however, sets a level of expectations that maybe no game could ever deliver—and that this one certainly doesn't.
The Kaleidoscope Effect

• Cardona-Rivera’s (2017) *Cognitively-grounded Procedural Content Generation*
  ▶ We can summarize expressive range in our heads
The Player Modeling Principle

- Sylvester’s (2013) *The Simulation Dream*
  - “The whole value of a game is in the mental model of itself it projects into the player’s mind.”

Research should target artifact and player!
Tacit Learning and Expectations

If Video Games Have Taught Me Anything

I can bomb this wall and find two secrets

If Video Games Have Taught Me Anything

This cat has a side quest to offer me.

If Video Games Have Taught Me Anything, it's that if I encounter enemies

I'm going the right way

My experience with #RPG is telling me to ask this guy if he has any rare weapons or abilities for sale.
The Bard’s Leap

Bethesda Game Studios; The Elder Scrolls V: Skyrim. Bethesda Softworks, 2011.
Ontological Framework: Games as Conversation

• Cardona-Rivera and Young's (2014) *Games as Conversation*
  ‣ Games are contexts for communicative exchange

• Blow's (2016) AIIDE Keynote
  ‣ Level Design as an NLG Problem

"Why not approach level design as a problem in natural language generation?"

"The level is like an utterance. The utterance is an expression of internal ideas."

"The internal ideas come first!"
The Science of Game Design

• The systematic organization of design knowledge encompassing game structure and player behavior

▶ The search for invariant relationships
  - e.g. F=ma, Fitts’ Law, Hick-Hyman Law
  - My research: AI generation as understanding
Recap

• Past: Understanding Player & Game
• Present: A Fragmented Field
• Future: The Science of Game Design
• Photography used to require expertise
  ▪ Digital camera changed that

• My work targets the science of game design through the invention of its digital camera

Rogelio E. Cardona-Rivera, Ph.D.
rogelio@cs.utah.edu
qed.cs.utah.edu
Spring 2020 Course!
EAE 6900-023: Game AI

In this course we will examine both traditional and modern artificial intelligence (AI) techniques that are used in the design of computer games. We will look for techniques for game playing as well as the design of AI agents tasked with creating targeted experiences for players.