

# G54GAM Games

Structuring Games

Balance

# But is it balanced?

- Contains meaningful choices
- The role of chance is not too great
- Perceived to be *fair*
- Player-versus-Environment
  - *Appropriately* challenging: neither too hard nor too easy
  - Balanced resources: actions are not too “expensive”
  - No dominant strategy: requires multiple play styles
- Player-versus-Player
  - Fairness: equal players have equal chance of winning
  - Pacing: players have “reasonable” chance of catch-up
  - Politics: skill should be more important than alliances

# Is it balanced?

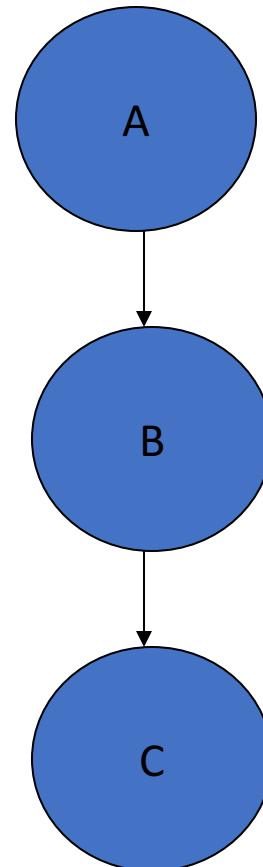
- Combinatorial analysis of the game components
  - Optimisation problem
  - Just because a result is mathematically correct does not mean it is aesthetically interesting
- Trial and error
  - Run out of time, release game
  - Tweak further by releasing additional patches
- What are we balancing and how
  - **Static** balance
    - Are the rules fair when considered as a static system?
    - Is the initial state of the system (formal) balanced?
  - **Dynamic** balance
    - Is an *equilibrium* maintained?
    - How does balance change with time and player interaction?

# Dominant Strategies

- Always buy presents
  - Always get positive payoff
  - Assuming there is no “memory” in the system
    - Rarely is in a game mechanic
- Never buy presents
  - Zero payoff
  - Massive loss
- **Strongly** dominant strategy
  - Guarantees winning every time
- **Weakly** dominant strategy
  - Guarantees not losing, but drawing – Tic-tac-toe
- All other strategies **recessive**
  - Why would a player choose to do something else?
  - Once discovered, they never have cause to use any other strategy

# Transitive Relationships

- A one-way relationship between objects
- A beats B, B beats C, C beats nothing at all
  - Therefore A beats C
    - Transitive property of “beats”
- Why would anyone want C?
- Examples?

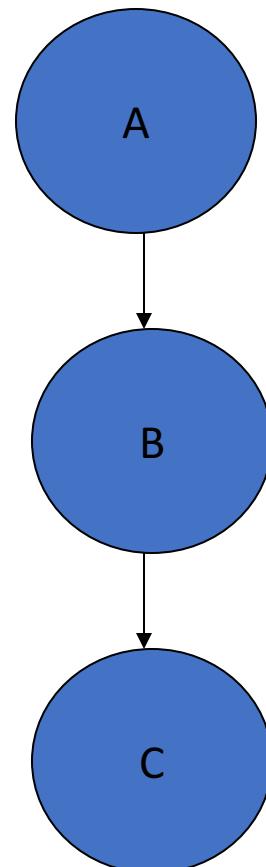


# Transitive Relationships

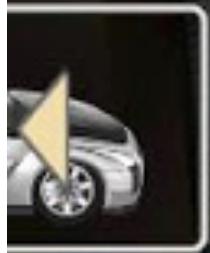
	A	B	C
A	0	1	1
B	-1	0	1
C	-1	-1	0

# Transitive Relationships

- Make C **free**, and A **cost** something
  - Literal resource cost
  - Effort required to achieve
- Reward without cost leads to a **dominant strategy**
- Transitive relationships continually drive a player towards a goal
  - Progression
    - Work from C up to A
  - Positive feedback
    - If you do well, you get better at doing well



# GARAGE



**BMW M3 E92**  
\$45000 [level 2]



YOU HAVE:

**\$439568**

**RP: 41122**

FILTER CARS:

**LEVELS 7,8**



**SELL UPGRADE PAINT RACE**

POWER

307 kW

WEIGHT

1680 kg

GRIP

9513

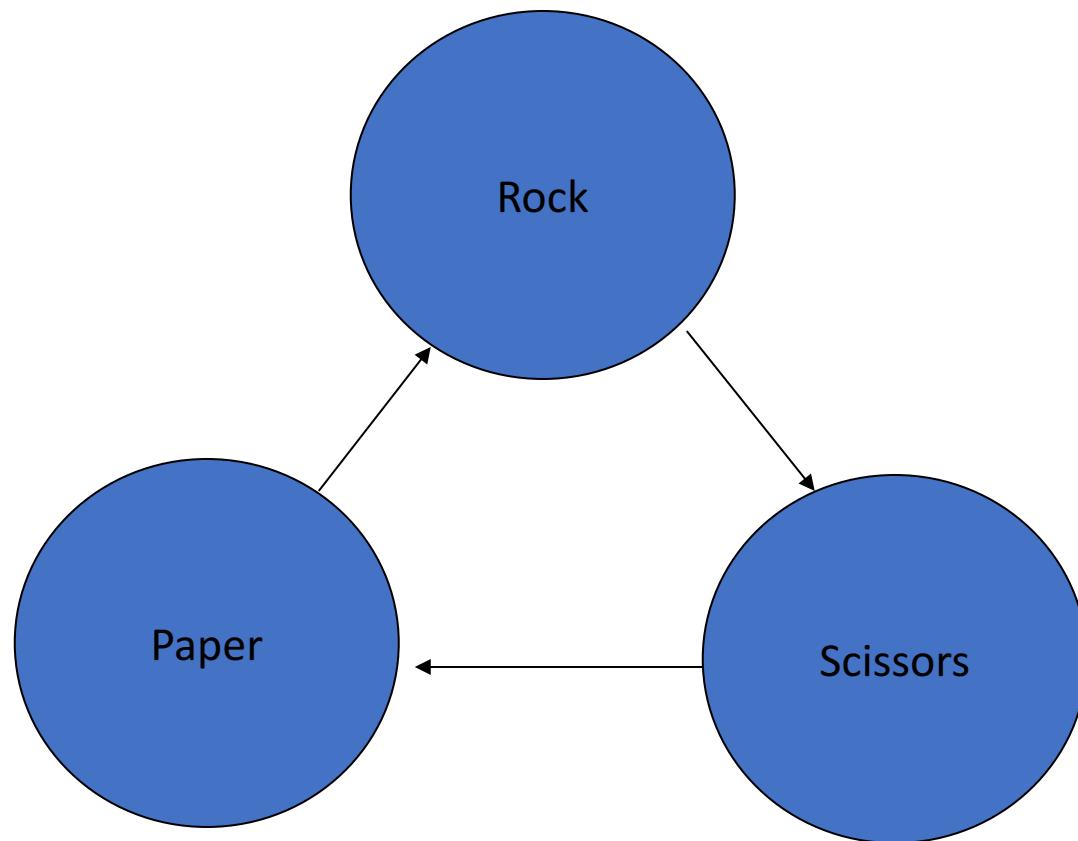
# Transitive Relationships

- A racing game in which players attempt to earn the most prize money by winning races
- Car speed Porsche > BMW > Fiat
  - Dominant strategy
  - Solution
    - Price each car in proportion to its advantage
    - \$\$\$Porsche, \$\$BMW, \$Fiat
    - The financial disadvantage of the Porsche offsets its speed advantage
    - Bland?
- Shadow costs
  - Build the cost into the game *mechanics*
    - A slow rate of fire to offset large amount of damage
    - Only discovered when starting to use the weapon
- Games involving upgrading or augmenting player abilities
  - Positive feedback
  - Regression
    - Loss of upgrades
    - Dramatic effect

# Quake 3 Arena (1999)

- <https://youtu.be/rSOChyMURXM?t=19>

# Intransitive Relationships



# Intransitive Relationships

	Scissors	Paper	Rock
Scissors	0	1	-1
Paper	-1	0	1
Rock	1	-1	0

# Intransitive Relationships

- No strategy always wins
  - Monotonous play is punished
  - Play becomes psychological
- Common in RPGs
  - “Trade off” one ability against each other
    - The player must decide which ability to maximise
      - Speed vs durability
  - Spend points on strength or charisma?
    - Stats-jugglings
    - Skills are independent and orthogonal
  - Still needs to be balanced
    - A strength point should give an equivalent advantage as a charisma point
    - Must still be able to complete the challenge
      - Arbitrary punishment for making the wrong decision

# The Rock, The Paper and The Scissors (2016)



# Orthogonal Differentiation

- Each type of unit a player can control should be *orthogonally different* from all others
  - Unlike the others in a different dimension
  - Differ in magnitude of power at performing a task
  - Display entirely different qualities
    - A distinct role to play in the game
    - Otherwise weaker units only serve as part of an upgrade path
    - RPG
      - Strength, intelligence, charisma...
- Avoids dominant strategies
  - A variety of units required to complete the level
    - Difficult to directly compare the advantages of weapon vs armour
  - Stealth & combat
    - Requires diverse *challenges*

# Balancing Techniques – Symmetry

- Only applies to PvP
  - Or PvE where the “computer” is embodied as a player
  - All PvE games are asymmetric because there is only one player
- Each player is given the same starting parameters / abilities
  - Most applicable to...
    - Sports simulations
    - Multi-player games
  - If a dominant strategy is available it is available to all
    - Starting turns governed by random chance therefore considered *fair*
  - Difficult to achieve precisely
    - Little in the “real world” is symmetric



# Balancing Asymmetry – Resources and Points

- **Quantify** abilities by reducing them to points
- Sources – how a resource can increase
  - Ammunition, health pickups
  - Spawn points
- Drains – how a resource can decrease
  - Firing a weapon, damage to the player
  - Killing a monster
- Adjust sources and sinks to *balance* economy
  - Together determine the *price* of the resource
  - Price of resource should reflect it's *power*
    - Skill + Power = *Agency*
- Failure states
  - Underpricing
    - Cheap, powerful actions limit play variety
  - Overpricing
    - Expensive, weak actions penalise usage, waste of designer's time
  - Engines
    - Spend one resource to get back another

# Balancing Asymmetry – Social Play Roles

Motive	Role of Player	Role of Counteractor
Race	To overtake	To stay ahead
Chase	To catch	To dodge or elude
Attack	Overpower a defense, to enter a guarded area	To defend an area, to ward off, to be on guard
Capture	To take person, position, symbol	To avoid being taken

# Balancing Asymmetry – Map Design

- Enhance and facilitate combat
  - Choke points
    - Enhance and facilitate combat
    - Narrow the map flow through 2-3 entrances
    - Before the map's objective
  - Both teams arrive at the same time
- Place bomb before counter terrorists arrive
  - Set up “defense”
- Support multiple play styles
  - Sniping, close combat, stealth



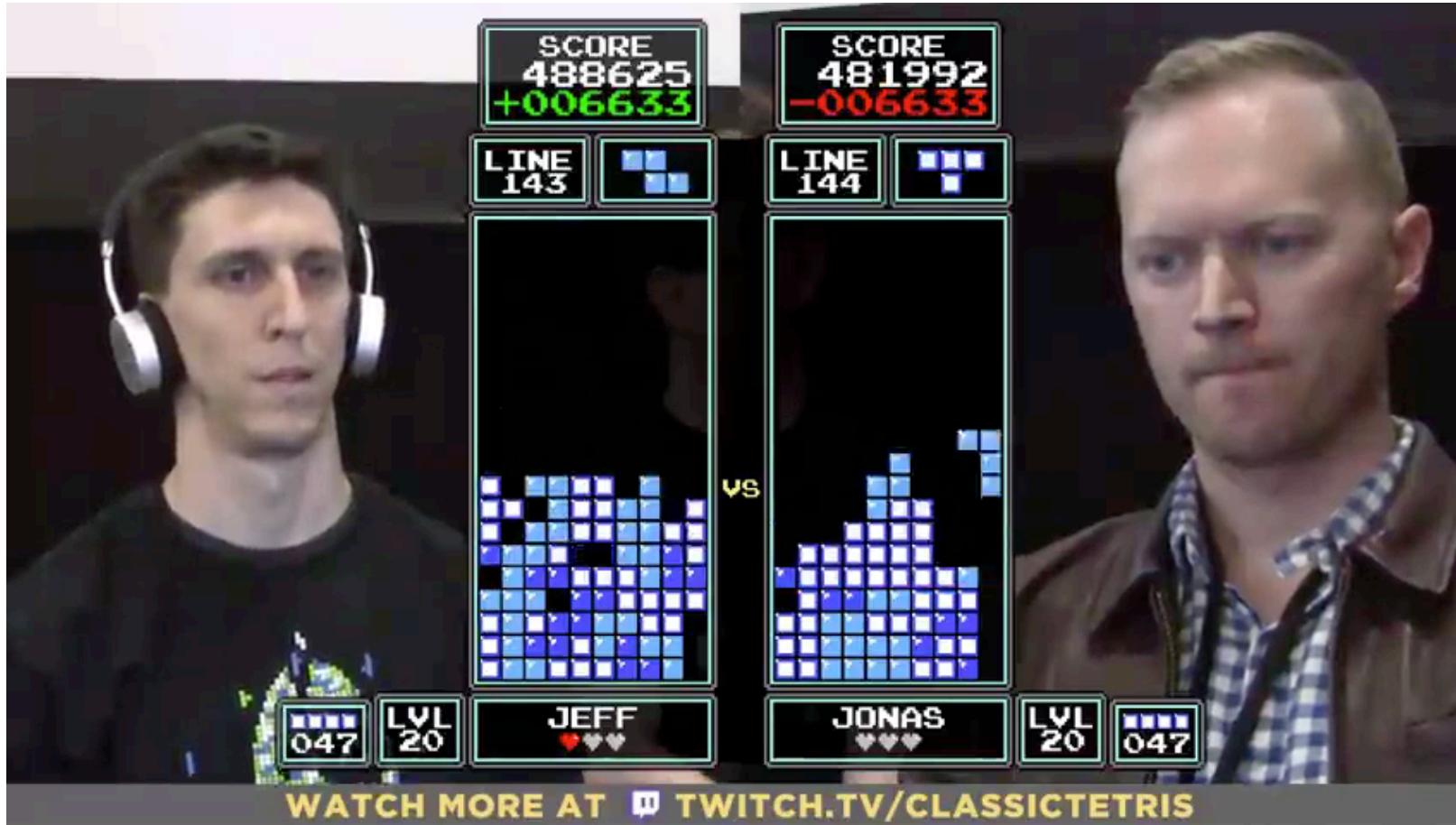




# Dynamic Balance

- As **time and player interaction** continue, what happens to the balance?
  - Is it maintained?
  - Is it destroyed?
  - Can it be restored?
- How the game is dynamically balanced defines the game play of the game
  - Balance is disrupted
    - The / a player wins or loses
  - Balance is maintained
    - The player can continue to play
    - Reach an *eventual* conclusion

# Tetris (1984-)

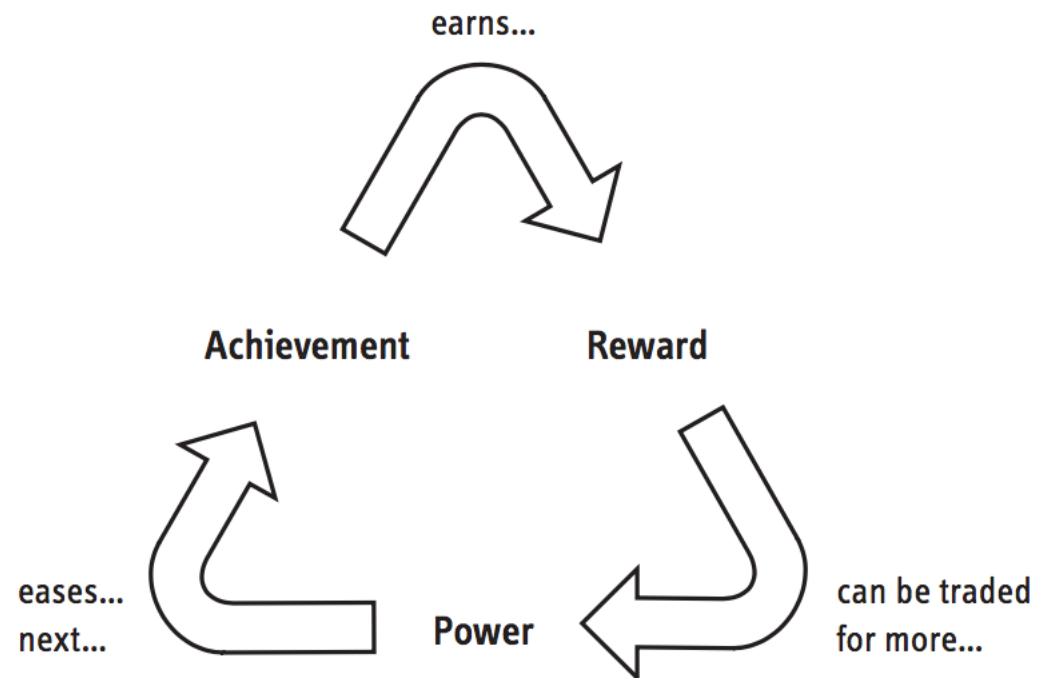


# Dynamic Balance - Longevity

- Longevity is a function of feedback
  - *Emergent or designed*
- **Positive Feedback**
  - Rewards player success
  - Leads to snowballing, destabilises the game
  - Can be constructive – increase attack ability
  - Destructive – drain opponent ability
  - Once a player gets ahead, difficult to catch up
- **Negative Feedback**
  - Punishes player success
  - Stabilises the game, forgives the loser
  - Can be constructive – boosts opponent
  - Game may go on forever without a winner
  - Winner may feel arbitrary

# Dynamic Balance - Pacing

- Feedback is a common form of dynamic, emergent behaviour
  - Game mechanics produce certain outputs
  - Outputs then modify the game mechanics
- **Positive**
  - Reward player for success
  - Power-ups / abilities in any shmup
  - “Stun lock”
    - Allow us to hit them again, “push home advantage”
- **Negative**
  - Handicap player for success
  - Blue shells in Mario Cart hamper the player in the lead



# Ultra Street Fighter II (2017)



# Need for Speed: Carbon (2006)



# Mario Kart (1992-2017)

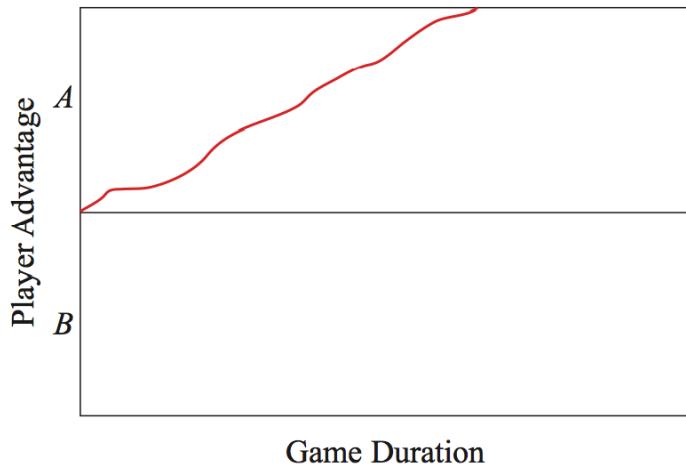


# Balancing Feedback

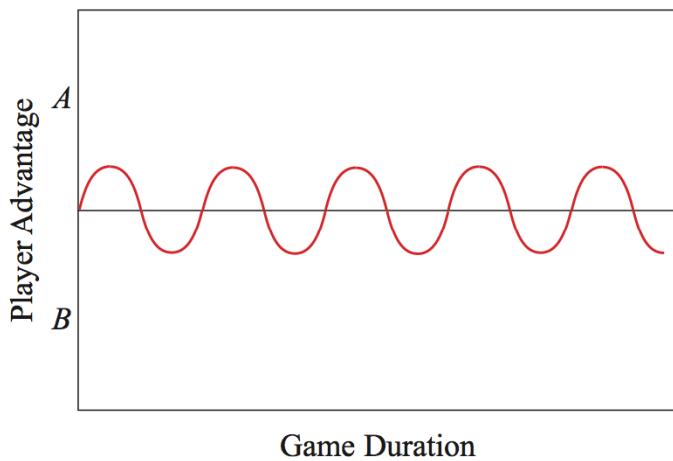
- Controlling positive feedback
  - Limit power as a reward for success
  - Introduce negative feedback
    - Associate cost with achievement
- Raise the absolute difficulty level of challenges as the player proceeds
  - Perceived difficulty remains constant
- Allow collusion against the leader
- Use the effects of chance to reduce the size of the player's rewards
  - “Random” loot lowers reward for achievement
  - *Half-Life 2* checks the state of the avatar’s health and ammunition when a crate is opened, adjusts the contents of the crate accordingly

# Feedback failure states

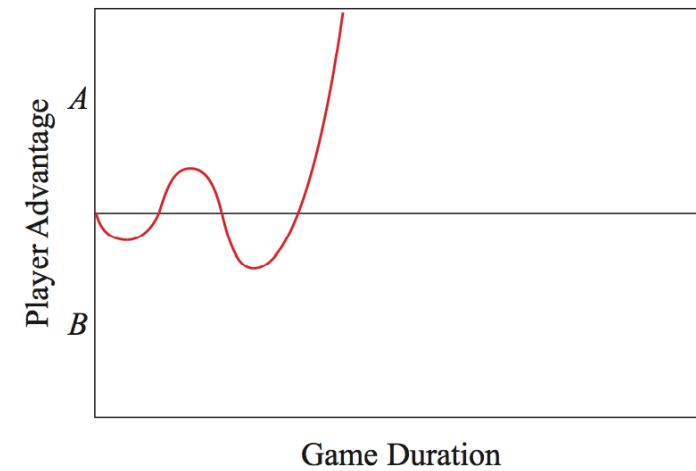
no feedback



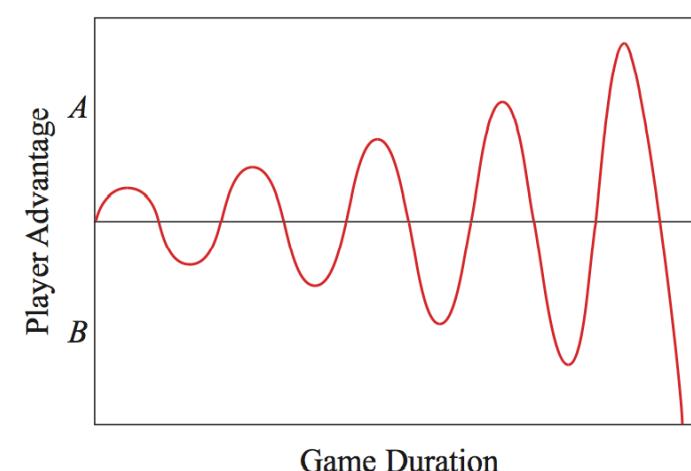
stagnation



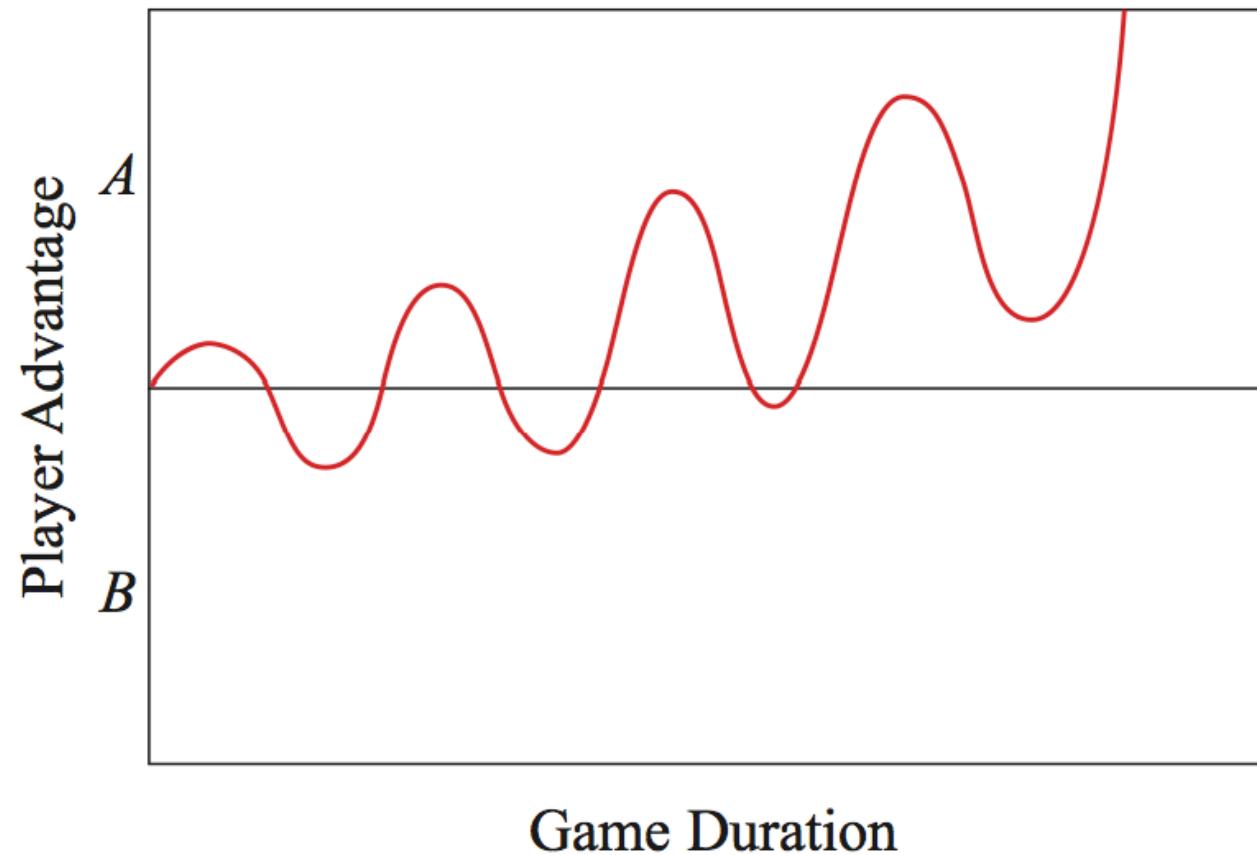
extreme positive feedback



extreme negative feedback



# Ideal pacing



# Parameter Tuning

- Mechanics have parameters
  - How fast the player can run
  - How far the player can jump
  - The power of an item or weapon
    - *Player efficacy*
- Tuning
  - Adjustment of these parameters
    - Dynamic feedback / dynamic difficulty
  - Allows you to adjust feedback
    - Feedback can be implicit, emergent – dominant strategy
    - How extreme should the effect of the “rubber banding” be?
- Requires significant play testing

# Reading

- Rollings and Adams, chapter 8.
- Salen and Zimmerman, chapter 18.