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.)

Passing the course

- Participate at least 80% of the time
- Final assignment: essay, Colab game analysis exercise, or a research game prototype. More instructions in a pdf in MyCourses.

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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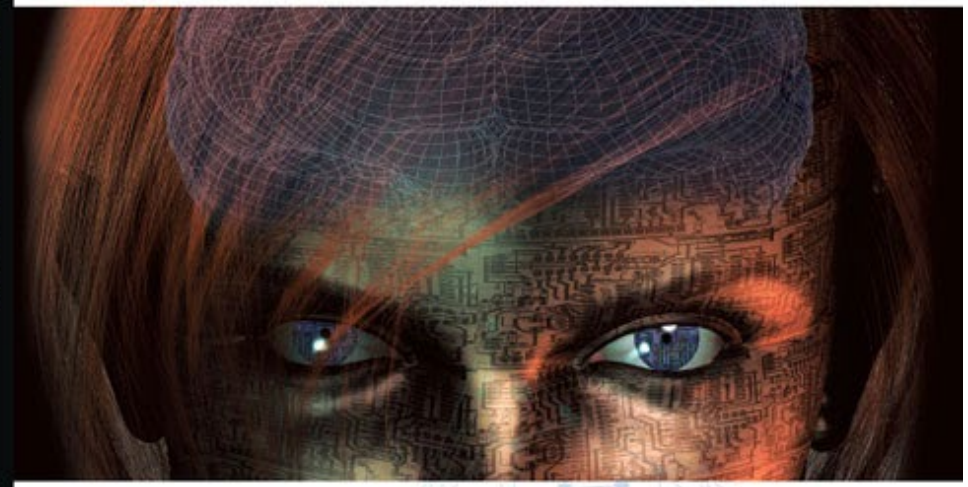
HODENT THE GAMER'S BRAIN CRC Press

The Gamer's Brain

How Neuroscience and UX Can Impact Video Game Design



Celia Hodent

Foreword by **Brenda Romero**

CRC Press
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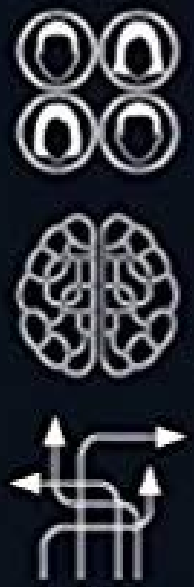


Players Making Decisions

Game Design Essentials
and the Art of Understanding Your Players

ZACK HIWILLER

Contents (first day, this lecture)

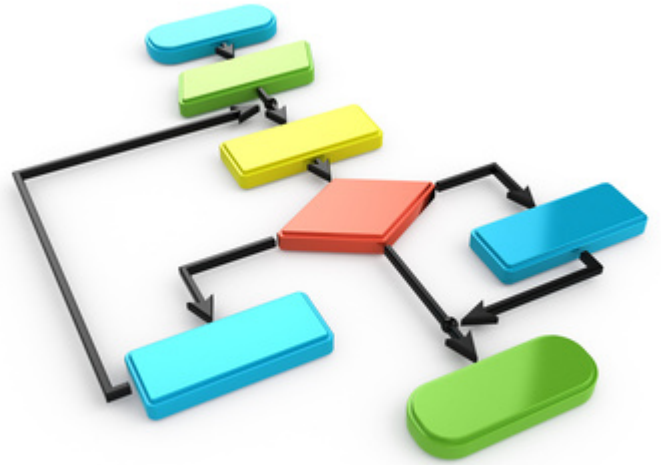
- Motivation: Why research & theory?
- Game definitions
- Game analysis and design frameworks
- Exercises, play games

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

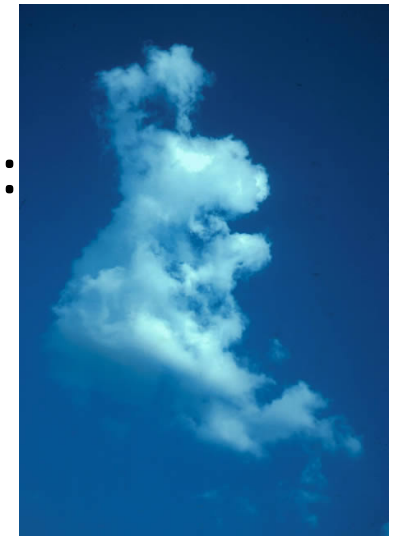
SYSTEM 2: EXPLICIT/CONSCIOUS:
SLOW, ALGORITHMIC, EFFORTFUL



ATTENTION,
PRIMING,
INHIBITION

IDEAS,
ASSOCIATIONS,
IMPULSES
(AUTOMATION)

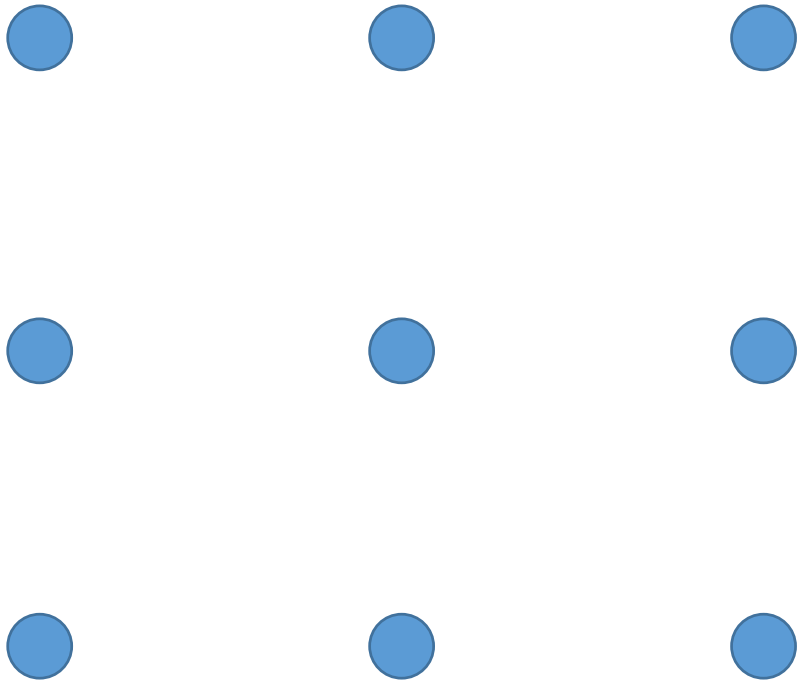
SYSTEM 1: IMPLICIT/UNCONSCIOUS:
FAST, ASSOCIATIVE, EFFORTLESS,
INTUITIVE



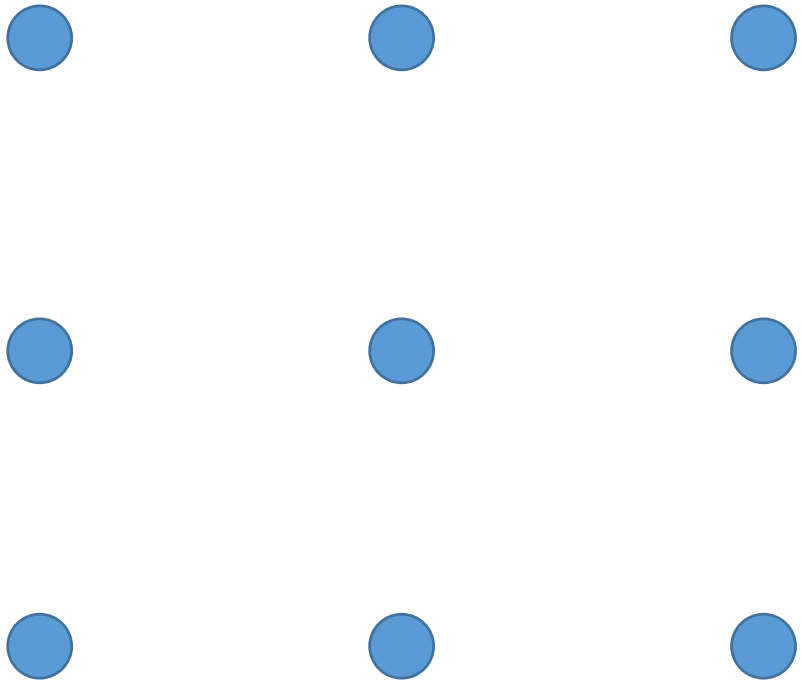
ASSOCIATION

Asking the right questions and focusing attention

Example: connect the dots with four connected straight lines



Can you think **outside the box**?



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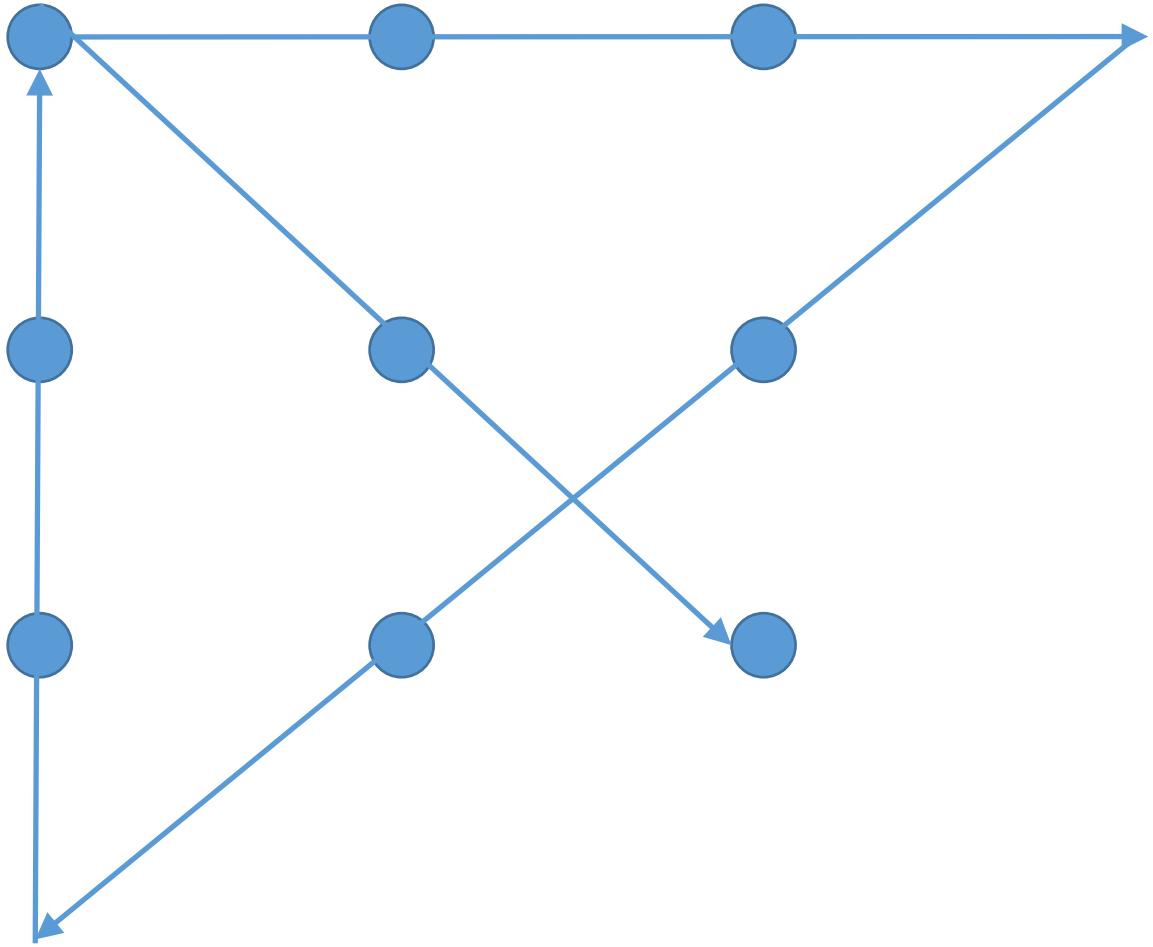
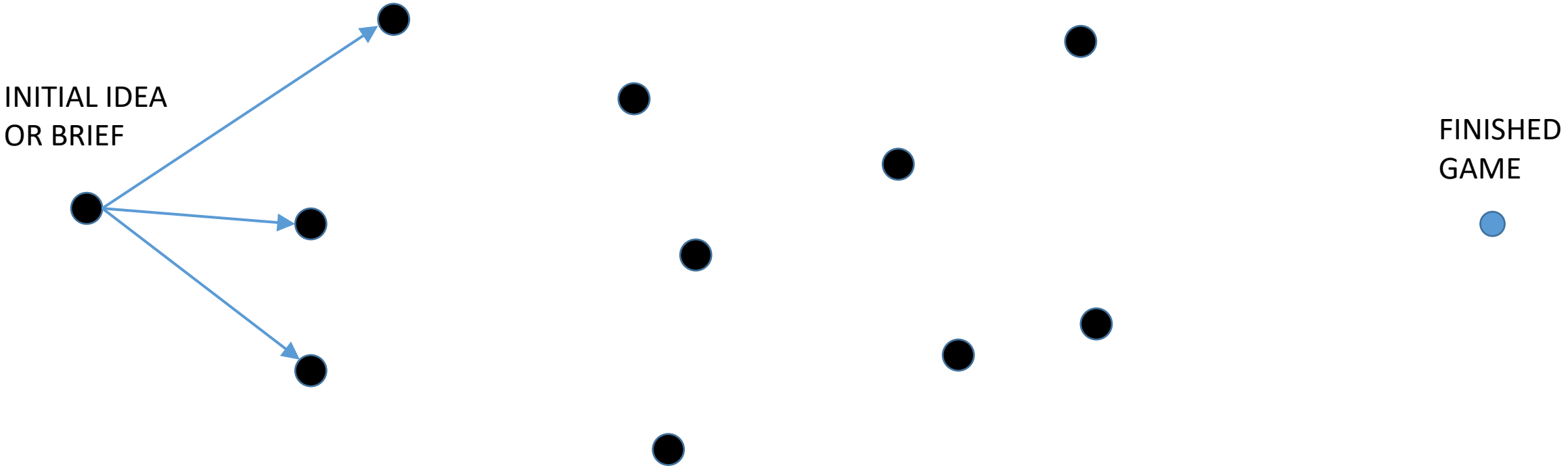
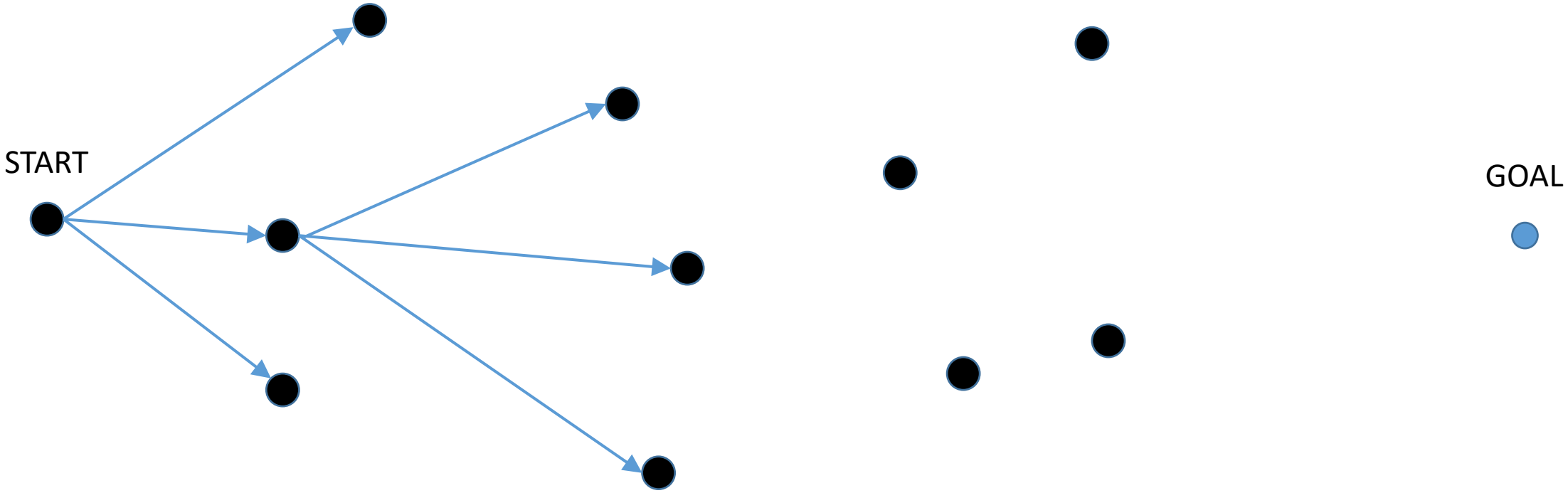


Killing ideas

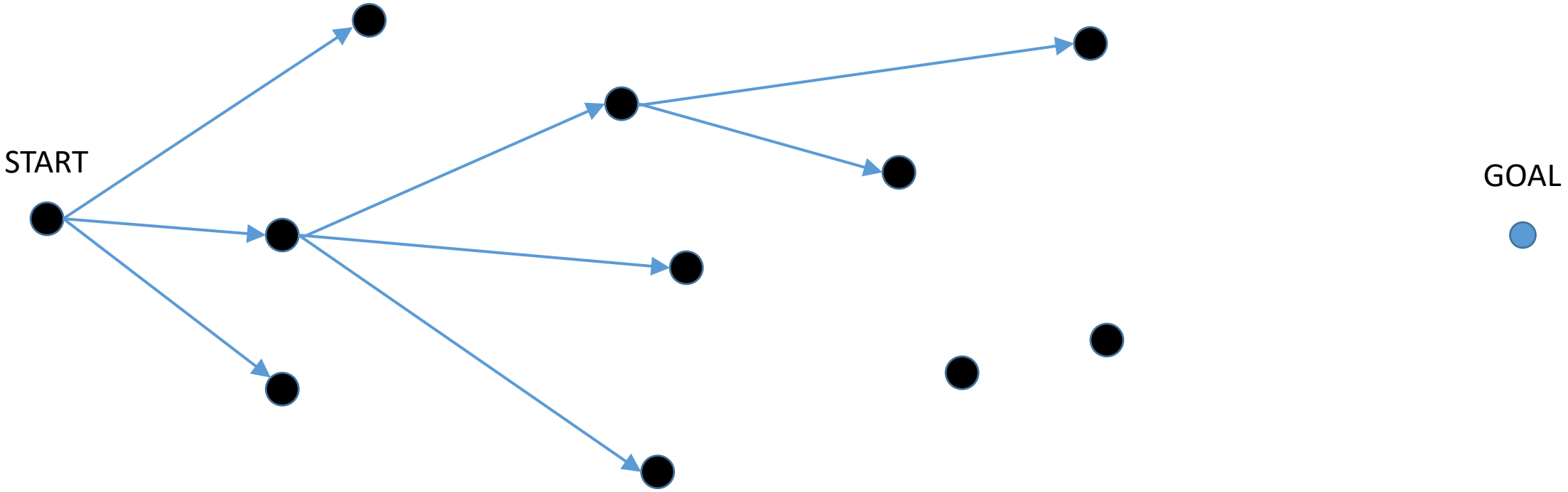
Game design as tree search



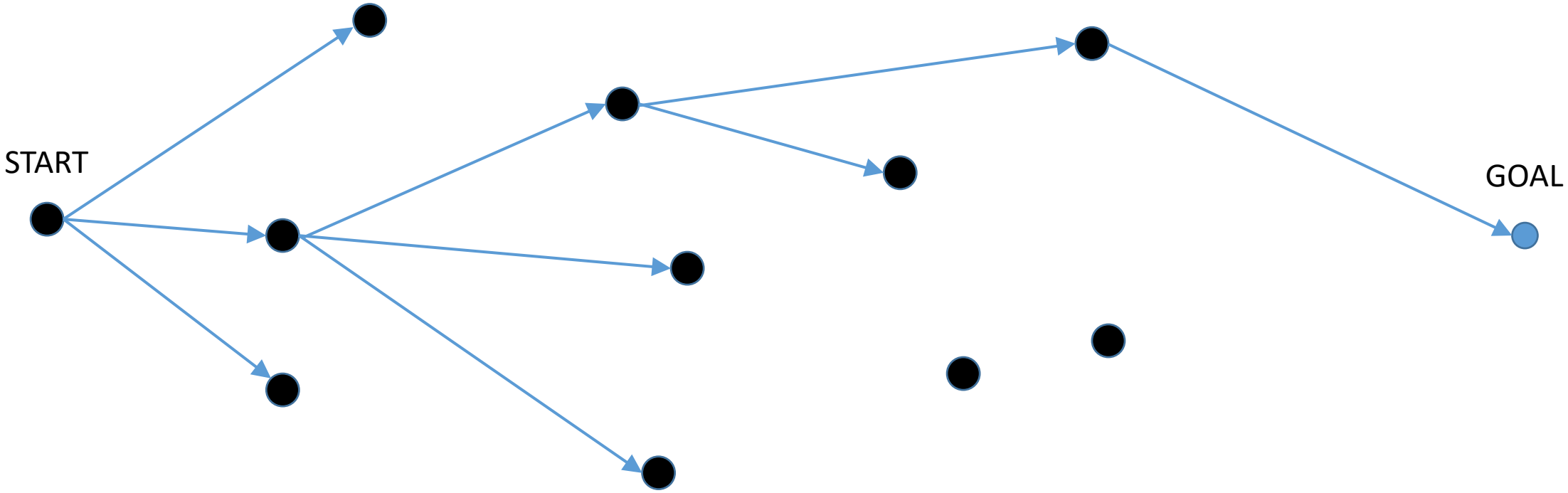
Game design as tree search



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”

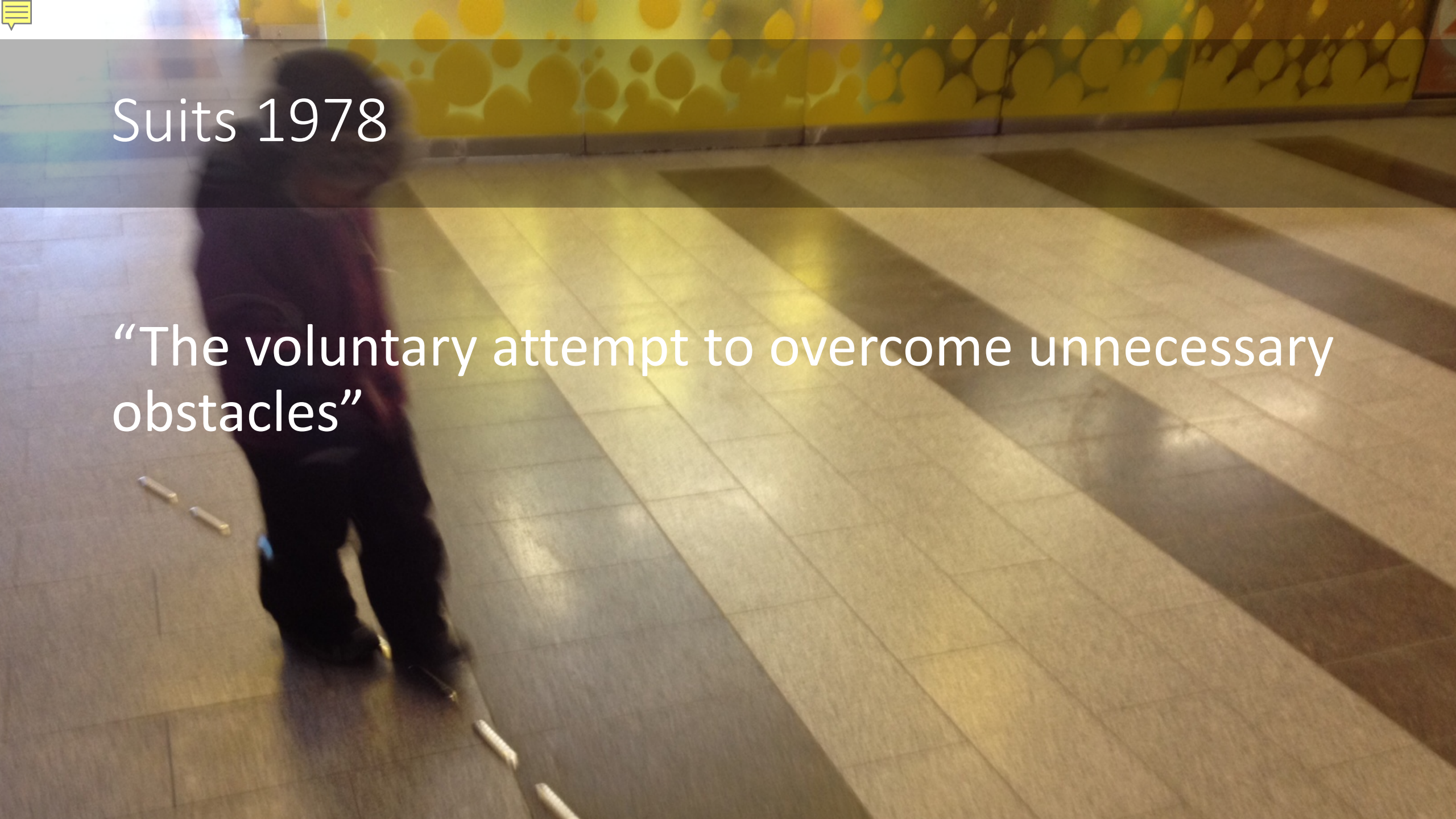
Caillois 1961

”An activity which is essentially:

- Free (voluntary)
- Separate (in time and space)
- Uncertain
- Unproductive (as opposed to work)
- Governed by rules (different that 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

- Why research & theory?
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- Current trends in game research

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

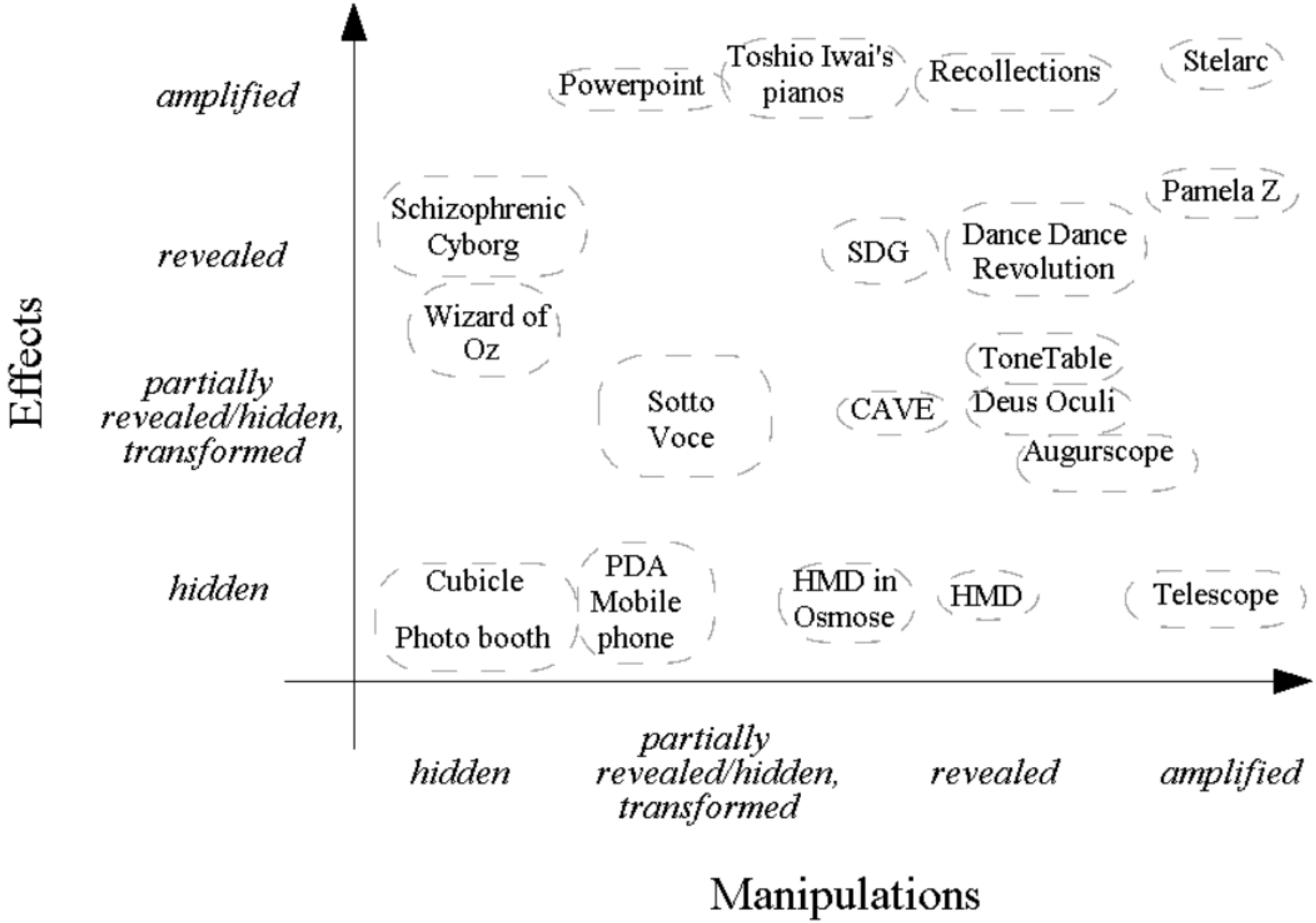
Pacing - The perception of how often game events occur.	**Scope -** The size of the possibility space afforded by a game.
Complexity - The measure, or sense, of the number of parts in a system and how they are interrelated.	**Demands -** The requirements imposed upon the player by the gameplay
Cognitive 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.

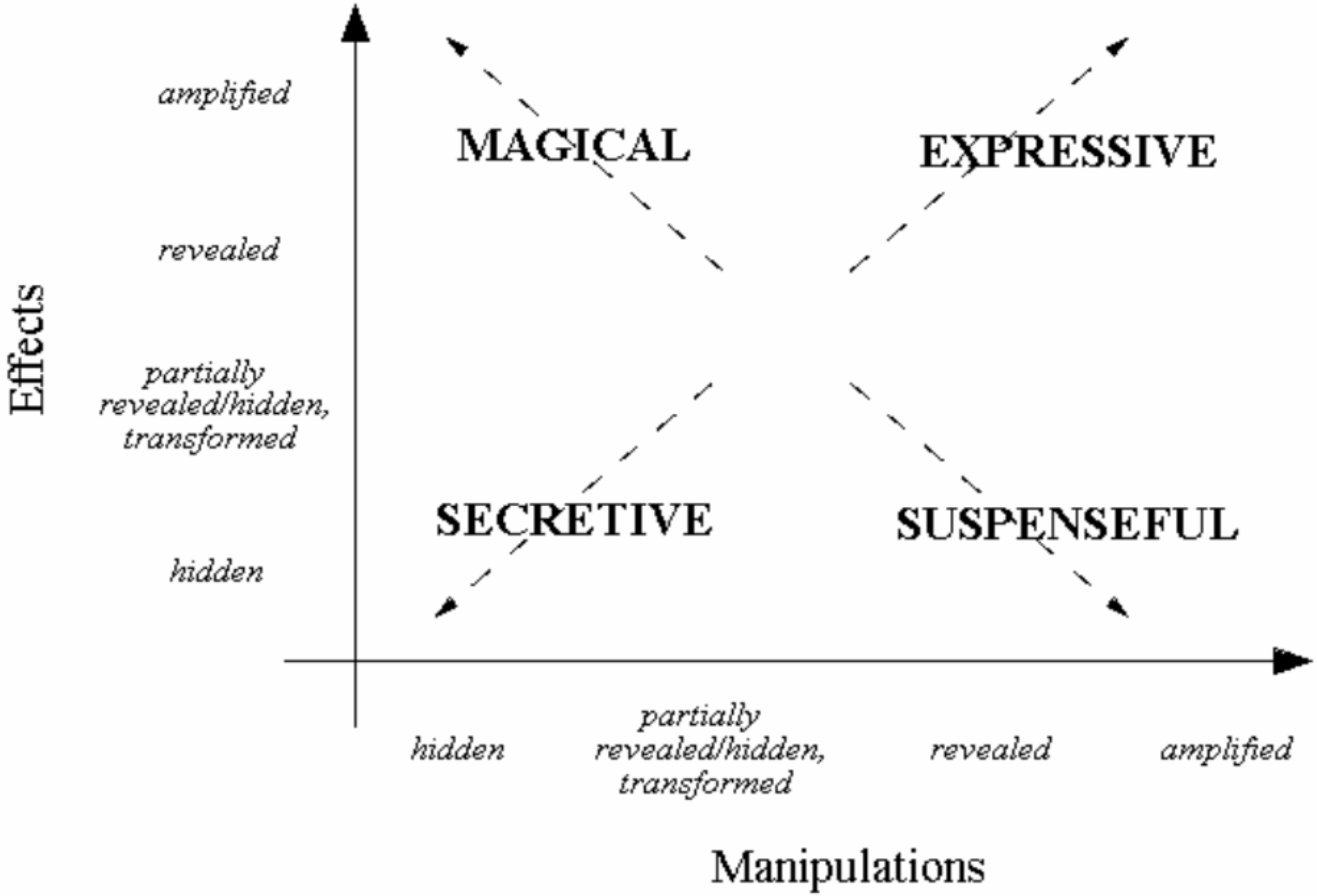
Describing the interface and controls

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
amplified
revealed
partially revealed/hidden, transformed
hidden
Powerpoint
Toshio Iwai's pianos
Recollections
Stelarc
Schizophrenic Cyborg
SDG
Dance Dance Revolution
Pamela Z
Wizard of Oz
Sotto Voce
CAVE
ToneTable
Deus Oculi
Augurscope
Cubicle
Photo booth
PDA Mobile phone
HMD in Osmose
HMD
Telescope
hidden
partially revealed/hidden, transformed
revealed
amplified
Manipulations


MAGICAL
EXPRESSIVE
SECRETIVE
SUSPENSEFUL
Effects
amplified
revealed
partially revealed/hidden, transformed
hidden
hidden
partially revealed/hidden, transformed
revealed
amplified
Manipulations


SCORE 0000028816
HI 0000161636
SCORE 0000028816
HI 0000161636

https://www.youtube.com/watch?v=TN2hodL8Mfk

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 (≈ 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)
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- 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.

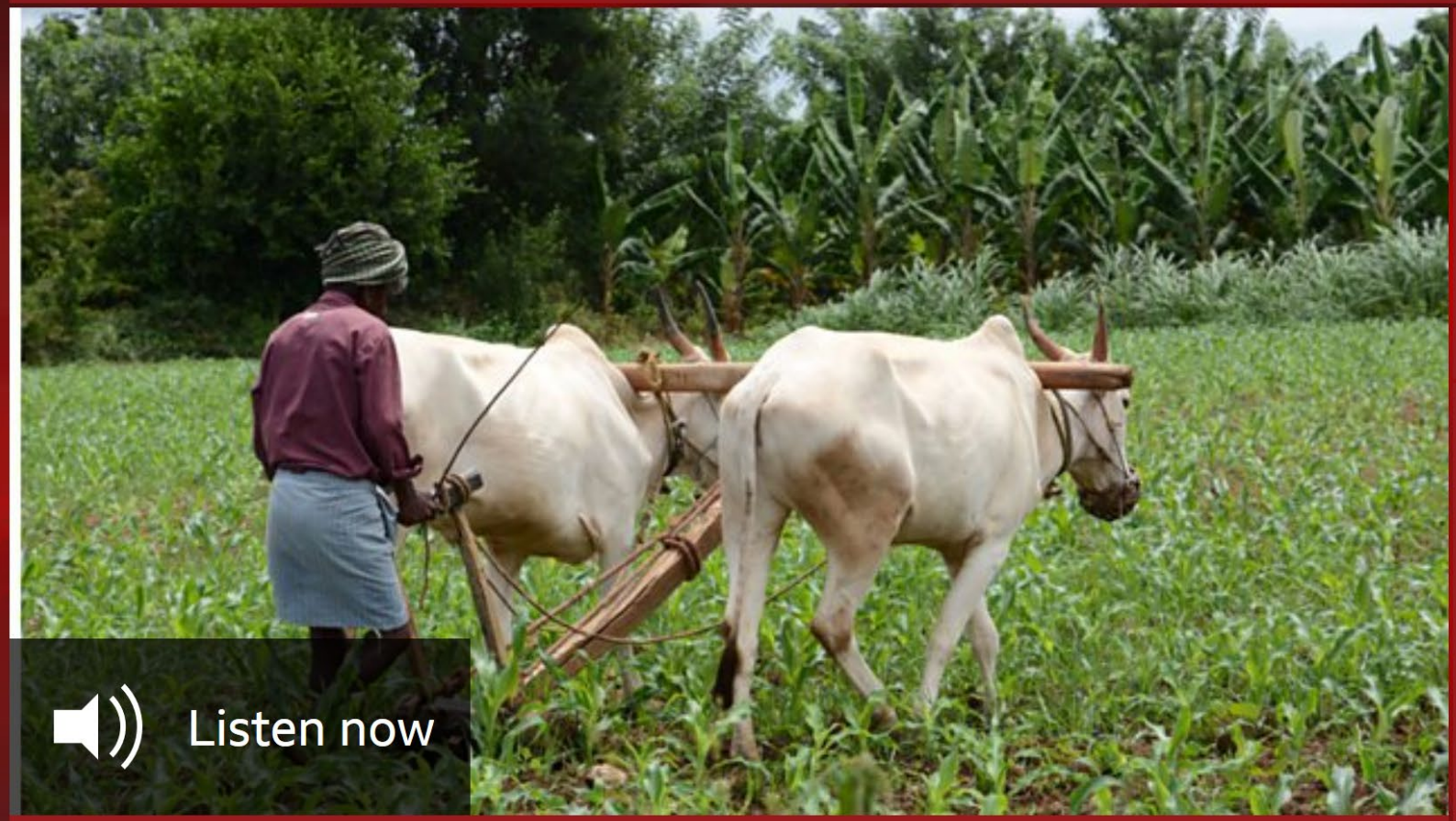
Gershman, Samuel J., Eric J. Horvitz, and Joshua B. Tenenbaum. "Computational rationality: A converging paradigm for intelligence in brains, minds, and machines." *Science* 349.6245 (2015): 273-278.

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://sciencenordic.com/how-heavy-plough-changed-world

50 Things That Made the Modern Economy



The Plough

Last on

BBC WORLD SERVICE

Mon 23 Oct 2017

06:50

Local time

BBC WORLD SERVICE ONLINE & UK DAB/FREEVIEW ONLY

More episodes

PREVIOUS

Cold Chain

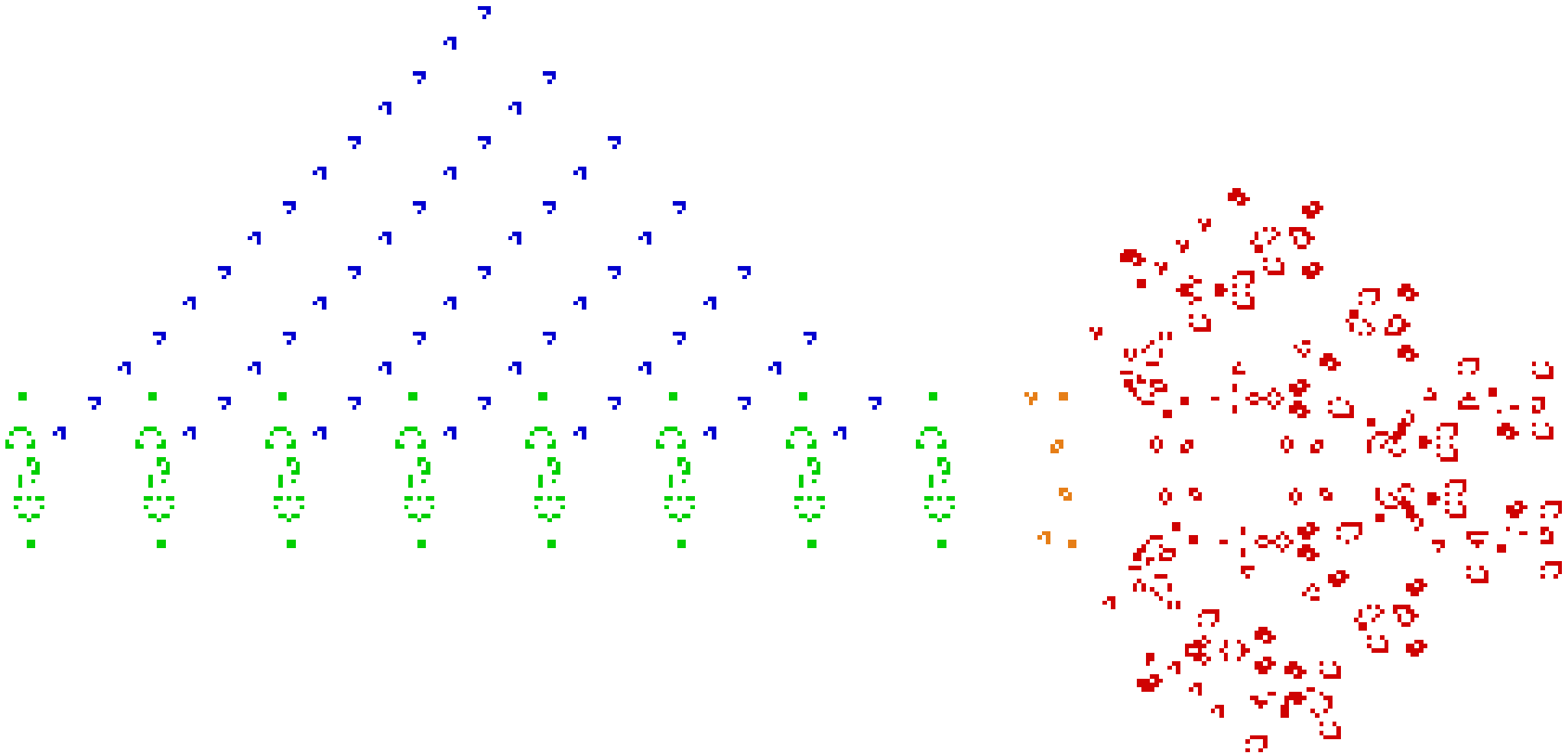
NEXT

Number 51

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

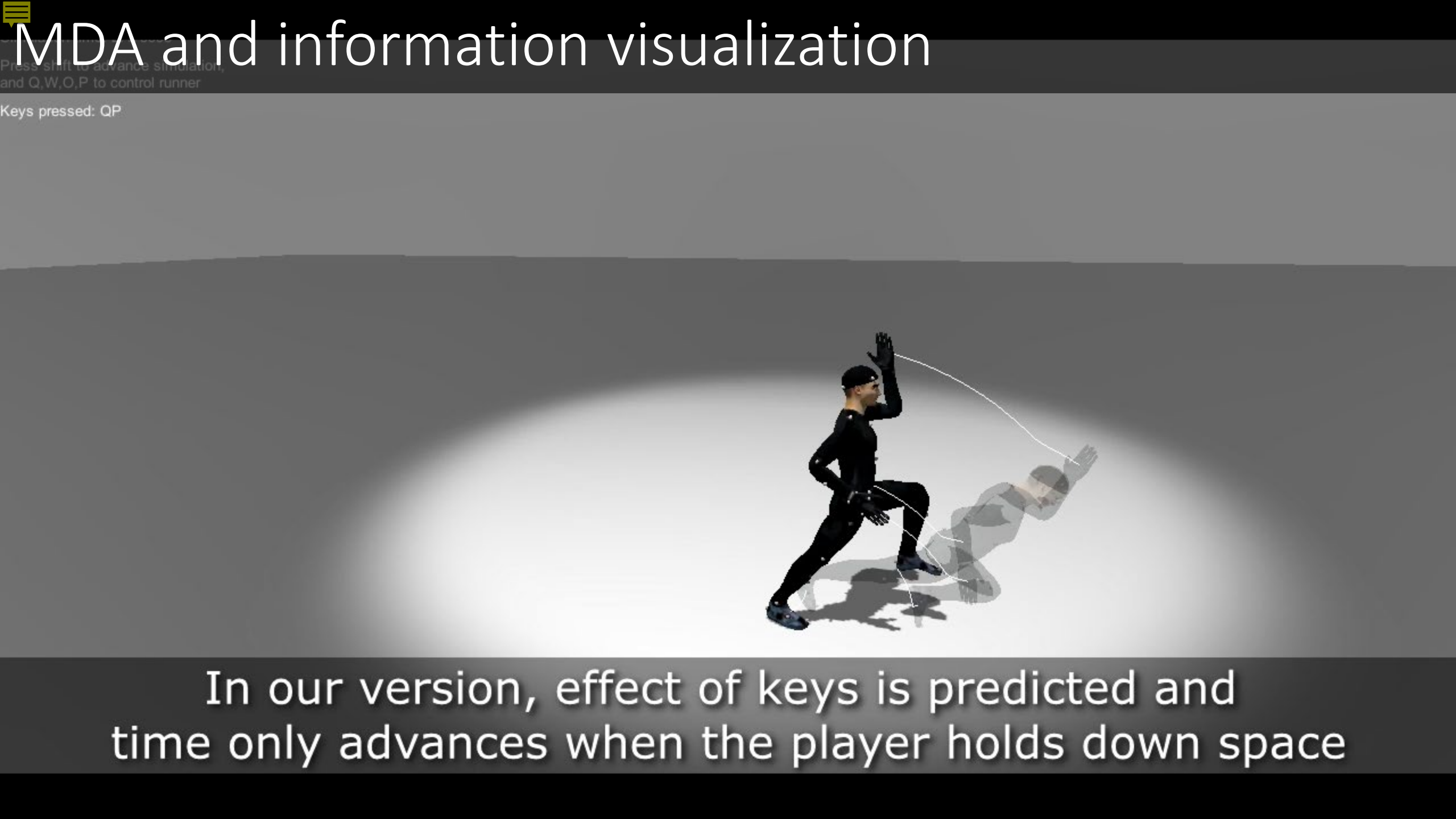


Game of Life rules

- 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



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