Functionality, Completeness, Balance, Interesting Choices
What do I do with my playtesting data?

- **What to test for in each stage**
  - **Foundation (basic idea)**
    - Is this idea compelling? FUN?
  - **Structure (rules and procedures)**
    - Functionality and fun
    - Is this concept worth continuing?
  - **Formal Details (fleshed out game)**
    - Functionality, internal completeness, and balance
  - **Refinement**
    - Was the fun removed by the previous step?
    - Accessibility
Functionality

■ Can the game be played (in some form)?
■ Rules and procedures in place
■ Can a resolution be reached?
Internal Completeness

- Are there missing elements?
- ...gaps in the rules?
- ...loopholes, dead ends, game breakdowns?
- Unexpected dominant strategies
  - Example: spawn camping
...some spawn camping solutions

- Spawning points = # of players
- Spawn Force field / invulnerability
- Random spawn points
- Invisibility when spawning
- No spawning (last man standing)
- Spawn points can be “neutralized” by opponents
- Large spawn area and maybe player defined spawn point
- Spawn point deathtrap for opponents
- Vigilante justice, “rules of engagement” rating
- It’s a feature not a bug!
Loopholes

■ Players are very resourceful
■ Very difficult to eliminate totally
■ Asteroids (safe place on screen)
■ “rocket jumping” (ROTT, Quake, Halo2)
  – …or is it a feature?
■ Mario64 (failure of collision detection)
■ Example: player killers
Dead Ends

- Player(s) cannot continue towards goal
- Your actions/choices in the past (or a bug) doom you to limbo
- Deadlock between competitors
Balance

- The process of making sure the game meets your player experience goals
- Are game elements working together with undesired results?
- Is there a dominant strategy or player?
- Is the skill level appropriate for target audience?
- Assessing this may involve some complex math
Areas to Balance

- Variables
- Dynamics
- Starting Conditions
- Skill
Variables

- The properties of the game elements
  - Size of arena, hit points, shields, money/costs, # of players, # of lives, speed etc.

- Example: Connect Four
  - 7 x 6 grid versus 8 x 6
Variables

■ Example: WarCraft III
  – Started with big numbers, then tuned them down
  – Less units, “concentrating the coolness”
  – Number of races (9 to 6 to 5 then to 4)
    • Demons messed up the balance
  – Heroes
    • No more “fodder units”, so heroes can have impact
      – But how do you enforce this?
        • Unit cap didn’t work
        • Upkeep (had to change the name from “tax”)
      • Originally 4 per race, then 3 (Petitions to reinstate “Ranger”)
  – Continuous patching as players become more adept
Dynamics

- What happens when the system is set in motion?
  - Combinations of rules and actions can cause imbalance
  - Dominant strategies, objects
- Avoid reinforcing relationships
- Add in randomness to even the scales
- Sweeping victory is satisfying
Dynamics

■ Symmetry
  – Rotational Symmetry (Rock Paper Scissors)
  – Remove turn order bias with chance or lots of turns

■ Asymmetrical games
  – Examples: fighting games, RTSes, historical games
  – More fun?
Dynamics

- Asymmetrical Objectives
  - Ticking clock
  - Protection
  - Complete Asymmetry
Skill

- If no explicit skill levels, balance for medium skill
  - High and low water mark from expert and novice gamer

- Dynamic balancing of skill
  - Tetris, MarioKart64
  - must avoid counterintuitive play as strategy
How do I balance my game!?

- Divide game into discrete functional units
  - Resource management, combat, magic etc.
- Focus on one subsystem at a time
- Make one change at a time
- “Purity of Purpose”
  - Each component has single, clearly defined mission
  - Nothing exists for no reason
  - Nothing has more than one function
  - Try stripping out game elements
- Spreadsheets
- Trust your intuition
Interesting Choices
Improving Player Choices

• What makes choice interesting versus uninteresting?
• How can you design choices that are interesting?
Consequences

- Choices should have consequences.
- Or, each choice must alter the course of the game.
- Upside and Downside to each choice
- Common flaw in existing games: Choices that have no bearing on outcome
- Examples of poor choices: too many weapons that are too similar, side quests/mini-games with no real impact
Types of Decisions

- Hollow Decision: no real consequences
- Obvious Decision: no real decision
- Uninformed Decision: an arbitrary choice
- Informed Decision: where the player has ample information
- Dramatic Decision: taps into a player’s emotional state
- Weighted Decision: a balanced decision with consequences on both sides
- Immediate Decision: has an immediate impact
- Long-Term Decision: whose impact will be felt down the road
Dilemmas

• Situations where player must weigh the consequences of their choices carefully
• In many cases, there is no optimal answer
• Often paradoxical or recursive
• Von Neumann studied dilemmas, diagrammed showing potential outcomes
Cake-Cutting Dilemma

• Divide a piece of cake between two children
• Each wants the largest piece
• Mother assigns one to be “cutter” the other as “chooser”
• Cutter slices the cake, chooser picks their slice
Chooser’s Strategies

Choose Bigger Piece

Chooser gets a slightly bigger piece.

Choose Smaller Piece

Chooser gets a slightly smaller piece.

Cutter’s Strategies

Cut as Evenly as Possible

Choose Bigger

Chooser gets a bigger piece.

Cut One Piece Bigger

Chooser gets a smaller piece.
Zero-Sum Game

• Total amount won at the end of the game is exactly equal to the amount lost.
• Cake-Cutting Dilemma is an example
• Interests of players are diametrically opposed.
• What one player loses is gained by the other.
Minimax Theory

• Von Neumann discovered that there is an optimal strategy for each player in zero-sum games
• Optimal strategy is “maximize their minimum potential result”
Problem with Zero-Sum Games

• Once players are aware of the optimal strategy, they will always use that strategy
• **Obvious Decision**
• How can we create more complex dilemmas?
The Prisoner’s Dilemma

• Created by two RAND scientists in the 1950’s
• Showed how non zero-sum games can create situations where the optimal strategy for each player can result in sub-optimal strategies for both
The Prisoner’s Dilemma

- Two criminals commit crime together
- Caught by police
- Held in separate cells with no means of communication
- DA offers each a deal, says that both are getting the same deal:
  - Rat on partner, he denies it, you go free and partner get 5 years in jail (and vice versa)
  - Both rat: each gets 3 years
  - Neither rat: each gets 1 year
<table>
<thead>
<tr>
<th>Thief B’s Strategies</th>
<th>Rat on A</th>
<th>Don’t Rat</th>
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<tbody>
<tr>
<td>Thief A’s Strategies</td>
<td>Rat on B</td>
<td>Don’t Rat</td>
</tr>
<tr>
<td></td>
<td>A: 3 years</td>
<td>A: 5 years</td>
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<tr>
<td></td>
<td>B: 3 years</td>
<td>B: 0 years</td>
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<tr>
<td></td>
<td>A: 0 years</td>
<td>A: 1 year</td>
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<tr>
<td></td>
<td>B: 5 years</td>
<td>B: 1 year</td>
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Hierarchy of Payoffs in the Prisoner’s Dilemma

• Temptation for defection (0 years)
• Reward for mutual cooperation (1 year each)
• Punishment for mutual defection (3 years each)
• Sucker’s Payoff for unreciprocated cooperation (5 years)
• Temptation > Reward > Punishment > Sucker
• If this hierarchy exists, the optimal strategy for each player will always result in a payoff that is less that if they had acted cooperatively.
Hypothetical Game Using Prisoner’s Dilemma

- Steve Boscska/Radical Entertainment presented at GDC
- Building/Customizing Spacecraft game
Spacecraft Game

- Requires bartering and trading of raw materials with budget of $10000, but high transaction cost of $8000 "shipping and handling"
- Technology can be purchased ($5000) that allows materials to be transported free of tax but…
- …both players must purchase
### Player A’s Strategies

<table>
<thead>
<tr>
<th>Player A’s Strategies</th>
<th>Buy Transporter</th>
<th>Keep the Status Quo</th>
</tr>
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<tbody>
<tr>
<td><strong>Player B’s Strategies</strong></td>
<td><strong>A:</strong> $5k</td>
<td>A: $0</td>
</tr>
<tr>
<td></td>
<td><strong>B:</strong> $5k</td>
<td><strong>B:</strong> $13k (B goes bankrupt)</td>
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<td></td>
<td><strong>A:</strong> $13k</td>
<td><strong>A:</strong> $8k</td>
</tr>
<tr>
<td></td>
<td><strong>B:</strong> $0 (A goes bankrupt)</td>
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Puzzles

• Contextualize choices that player makes: moving towards or away from solution?
• Key element in creating conflict in many single-player games
  – Innate tension in solving puzzles
• Tie to system of rewards for success and punishment for failure
  – transforms into a dramatic element
• Puzzle should be integrated seamlessly into game
  – Advance storyline
  – Enable progress
Rewards and Punishment

• Most direct consequences for player choices
• Emphasize rewards, while limiting punishments
• Threat of punishment, *not punishment itself*, carries dramatic tension
• Rewards should have utility or value
Reward System Guidelines

• Rewards that are useful in obtaining future victory carry greater weight
• Rewards that have a romantic association, like magic weapons or gold, appear more valuable
• Rewards that are tied into the storyline of the game have an added impact
• Pay attention to timing and quantity of rewards, otherwise they can become meaningless
EverQuest: Addictive Game

• Psychologist Nick Yee studied reward/punishment structure in EQ
• Believes EQs addictive power lies in a behavior theory advanced by B.F. Skinner, *Operant Conditioning*:
  – The frequency of performing a given behavior is directly linked to whether it is rewarded or punished
Skinner Box

- Rat in box with lever and food dispenser
- Fixed interval schedule: food comes out on fixed interval
- Fixed ratio schedule: food comes out every time rat presses lever fixed number of times
- Random ratio schedule: must press lever a randomly determined number of times
- Everquest is Random Ratio Schedule
- Gambling in Las Vegas?
Recognition

- Powerful type of reward
- Humans crave acknowledgement for achievements
- Examples: high scores, tournaments
Anticipation

- Useful for complex choices (random ratio schedule good for simple, repetitive game play)
- Closed versus mixed information structures – is all information available to player?
- Chess versus Warcraft II with Fog of War
Surprise

- Feel random to players, but in a good way
- Example: foot soldier versus ogre
  - Foot soldier: strikes for 1-5 HP, 10 HP
  - Ogre: strikes for 1-20 HP, 20 HP
- Chance that foot soldier will win
- Trick is to find right balance of surprise versus meaningful decisions
Progress

- Advertise milestones to player
- Reward after each accomplishment
- Providing a path for player gives a sense of achievement
- Be creative in finding way to represent progress to player
- Plan “mini-arcs” after which player encounters “memorable moment”
Fun Killers

- Micromanagement
- Stagnation
- Insurmountable Obstacles
- Arbitrary Events
- Predictable Paths
Micromanagement

- Tedious
- Boring
- Overwhelming
- Solutions for RTS
  - Command queuing
  - Formations
  - High-level strategies (defend, attack, patrol, etc.)
Stagnation

- Repetition
- balance of power (team up against player that is ahead)
- endless loop (caught in debt)
- no progress being made
Insurmountable Obstacles

• Perceived as being such by some percentage of gamers
• Adventure games
Arbitrary Events

- Frustrate user, especially if a negative event
- Zombie closets
Predictable Paths

- Don’t force user down one path if possible
- Create illusion of freedom