

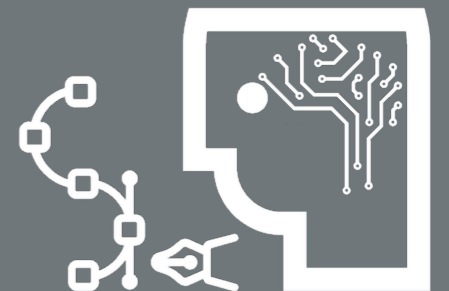
HCI & Games Research

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](https://twitter.com/recardona)



The dominant
research
questions in this
field have yet to
be defined.

It is an exciting time to get
involved with games
research!



UX Lab, Epic Games

What's in a Game?

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

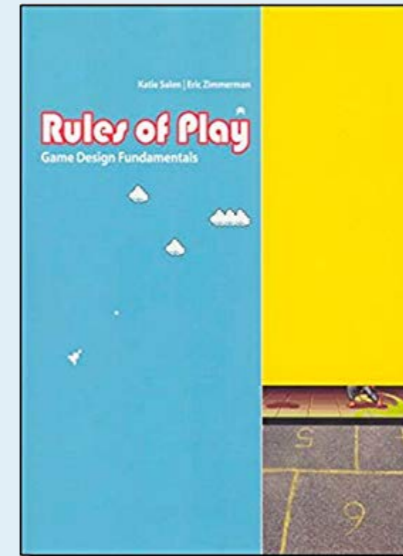
```
{ "<start>" : "<template>",  
  
  "<template>" :  
  "<object> in which players <engagement>."  
  | "<object> that involves <characteristics>."  
  | "<object> <constraints>."  
  | "<object> characterized by <relationship>.",  
  
  "<object>" :  
  ...  
}
```

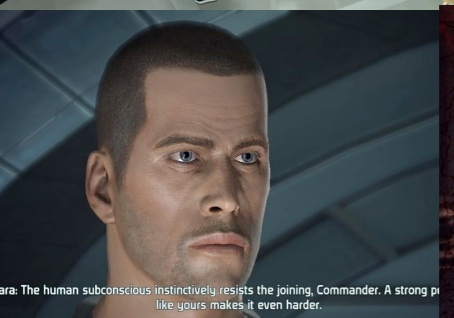
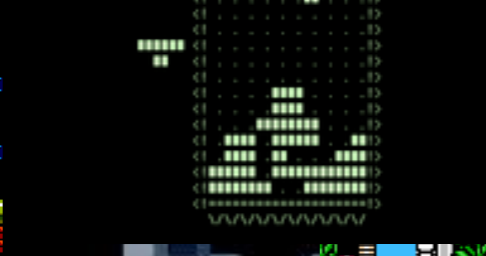
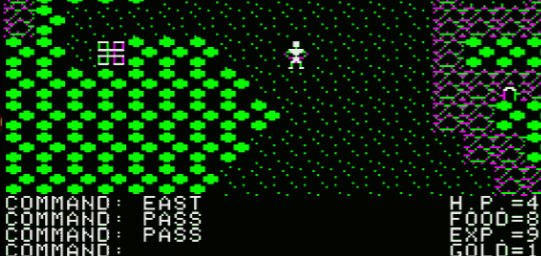
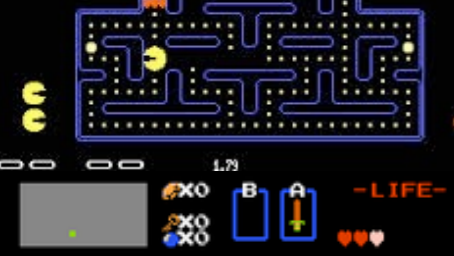
molleindustria. <http://www.gamedefinitions.com/>

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





ara: The human subconscious instinctively resists the joining, Commander. A strong p
like yours makes it even harder.

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

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 2
Heuristics for Designing Enjoyable
User Interfaces

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

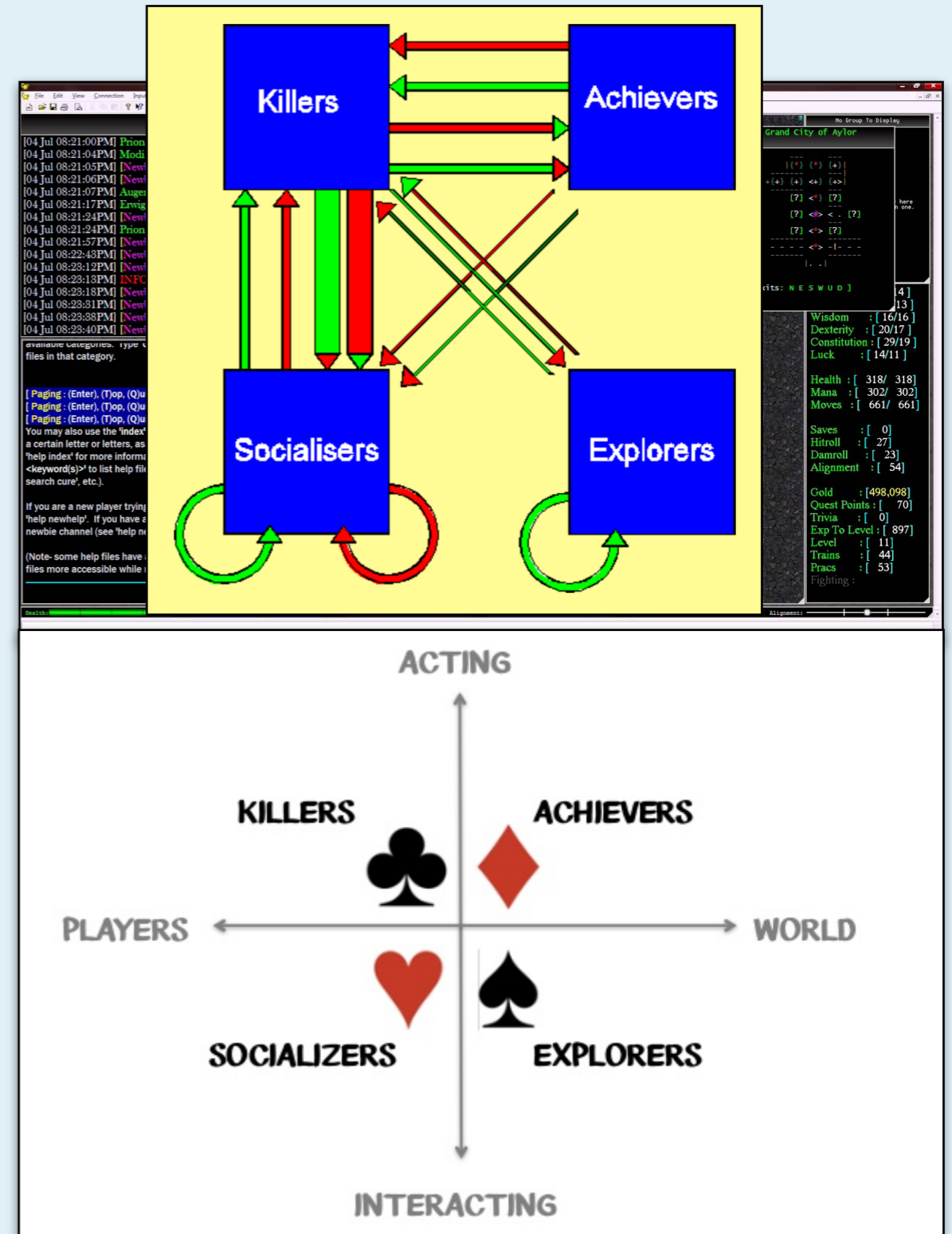
- Bartle's (1996) *Players Who Suit MUDs*
 - ▶ Different players value challenge, fantasy, curiosity differently

The top image is a screenshot of a MUD game interface. The left pane shows a communication log with timestamps and player messages. The right pane shows a top-down view of a city grid with various colored squares representing buildings and terrain. A status window on the right lists player attributes: Wisdom, Dexterity, Constitution, Luck, Health, Mana, Moves, Saves, Hitroll, Damroll, Alignment, Gold, Quest Points, Trivia, Exp To Level, Level, Trains, Fracs, and Fighting.

The bottom image is a 2x2 matrix diagram illustrating Bartle's player types. The vertical axis represents the player's orientation towards the game world, with 'ACTING' at the top and 'INTERACTING' at the bottom. The horizontal axis represents the player's orientation towards other players, with 'PLAYERS' on the left and 'WORLD' on the right. The four quadrants are: Killers (top-left, Club symbol), Achievers (top-right, Diamond symbol), Socializers (bottom-left, Heart symbol), and Explorers (bottom-right, Spade symbol).

Understanding Player & Game

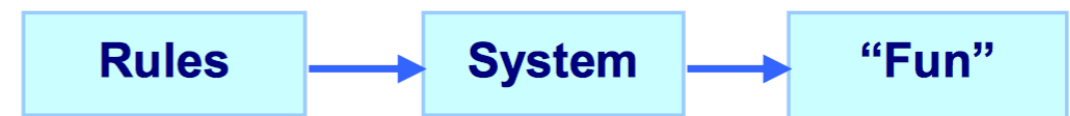
- Bartle's (1996) *Players Who Suit MUDs*
 - ▶ Different players value challenge, fantasy, curiosity differently
 - ▶ Tradeoffs for experience



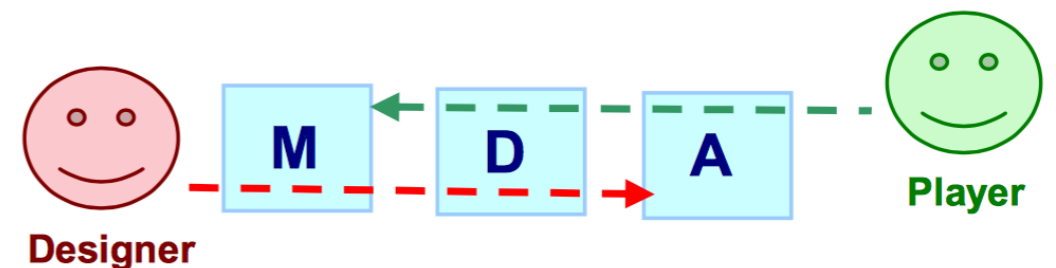
Understanding Player & Game

- 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:



...and establishing their design counterparts:



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*



The screenshot shows the homepage of the CHI PLAY 2014 conference website. At the top, there is an orange search bar. Below it is a large banner image of the Toronto skyline with the CN Tower. The text "CHI PLAY 2014" is prominently displayed in the center of the banner. To the right, the dates "October 19-22" and the location "Radisson Admiral Hotel Toronto Harbourfront" are listed. Below the banner is a blue navigation bar with links for "Attending", "Program", "Participate", "Courses", "Workshops", "Keynotes", and "Organizers".

Welcome

CHI PLAY is an international and interdisciplinary conference (by ACM SIGCHI) for researchers and professionals across all areas of play, games and human-computer interaction (HCI). We call this area "player-computer interaction."

A Fragmented Field

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



Welcome

CHI PLAY is an international and interdisciplinary conference (by ACM SIGCHI) for researchers and professionals across all areas of play, games and human-computer interaction (HCI). We call this area “player-computer interaction.”

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

THE BUSINESS OF     
GAMIFICATION

WHAT IS GAMIFICATION?  
Gamification is the use of elements of game play in non-game contexts. It provides rewards and engagement for customers.

HOW GAMIFICATION WORKS:

5 COMMON MECHANICS

-  **POINTS**
Measure a user's achievements in relation to others
Can double as currency to exchange for rewards
-  **BADGES**
Reward achievements visually
-  **LEVELS**
Encourage users to progress and unlock new rewards
-  **LEADERBOARDS**
Organise players by rank
-  **CHALLENGES**
Encourage engagement by offering specific tasks to complete

4 MAIN WAYS TO DRIVE ENGAGEMENT

-  **ACCELERATED FEEDBACK CYCLES**
-  **CLEAR GOALS AND RULES OF PLAY**
-  **A COMPELLING NARRATIVE**
-  **CHALLENGING BUT ACHIEVABLE TASKS**

A Fragmented Field

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

Plunkett, Luke. (2010). *Where Board Games and Video Games Come Together*. Kotaku. Available: <https://www.kotaku.com.au/2010/07/where-board-games-and-video-games-come-together/>



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



Fighter



Wizard



Rogue

A Fragmented Field

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



Twitch Plays Pokémon

<i>Pokémon Red</i>	12 February 2014	1 March 2014	16 days, 9 hours, 55 minutes, 4 seconds
--------------------	------------------------	--------------	--

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

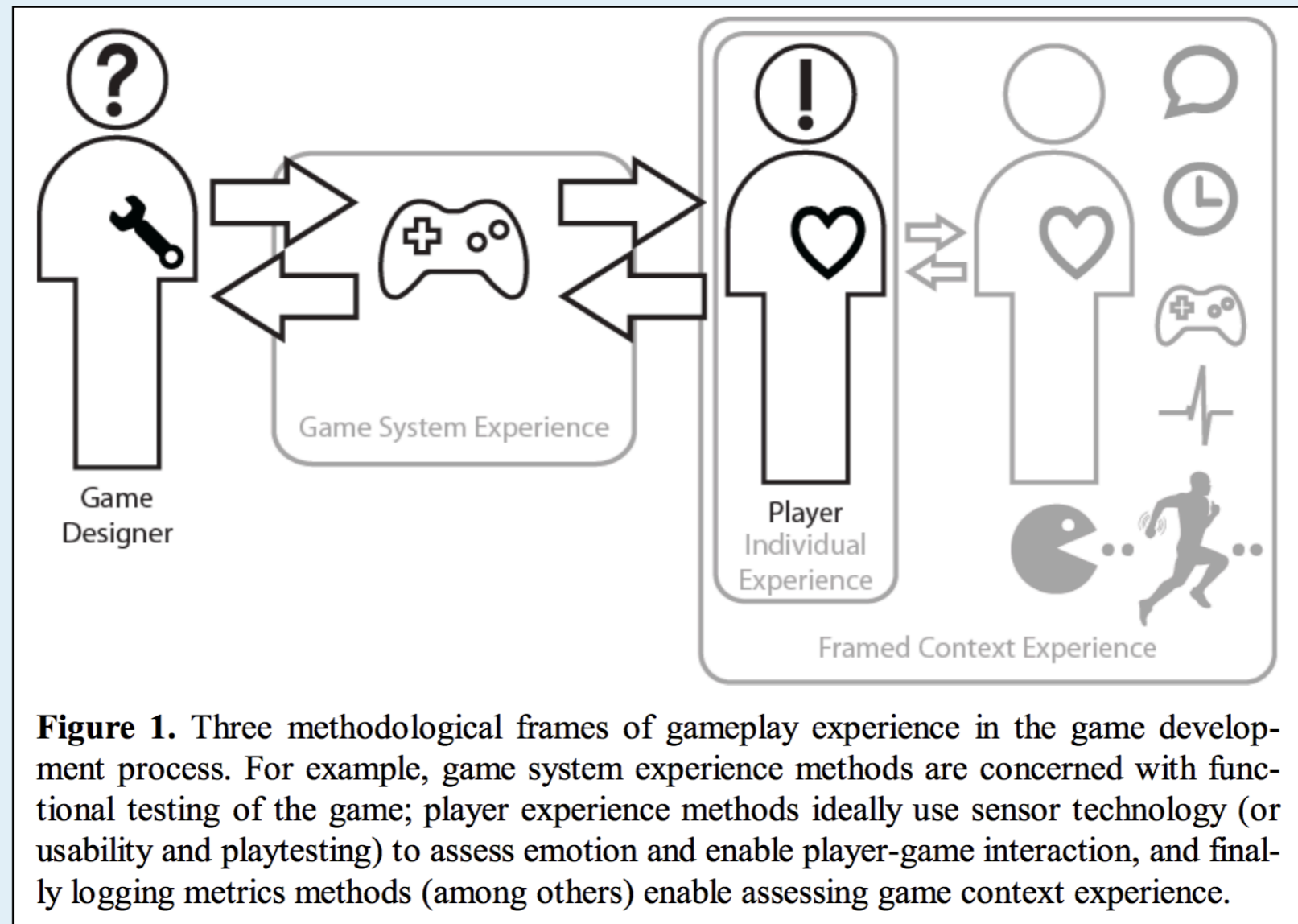
A Fragmented Field

- 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*



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

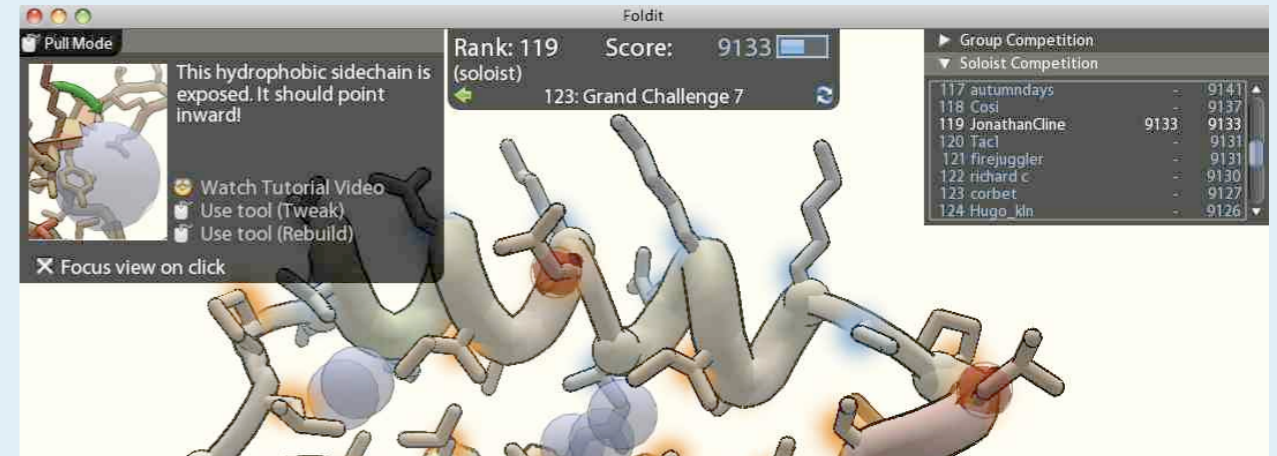
- Past: Understanding Player & Game
- Present: A Fragmented Field
- **Future: The Science of Game Design**

A Science of Game Design is Needed

Gamification



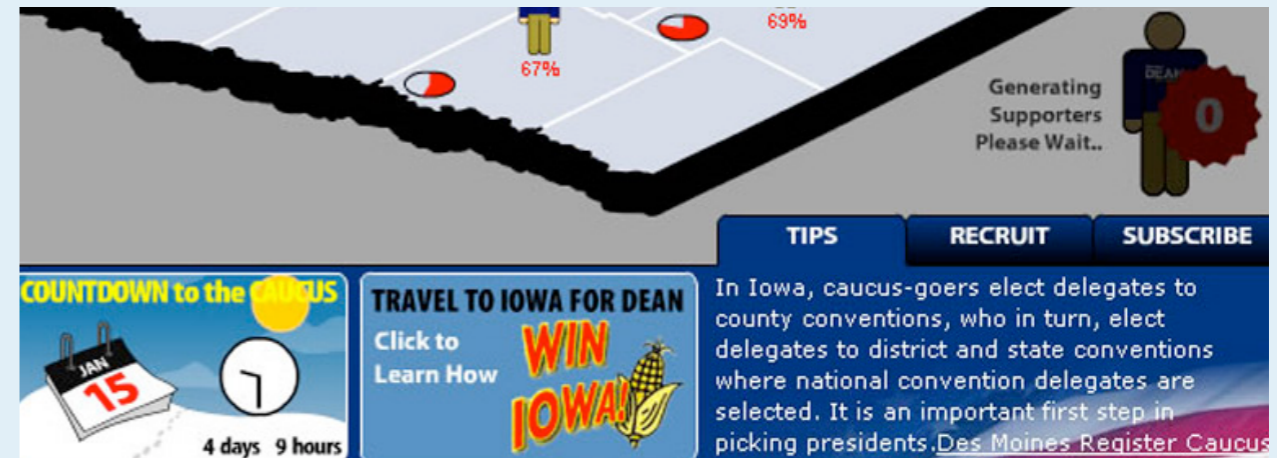
Science discovery



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™

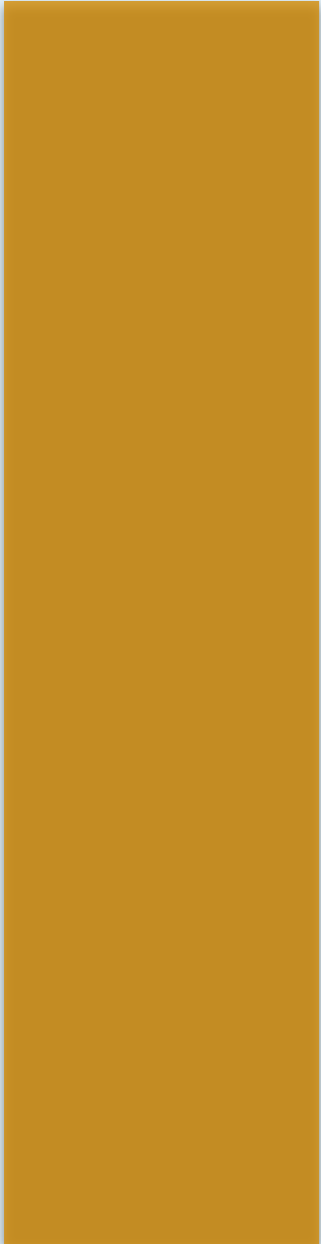


- Costly
- Difficult
- Poorly understood

Cost of Most Expensive Games per Year



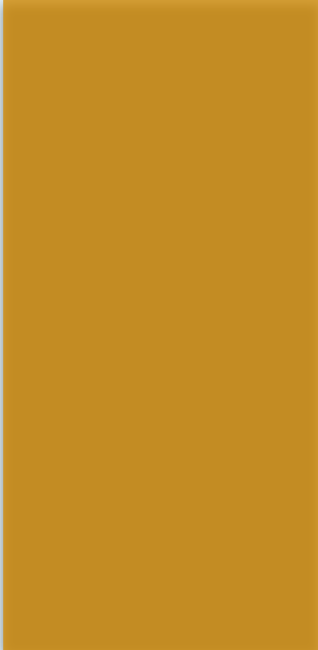
\$200M



2011



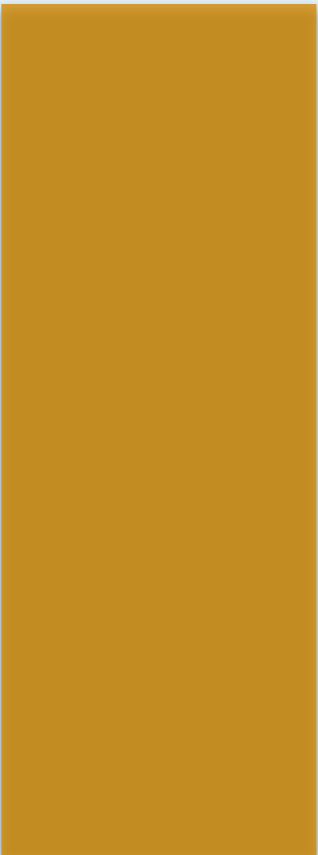
\$105M



2012



\$137M

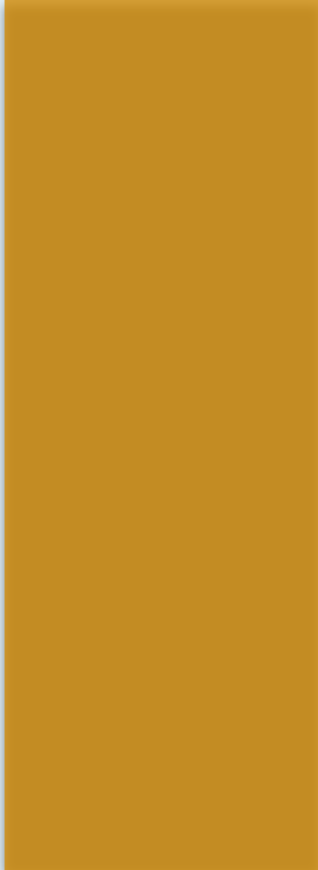


2013

D E S T I N Y



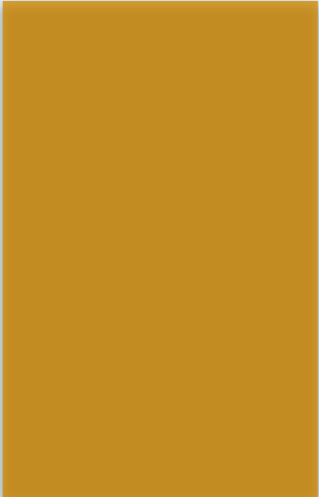
\$140M



2014

MGSV

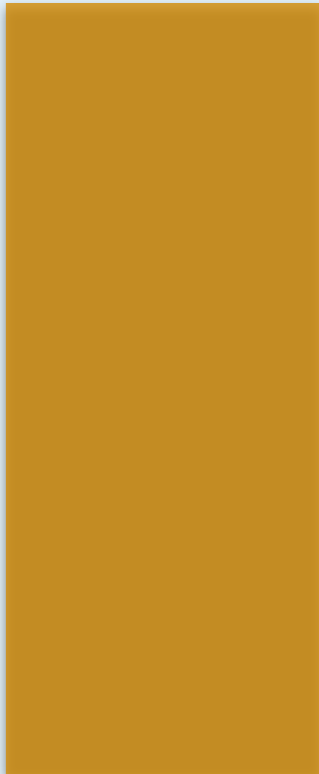
\$80M



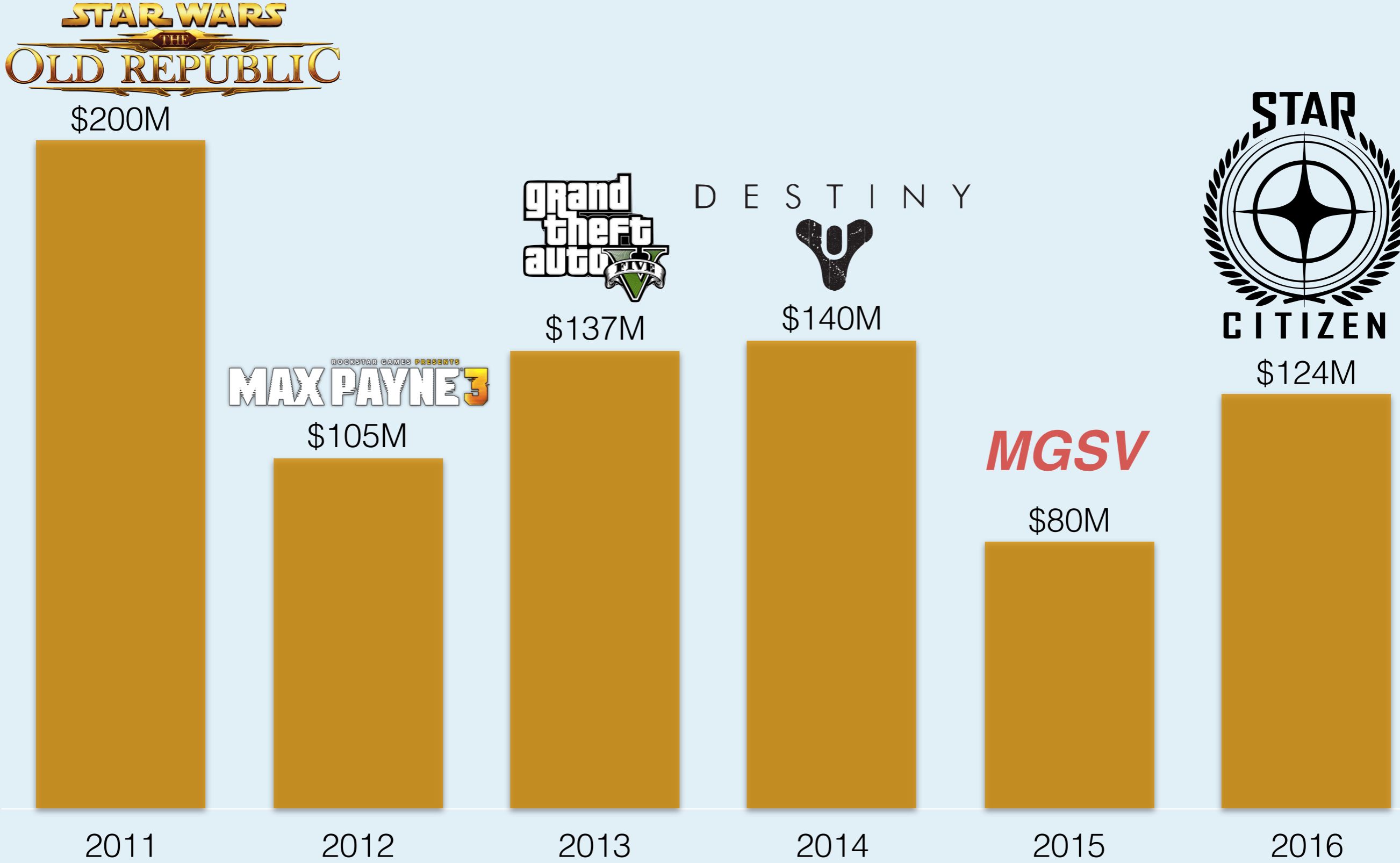
2015



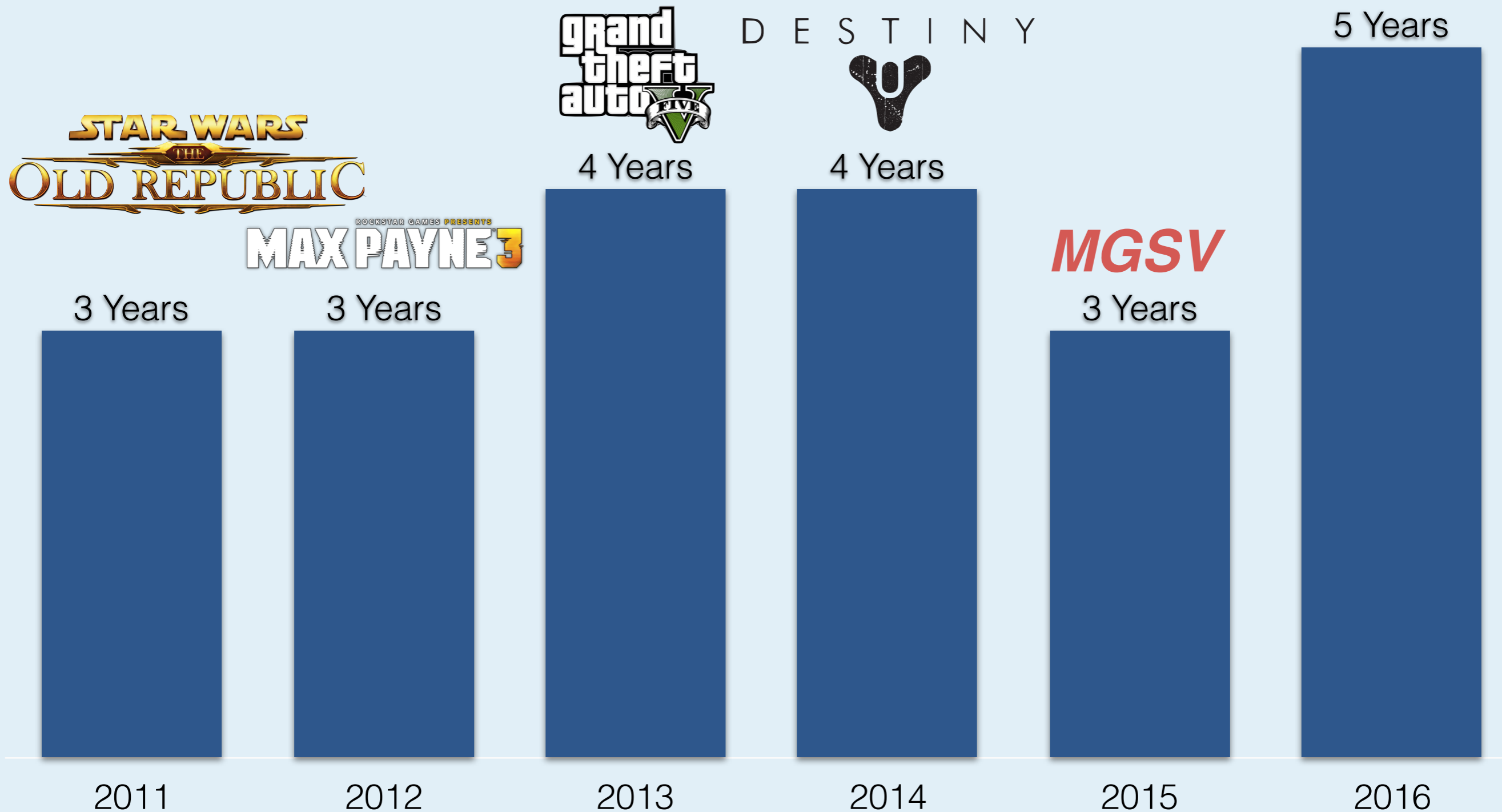
\$124M



2016

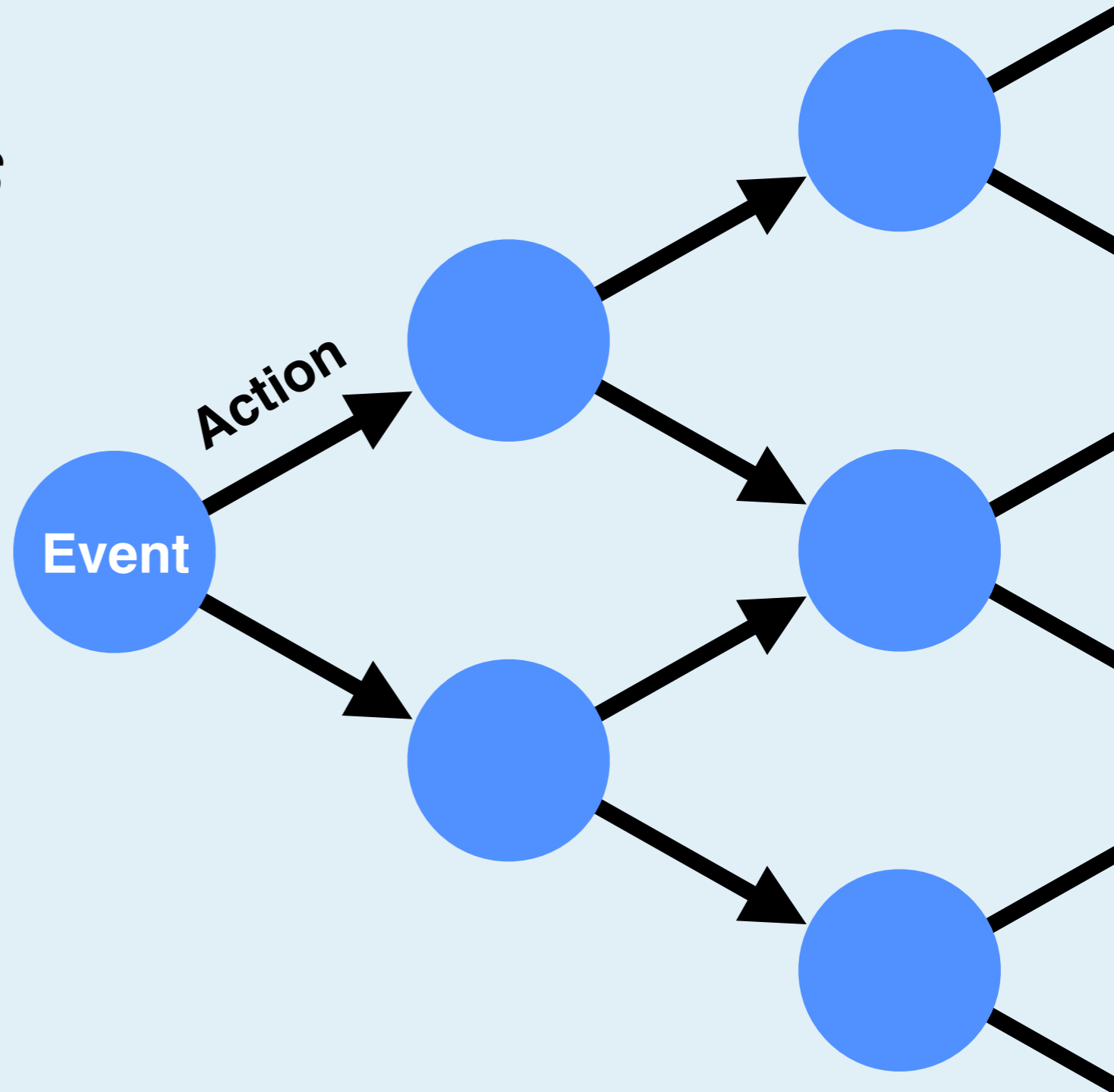


Time to develop those games



Authorial Combinatorics Problem

- Bruckman's (1990) *The Combinatorics of Storytelling: Mystery Train Interactive*
 - Content authoring increases exponentially with player choice



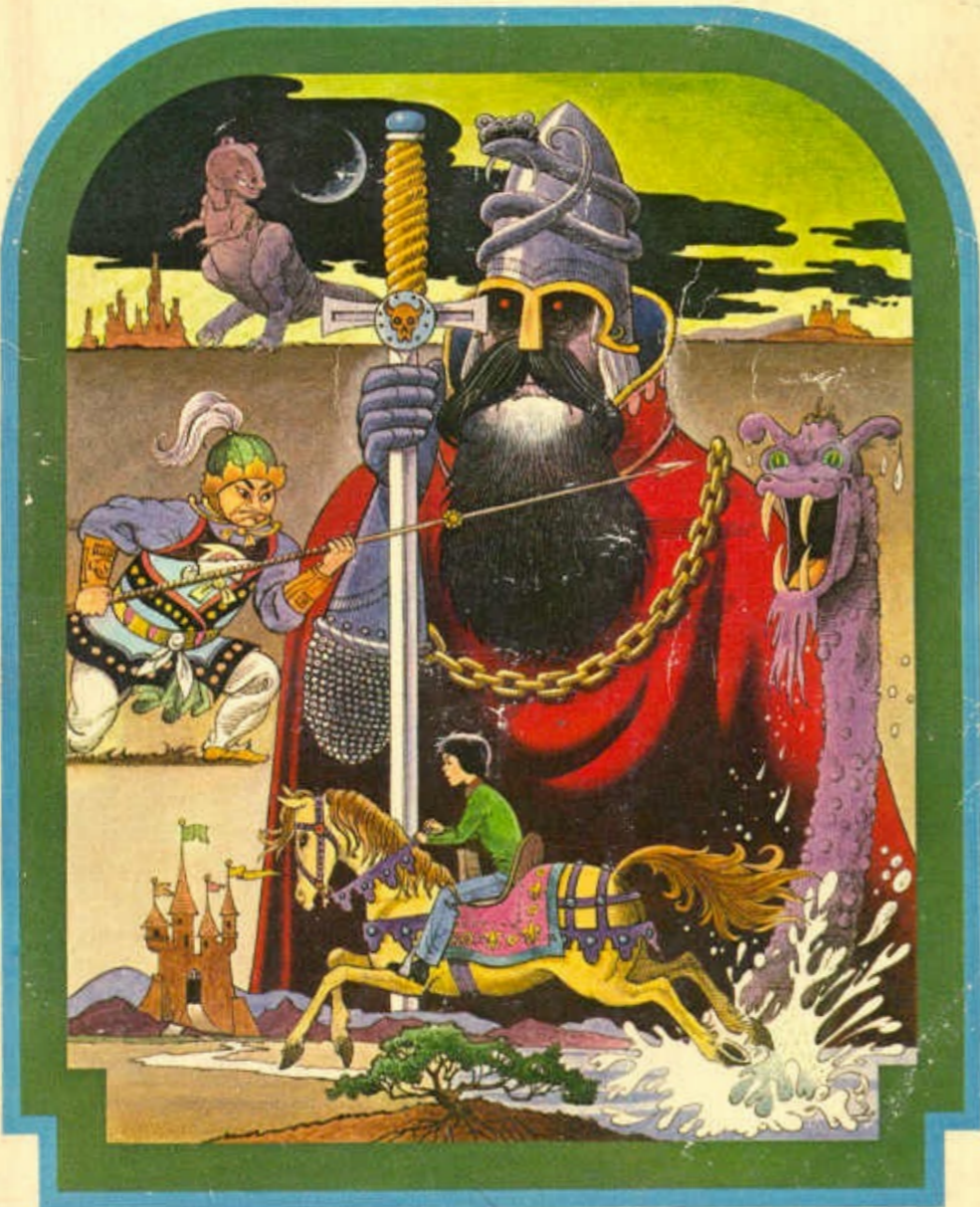
CHOOSE YOUR OWN ADVENTURE · 1



Random House

THE CAVE OF TIME

BY EDWARD PACKARD



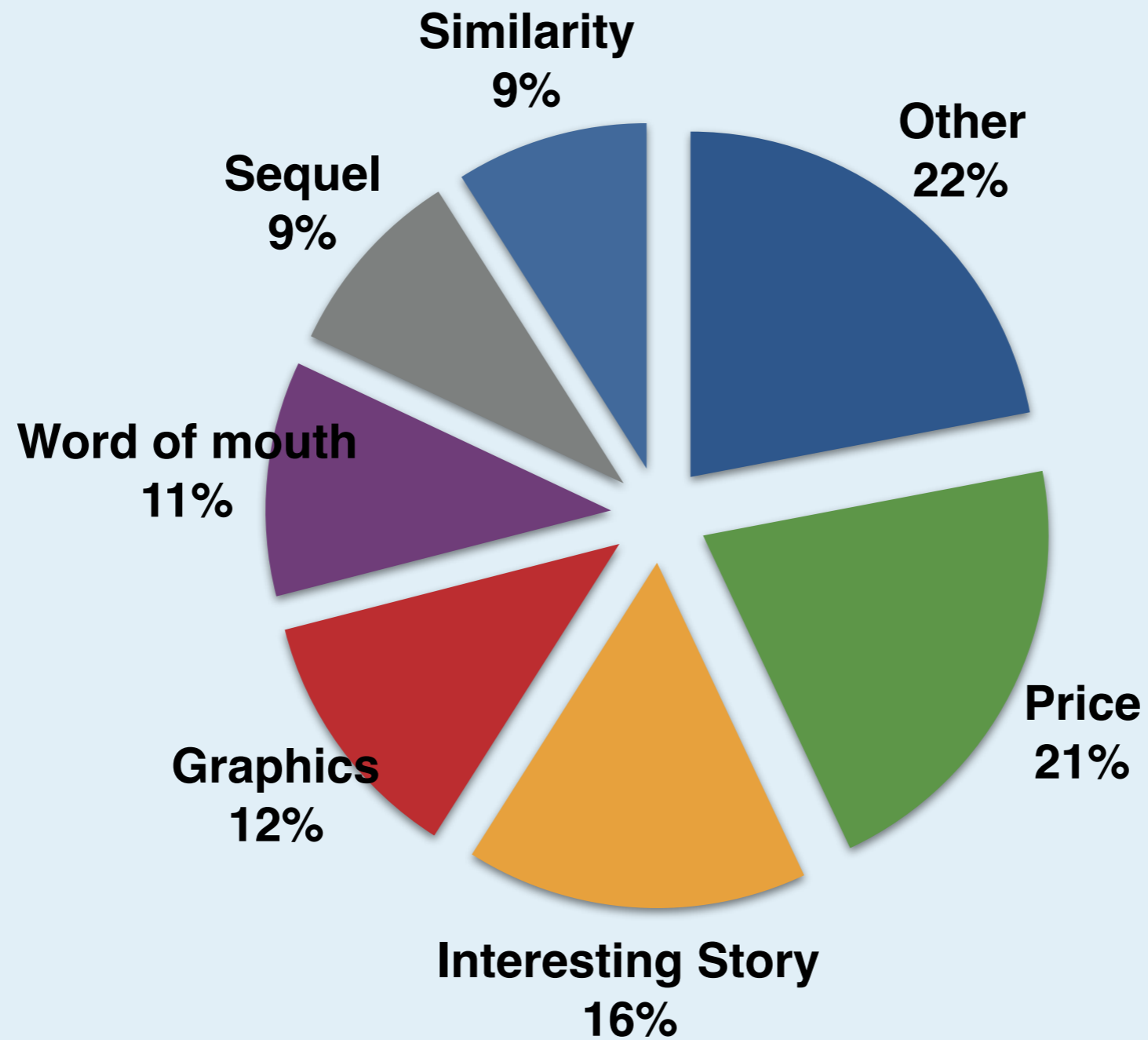
STAR WARS THE OLD REPUBLIC

12 full-time writers + 3 years
= 200,000 lines of dialogue
(approx. 1,000,000 words)

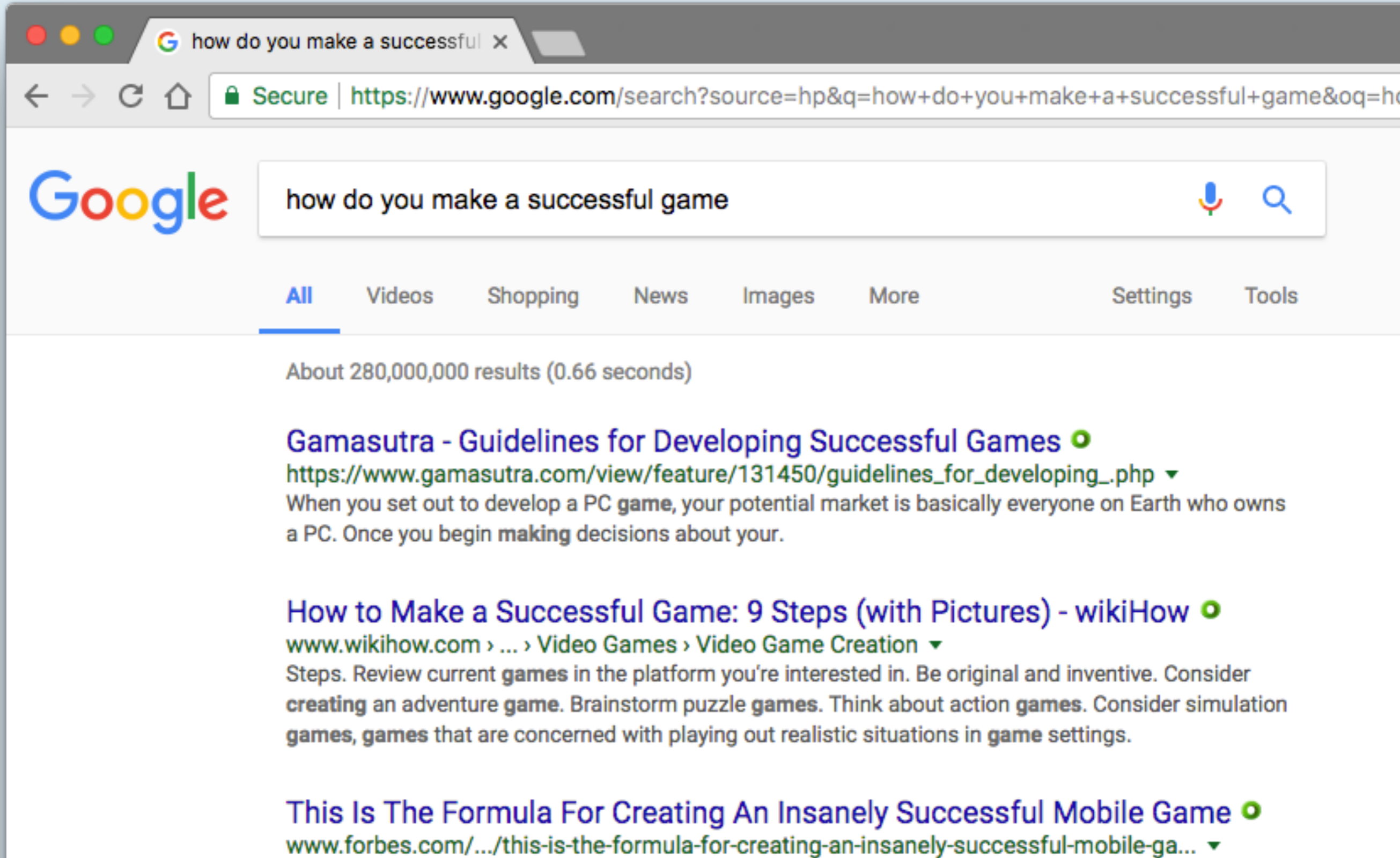


(1,094,170 words)

Factors Influencing the Decision to Buy a Game



Engineering Successful Games



A screenshot of a web browser showing a Google search for "how do you make a successful game". The search results page displays the Google logo, the search query, and navigation tabs for "All", "Videos", "Shopping", "News", "Images", "More", "Settings", and "Tools". The search results show approximately 280,000,000 results in 0.66 seconds. Three search results are visible, each with a title, a URL, and a brief description.

how do you make a successful x


Secure | <https://www.google.com/search?source=hp&q=how+do+you+make+a+successful+game&oq=ho>

Google

how do you make a successful game


All Videos Shopping News Images More Settings Tools

About 280,000,000 results (0.66 seconds)

Gamasutra - Guidelines for Developing Successful Games 


https://www.gamasutra.com/view/feature/131450/guidelines_for_developing_.php ▼

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 

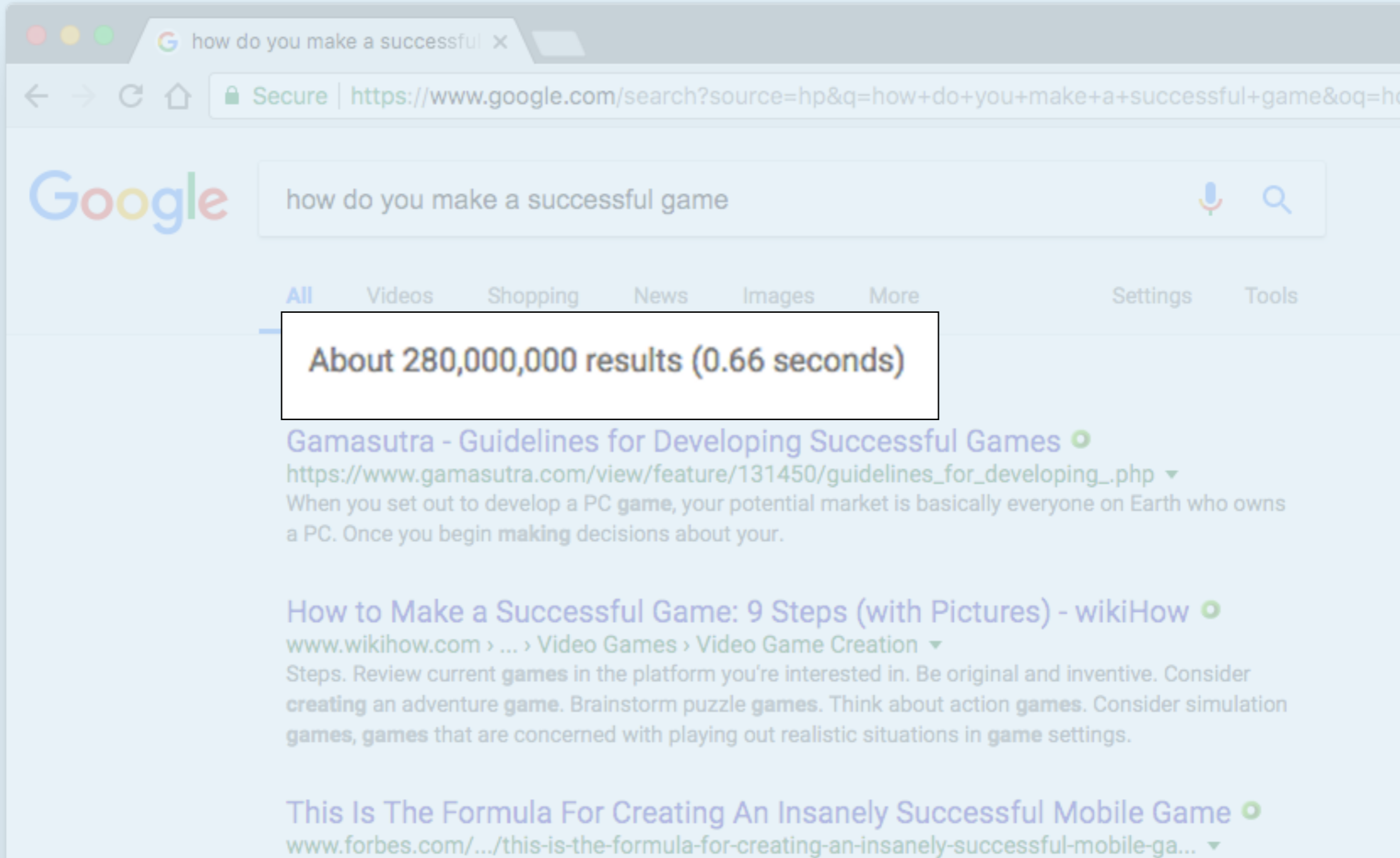
www.wikihow.com > ... > Video Games > Video Game Creation ▼

Steps. Review current games in the platform you're interested in. Be original and inventive. Consider creating an adventure game. Brainstorm puzzle games. Think about action games. Consider simulation games, games that are concerned with playing out realistic situations in game settings.

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



A screenshot of a Google search page. The search bar contains the text "how do you make a successful game". Below the search bar, there are navigation tabs for "All", "Videos", "Shopping", "News", "Images", and "More". A yellow box highlights the search results summary: "About 280,000,000 results (0.66 seconds)". Below this, three search results are visible:

- Gamasutra - Guidelines for Developing Successful Games**
https://www.gamasutra.com/view/feature/131450/guidelines_for_developing_.php
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
Steps. Review current games in the platform you're interested in. Be original and inventive. Consider creating an adventure game. Brainstorm puzzle games. Think about action games. Consider simulation games, games that are concerned with playing out realistic situations in game settings.
- 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...



FROSTBITE
A DICE TECHNOLOGY



UNREAL
ENGINE



CRYENGINE 3





**UNREAL
ENGINE**

FROSTBITE
A DICE TECHNOLOGY



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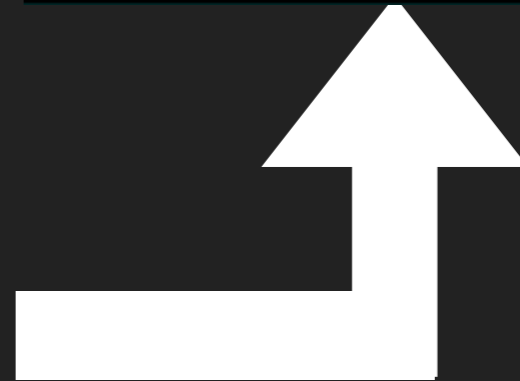
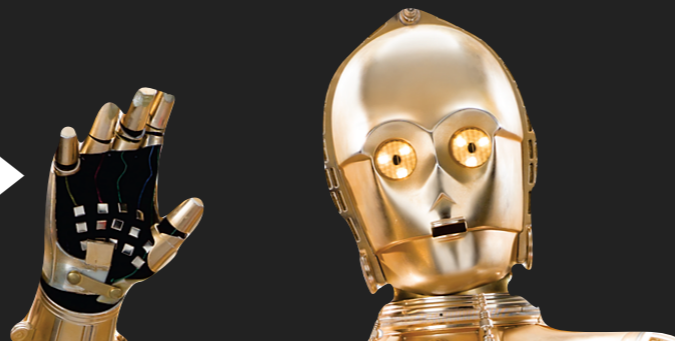
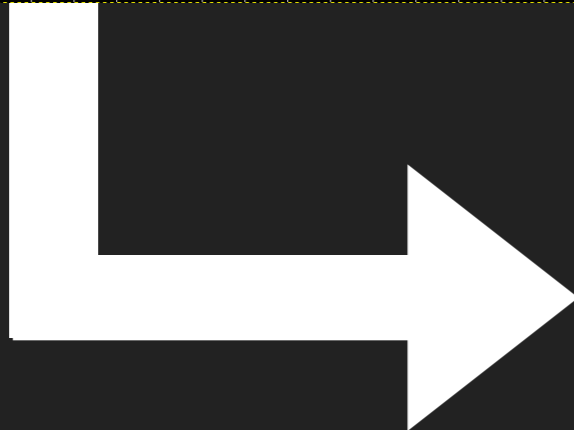
Thomas Zimmermann and Nachiappan Nagappan
Microsoft Research
Redmond, Washington, U.S.
{tzimmer,nachin}@microsoft.com

Meaningless Procedural Content Generation



Procedural content generation

- Artificial intelligence for game content creation



Meaningless Procedural Content Generation

- No Man's Sky can generate 1.8×10^{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?

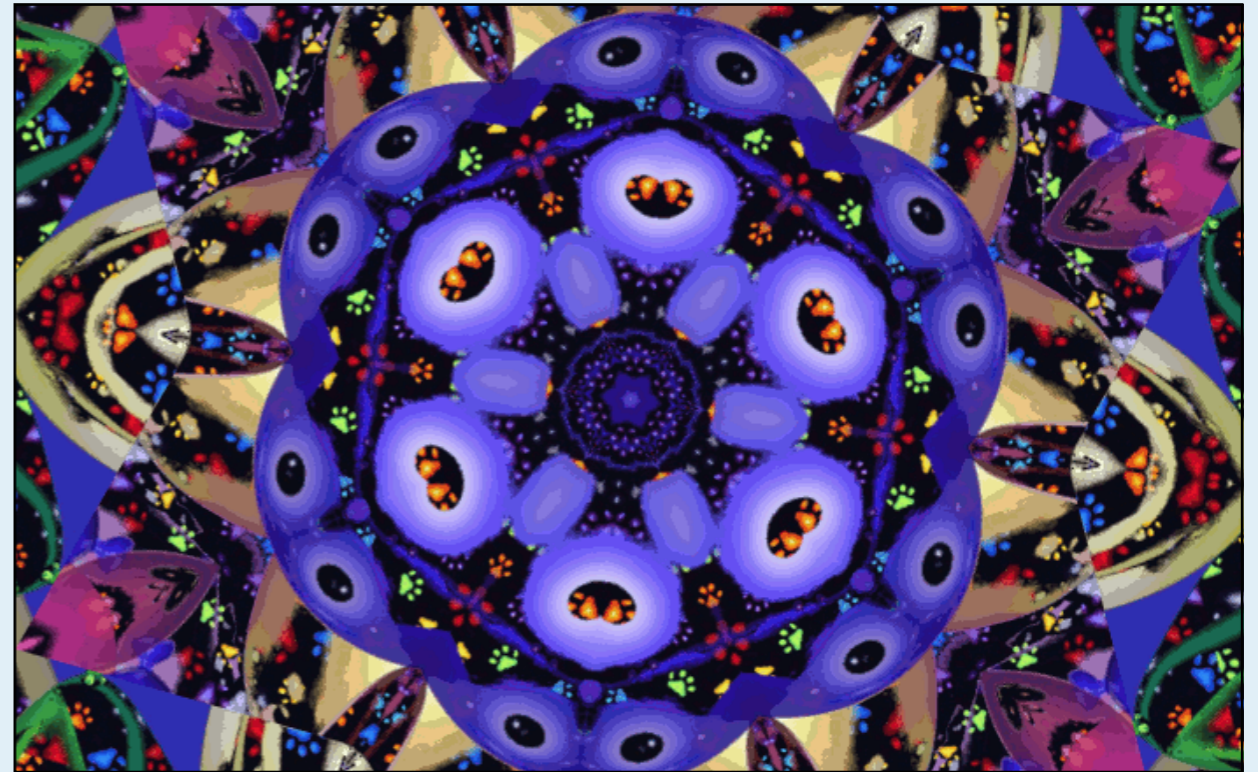
The image shows the title screen of the video game No Man's Sky. The title "NO MAN'S SKY" is written in large, white, sans-serif capital letters across the center. The background is a vibrant, stylized landscape with a green and blue sky, a large white sun or moon, and a variety of colorful, alien-looking plants and structures. In the foreground, a small, red and white rover is parked on the right, and a small, red and white robot-like figure stands in the center.

NO MAN'S SKY

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.

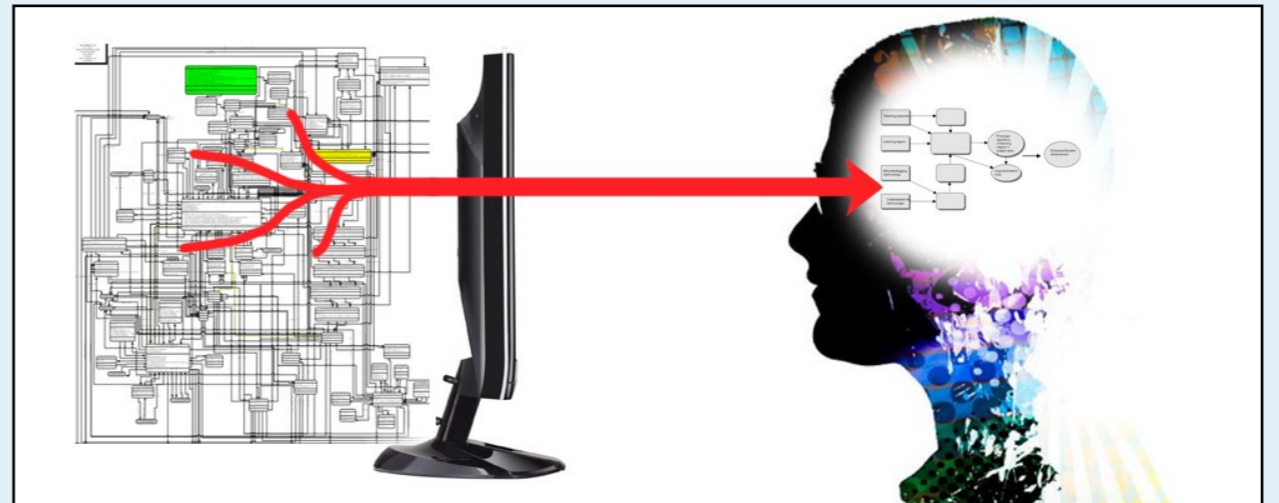
The Kaleidoscope Effect

- Cardona-Rivera's (2017) *Cognitively-grounded Procedural Content Generation*
 - ▶ We can summarize expressive range in our heads



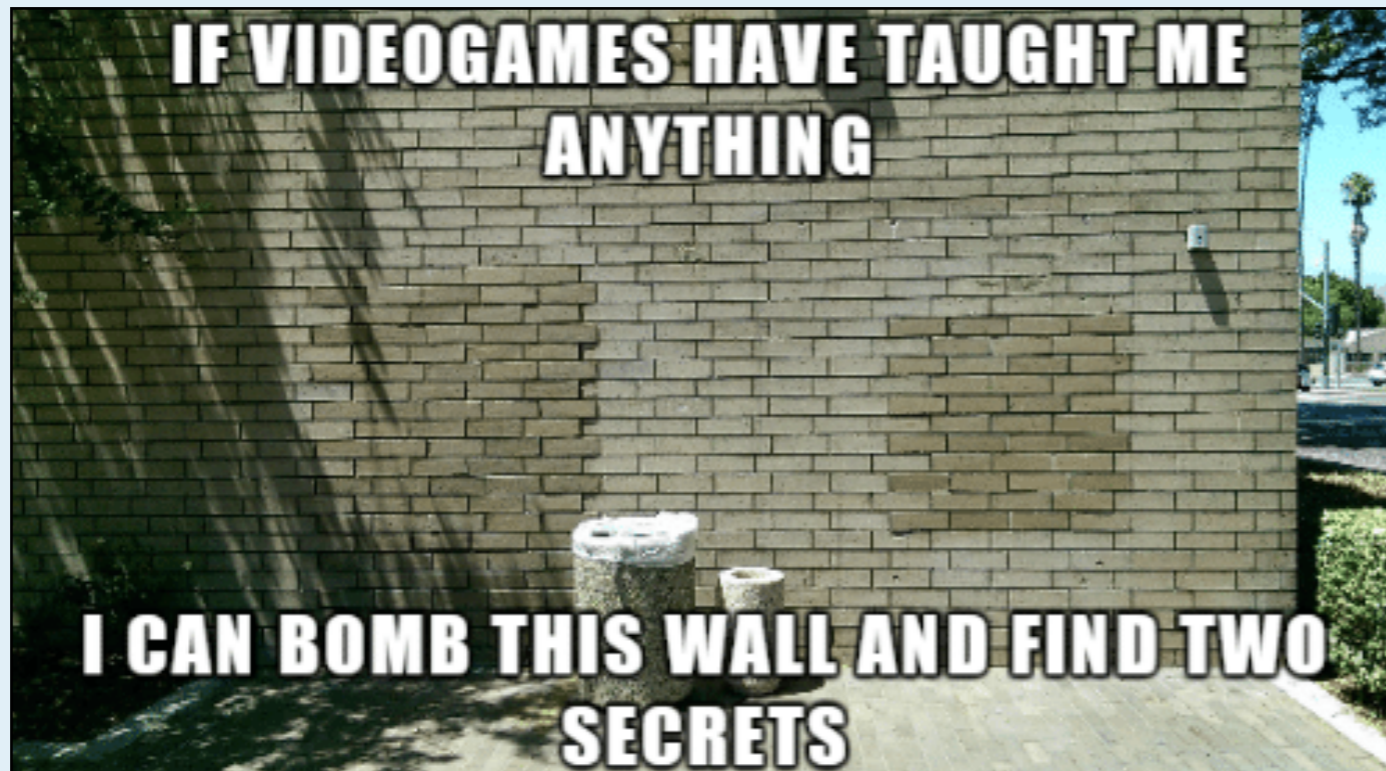
The Player Modeling Principle

- 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



My experience with [#RPG](#) is telling me to ask this guy if he has any rare weapons or abilities for sale.



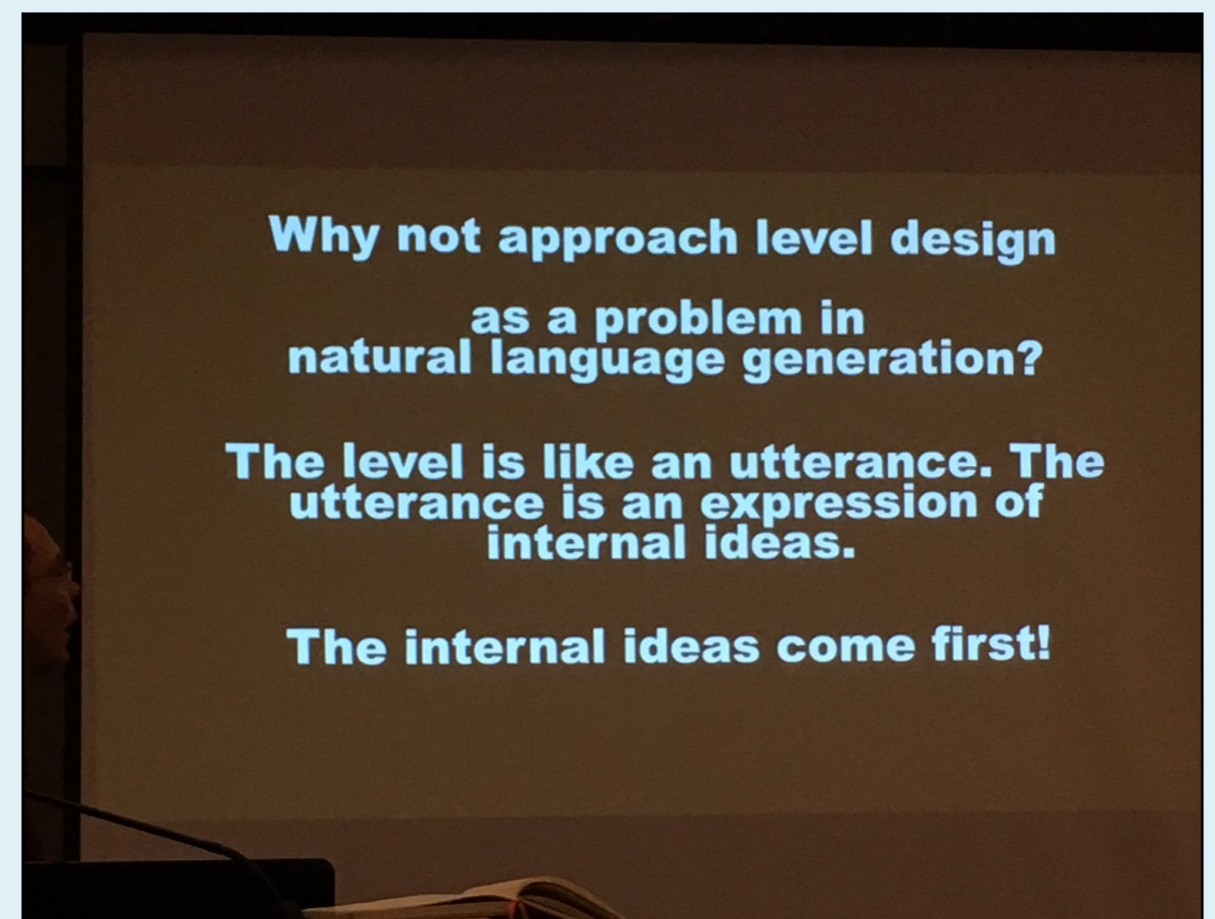
The Bard's Leap



Bethesda Game Studios; The Elder Scrolls V: Skyrim. Bethesda Softworks, 2011.

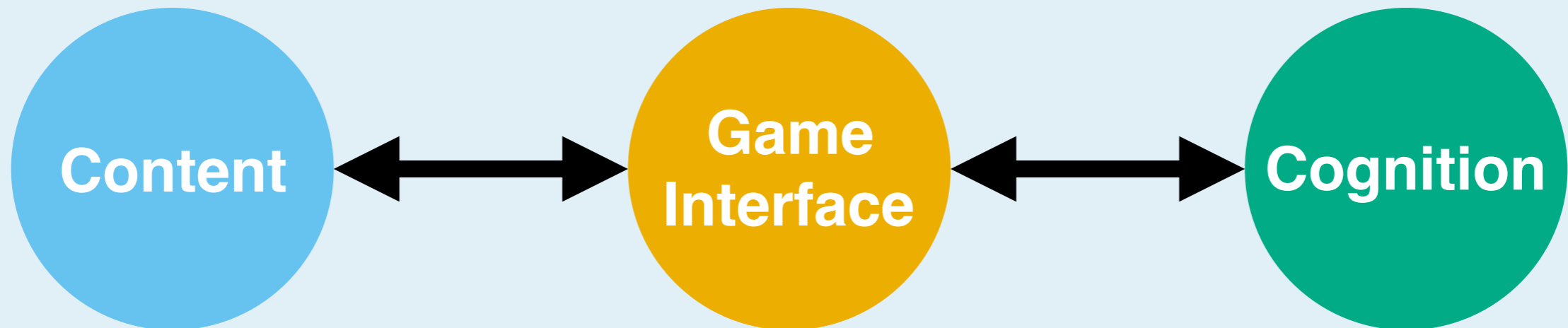
Ontological Framework: Games as Conversation

- 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



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

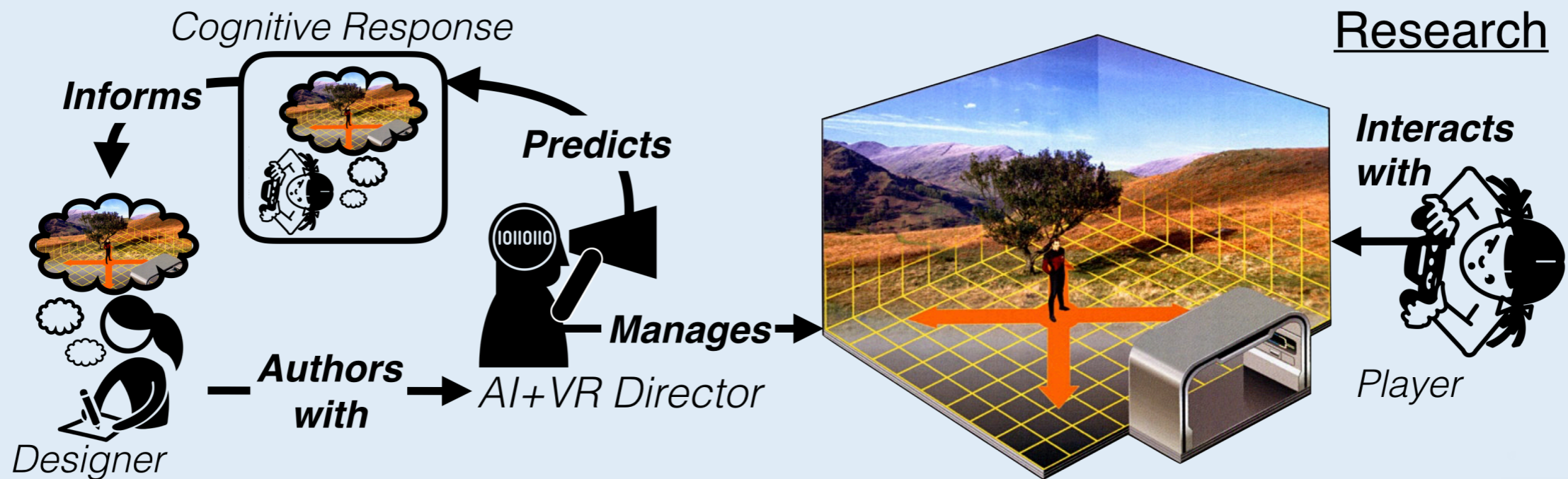
- Past: Understanding Player & Game
- Present: A Fragmented Field
- Future: The Science of Game Design

Wrap

- Photography used to require expertise
 - Digital camera changed that



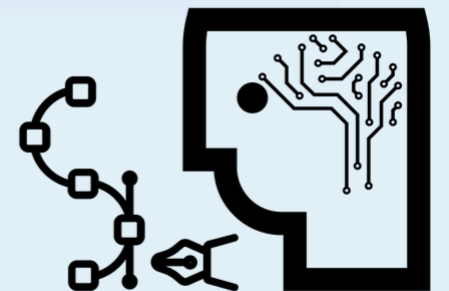
- My work targets the science of game design through the invention of its digital camera



Rogelio E. Cardona-Rivera, Ph.D.
rogelio@cs.utah.edu

qed.cs.utah.edu

LABORATORY FOR QUANTITATIVE EXPERIENCE DESIGN



Shameless Plug

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.



SPRING 2020
**ARTIFICIAL
INTELLIGENCE
FOR
GAMES**

EAE 6900-023
TH / 4:35-5:55PM

TO LEARN MORE VISIT
[HTTP://QED.CS.UTAH.EDU/](http://qed.cs.utah.edu/)

