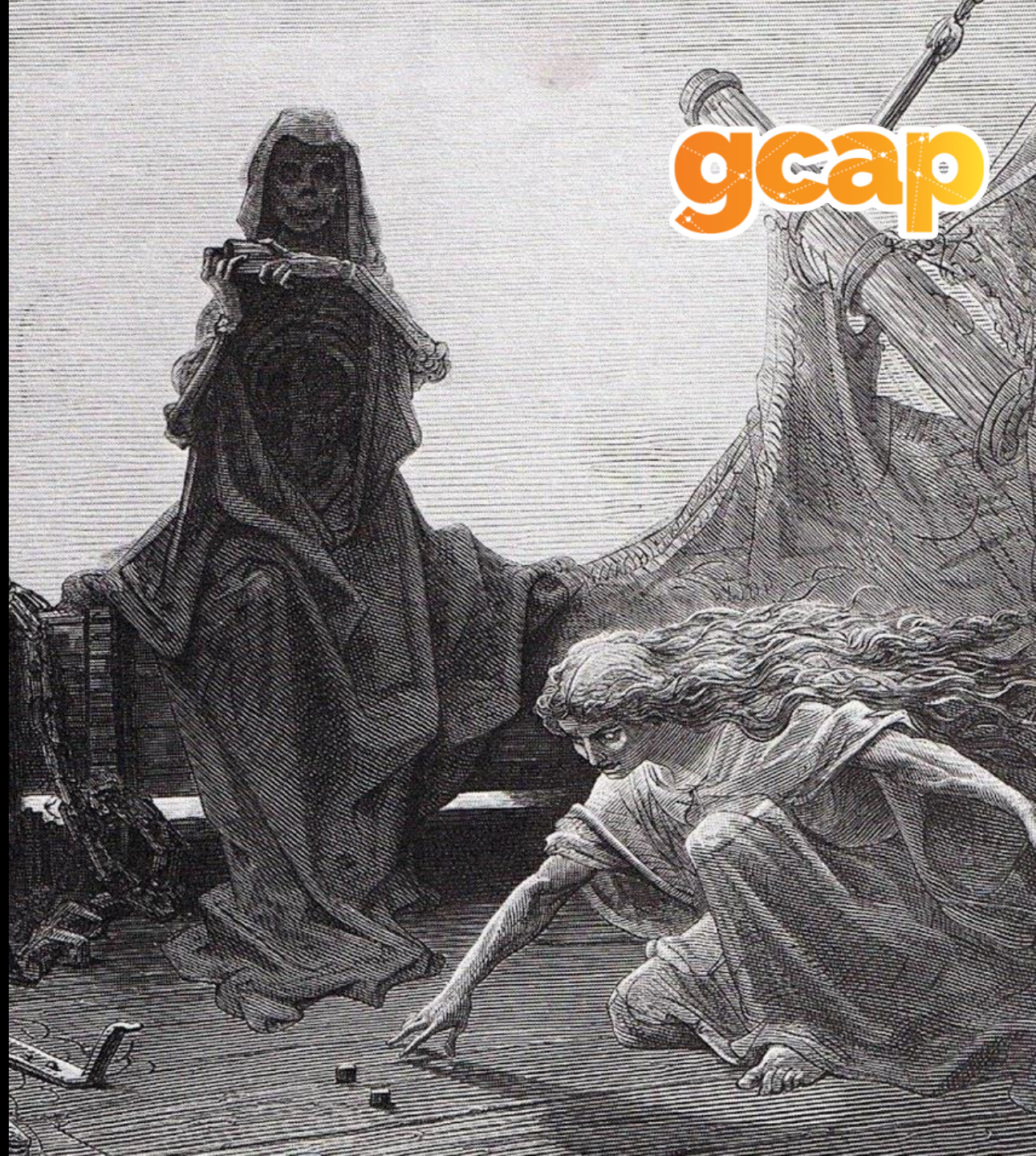
Uncertainty for uncertain times

Adapting RNG to broaden appeal and improve accessibility

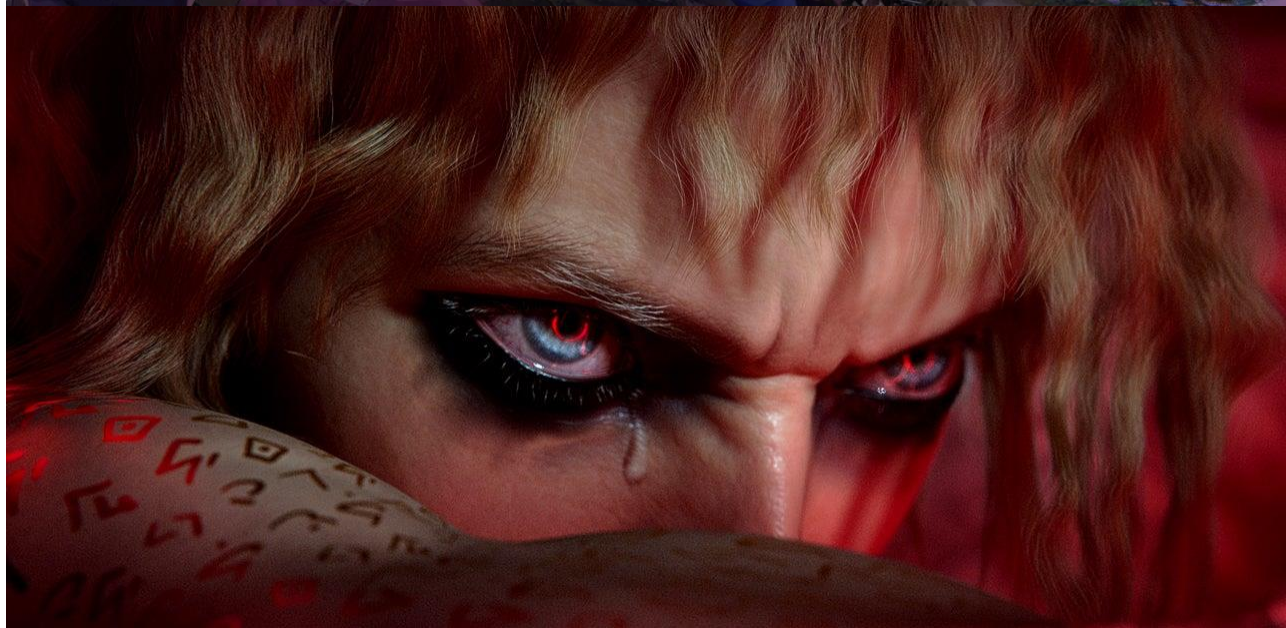


Prologue

God is dead
and we have
video games

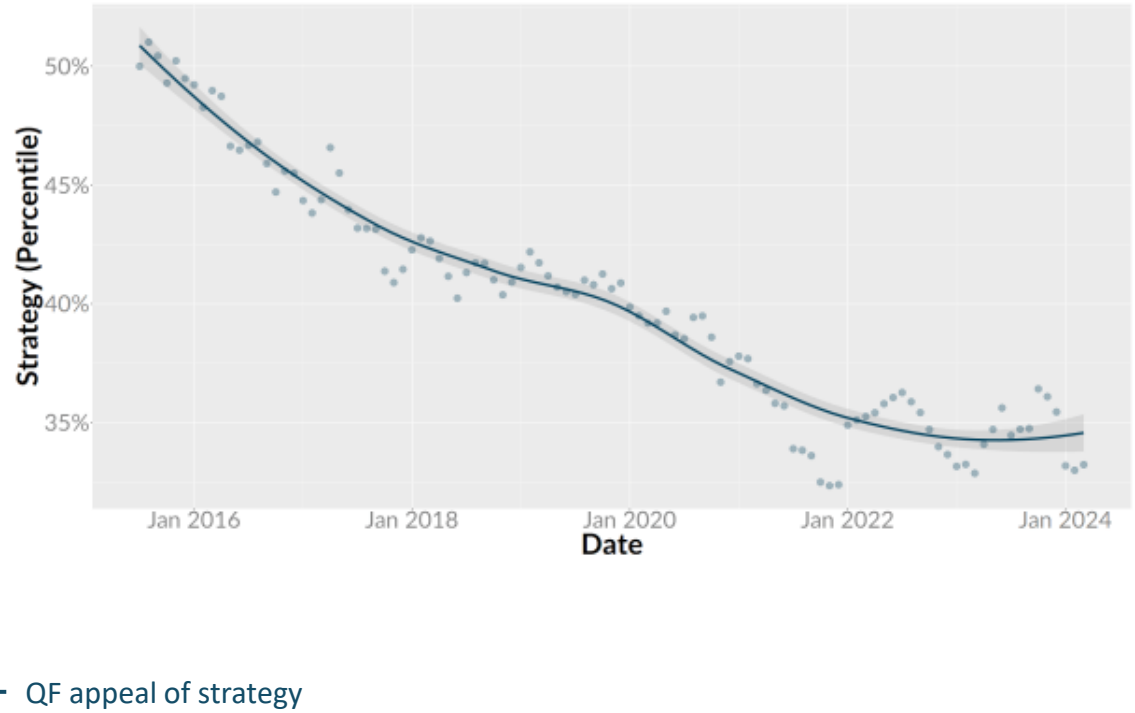
Who am I?

- I’m William ☺
- I’ve been working in games for 11 years, including 9 as an **AI & system designer** on titles like *Endless Legend*, *Endless Space 2*, *Humankind*…
- … and *Solium Infernum,* OpenCritic’s **top-rated Australian game of 2024** 🥳
- I’m now **working as a technical designer** on *Winnie’s Hole*…
- … and doing some **design consulting** for *Amplitude Studios* and *Studio Imugi.*



This is fine

- **<u>Interest in *“strategy”* has decreased</u>** for a decade, according to *Quantic Foundry:*

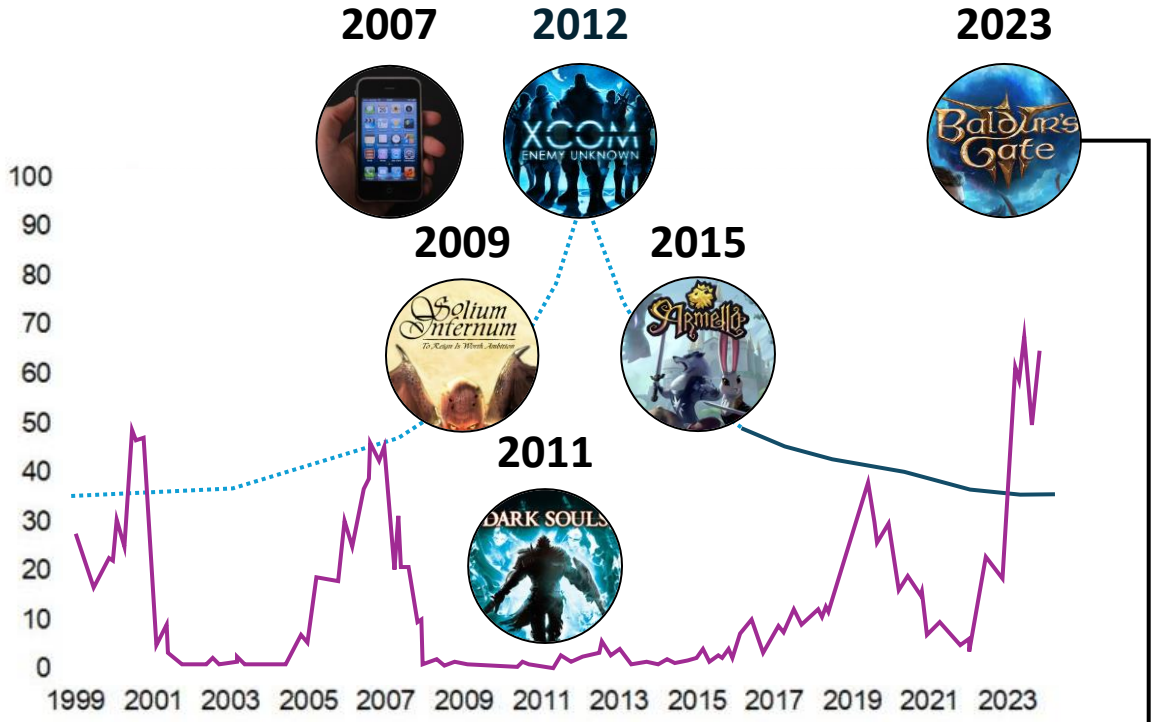


This is fine

- **Interest in *"strategy"* has decreased** for a decade, according to *Quantic Foundry*.
  But is this…
  - … presented in a **misleading** way?
  - … just part of **20-year cycle**?
  - … **the economy**, stupid?
  - … consistent with **sales data**?
  - … a cause for **moral panic**?

- The original graph resonates because it **taps into a foundational myth**: *The Fall!*

- Games tap into it too: they promise an **escape from alienation** and a **return to *Eden*** in uncertain times like these.



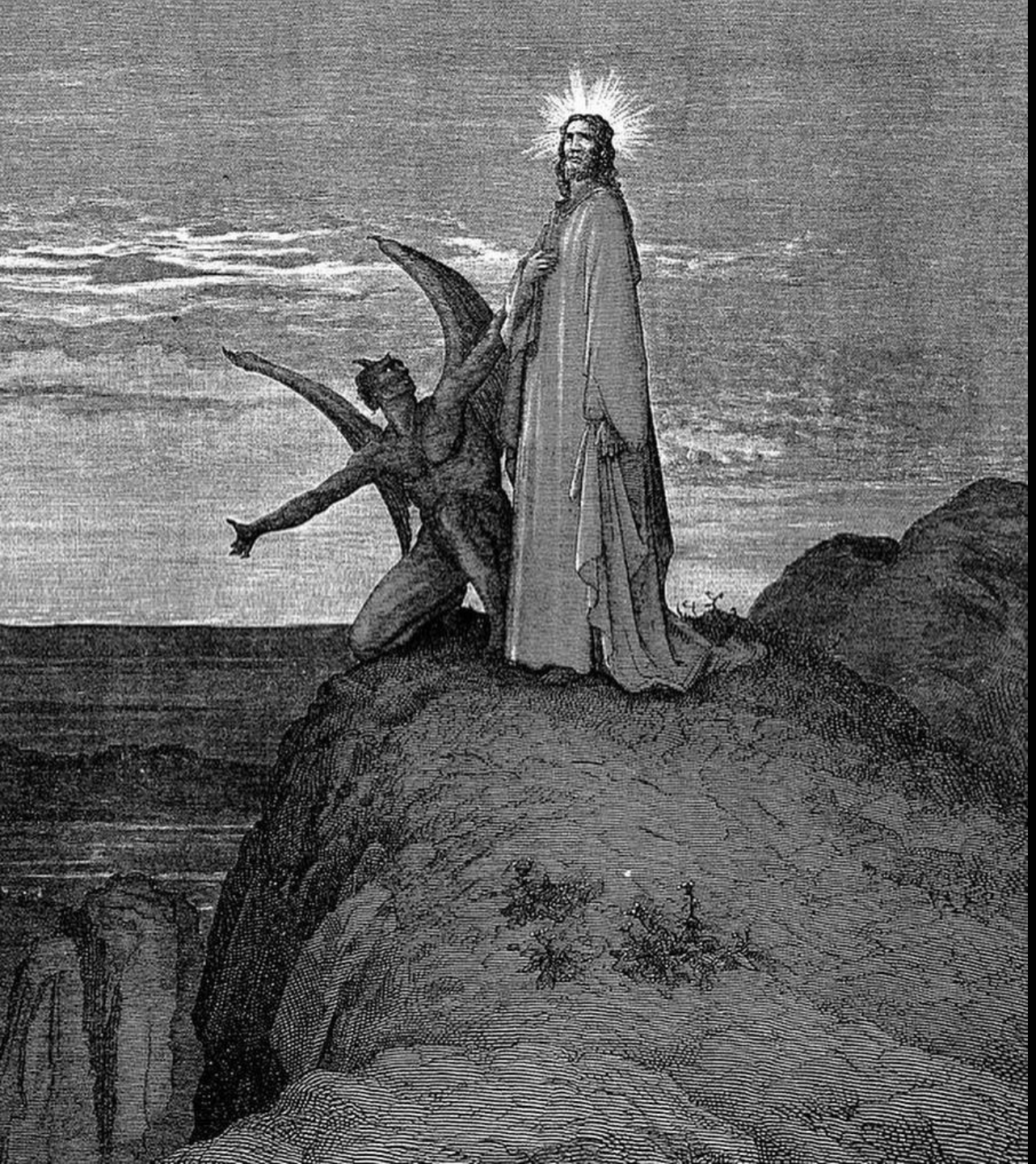
This is finding Eden

- **Times are even harder** for players than for developers: it's more vital than ever to **excise unnecessary friction** from our games.

- Of particular interest today: how **randomised systems can cause friction**, and what to do about it.

  E.g. every *"shuffle"* feature ever designed for a music app.

- **This isn't *just* a UX problem**: the best UX in the world can't fix an inherently frustrating system!



Chapter I

The temptation of RNJesus

What is *Solium Infernum*?

- The original *Solium Infernum* (OSI), released in 2009, was a **beautiful but very niche** play-by-email strategy game.
- It was **infamous for the capriciousness of its randomised systems**: these helped sell its Kafkaesque vision of Hell.
- Our remake released in February 2024 to **universal critical acclaim**.
- Today I'll share the **situational approach to uncertainty** that we used to adapt OSI to a broader audience, without compromising its aesthetic.

Situational Game Design

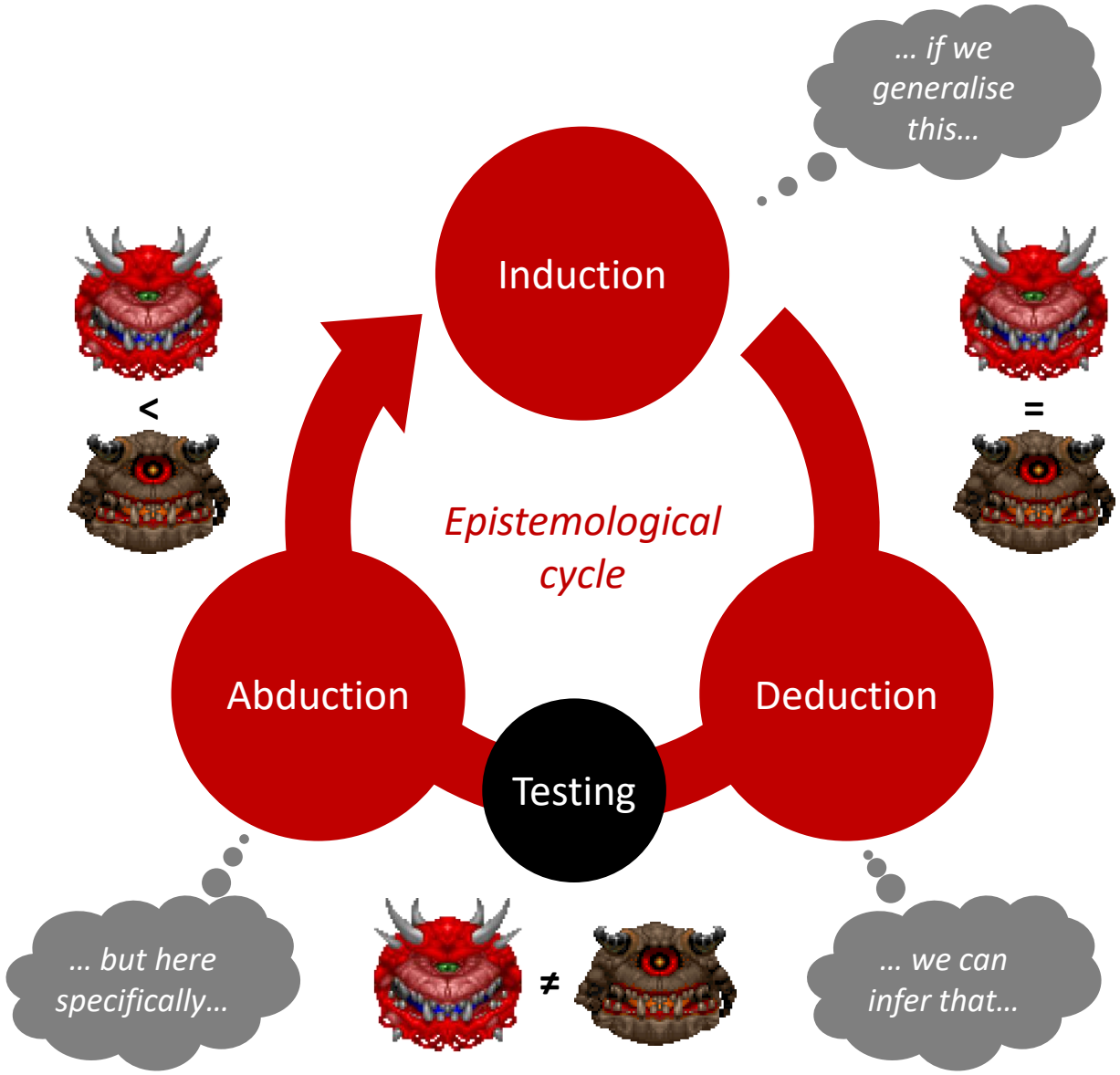
- A game situation is **a moment of agency** →
- Game situations can be **scripted by hand**, but more often we design them only indirectly, by crafting the systems that will **generate them on the fly**.
- Not all situations were created equal. *Upton*'s book contains a list of heuristics to help **weed out the bad ones**:

Choice – Variety – Consequence – Predictability – Uncertainty – Satisfaction

- We'll be focusing on **uncertainty** today.

Uncertainty

- Uncertainty is a fundamental part of the *Epistemological Cycle*: it is what **<u>separates "play" from "grind"</u>**.



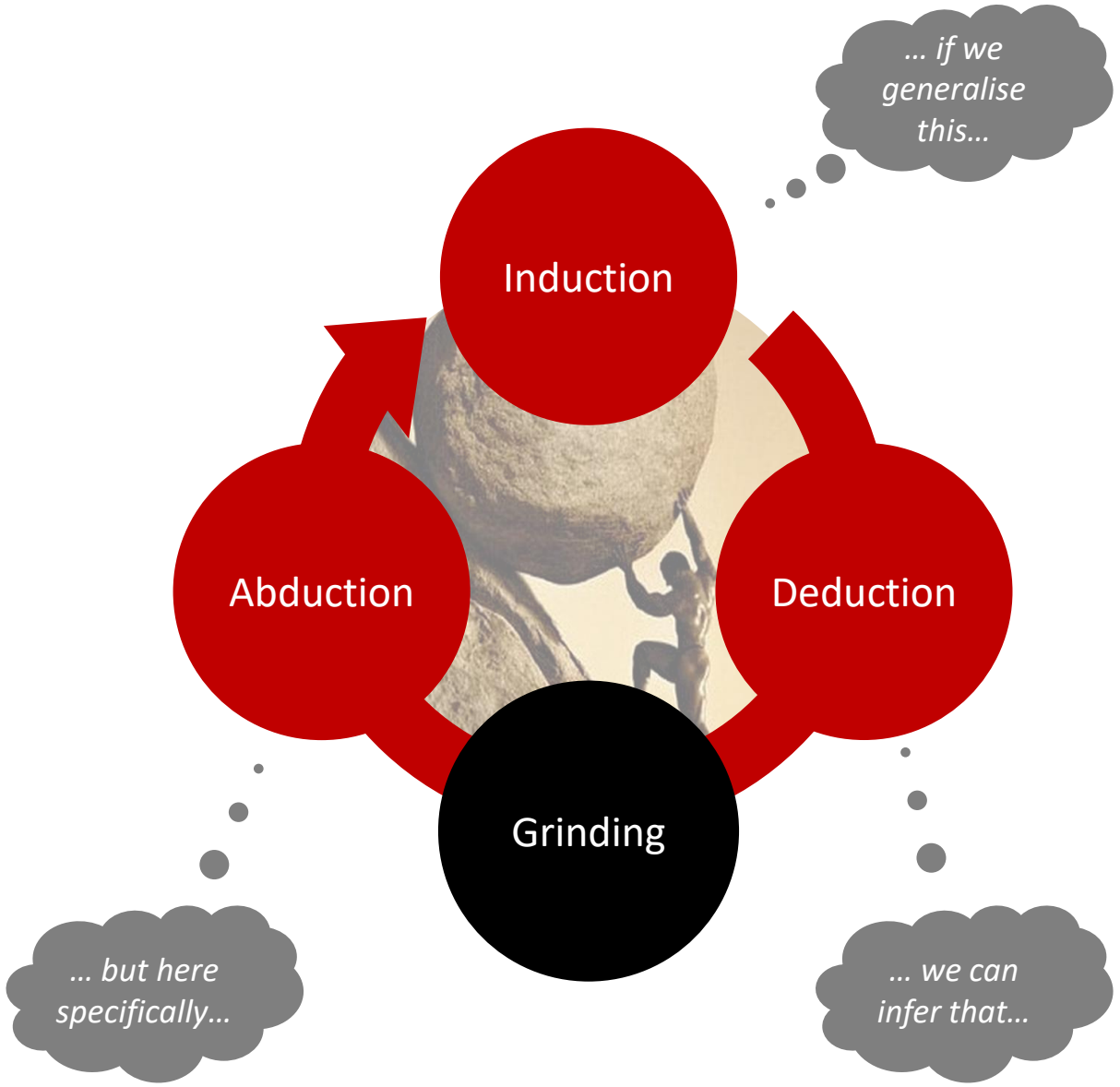
Uncertainty

- Uncertainty is a fundamental part of the *Epistemological Cycle*: it is what **separates "play" from "grind"**.

- The less uncertainty there is, **the further ahead we can safely plan**:

  - Longer plans mean **more labour** before we find out if we were right.

  - And a perceived need to think too far ahead can lead to **analysis paralysis**.



Uncertainty

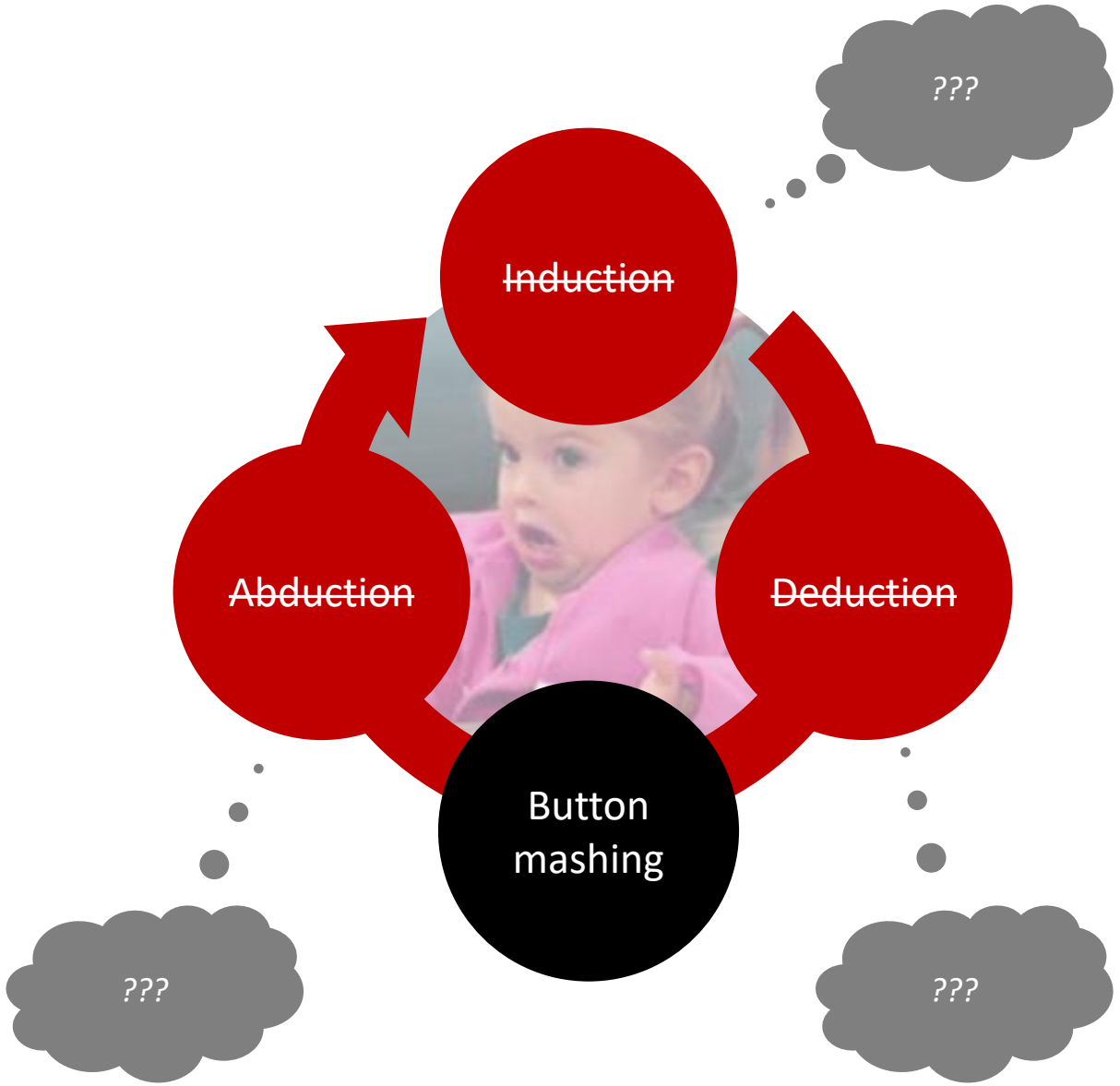
- Uncertainty is a fundamental part of the *Epistemological Cycle*: it is what **separates "play" from "grind"**.

- The less uncertainty there is, **the further ahead we can safely plan**:

  - Longer plans mean **more labour** before we find out if we were right.

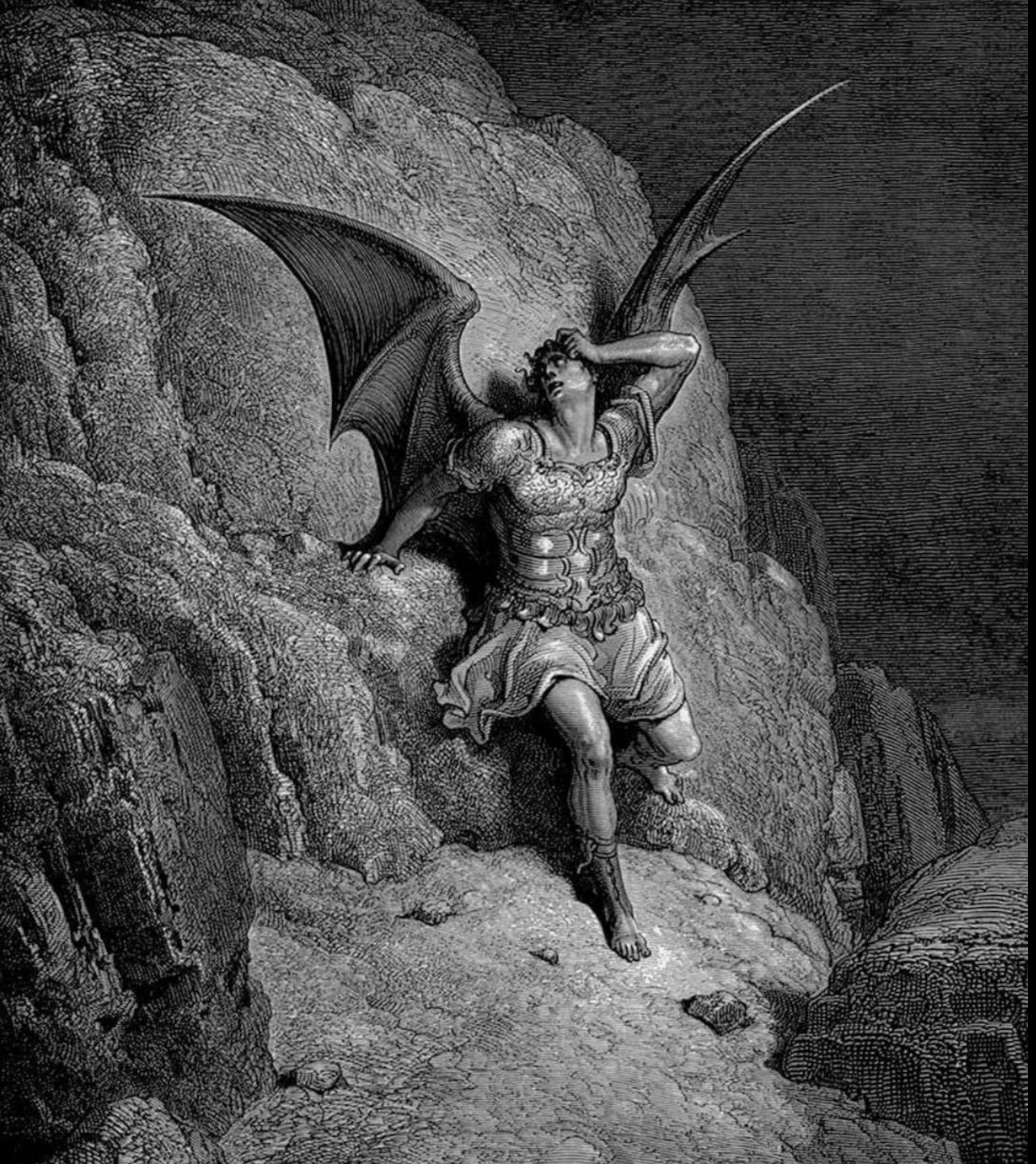
  - And a perceived need to think too far ahead can lead to **analysis paralysis**.

- But too much uncertainty **makes planning pointless**.



Uncertainty – Legion combat / Duels

- In the original *Solium,* legion combat and duels both involved **a *lot* of dice rolls**…
- … but the game is *"We-Go"*, like *Diplomacy*, so your actions **can be interrupted** in any number of ways!
- For the remake we **extirpated the RNG** from these systems, and others: we felt there was enough uncertainty already.
- Does your system *need* RNG? Before *"sprinkling it on top"*, it's worth **considering what forms of uncertainty** are already present: is there enough?



Chapter II

The Monty Hall of mirrors

Stochastic variables

- A “stochastic variable” is **a quantity or object that depends on RNG**.

  E.g. the destination of *Lethal Company*’s inverse teleporter →

- A variable has a **“domain” of possible results** that it can return when it is “sampled”.

  E.g. a position on a moon, the moon itself, what’s in the store, … etc.

- Less-than-ideal situations can result from **insufficiently constrained** domains.

Mulligans

- The easiest way to constrain a stochastic variable's domain is to **define failure conditions**.

  E.g. there must be a path from a teleport destination to an exit →

- Then, when we sample a result that *"fails"*, **we simply try again**.

- This is trivial to implement, but **how many times should we sample** before we accept a failed result? And what if this latest one is the worst yet?

Optimisation

- Rather than passing or failing results outright, we can **give them a score**.
- Then, after sampling a variable a set number of times, we simply **pick the best result we've seen so far**.
- We can also define rules for **locally tweaking samples** to improve scores.

  E.g. *Endless Legend* modifies the terrain around player start locations to meet yield quotas →

Invariants

- Ideally, you want to **avoid the need to reroll in the first place** by imposing constraints from the beginning:

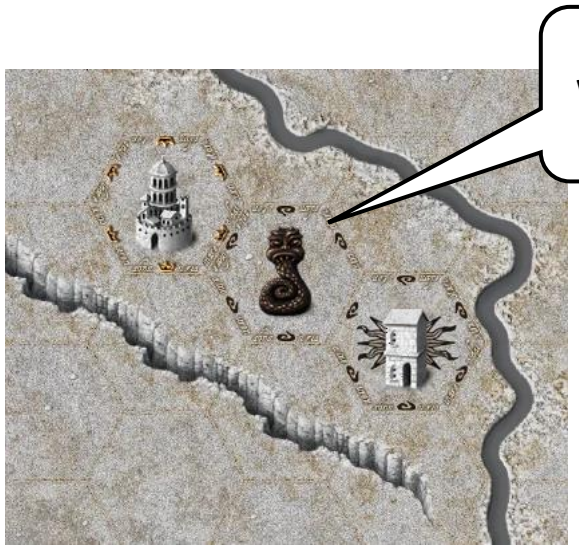
  E.g. in *Winnie's Hole* we exclude mutations that you can't use at all before the drawing ones for you.

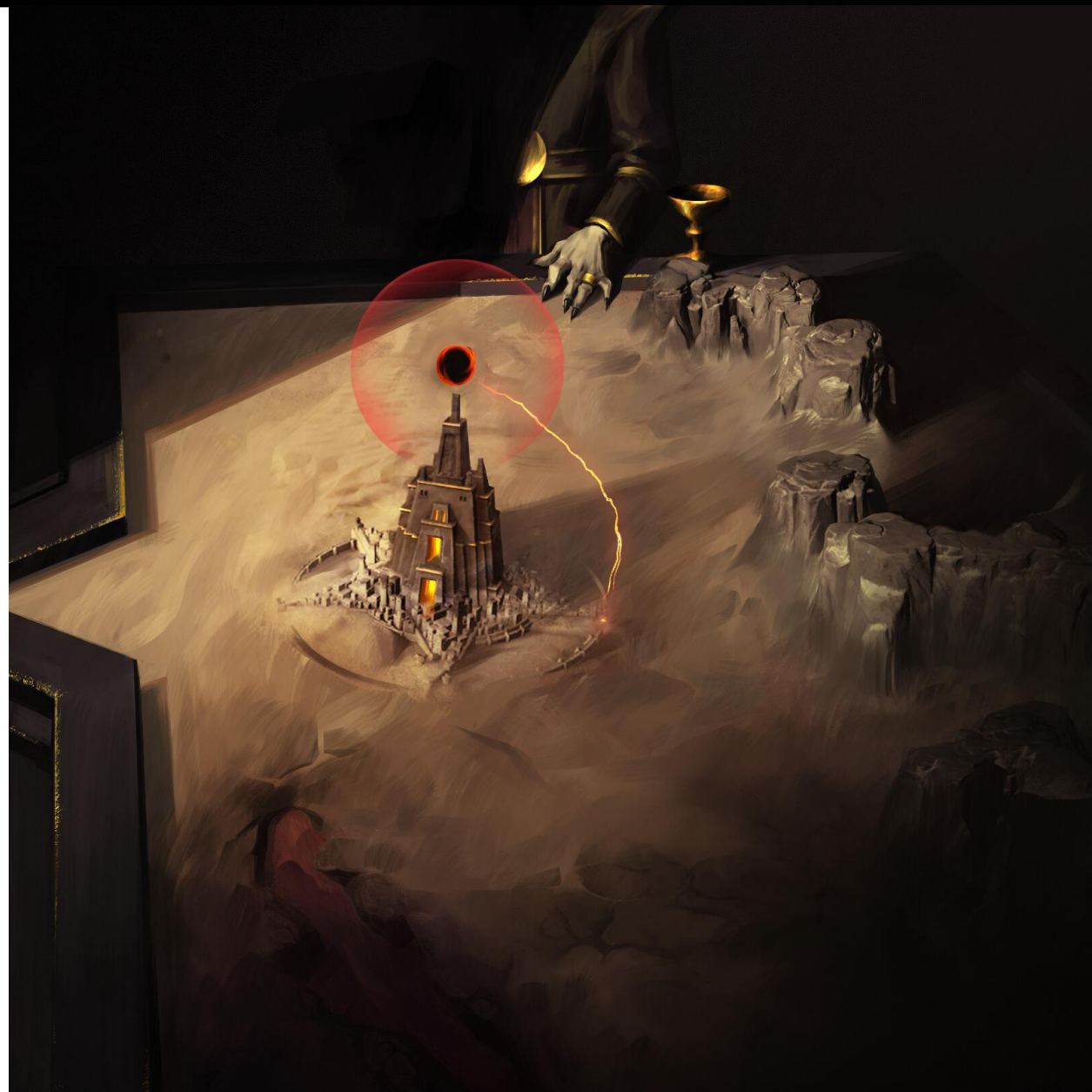
- Procedural generation 101: the **initial state respects** all your invariants, and every **operation maintains** them.

  E.g. *Solium*'s board generator will never expand a ravine or river into contact with a previous one.

Invariants - Board generation

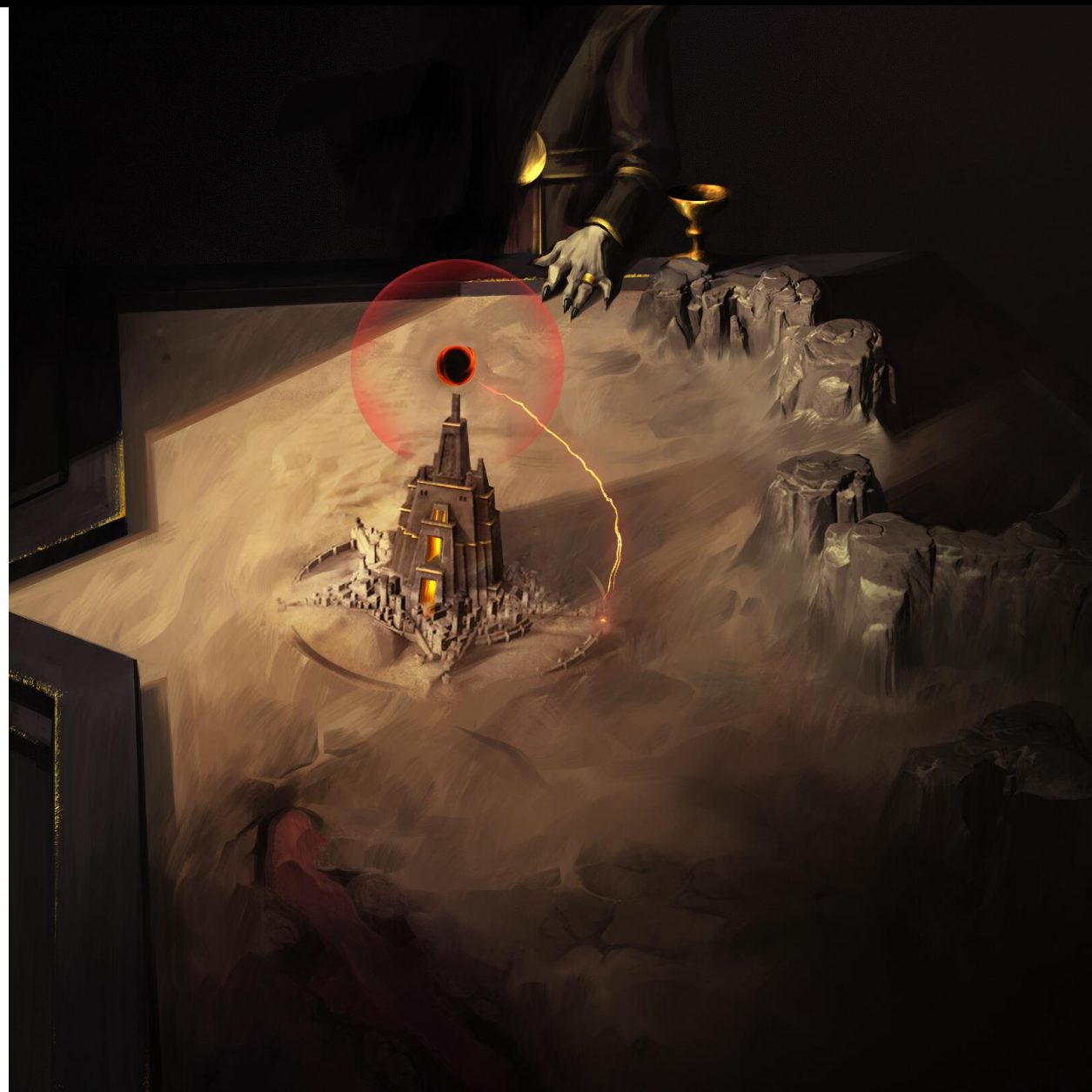
- The original *Solium* would sometimes spawn players in impossible situations:





Invariants - Board generation

- The original *Solium* would sometimes spawn players in impossible situations.
- The remake's invariants guarantee…
  - … that the map is **always navigable**.
  - … **low-hanging fruit** near each player's starting location.
  - … **an equal total count** of weak and strong *Places of Power*.
  - … a minimum **number of access paths** to each *Place of Power*.



Invariants - Event draw

- In *Solium Infernum* players are regularly given *“events”* to play at their discretion.
- As developers, we **don’t** want…
  - … the same event to **come up too many times** per match.
  - … highly disruptive events to occur too early and **stall the game**.
- So we **draw without replacement** and **hold back some events** from the draw for the first few turns.

Invariants - Bazaar quotas

- *Solium*'s military units come from the *Bazaar*, which is **restocked by sampling a stochastic variable**.

- At first the draw was *entirely* random, but this would **invariably lead to a shop with nothing affordable** in it.

- We solved this problem by **reserving slots** in each category for items matching very specific criteria.

- If bad draws are *possible,* some players *will* have a bad time: **don't make it *unlikely* if it should be *impossible***!

Chapter III

A mind made for Eden

Audience participation – Round 1

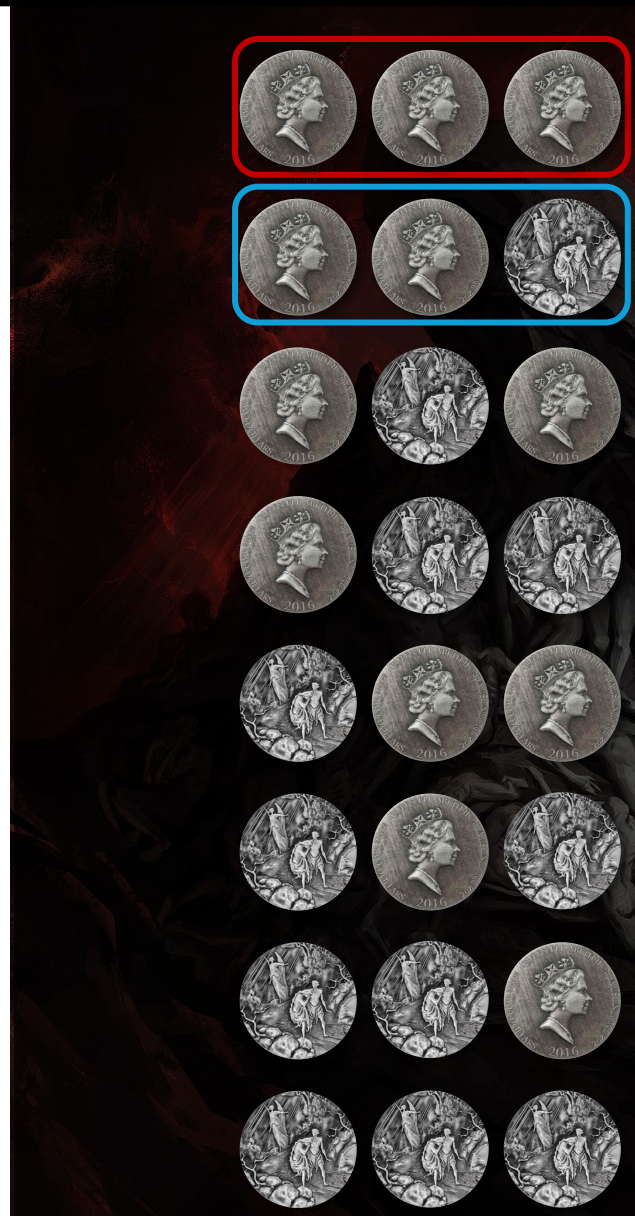
Let's say I'm **flipping a coin 3 times**. Which result is more likely to occur?

Heads, Heads, Heads (**HHH**)?

→ 1/8
= 12.5%

– or Heads, Heads, Tails (**HHT**)?

→ 1/8
= 12.5%



Audience participation – Round 2

Let's say I'm **flipping a coin 3 times**. Which result is more likely to occur at least once?

Heads, Heads (**HH**)?

→ 3/8
= 37.5%

– or Heads, Tails (**HT**)?

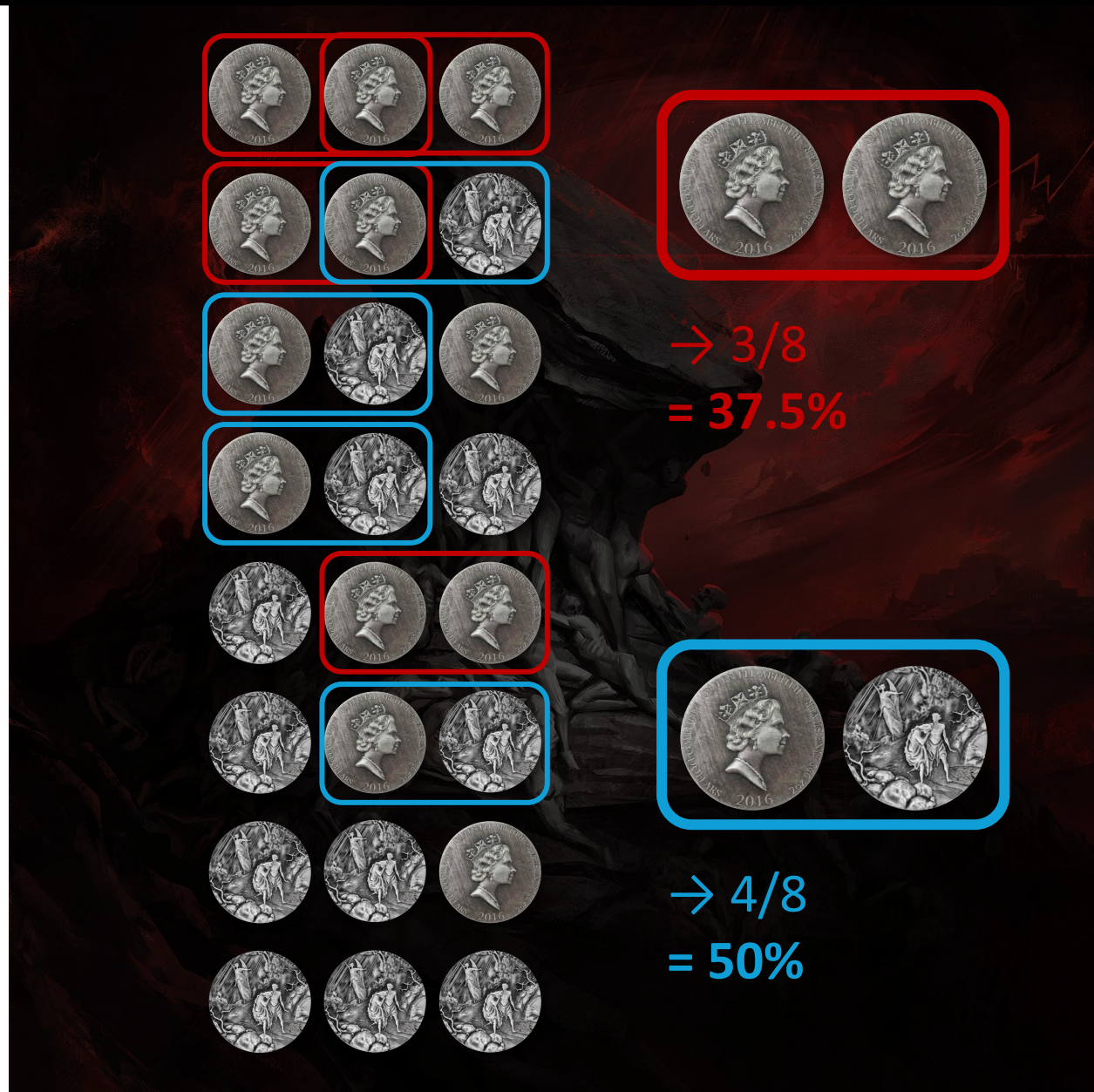
→ 4/8
= 50%

Sequence-subsequence model

- *Hahn & Warren 2009* suggests that our **cognitive bias towards alternation** is adaptive, given the finite nature of our memory, attention and lifespan.

- As they put it, given **finite sampling** *"(…) key aspects of laypeople's supposed misperceptions of randomness actually have probabilistic support"*.

- **In game terms**: if DPS is the same in both cases, it is *rational* to choose consistent damage over a high critical hit chance, because you're only going to attack a finite number of times ☺



Without replacement

- Indeed, the *fewer* times you're sampling, the more similar the results of **sampling with and without replacement** become.
- Understanding stochastic variables as **finite-sized "bags"** of possible results is thus a fair approximation… for mortals.
- How finite? Well, most people can remember **between 5 and 9** entirely unrelated *"chunks"* of information.
- This suggests that the **finest unit of probability** players will *"grock"* intuitively is well above 1% →

Without replacement – Ritual resistance

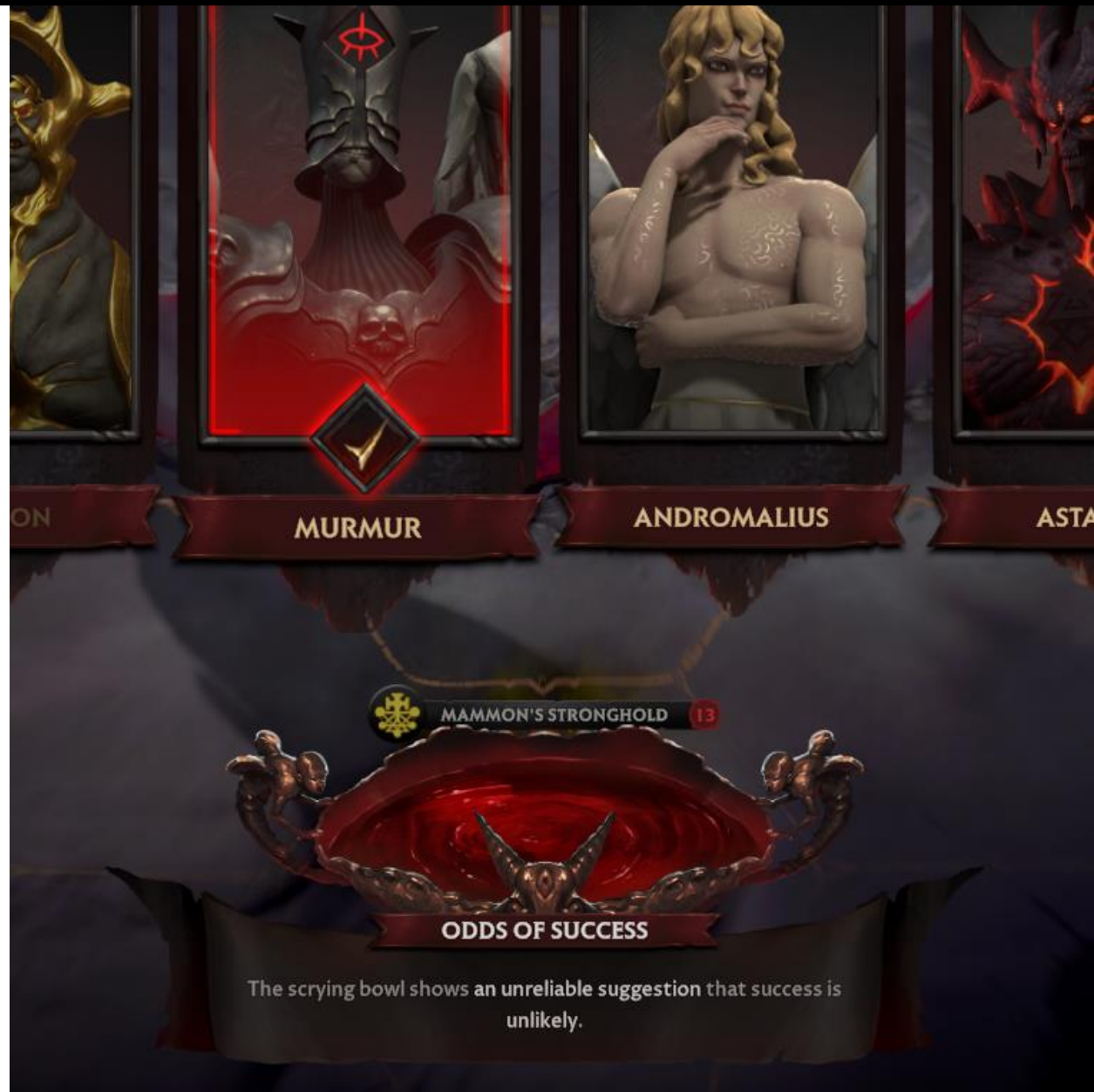
- To avoid disappointment, *Solium* **hides the exact probabilities**, and uses **pessimistic wording** for its predictions.

- We are also careful to **frame a *"miss"* as a successful resistance**, *not* a "failed attempt", to empower both sides.

- Rituals are **still a source of frustration** for players though, given all the **hidden information**. If I did it all again I'd…

  - … draw **without replacement**, or…

  - … **eliminate RNG** entirely!



Without replacement – tribute generation

- There are 4 resources in *Solium*, drawn at random*:* testers would get **frustrated waiting** the type they needed.

- Drawing **types *without* replacement** had a huge impact, but nobody could identify what we'd changed.

- We don't expect players to hear ultrasounds or to see ultraviolent light, but there is a **visible spectrum of entropy too**.

- Lowering the entropy of your variables will **improve accessibility**.

Without replacement – Caveats

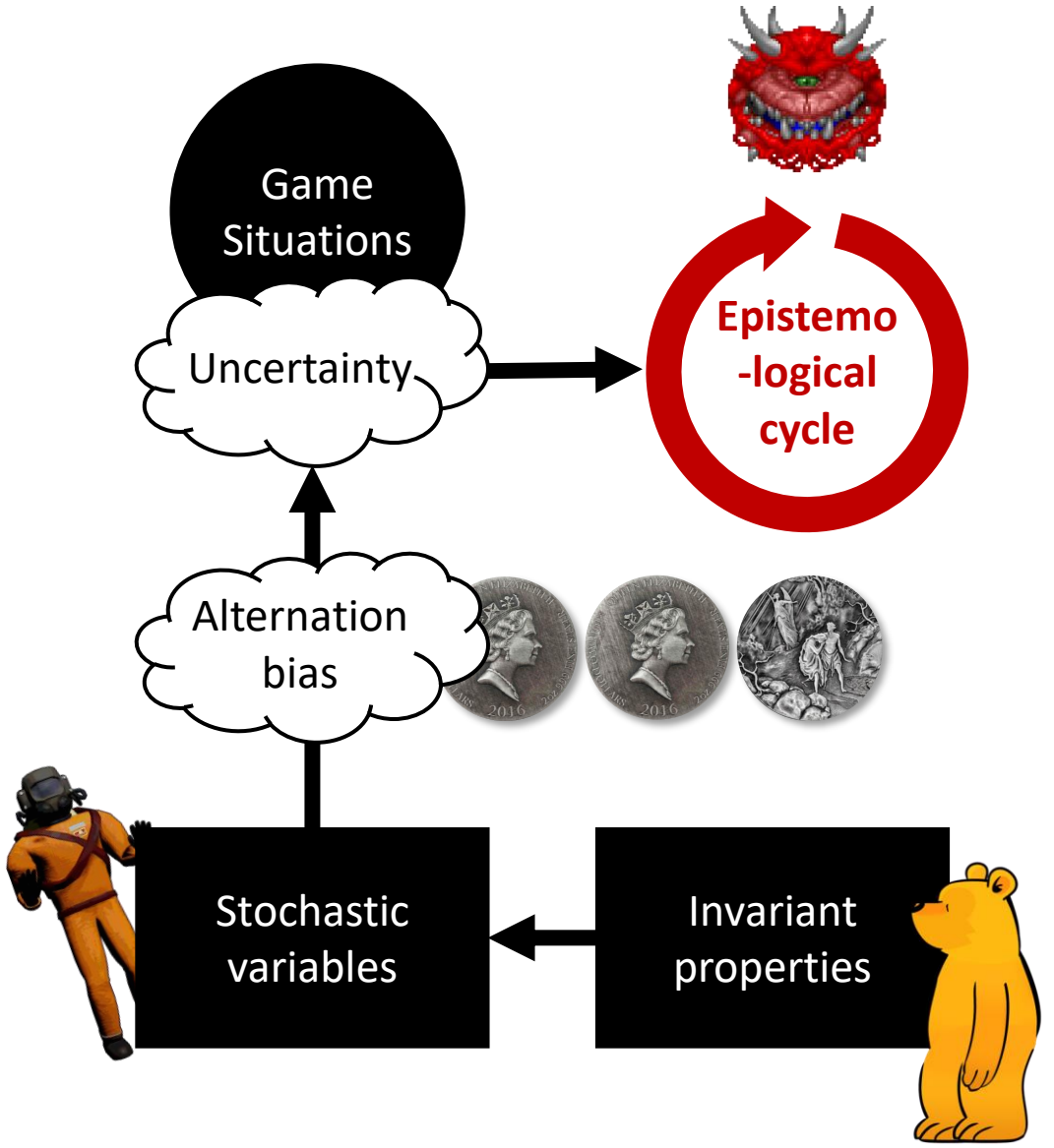
- We originally biased *Manuscript* draws **towards completing sets** the player had started to collect…
- … which assumes the player *wants* to complete these partial sets: **they may want something new**!
- Storing decks of tribute and manuscript types **inflated the size of our saves**: this matters when you're paying to maintain the game's network infrastructure.

Epilogue

Edenic game design

Take-aways

- In trying times, we must take particular care to banish inferior **game situations**.
- **Uncertainty** can lead to *grind* or *button-mashing* if dosed incorrectly.
- **Stochastic variables** are just one source of uncertainty among many.
- Designing **invariant properties** can help constrain your variables' **domains**.
- Humans tend to assume that all draws are **without replacement**.



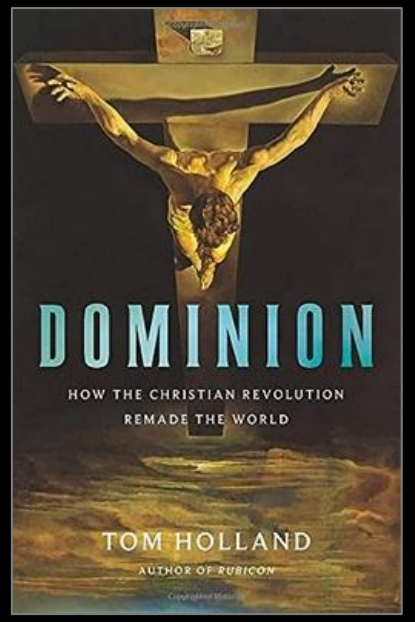
Recommended reading

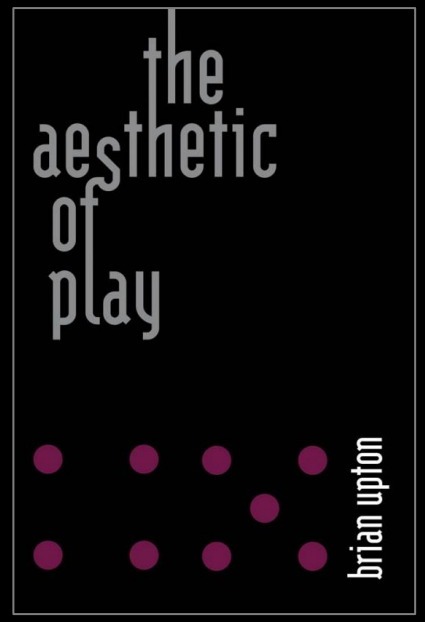
Books:

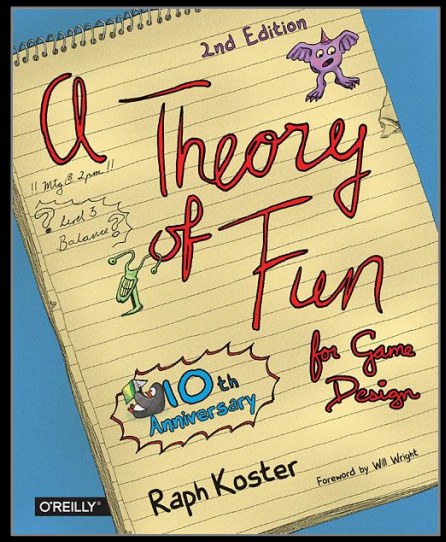
- *Dominion* – Holland (2019)
- *The Aesthetic Of Play* – Upton (2021)
- *A theory of fun* – Koster (2005)

Papers:

- *The Magical Number Seven, Plus or Minus Two* (1956)
- *Perceptions of randomness: why three heads are better than four* (2009)
- *Who "believes" in the Gambler's Fallacy and why?* (2017)







Thank you for your time!

Questions?

HAVE DICE
WILL DYCE