

Game Analysis and Research

(a.k.a The Science of Game Design)

Prof. Perttu Hämäläinen 2020

Course contents

- Day 1: Game design and research intro
- Day 2: Game design math, balancing, analytics
- Day 3: Psychology of game design: Behavioral game design, behavioral economics, monetization, free-to-play
- Day 4: Psychology of game design: Intrinsic motivation, emotion
- Day 5: Understanding the human body: Motor learning and performance for action game design, movement-based games (visit to Valo Motion: Not this year because of COVID-19. You're welcome to join next year.)

Books



Games & Animation

Making a successful video game is hard. Even games that are successful at launch may fail to engage and retain players in the long term due to issues with the user experience (UX). In a nutshell, game UX is about considering the gamer's brain: understanding human capabilities and limitations to anticipate how a game will be perceived, the emotions and motivation it will elicit, and how players will interact with it. This book is designed to help readers identify the ingredients for successful and engaging video games, empowering them to develop their own unique game recipe more efficiently.

Key Features:

- Provides a complete overview of how the brain works in a very accessible way.
- Provides a unique game UX framework, using numerous examples from released games.
- Covers design thinking, user research, analytics, and UX strategy.
- This book is a practical tool that any professional game developer or student can use right away and includes the most complete overview of UX in games existing today.

Author Bio:

Celia Hodent, Ph.D in psychology with over ten years of experience in the entertainment industry, is recognized as a leader in the application of user experience and psychology in video games, and in the development of UX strategy in game studios. Celia has worked at Ubisoft, LucasArts, and Epic Games on many projects across multiple platforms, including the *Tom Clancy's Rainbow Six* franchise, *Star Wars: 1313*, *Paragon*, *Fortnite*, and *Spyjinx*.

Reviews:

"The beauty of this book is that it is two things at the same time:

- 1. An amazingly complete introduction to psychology, using examples from video games to make the concepts clear and memorable.*
- 2. An amazingly complete introduction to video game design, using psychology to help design more compelling games*

So whether you are a game designer, a player, or someone wishing to understand psychology, this is the book for you."

—**Don Norman**, Director, the Design Lab at the University of California, San Diego
author of *The Design of Everyday Things*

"By blending up-to-date brain science with game-relevant UX design principles, this book doesn't just give great tips about how to make better games, it gives designers the mental tools to get better at thinking about games. Read this, and suddenly you'll know what you're talking about."

—**Jesse Schell**, Game Designer, author of *A Theory of Fun for Game Design*

"This book is an invaluable asset for game developers, whether you work in game design, user experience, or programming. With a lucid overview of the current best knowledge from cognitive psychology, Hodent provides guidelines and approaches to improve the game experience for players that are based on actual science."

—**Raph Koster**, author of *A Theory of Fun for Game Design*

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HODENT

THE GAMER'S BRAIN

The Gamer's Brain

How Neuroscience and UX Can Impact Video Game Design

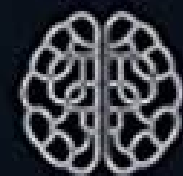


Celia Hodent

Foreword by Brenda Romero

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Players Making Decisions

Game Design Essentials
and the Art of Understanding Your Players

ZACK HIWILLER



Contents (first day, this lecture)

- Motivation: Why research & theory?
- Game definitions
- Game analysis and design frameworks
- Exercises, play games

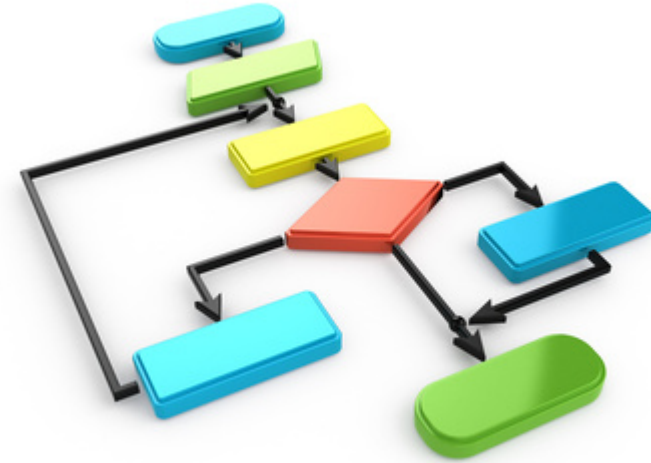


Game research

- Design theory
- How players experience games
- How to predict player behavior, e.g., retention
- How people talk and write about games
- How and why people spectate games (eSports research)
- Design guidelines and heuristics
- Novel game testing methods
- Innovative game design case studies
- Novel technologies
- Novel game mechanics
- Computational intelligence in games
- Games for X (serious games)
- Gamification / persuasive tech

Two types of thinking

SYSTEM 2: EXPLICIT/CONSCIOUS:
SLOW, ALGORITHMIC, EFFORTFUL



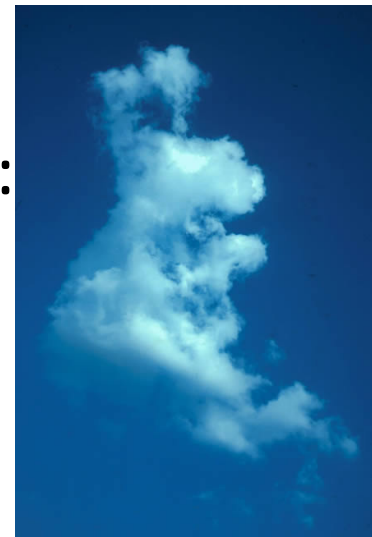
ATTENTION,
PRIMING,
INHIBITION



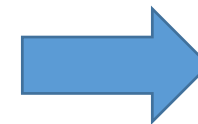
IDEAS,
ASSOCIATIONS,
IMPULSES
(AUTOMATION)



SYSTEM 1: IMPLICIT/UNCONSCIOUS:
FAST, ASSOCIATIVE, EFFORTLESS,
INTUITIVE



ASSOCIATION

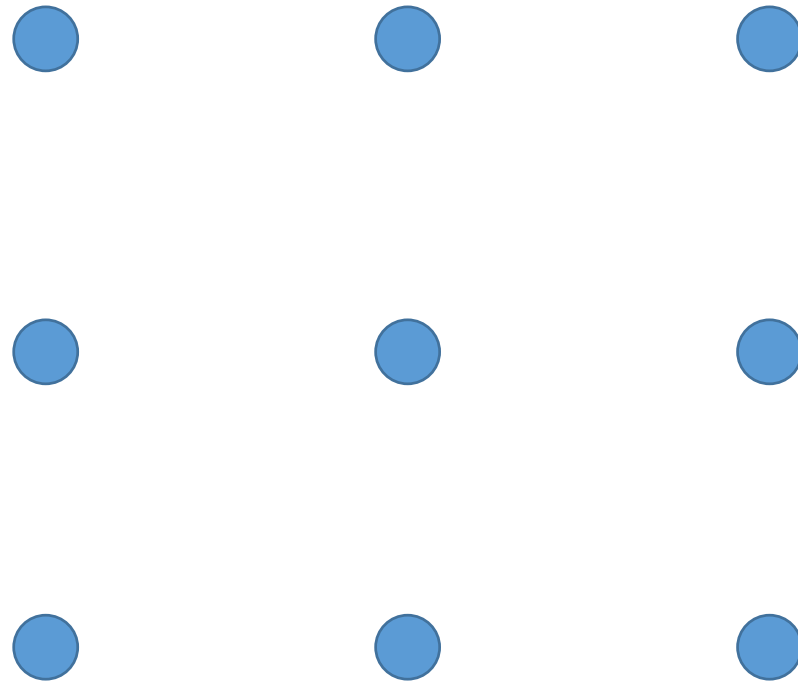




Asking the right questions and focusing attention

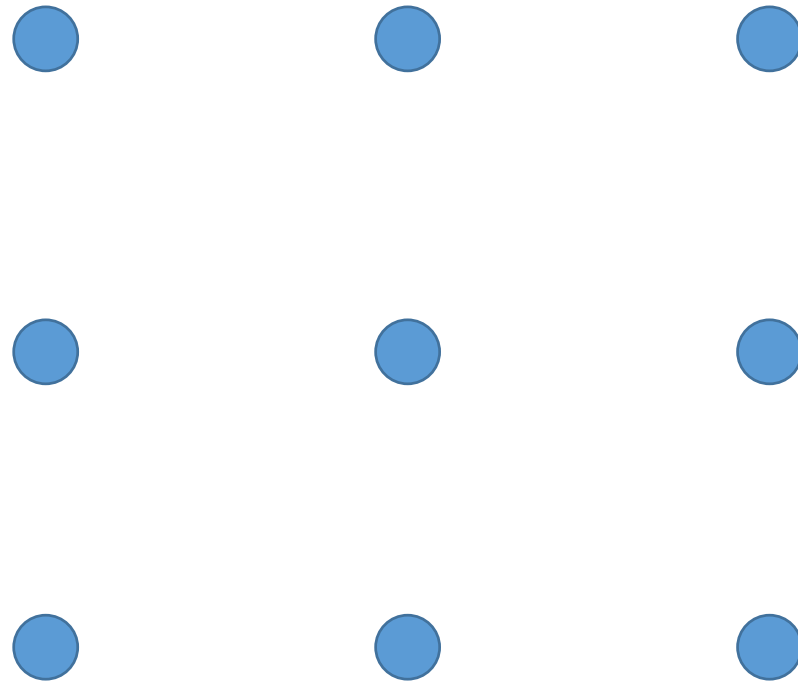


Example: connect the dots with four connected straight lines





Can you think **outside the box**?

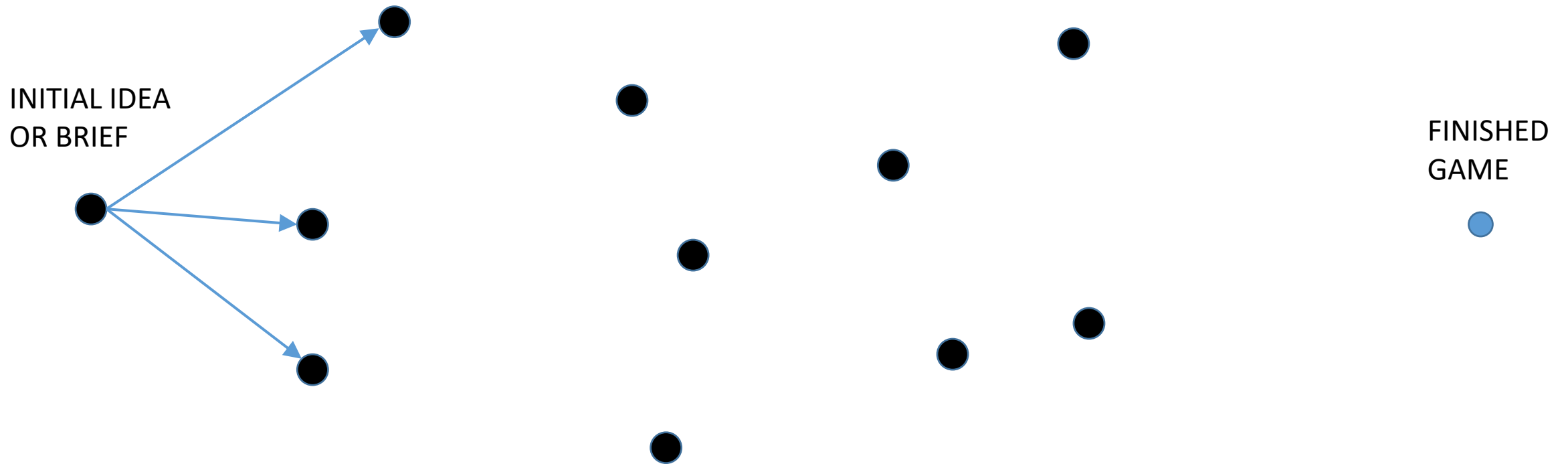




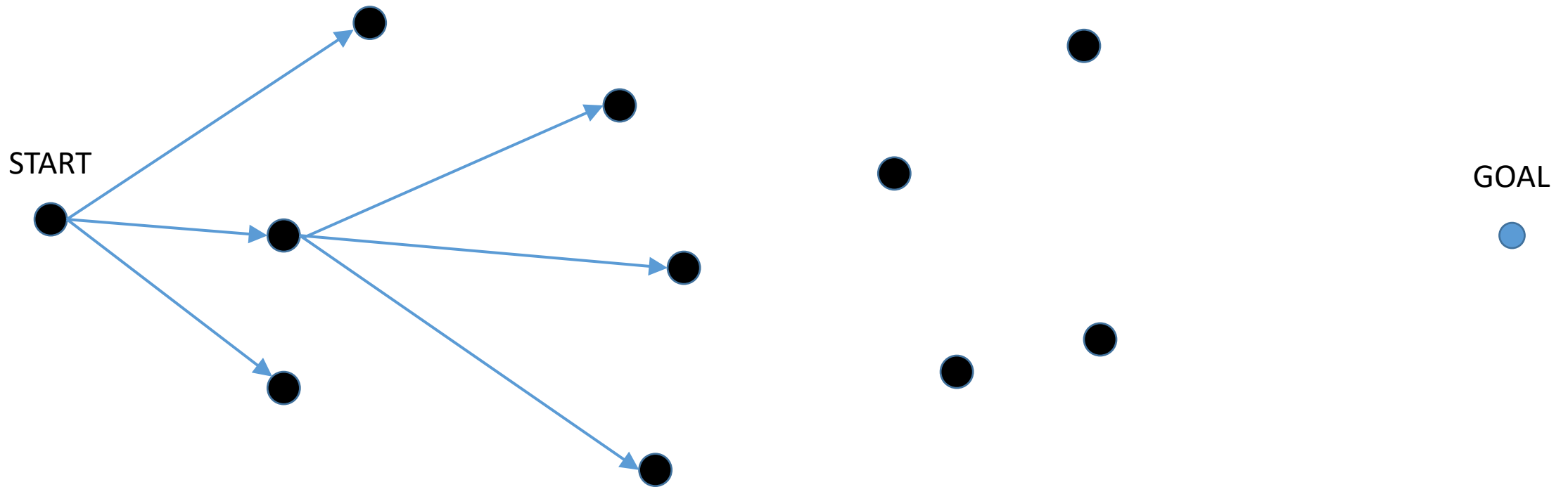
Killing ideas



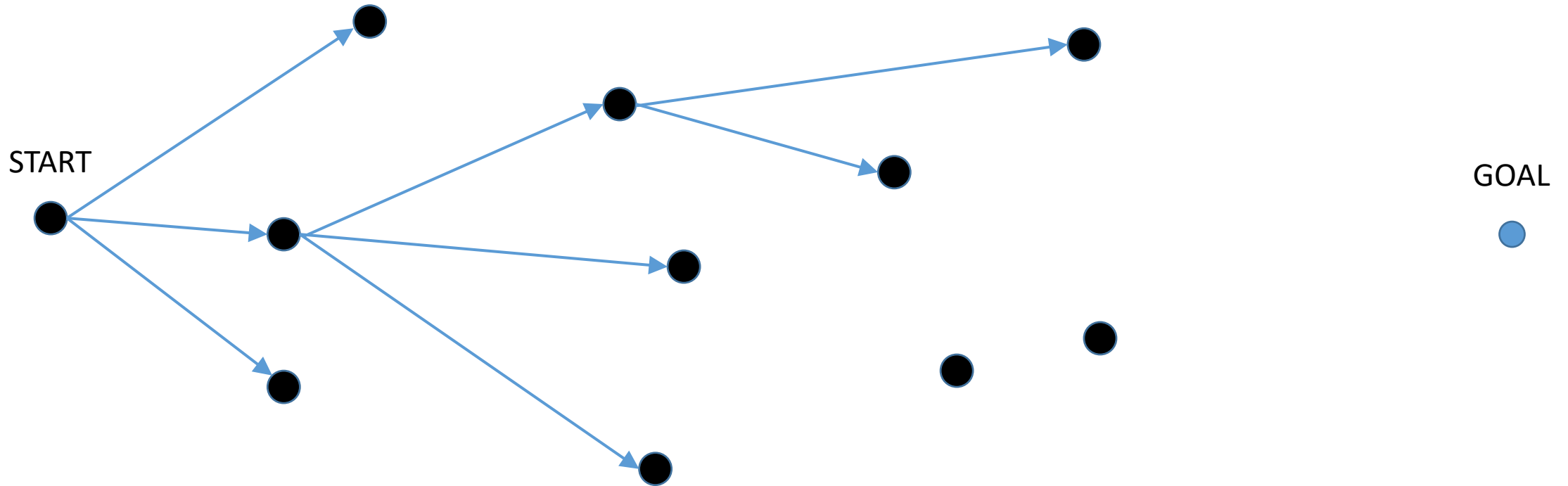
Game design as tree search



Game design as tree search

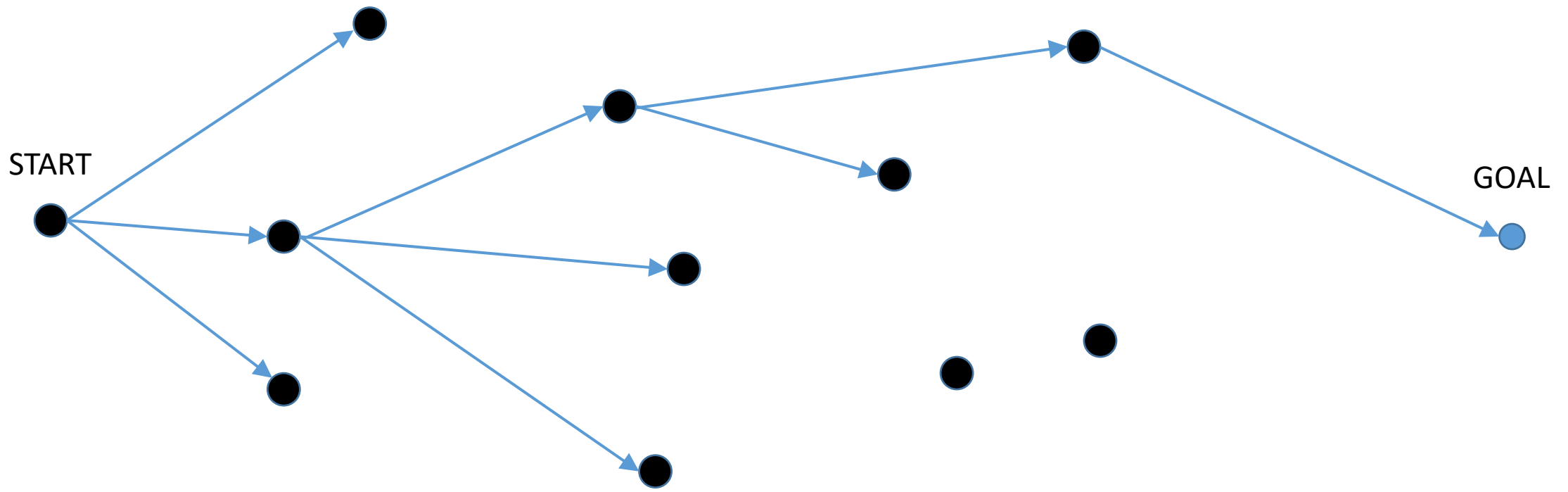


Game design as tree search





Game design as tree search





“We’re agile and iterative”



“We really don’t know shit, it’s just trial and error”



Tree search efficiency

- Time spent in implementing and evaluating a branch – Using agile tools and methods that speed up the feedback cycle
- Search depth – Scoping the game.
- Confidence in making decisions and selecting what alternatives to evaluate – Research of what works and what does not



Science of game design



Contents

- Why research & theory?
- **Game definitions**
- Game analysis and design frameworks
- Current trends in game research



Costikyan 2002

“Interactive structure of endogenous meaning that requires players to struggle toward a goal”



Caillois 1961

"An activity which is essentially:

- Free (voluntary)
- Separate (in time and space)
- Uncertain
- Unproductive (as opposed to work)
- Governed by rules (different than ordinary laws)
- Make-believe (accompanied by an awareness of a second reality)



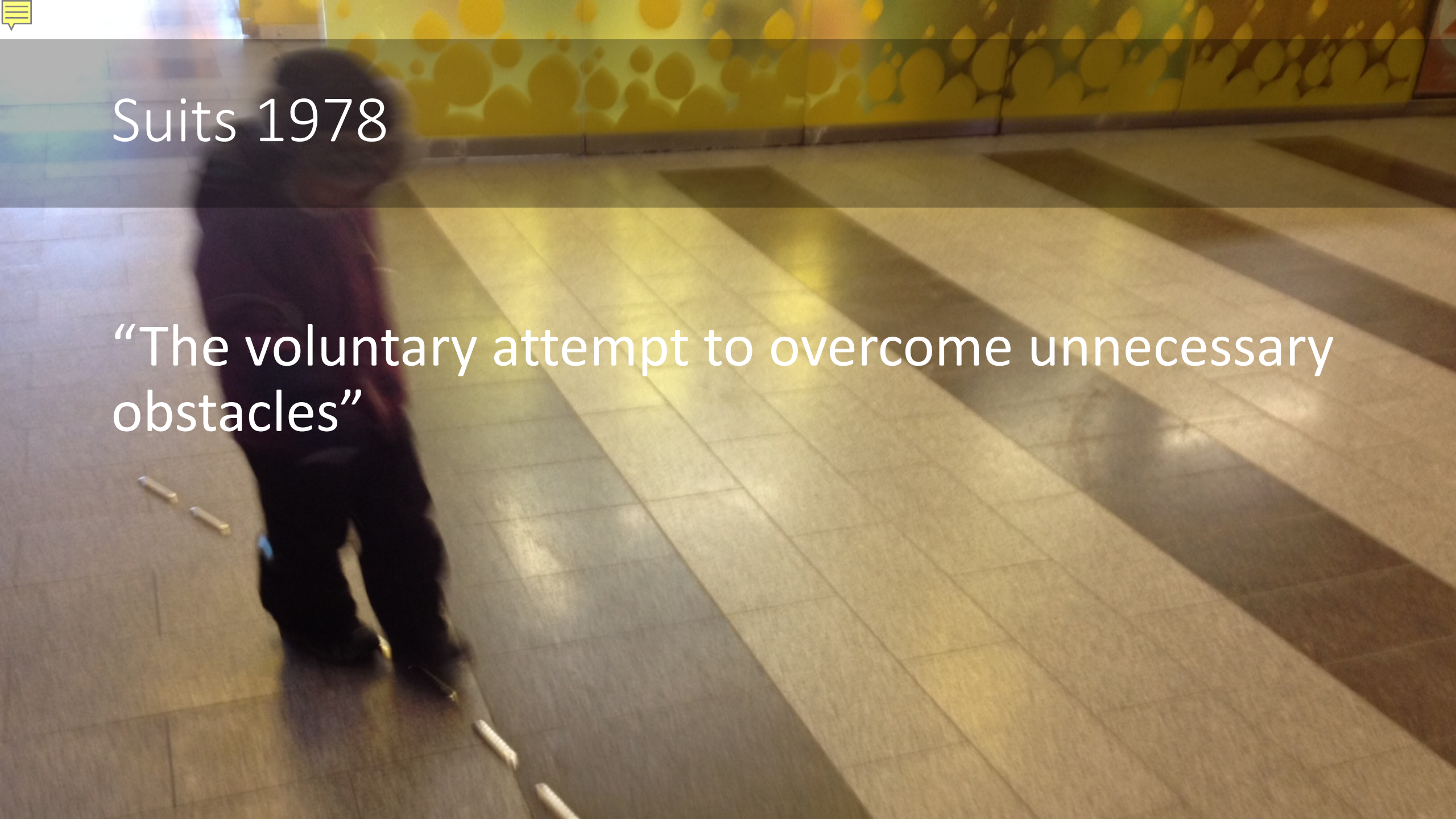
Schell

“A problem-solving activity approached with a playful attitude”



Suits 1978

“The voluntary attempt to overcome unnecessary obstacles”



Contents

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Game design and analysis frameworks



Caillois' 4 types of play

- Agon, or competition. (Chess)
- Alea, or chance. (Slot machines)
- Mimicry, or role playing.
- Ilinx (Greek for "whirlpool"), or *vertigo*



Data-driven analysis: Zagal 2010

- What topics do reviews address? What adjectives are used?
- Natural Language Processing (NLP) analysis of 100k+ user-submitted game reviews

Zagal, J. P., & Tomuro, N. (2010, October). The aesthetics of gameplay: a lexical approach. In *Proceedings of the 14th International Academic MindTrek Conference: Envisioning Future Media Environments* (pp. 9-16). ACM.



Table 3 - Primary Elements of Gameplay Aesthetics

Pacing - The perception of how often game events occur.	Scope - The size of the possibility space afforded by a game.
Complexity - The measure, or sense, of the number of parts in a system and how they are interrelated.	Demands - The requirements imposed upon the player by the gameplay
Cognitive Accessibility - The measure, or sense, of the opacity of a system and the challenges it poses in understanding it.	Impact - What we feel games “do to us” when we play them, and how they make us feel.

Describing the interface and controls

*easy, frustrating, clunky, dumb, normal, hard,
intuitive, tight, responsive, sloppy, simplified,
sluggish, complicated, awkward, confusing,
intelligent, clumsy, faulty, problematic, inconsistent,
direct, cumbersome, tricky, managed, precise, sketchy,
twitchy, unresponsive, adaptive, dodgy, efficient,
inept, loose, practical, unorthodox, jumpy, reduced,
sensitive*

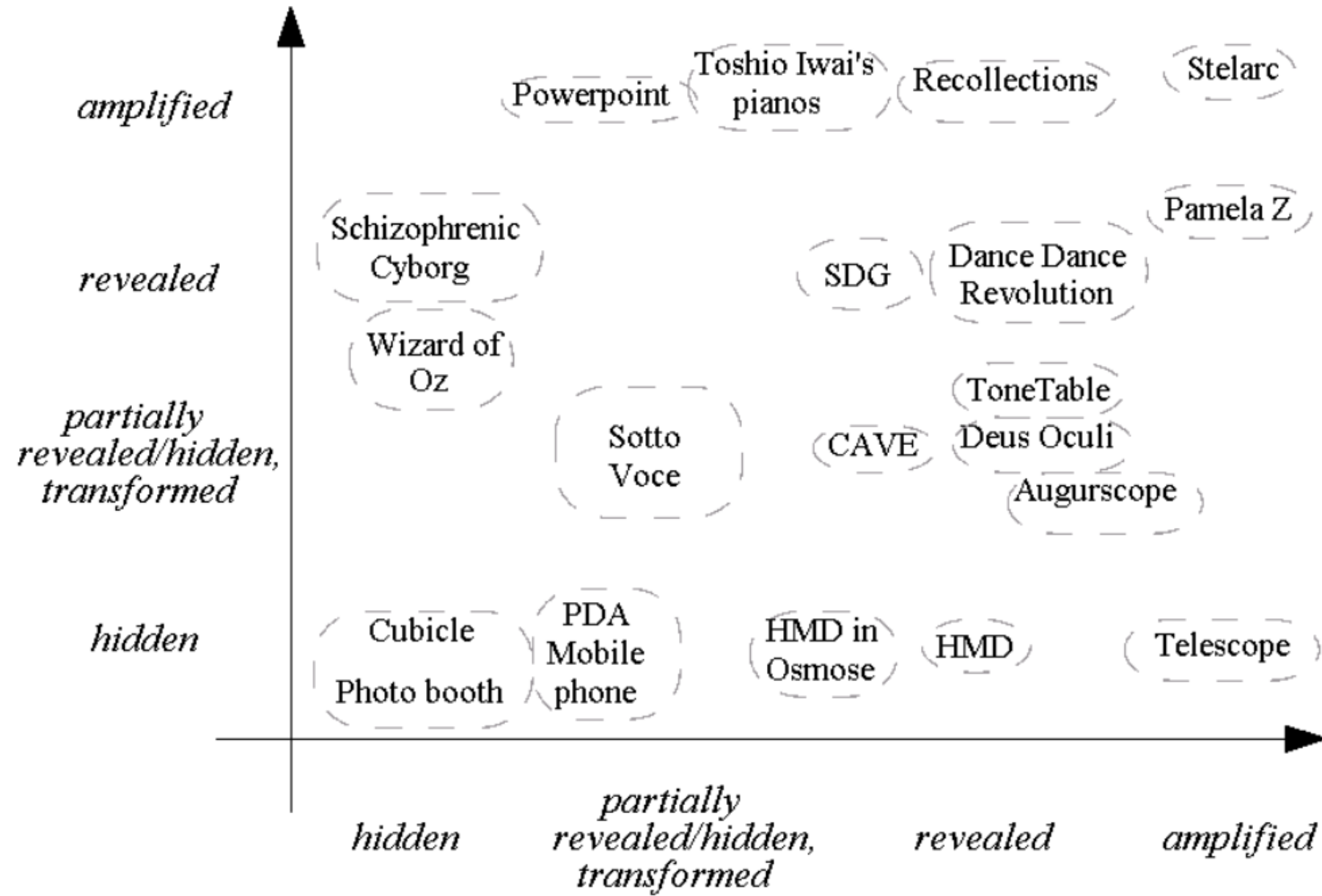


Novel points of view

- For example, Reeves et al. 2005: "Designing the Spectator Experience"
- Years before eSports became a thing



Effects



Manipulations



Effects

amplified
revealed
*partially
revealed/hidden,
transformed*
hidden

MAGICAL

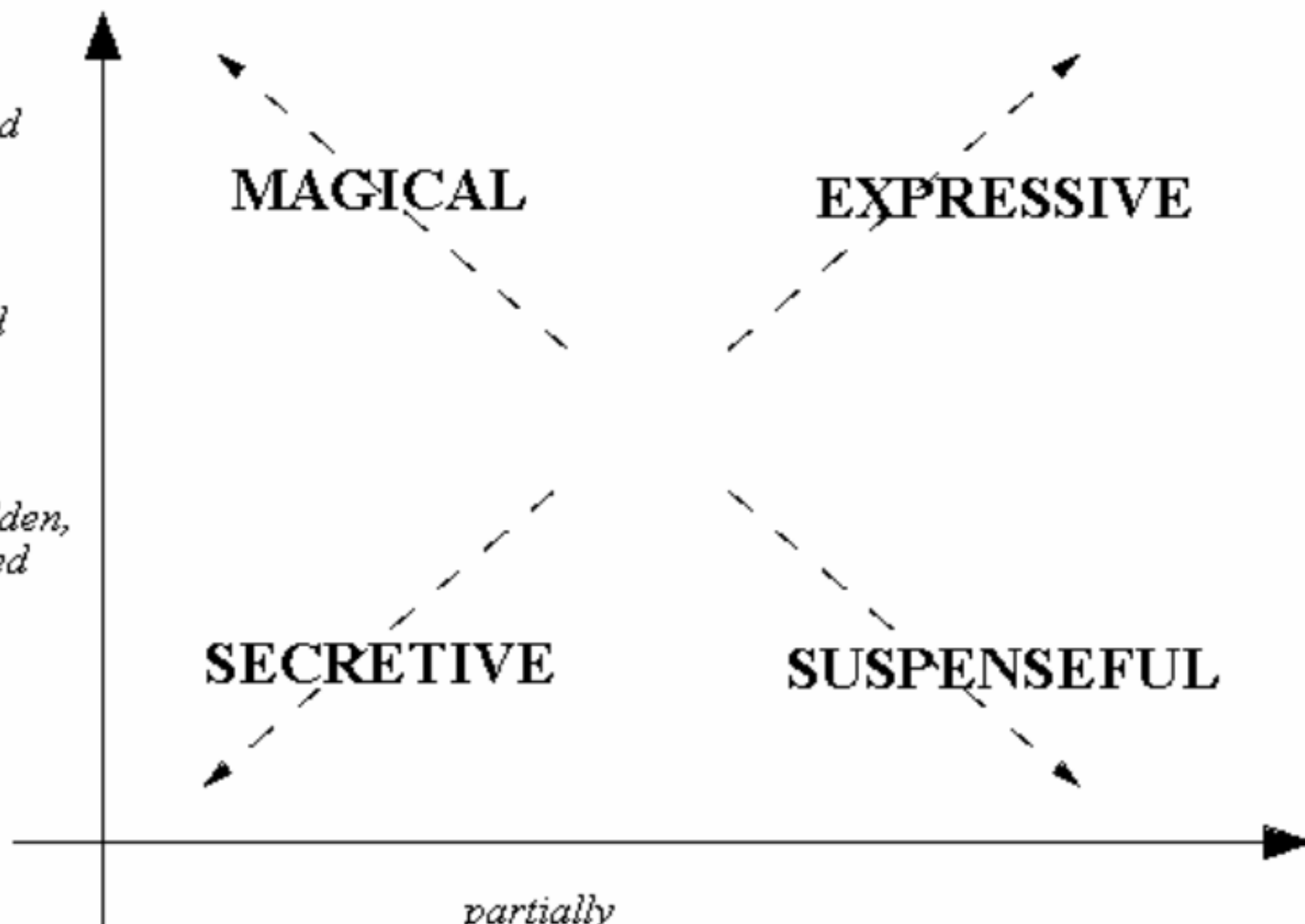
EXPRESSIVE

SECRETIVE

SUSPENSEFUL

hidden *partially
revealed/hidden,
transformed* *revealed* *amplified*

Manipulations







Schell's lenses



Mechanics, Aesthetics, Dynamics (MDA)

- Mechanics (rules, verbs – what is designed and implemented)
- Dynamics (behavior patterns, strategies emerging from mechanics)
- Aesthetics (emotions & Player Experience emerging from dynamics)





Designers can only directly control the mechanics



Predicting player behavior becomes even more difficult with multiple players



MDA Aesthetics (\approx player experience)

- Sensation (Game as sense-pleasure)
- Fantasy (Game as make-believe)
- Narrative (Game as drama)
- Challenge (Game as obstacle course)
- Fellowship (Game as social framework)
- Discovery (Game as uncharted territory)
- Expression (Game as self-discovery)
- Submission (Game as pastime)



MDA Aesthetics

- Sensation (Game as sense-pleasure)
- Fantasy (Game as make-believe)
- Narrative (Game as drama)
- Challenge (Game as obstacle course)
- Fellowship (Game as social framework)
- **Discovery (Game as uncharted territory)**
- Expression (Game as self-discovery)
- Submission (Game as pastime)

Basic human psychological needs

- Need for competence
- **Need for autonomy**
- Need for social relatedness
- **Need for novelty (of sensations and experiences)**
- Need for self-esteem



Other game pleasures

Anticipation

Delight

Gift giving

Humor

Purification

Thrill

Wonder

...



MDA Example: Chess

- Mechanics: rules such as "A player cannot move his king into check"
- Dynamics: sacrificing lesser pieces to capture opponent's queen
- Aesthetics/experience: challenge, discovery, fellowship



MDA Example: Monopoly

- Mechanics: movement and transaction rules
- Dynamics: the rich get richer and the course of the game is set very early
- Aesthetics/experience: power fantasy, challenge, fellowship



MDA Example: Monopoly

- Mechanic: Auction (if player does not want to buy a property they land on, it is auctioned)
- Dynamic: All properties are bought early in the game
- Aesthetics/experience: Might feel "unfair", but fixes a problem of the game being too long without it

MDA Example: Knizia scoring

- Mechanic: Player counts for scoring only the resources of which he has the least
- Dynamic: Players collect all kinds of resources.
- Aesthetics/experience: Increased variety of gameplay (no motivation to keep hoarding just one resource that one happens to gain early in the game)



MDA Example: Drop item

- Mechanic: Player is able to slough of excess inventory by dropping items on the ground
- Dynamic: Trading, bartering
- Aesthetics/experience: Increased social connection with other players

MDA Example: Physics/dynamics simulation

- Mechanics: Newton's laws of motion
- Dynamics: Domino effects / chain reactions, shooting a target by bouncing a projectile, stability/instability of buildings...
- Aesthetics: Emergence, surprise, curiosity





MDA Example: What mechanics make this dynamic emerge?

- Dynamic: Turtling, camping
- Mechanics: predetermined spawn locations (camping where a valuable item is due to spawn)
- More generally: lower cost or higher rewards in passive than active play



MDA Example: What mechanics make this dynamic emerge?

- Dynamic: Button mashing
- Mechanics: Actions with no cost and no cooldown



Computational rationality: A converging paradigm for intelligence in brains, minds, and machines

Samuel J. Gershman,^{1*} Eric J. Horvitz,^{2*} Joshua B. Tenenbaum^{3*}

After growing up together, and mostly growing apart in the second half of the 20th century, the fields of artificial intelligence (AI), cognitive science, and neuroscience are reconverging on a shared view of the computational foundations of intelligence that promotes valuable cross-disciplinary exchanges on questions, methods, and results. We chart advances over the past several decades that address challenges of perception and action under uncertainty through the lens of computation. Advances include the development of representations and inferential procedures for large-scale probabilistic inference and machinery for enabling reflection and decisions about tradeoffs in effort, precision, and timeliness of computations. These tools are deployed toward the goal of computational rationality: identifying decisions with highest expected utility, while taking into consideration the costs of computation in complex real-world problems in which most relevant calculations can only be approximated. We highlight key concepts with examples that show the potential for interchange between computer science, cognitive science, and neuroscience.

Gershman, Samuel J., Eric J. Horvitz, and Joshua B. Tenenbaum. "Computational rationality: A converging paradigm for intelligence in brains, minds, and machines." *Science* 349.6245 (2015): 273-278.

MDA in the real world

- Mechanics: The plough
- Dynamics: Specialization, trade, rulers and ruled, social inequality, misogyny, tyranny, malnutrition, dense population, disease, war
- Aesthetics: Cultivation, Ownership, Safety, Fear



<http://scienordenic.com/how-heavy-plough-changed-world>



50 Things That Made the Modern Economy

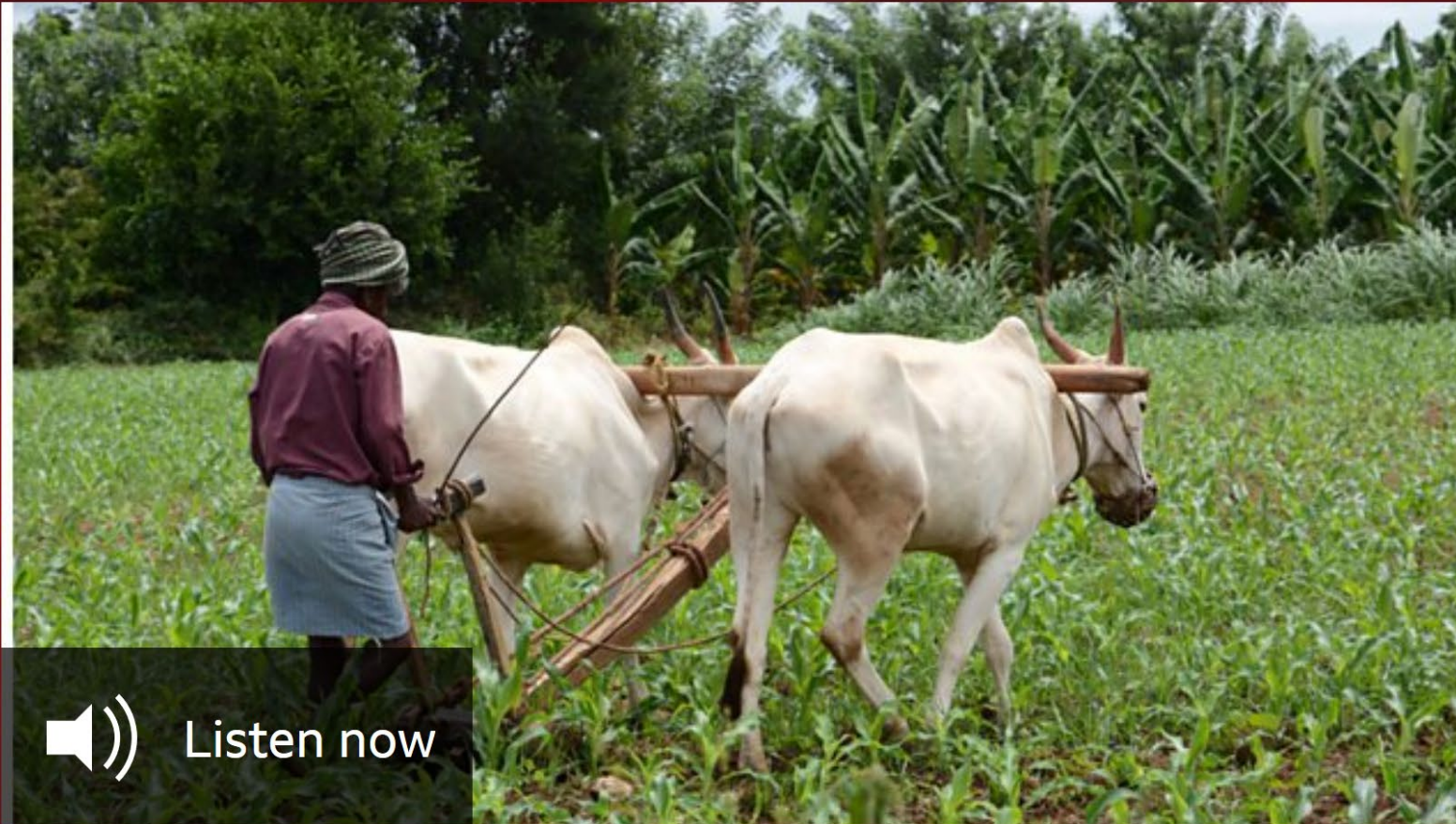
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The Plough

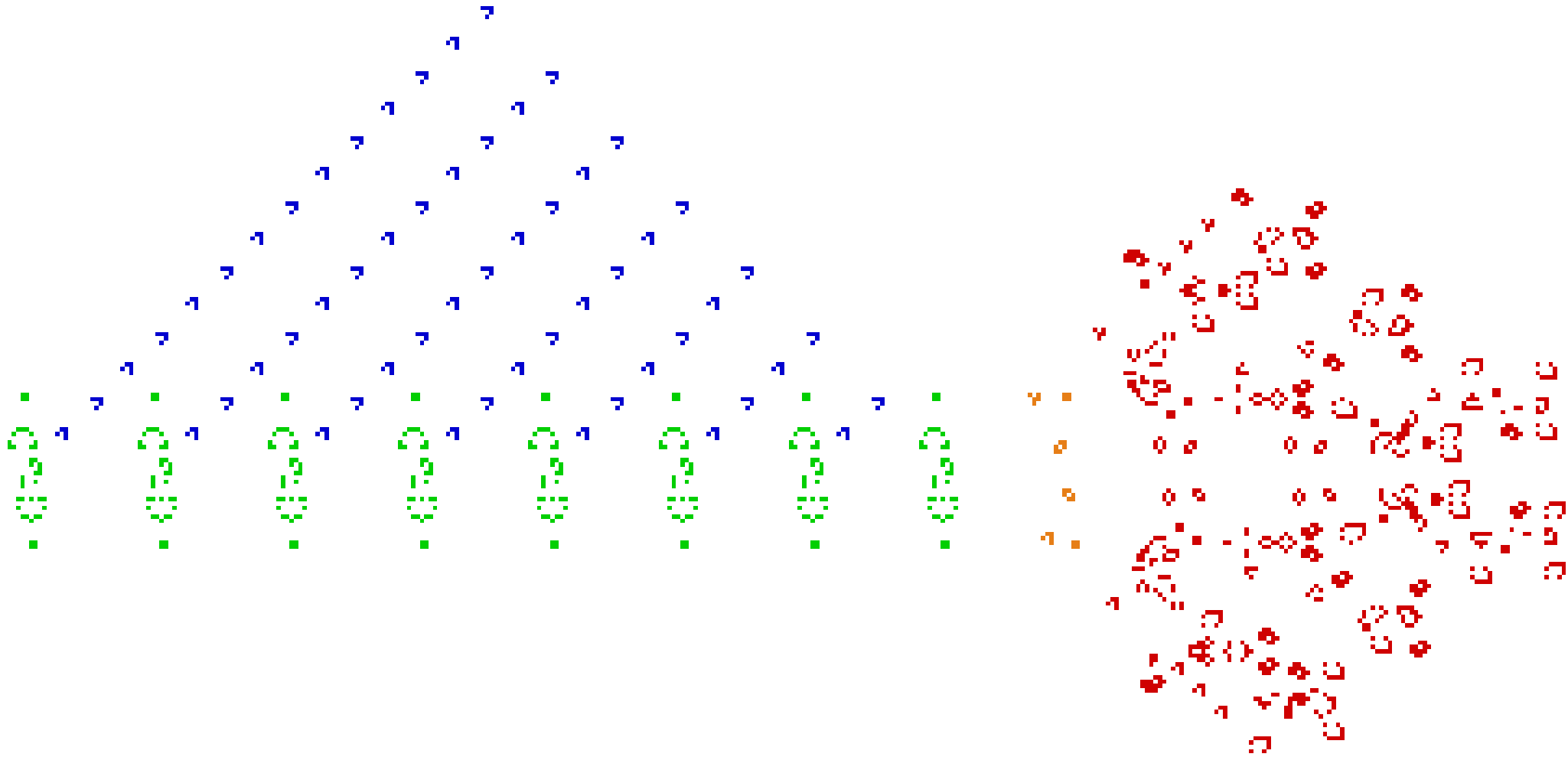
Designing for Emergence: PlusMinus



Successful student game (CHI PLAY game design competition winner, showcased at Experimental Gameplay Workshop 2019)

Juuso Toikka's master's theses about the core mechanics: <https://aaltodoc.aalto.fi/handle/123456789/39850>

Designing for Emergence: Conway's Game of Life



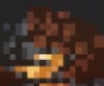


Game of Life rules

- Any live cell with fewer than two live neighbours dies, as if by underpopulation.
- Any live cell with two or three live neighbours lives on to the next generation.
- Any live cell with more than three live neighbours dies, as if by overpopulation.
- Any dead cell with exactly three live neighbours becomes a live cell, as if by reproduction.



Noita



MDA and information visualization

Press shift to advance simulation,
and Q,W,O,P to control runner

Keys pressed: QP



In our version, effect of keys is predicted and time only advances when the player holds down space



MDA and information visualization exercise

- Play these "explorable explanations", together with a pair:
 - Parable of Polygons (<https://ncase.me/polygons/>)
 - Evolution of Trust (<https://ncase.me/trust/>)
- What are the mechanics, dynamics & aesthetics?



Exercise: MDA

- Pick a game you have made or are making. Identify its mechanics, dynamics, and experiential aspects that emerge from the dynamics (don't limit yourself to the 8 ones in the original MDA paper)
- Add a screenshot and the answers to the following questions to the Google Slides document here: <https://urly.fi/1o7s>
- **Has there been something unexpected about the dynamics and aesthetics?**



Exercise: Schell's lenses

- Scrutinize your game using the following 5 lenses plus 3 others (hand-picked or randomly selected):
 - #1 (Essential experience)
 - #10 (Resonance)
 - #11 (Infinite Inspiration)
 - #15 (Toy)
 - #88 (Love)
- Answer in the Google slides: **Which of the lenses was the most useful for you? What did you learn or what new ideas did you get?**
- If you don't have the book, download the Deck of Lenses app.

MDA & Deck of Lenses exercise recap:

- **Has there been something unexpected about the dynamics and aesthetics?**
- **Which of the lenses was the most useful for you?**
- **What did you learn or what new ideas did you get from the lenses?**

Preparation: Play games

- Clash Royale (reach 1-2 new arenas after the training ground, before Tuesday)
- Walking Dead No Man's Land (Complete 1-2 chapters before Wednesday)
- The games will be used as examples during the rest of the week.
- Other games discussed, play if you have time: Journey, Thomas Was Alone, Gone Home