DESIGN IN DETAIL
Jaime Griesemer

(Splash)
We are in room 130, it is Thursday at 1:30, and I have about 130 slides. So I am going to talk very fast and cover a lot of ground!

Welcome to Design in Detail: How toSubtitle Your Talk with an Entire Paragraph and Make Sure You Don’t Forget to Mention Halo 3

Before we start, is anyone thirsty?
First, let me tell you a bit about myself

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Gameplay Design Lead

--

11 Years at Bungie

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Weapon Balance for All 3 Halos

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(Except the Halo 1 Pistol)

I didn’t make that call, I didn’t even know about that call... but I’m not bitter about it

--

When you curse someone for the Battle Rifle Spread™, that’s me

Do you think it will help to put a face on it?
Last year I was at the Art Institute of Chicago
I saw one of the most famous paintings of all time
I took a picture of it with my phone
Any guesses?
It’s “A Sunday Afternoon on the Island of La Grhand Zhot”
By Zhorzh Soo-rah
This painting inspired my talk
And its very long title
Still don’t recognize it?
Here it is from a little farther back
(I showed you the part in the lower right by the monkey)
This painting isn’t famous for how it looks, or what it shows, but how it was made
Seurat lived in the 1800's
He was very interested in how we perceive color
Scientists were just discovering that what we see as one color is actually a mixture of different colored light
To demonstrate this fact, he invented Pointillism
Using tiny dots of basic colors to produce an image
So I started thinking...
What happens if we take Halo 3
Break it into it’s tiny details
And analyze just one of them
Take one tiny Decision, and explore it exhaustively

Specifically, the time between shots for the sniper rifle
So here is the actual title of my talk
- My opinions may not represent Bungie management
  In fact, I know they don’t!

- My opinions may not represent reality
  This is the past as I remember it, but as we will find out, brains are not reliable

- All examples, even negative ones, are from good games
  I tried to pick on games that everyone knows are great, to avoid controversy

- This talk was really hard to write!
  Really hard. The more specific the topic, the more there is to say
  It ballooned to almost 300 slides, editing took forever (and it turns out I still didn’t edit it down enough!)

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I’m presenting the full version at SniperRifleCon 2011
I will be presenting the full version at Halo Sniper Rifle Con 2011
First, some context from Halo 2
Halo 2 was Popular

- Shipped in 2005
- Top Live Game of 2006
- Will shut down in April
- The Sniper Rifle remained balanced the whole time
- *Balance is Longevity*

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**Shipped in 2005**
According to Major Nelson

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**Top Live Game of 2006**

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**2007, 2008, 2009**

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**Will shut down in April**
Halo 2 wasn’t just popular, it was popular for years

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**The Sniper Rifle remained balanced the whole time**
The SR never needed to be changed, limited, banned, it was still fun

This can give us a practical definition of Balance:

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*Balance is Longevity*
Balance this equation:

\[ x^2 - 2x + 4 = 7 \]

- 
  Any guesses?
  X = 3, I told them my talk would appeal to Engineers!

Great! Now...

--

Balance this stack of blocks:

- 
  (pause)
  Balancing an equation is a process
  But game balance is a state that either exists or it doesn’t
Let’s talk about those blocks for a second
The 4th rule of Jenga makes it clear (say it with me)

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4. Your turn ends 10 seconds after you stack your block

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It isn’t balanced unless it lasts
I bet you didn’t expect to see a Jenga reference!
There have been other talks about Halo 2’s crunch
I’m not going to re-hash them

Less-than-ideal circumstances
My really quick post-mortem, don’t set yourself up to try and fix bugs in the Tutorial and balance the Weapons at the same time
It’s not going to work

Production is always worried about a repeat
Production and I have a love-hate thing going
Always asking me when I am going to be done
So I invented the Balancer’s Paradox

Balancer’s Paradox
I can’t balance the Sniper Rifle damage until we set the Player’s health
I can’t balance the player’s health until we know the engagement distance
I can’t balance the engagement distance until we set the Sniper Rifle damage
But after using this for awhile, I actually had to invent a solution...

Balance in passes
The Sniper Rifle always has to be balanced! You could ship at any time!
But there’s balanced, and then there’s balanced...
At the end of each pass, the game is balanced to a certain level
Do not backtrack
Halo 3’s Balance Passes
  — Role
  — Flow
  — Strength
  — Limitations
  — Exceptions
  — Perceptions

At the end of each pass, the game is balanced to a certain level

Do not backtrack
Unless you have to, of course
And then it impacts the schedule

Halo 3’s Balance Passes

I’m going to suggest the following passes
They match with stages of game development
I’ll go over them in more detail later
Halo 2 was NOT Balanced

- Halo 2 shipped
- Designers played it on Live
- It felt wrong, different, broken
- Somehow we knew it wasn’t going to have legs
- *Develop a sense of balance*

Remember: Balance is Longevity

- Halo 2 shipped
- Designers played it on Live
- It felt wrong, different, broken
- Somehow we knew it wasn’t going to have legs
  How did we know?
- *Develop a sense of balance*
  We had developed our sense of balance
In Outliers, Malcolm Gladwell lays out his 10,000 hour rule

- This makes me the world’s only expert in trying to balance the Halo Sniper Rifle
- Sort of a narrow expertise
Niels Bohr offers this definition

"An expert is a person who has made all the mistakes that can be made in a very narrow field."
-Niels Bohr

This also makes me the world's foremost expert in trying to balance the Halo Sniper Rifle
and in Driving too Fast for Conditions
(Don't ask)
In order to develop a sense of balance, you need to understand how your brain works.

**The Neuroscience of Intuition**
You have an Orbito-Frontal Cortex
It’s called that because it is located behind your eyes

But it’s really your Gut

**Learning process**
It goes through a process when you learn
It builds a model of the world
Makes predictions about that model
If it is right, it releases Dopamine, which cements the model a little bit

If you are a designer, you need to familiarize yourself with how this process feels

The ultimate goal is to

*Get the game inside your head*

You want the model in your gut and the game in the world to be the same
Ok, back to Halo 2

--

Choosing to patch was hard
Nobody wants a patch, it is expensive
Luckily we had network bugs, so we were going to have to patch anyway

--

Choosing what to patch was harder
You want to tweak everything, but you can’t because then testing gets out of hand

--

Choosing what NOT to patch was hardest
We didn’t change the Sniper Rifle
It was right below the line of what we could safely re-balance

Which brings me to my final theme:

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Make the hard choices
Balancing is hard because it requires you to do things you don’t want to
And it is tricky because there are so many ways to confuse or talk yourself out doing it properly
Why are these choices hard?
Again, the answer is your brain

The Neuroscience of Reason
You also have a Pre-Frontal Cortex

It’s called that because... Who knows?
We call it your brain

Your brain is a poor tool
But it’s what we have
You can’t reason out everything
You can’t reason out very much at all
There are so many ways that your logical mind has to trick you

You must confine yourself to
Reason on the detail scale
Radiolab is a great show on New York Public Radio
They have a podcast, you should subscribe!
In an episode called “Choice” they describe this experiment

Give people a number to memorize, 2 digits to 10 digits
Send them to another room to repeat their number
On the way, interrupt them
(All good psychological tests are about fooling the subjects)

They ask them if they want an Apple or some Cake
The people with short numbers pick Apples at a high rate
Apples are better for you, fewer calories, watch your waistline

Longer numbers more often choose Cake
They are so busy with numbers, they make the decision emotionally
7-10 numbers are enough to completely fill your rational brain!
My high school calculator had more horsepower than that!

So when you have to think rationally, think about details or you will get hopelessly lost
Ok, here are the four themes of my talk

**Balance is longevity**
**Balance in passes**
**Develop your sense of balance**
**Make the hard choices**

I am going to use these themes to explore the Detail

Now let’s get to the Sniper Rifle!
The first step in Halo 3 was the paper design
Are there any producers in the audience?
I have like 4 slides for you, here’s the first one

- **Happens in Pre-production**
  - Start before “The Burn”
  - Don’t leave it too early

- **Every gameplay object gets a Paper Design**
  - Maintain discipline
  - You will save time in the long run

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Are there any producers in the audience?
I have like 4 slides for you, here’s the first one

- **Happens in Pre-production**
  You need to do paper designs *first*
  You don’t want 40 artists sitting around while you do it
  On the other hand, if you leave it too early, you are going to waste lots of time later
  So as producers, you need to find creative ways to give us room in this stage

- **Every gameplay object gets a Paper Design**
  Don’t let Designers hand wave
  We are great at it!
  If we can’t write it down it means we haven’t figured it out
  Lack of design discipline is a huge threat to your project
  But if you have a designer that has proven his discipline, then trust his paper design
  Take off your design hat
Nobody has ever seen this outside of Bungie
Most people at Bungie have never seen this
I didn’t ask if I could show it... oh well
It’s the original paper design for the Halo 1 Sniper Rifle

- Embarrassingly simple... right?
(wait)
(Sorry I can’t leave it up)
Here’s the important things to note:

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Some specifics are wrong

--

Some mechanics are unclear

--

Many details are missing

--

It’s very flawed as a spec, but one thing comes through, the Role of the weapon.

The Role is an abstract concept
So now let’s look at Halo 3’s paper design
--
It’s a lot more detailed
It ought to be, it was the third iteration!
--
Still pretty abstract
The role is even more clear
(wait)
Halo 3 Paper Design

- “Role: Long-range instant-kill sniper rifle, but reloading makes it difficult to use”
- Range
- Damage
- Limitations
- Clearly specify the role

--

“The Role is even more clearly called out

(The part about reloading is in there to make it different than the Covenant Sniper Rifle)
Let’s look even closer

**Important mechanics**

**Desired feelings**

**Critical assets**

**Special details**

*Include whatever is necessary, nothing more*
How do you develop your sense of balance for paper designs?

It can be done, you can look at a paper design and have an intuition about how it will work.

You are looking for role
And you are looking for a couple key factors that are the results of the role.
Balance between Simple and Complex

- Too Simple => Bored
- Too Complex => Boggled

*Balance is a barely manageable number of choices*
This is where roles come in

--

**The Sniper Rifle is the best weapon in some situations**
The Sniper Rifle has a clear role
Times and situations where it is the best

--

**Equal payoffs lead to randomized strategies**
Game theory tells us that if all the possible strategies have the same payoff, players will pick randomly
You want to avoid choices that don’t ultimately matter

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**Asymmetry demands movement**
But roles provide asymmetry
Incentives to move from one strategy to another depending on the situation

--

**Roles require real differences**
One of the tropes of the design community... Rock, Paper, Scissors

But it’s a terrible game!!!

Every choice has the same payoffs, so you pick randomly

A cool shirt, though (www.noisebot.com)

EDIT:

After my talk, several people took issue with the fact that RPS is a bad game

“It is the foundation of all good RTS games!”

But imagine a RTS game where you could only pick one unit, you had to pick it before the game started, and if you picked wrong you couldn’t possibly win, it’d be a bad game!

The reason a RTS game works is because it isn’t RPS:
-You can play mixed strategies (choose more than one kind of unit)
-Strategies have different costs to play (tanks cost more than barbarians)
-You can change strategies mid-game
-Strategies rarely have an all-or-nothing payoff (10 Air units can usually kill 1 Anti-air unit)

So I am not using RPS in the casual sense of “a game with counter-strategies” but as defined in game theory

Hopefully that clears things up a bit

EDIT 2:

I also got a lot of people saying, “It is the foundation of Street Fighter!”

This is true, somewhat, more than the RTS case, anyway

But imagine a turn-based game of SF where the first hit wins the match, again, a bad game

The reason SF works is that it is also not really RPS:
-SF is a series of RPS interactions, so things like reputation and anticipation come in
-It is played very quickly, so low level decision making and muscle memory determine your strategy more than choices
-And even with that, most non-expert players tend to “button-mash” which is a great example of “random strategy”

Believe me, I am not trying to insult RTS games or SF (or even Ro Sham Bo Tournament Champions) but to encourage designers to see how roles lead to non-equal payoffs, and therefore avoid random strategies
The Sniper Rifle is the *only* very long-range weapon
(Okay, technically there is a Beam Rifle, but not on the same mission!)
Role: Weapon is 1:1
Weapons without unique Roles add complexity, not depth
It is hard to add weapons to Halo, all the roles are filled
*Roles must be unique*
“Rock, Paper, Scissors, Lizard, Spock” is worse game design
This game is from the show “Big-Bang Theory”

It looks more interesting, but it isn’t

It is just more complicated

It will still reduce to equal payoffs and random play
Roles Provide Depth

- The Sniper Rifle is necessary
- Weapons:Roles is 1:1
- Roles without Weapons make the game incomplete
- This is why every game has the same set of weapons
- **Roles must be filled**

The converse is also true!

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The Sniper Rifle is necessary
---

Weapons:Roles is 1:1
---

Roles without Weapons make the game incomplete
---

This is why every game has the same set of weapons
---

**Roles must be filled**
This doesn’t even make sense!
(Interesting note: Halo 1 was this close to shipping without a Shotgun, can you imagine?)
Roles Provide Depth

- No “Crappy Sniper Rifle”
- Avoid strict dominance

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No “Crappy Sniper Rifle”
--
Avoid strict dominance
Wait, what is strict dominance?
Who picked the Health Potion? The single-use health replenisher you can buy for 30 rupees?
Who picked the Piece of Heart? The totally unique health-extender you can never buy?

Right, everyone picks the Piece of Heart
(If you didn’t, it’s ok, you were probably eight.)
Practice “iterative deletion”

Iterative deletion means you remove all the dominated strategies
Then you remove all the strategies that were only good against those strategies

If you cut the Tank, cut the Anti-Tank Mine
The second way to develop a sense of balance about paper designs is to look for anticipation.

(Anticipation really isn’t the right word for it, maybe “Imperfect Predictability”?

--

Between Chaos and Certainty
  Too Chaotic => Guesses
  Too Certain => Fatalism

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If you make players guess, they won’t see the point and will quit

If you don’t give them a chance, they will feel controlled and quit

---

*Balance means probable, but not inevitable, future events*
So what is Vizzini doing in this scene? Other than drinking the poison? (Spoilers!)

EDIT:
He is engaged in a never-ending series of second-guesses

“"I'm not a great fool, so I can clearly not choose the wine in front of you. But you must have known I was not a great fool; you would have counted on it, so I can clearly not choose the wine in front of me."”

-Vizzini
David Sirlin (sirlin.net) is a SF Champion and a game designer (Wave to David in the audience!)

He calls this concept Yomi

**STOP!**

In an action game like Halo you don’t want players to engage in this kind of second-guessing. It will paralyze them from acting and end up in random guessing.

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**The Sniper Rifle has one purpose**

You *know* what someone with a sniper rifle is going to do. The role prevents you from guessing.

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**Limit the amount of second-guessing**

Because you want people to be able to anticipate what is going to happen. If they are expecting an event, they can process it more quickly and follow the action better.

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EDIT:

I should have made the point that this *doesn’t* apply to all games. RTS, Street Fighter, a lot of other games *are* about reading your opponent. And those games are *extremely* hard to make. You need to give players clues to what their opponent is thinking, like what buildings they have, or what the first frame of the next animation looks like.

So this point is probably only true for action games like Halo.
Successfully sniping confers no benefits
As designers, we throw around the term “Feedback Loop” a lot
But they are not always good
They lead to a game being overly predictable

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**Success Feedback => I win!**
I can predict with certainty that I will win, so I stop needing to anticipate

---

**Failure Feedback => I lose!**
The same is true from the opposite perspective

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Anticipation requires uncertainty, and feedback loops work against that

*Feedback loops push away from balance*

EDIT:

Chris Hecker (and others) pointed out that I had misused the term “Negative Feedback” to describe positive feedback that made me feel bad
This was the result of me hastily combining two slides at the last minute (which was the result of me being a procrastinator)
Sorry for the sloppiness!
The best thing about roles is that they help you keep things manageable. They break the design into workable parts.
If you are using roles, make sure players always have other options

**The Sniper Rifle is never your only option**

--

**The entire balance never rests on one weapon**

--

**Use multiple Gameplay Channels**

EDIT:

I could write a whole talk on this topic (maybe next year) but it doesn’t fit on a slide very well.
The Sniper Rifle takes up a specific inventory slot

Monolithic is hard

Slots are easier

I won’t say that monolithic is always bad, just harder

Use balance groups

Balance groups are collections of objects that only have to be balanced against each other

EDIT:
Somebody mentioned that this sounded like a swipe at Monolith Productions Inc...
That’s a stretch

Somebody else said this sounded like a swipe at action games with classes...
Maybe? 8)

No, not really. There are plenty of cases where classes make sense, just as long as you understand you are making your job harder when it comes to balancing
Roles are Manageable

- The Sniper Rifle is not on every map
  - 75% of MP Maps
  - 50% of SP Maps
- Limited interactions
- Removal based on Role
- Use subsets of your arsenal

The Sniper Rifle is not on every map
Limited interactions
Removal based on Role
Use subsets of your arsenal
Imagine somebody is holding a gun to your head... There is too much to do, what are you going to cut!

What are you going to do? How can you get control of your scope?

By making the hard choices
What are the Hard Choices in this pass?
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**Picking the mechanics**
--
**Capturing the mood**
Core before Spice
Producers, please insert your fingers in your ears at this time

“Once you are done, cut half”
Some of the best advice I ever got
I have never regretted doing this

I’m not going to say “Kill your babies”
Now that I am going to be a dad, the term doesn’t seem appropriate anymore

How about “Put your babies up for adoption”? 

There’s always the sequel!
There’s ALWAYS the sequel...
After paper design, we move to initial settings
(Sometimes you would have a long wait while the Engineers prepare the weapon system)
Wake up Producers!

- Early in Production
  - As objects come online
  - Set the tone up front
  - Stay ahead of everyone else

- Get plenty of space
  - Feedback is not important
  - Best done in private

Some of the best producers I have worked with really understood the fact that this stage needs some breathing room!
How many of you are familiar with the concept of Flow?

Lots of talks have been done on this, I’m going to assume you know what I am talking about in general

“If one takes control of what the body can do, and learns to impose order on physical sensations, entropy yields to a sense of enjoyable harmony in consciousness.”

Mee-high-ee Cheek-sent-me-high-ee
(I swear you can get into a flow state just by repeating his name over and over)

The problem is, he wrote in the ’70s, he doesn’t address video games
So what does flow look like in a video game?

EDIT:
If you are an aspiring game designer, read this book!
Heck, if you work on an assembly line or as a tennis pro you should read this book, too!
Smiling makes you happy
Laughing makes you healthy
Certain finger movements make you have flow
We call that Cadence

- The Sniper Rifle fires with a very specific timing
  -- Too slow isn’t flow
    -- Fingers get bored
  -- Too fast isn’t flow
    -- Shots blur together
    -- A single shot doesn’t matter
- Cadence leads to flow

This timing is different for different weapons or different parts of the game
But Cadence is important in all kinds of flow

- Cadence leads to flow
Verisimilitude: the quality of seeming to be true

--

The Sniper Rifle is on a trigger

Ok, that’s obvious, but it isn’t always the case for all game mechanics

--

Finger movements match the action

--

No verisimilitude, no comfort

The only thing that I have seen work on a stick-click was the Dead Space breadcrumb trail

--

Remember the Paper Design for Halo 1? It speculated that zoom was on a trigger
If I could go back in time, it probably would be
The Sniper Rifle has a carefully planned effect on the world

- Sound delay
- Hanging contrail
- Headshot animations and physics
- Unzoom late

Plan the Spectacle

Spectacle is part of the flow state
It encourages your brain to maintain flow
Let me tell you a story

Once upon a time:
This red guy shot at this blue guy
But the blue guy ducked, so he missed
Then there was this CRAZY RICOCHET INSANITY!!
And the red guy got a Betrayal

How can I tell this story?
I wasn’t that red guy
(I was the blue guy that ducked!)
--
The answer is: Causality
The Sniper Rifle looks great on YouTube
You can really follow the action
Even someone that has never played Halo can figure out what happened

--

Exaggerated Causality
The key is to stretch out the time
So cause and effect are very clear

--

*Causality preserves flow*
Your brain can connect the events unto a continuous stream of events
But how do I know which initial settings will lead to flow?

How do I train myself to set things up the right way?
Sniping flow is very fragile
It is so easy to break out of
Distractions, misses, frustration
Especially when you are first setting it up

--
Make yourself easy to entertain
So you while you are setting it up
You need to put yourself in a mindset that allows you to maintain flow

--
Practice filling in details
I’m not kidding, get your mouth engaged!
Kids are easy to entertain because they make up the fun as they go along

--
Play B-Games with an open mind
The last game I played... Avatar!
I had enormous fun!
If you can’t have fun with an imperfect game, you won’t be able to find the flow in your imperfect game
On the other hand, don’t be satisfied with “sorta fun”

---

**Sniping flow has a high ceiling**
By this I mean that when you get into a flow state, it can be incredibly deep
So don’t sell it short by being easy to entertain
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**Never be satisfied**
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**Play good games harshly**
Play Halo and then rip the hell out of it!
I can barely stand to play our old games, because I see every flaw

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Warning: This is going to wreck your ability to *play* games
That’s ok because you get to *make* games, which is a lot more fun
Control over Flow is the essential design skill
In my opinion, control over flow is what makes someone a good designer
This is the BIG skill

Don’t expect other disciplines to have it
Most Programmers see bugs
Most Artists see in still frames
Most Producers see inexplicable delays

Apply conscious control
Know when to have fun
Know when you are fooling yourself
Half our designers were Philosophy Majors

EDIT:
This slide could be another talk. I flew through it at GDC because I’m not sure it can be explained. Either you understand it instinctively, or you don’t.
Most Sniper Rifles aren’t fun
And sniper rifles are easy compared to some things
So find the fun at all costs!
--

Not Doing Science

This is why you do this step in private
You don’t need everyone to know all the dead ends you ran down

I would never tell the Engineers half the crazy stuff I have tried

EDIT:
This is not strictly true, I have a reputation for being crazy, so I can get away with more experimentation
Learning to Drive

Imagine you were learning to drive, but nobody was able to teach you
You might never figure it out

Change in groups

Again, this is not science
You are training your powerful emotional brain
You are making modes and releasing dopamine
Daniel Tammet has Asperger’s disease
He has amazing skill with numbers
He can just intuitively spot prime numbers
(Read Quote)

- “Unlike the ‘jaggedness’ of composite numbers, I visualize primes as smooth and round ‘pebbles’... I am able to generate larger primes... by drawing on my intuition of how prime numbers ‘look’”

For me, there is an audible click when something hits the sweet spot
Like a record player falling into the groove

So, go with your gut!
Trust your heart.
Reach out with your feelings?
(wait)
This picture has nothing to do with the topic, I just loved it
Remember the Flow Knobs

• Certain things about the Sniper Rifle lead to flow!
  • 4 Shots per clip
  • Max zoom distance
  • Zoom time
  • Overpenetration
  • Zero error
  • No permanent kick
  • Total Ammo
  • Headshots always kill

• Once you find them, make note

• Know what cannot change, and then don’t change it!

--

Certain things about the Sniper Rifle lead to flow!
--

Once you find them, make note
--

Know what cannot change, and then don’t change it!
--

Remember, no backtracking! Don’t wreck the flow balance during future passes
Once you have the knobs, crank them to 11! Don’t be shy!

--

The Sniper Rifle:
All of them are set to the max, no hedging for fear of balancing them later

--

Too strict => Fewer reach flow state
If you don’t, people won’t have room to reach the flow state.

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Too loose => Heightened sensitivity to distractions
Ironically, the more you loosen up these knobs, the more obvious other distractions get
Do it anyway!
Ok, now you have a flowing Sniper Rifle
And all the other weapons are fun by themselves

How do you put them together?
This slide is for the Engineers

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**Mid-to-Late production**
Design needs to start doing rough balancing in the middle of production
Probably before you hit any kind of Code Complete milestones

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**Solid build**
Write bug free code, easy for me to say, right?
But stability is important, if the build is broken it interrupts the process and I have to start over
And if you don’t maintain the gameplay systems the whole time, the game will never get fun

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**Optimized build**
And I know coding practice is to “optimize at the end”
But you are killing us!

True fact: If you do not have good lighting in a playtest build, your AI will score lower
I don’t know why, but it is an example of how performance problems make it hard to balance the game

So once you have a solid build, what exactly are you balancing?
During this pass, you are balancing strength
In What the Dog Saw, Gladwell tries to figure out why there are 50 kinds of mustard, but just one kind of Ketchup

(Read Quote)
Gladwell goes on to say that Heinz is the best because it has all of them in balanced proportions.

EDIT:
I couldn’t find a way to fit this into my talk, but I found it interesting
Well after publication of this book, some research came out that we can also taste fat, which is probably why we put ketchup on french fries.
Heinz Ketchup

- Heinz Ketchup
  - Salty, Sweet, Sour, Bitter, Umami
  - All really strong flavors
  - All perfectly balanced
- Professional Tasters call that “Amplitude”

Heinz Ketchup
Tasters call that Amplitude
Halo is like ketchup
--
Lots of flavors
--
All of them strong, working together
--
**Balance requires strengths**
A big part of knowing if something is strong or not is Affordance

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**Affordance**

- A visual clue to the function of an object.
  - Heidegger called this “Ready-to-hand”
  - This is where Sci-Fi games have trouble
- *If you have to explain it, it’s not a strength*

A visual clue to the function of an object.
We have trouble with this in sci-fi
What is a Proton Phase Amplifier good for?

---

*If you have to explain it, it’s not a strength*
If it isn’t affordant, it probably doesn’t have a strength
This book is a hardcore textbook and it rocks
And by that I mean it is dense and hurts your head

---

The authors define competence this way

The desire to show competence is a major human motivator
Sniping starts off hard
--
The more you learn, the more competent you get
--
Strengths are things you can get good at

But why is competence so important?
Because they are implicit motivators

- External motivators evaporate fast
  When you reach the level cap, you stop playing
  When you finish the story mode, you stop playing

Internal motivators last and last
  When you get good at sniping, you want to play MORE!!!

And remember, balance is longevity, so you need long-term motivators
So how do you recognize strength when you see it?

How can you train yourself to appreciate strength?
People hate it when the Sniper Rifle changes
Why do they hate it?
It resets their competence
Why should you do it anyway?

Prevent optimization
Brains are lazy, don’t let your playtesters optimize
Beginner’s Luck

Prevent Inertia Bias
“But that’s the way it has always been”
“It’s perfect now”
“Why is that Designer still making changes?!”

Every playtest, something different

---

**People hate it when the Sniper Rifle changes**
Why do they hate it?
It resets their competence
Why should you do it anyway?

---

**Prevent optimization**
Beginner’s Luck is what happens when your brain is sub-optimal
You think it through, you are very careful

---

**Prevent Inertia Bias**
You could also call it “We have a Deadline Bias”

---

*Every playtest, something different*
Keep the changes coming!
During this stage, you should be continuously making passes because

--

**Strength is relative**

By the time you get through all the weapons, the ones you started with will be weak again.

That’s how you get to the point where lots of weapons kill in one shot.

--

**Make passes**

--

**Bring everything to the same level of strength**
This guy is really good at Halo
Pro-players often complain that “The guys making decisions suck at their own game”
-
That’s true
I am not really good
-
The problem is
Dopamine is not specific
--

*Keep your neurons plastic*

You should always feel like you are learning about your game
If you start to feel like you have mastered it
Change something so you aren’t good again
It isn’t just about getting good
--

**Don’t play too much**
Even if you aren’t getting good
Your lazy brain will like what is more familiar
--

**Don’t specialize**
I must admit, I love the Warthog
It got a lot more time than anything else, and it shows
But be responsible, at least make sure your favorite things are the most important things
--

**Spread yourself out**
Jump from thing to thing
If it starts to feel comfortable, move on to something else
BUT sometimes this is not true!

On the other hand... sometimes you **do** want to play a lot

--

Spend more time with what works than what doesn’t

— Just driving the Warthog around
— Playing a Sniping encounter over and over

**Once it works, get it stuck in your head**

This is going to help you notice problems later
Some bug will make the Warthog drive funny and you will notice immediately
Notice that these guys are getting stronger and stronger as we go?
Hey Producers, this is the most important slide!

--

**Bug#12: The Sniper Rifle reload is too long**
I actually got this bug once
Note that it is only the 12th BUG!

--

**Don’t let people file bugs against balance during rough stage**

--

**Don’t let people file bugs against balance period**

--

**Don’t even listen to complaints yet, they have no foundation**

**Don’t be reactive**

You are getting paid to do this, it is your duty to use your best judgment
And enjoy it, because after this stage you don’t get to ignore feedback!

NOTE:
Early in my career, I was often accused of ignoring feedback
Mostly because we spent a _lot_ of time in the rough balancing stage
When really I was just unable to do anything with the feedback until it was working
Now I try to make it clear to people that “This thing is not working yet, please hold your feedback until it is ready”
If you design by committee, you end up like these guys
Certain things about the Sniper Rifle make it strong

Here are a few of them

Write them down for later

Remember, no backtracking

Know what cannot change, and then don’t change it!
If you get one thing from me, it’s this:
--
**Crank them to 11**
Don’t do half measures, if you find something that works, CRANK IT!
This is especially true of strength
--
**Make everything overpowered**
If you do this to every part of the game, balance will still be attainable
--
To paraphrase The Incredibles...
*If everything is overpowered, nothing is*
So at this point

**Flow Knobs are set**

--

**Strength Knobs are set**

And here comes the hard choice

--

**Flatten the Rest**

There are going to be a lot of little subtle things that get lost

But those things are just noise, confusion

Maybe find a way to make them strengths

Maybe add them in as polish details

But for now they just get in the way!
Hard Choices

- The Sniper Rifle was balanced for Multiplayer
- Once you have Multiplayer, Single-player is simple
- Make the AI accommodate
  - Halo AI knows when they are in your sights
  - Sniper Ammo is doled out sparingly
  - Some encounters are intended to be easy
- Focus on the multiplayer

EDIT:
I think I went through this slide in about 3 seconds because we (Bungie) have talked about this before
But it is important, multiplayer is much harder to get working than single-player
And you don’t want to have difference between the two if you can help it
So a lot of times single-player balance needs to wait
(Which makes the mission designers nervous, of course, so get it done before the missions are being tuned for difficulty)
Again, you can’t make things too powerful!
How do you fine tune a sniper rifle?
Late Production
You need to start before things start to settle
You don’t want game balance to happen randomly
It needs to be an intentional process

--

Playtest Lab
There have been other talks on our playtest process
John Hopson gave a good one last year
Here’s a quick summary

--

Focus Groups
At this stage, most of your feedback is going to come from focus groups
Probably with members of the dev team
So how do you tune a sniper rifle?

The answer is NOT by adding weaknesses!

It’s by limiting the strengths
Balance is Choices

- Balance between Predictability and Random
  - Too Predictable => Only One Choice
  - Too Random => No Basis for Choices

- Watch for Mixed Strategies

Balance between Predictability and Random
If your game becomes predictable, you probably need to limit strengths

Watch for Mixed Strategies
Game theory tells us that the ratio of people playing strategies is roughly the same as their effectiveness.

Ok, here comes the hard part...
Taking Team Feedback

Without anyone getting kicked in the face
There are three kinds of feedback

--

**Desirable Feedback**

--

**Thoughtful Feedback**

--

**Undesirable Feedback**

--

**People can tell you what they don’t like, but not how to fix it**

--

You always need to listen when people don’t like something
You are too close to it
And you probably already fixed all the things *you* didn’t like

--

**Trust their guts, not their brains**

Trust people’s emotional reactions, don’t just blindly take their advice
Before you can interpret someone’s feedback, you need to know the source

--

**Feedback means "the game in my head is different"**
Always preface any feedback with this phrase
Often times your response to feedback should be to probe about what kind of game they are imagining

You don’t necessarily need to agree on the game you are making

--

**Watch out for Development Bias**

You see this a lot with the public when the development process is very open, as well
You also need to understand the source of feedback

---

**Look for Types of Players**
If you can categorize someone’s play style, it will help you understand how to react to their feedback

Here are some examples:
The names have been changed to protect the guilty

---

**The Optimizer**

---

**The Rager**
The Role Player

“Your Mom”
As in, this is so obvious, even your Mom could do it

I used to balance “Easy” by playing with my nose
Steve still couldn’t beat it
I miss that guy, he was incredibly useful for balancing
The Griefers

The Pros

Most importantly, figure out what kind of player you are!
(I’m a role-player)
And then

Watch people that play differently than you
Sometimes, you need to let your head drive

EDIT:
I removed the next three slides about how a million monkeys will not make Hamlet in a million years
I SHOULD have removed them BEFORE my talk

They were tangential, complicated, too long, full of math, distracting, boring, lame
And I didn’t even do the math correctly
A disaster that I could have avoided by following my on advice
“If it doesn’t support the role, cut it”

Sorry for the revisionist history...
Take it as a concrete example of what happens when you think something is just too clever to get rid of, even if it doesn’t work
Physics Over Math
Players can’t see math, they can’t develop a feel for it

--

Instant over Average
Players don’t care about the average
They care about individual events

--

As a Designer you can see the math
As a Designer you do care about the average
Resist the urge to use those to balance

*Balance what the players can see*
Hey look, a totally fair game

A totally boring, pointless, frustrating, fair game
“Fairness” isn’t the goal
It is part of the goal, but balance is longevity
Making a game fair by making it homogenous will wreck longevity

Temptation to Symmetry

Tic-Tac-Tie is a bad game

Don’t polish off your edges

If there is nothing to complain about, there probably isn’t anything work talking about at all

Ok, now we are ready
We have done our passes
We have trained our sense of balance
We have made the hard decisions
This is the point in development where we finally changed the Sniper Rifle

Now I will try to describe how all the work from previous passes informed this decision
The Sniper Rifle was overpowered
   — Remember, we made it that way!
   — But now the other weapons felt weaker
• Optimizers were using it exclusively
   — Depth was gone, game was too simple
   — Role Players were getting creamed

--

The Sniper Rifle was overpowered
But it made the other aspects of the game feel weaker

--

Optimizers were using it exclusively
Note that not everyone was using it
But certain people I knew were optimizers were
It was being used at close quarters

- Outside its role, dominating other weapons
- Contrary to all the effects and expectations

No counter-strategies

- Sniper could acquire, zoom and fire too quickly
- Even after a body shot, couldn’t make it to cover
Most importantly, every time I saw someone use it, I got nervous
When something impacts you emotionally we say we were “moved”
Emotions are what compel you to act, not data, not graphs

--

*Use your Sense of Balance to feel when something is wrong*
After we came to the conclusion that the sniper rifle was broken, how did we fix it?
Here's what we didn’t do

--

**Don’t touch the Strength Knobs**
In most cases, they aren’t the problem anyway
When a weapon is being used as intended, it *should* feel overpowered
So most imbalances come from using it outside its role

--

**Don’t try to add weaknesses**
It often feels like the only option, but find something else!
Making the Change

- Have to touch the Flow Knobs
  - Remember, we removed all the other knobs
  - What happened to “Don’t backtrack”?  
- Fine tune without losing flow state
- Cadence is the most flexible
  - Most prominent part of the Sniper Rifle’s flow
  - Has a large impact on strength
- **Use your Rational Brain to decide how to change**

---

**Have to touch the Flow Knobs**

There isn’t anything else, because we removed it
But wait, I said don’t backtrack!

---

**Fine tune without losing flow state**

Revisit in light of what you now know about the game
Don’t change them so far that you lose flow

---

**Cadence is the most flexible**

So many problems can be fixed by adjusting cadence
Because so many cadences work for flow

---

**Use your Rational Brain to decide how to change**

Don’t rely on your gut, you need to make this change very intentionally
Making the Change

• Balance by limiting strengths
  — Which change fixes the problems?
  — Which change has the least impact?
• Shots in the clip
  — 3 shots isn’t enough to kill two people
  — Pressure to reload after every kill
• Length of the reload
  — Would have to be increased a lot
  — Felt like adding a weakness

--

**Balance by limiting strengths**
Where is strength happening outside of the role?

--

**Shots in the clip**
So we couldn’t change the shots in a clip

--

**Length of the reload**
This is also a cadence knob
But we would have had to increase it so much
It would have felt like a weakness
Making the Change

- Time to full zoom
  - Fixes the problem with acquisition speed
  - Doesn’t fix the problem of close range use
  - Encourages people to fire without zooming, breaks the role

- Unzoomed Headshots
  - Fixes the problem of close range use
  - Doesn’t fix the problem with acquisition speed
  - Severely limits strength

---

Time to full zoom
We actually tried this
But it broke the role

---

Unzoomed Headshots
Making the Change

- Maximum total ammo
  - Strictly limits kills
  - Fixes the average, but not the instant
- Time between shots
  - Fixes acquisition speed and close range use
  - A small change goes a long way
  - Isn’t a negative feedback loop (prolongs the fight)
  - This is the one
- *Make the hard choices carefully*

---

**Maximum total ammo**

---

**Time between shots**
There were actually a number of other options we considered
Many of them we made, tested, and then reverted

---

*Make the hard choices carefully*
0.5 -> 0.7
And there is the change
0.2 seconds
--
My rough policy is
Don’t make changes less than 10%
It’s very easy to convince yourself you can feel tiny changes
But even if you can, nobody else will be able to
Balance never hinges on a 5% difference in a single number
--
Overshoot and come back
I think I initially tried 0.9 seconds
Which totally wrecked the flow
But did fix the problem, so we knew we were on the right track
--
Don’t break the flow
Verifying the Change

Go back to what told you that a change was required
And verify they have been addressed

The Sniper Rifle is still overpowered
— Remember, we want it that way!
— But other weapons don’t feel weak

Optimizers started to diversify
— And complain, of course
— Jason the Shotgun Ninja is happy again

---

Verifying the Change
Go back to what told you that a change was required
And verify they have been addressed

The Sniper Rifle is still overpowered
Only overpowered in its role
When you are using it right, we want to reward you

Optimizers started to diversify
Much less effective at close quarters
   -- Can’t get the second shot off fast enough
   -- Requires a no scope, which is an event
• No longer predictable outcome at range
   -- Maybe you get a second body shot
   -- Maybe they get back to cover
• I was no longer nervous
• *Use both your brain and your gut to verify a change*
EDIT:
At this point, the audience at the GDC talk started clapping, cluing me into the fact that I was out of time.
So I just went with the flow and ended it there, which was fine.

I had walked people through the balancing process, brought up the important principles, and applied them to the sniper rifle change.

But I had also intended to mention a couple things about the last stages of balancing, so here they are!
I'm talking about a public beta, like we had for Halo 3
Wait until you have *finished* the polish balance
- In this stage you shouldn’t have to make balance changes
- You will be dealing with exceptions and perceptions

Do it early enough to react

Treat it like a release cycle

Don’t include everything

---

**Wait until you have *finished* the polish balance**
You need to be confident in your balance before you start setting expectations

---

**Do it early enough to react**
It doesn’t have to be that long, I think we had 2 weeks for Halo 3

---

**Treat it like a release cycle**
Because your customers will treat it like a demo
It better be solid

---

**Don’t include everything**
Because you don’t include everything in a demo
And some pieces may not be through the polish pass when you need to be ready for the beta
What are you looking for in a beta, if it isn’t balance?

--

**Unexpected uses**
Remember, most balance problems come from using a weapon outside its role
And beta testers are great for finding ways people will abuse the roles

--

**Glitches and Bugs**
Especially bugs that break the balance
No test team could catch them all

--

**Untested combinations**
Tests everything vs everything

--

**Map or Mission imbalances**
Tests everything everywhere

--

**Trust your balance, but look for where it breaks**
It’s not a good idea to overreact to feedback and do last minute re-balances
(Halo 1 Pistol again)
Betatesters definitely suffer from Development Bias, if it doesn’t change the forum posters will still accept it
The other thing you are looking for is perceptions that don’t match the balance

---

**New players have no expectations**

They find mis-matches between what the game is telling them and the actual balance

Beta players thought the Spartan Laser should be a super weapon like the rocket launcher

We intended it to be an anti-vehicle weapon

We had to change a lot of the effects, especially the targeting laser

---

**Make sure perceptions match reality**

But we change the effects, not the role

Don’t change reality to match perceptions (if you can get away with it)
RECAP!
Conclusions

- **Balance is Longevity**
  - It’s a state, not a process
  - Balance strengths, not weaknesses
  - Doesn’t need to be perfect, just lost in the noise

- **Balance in Passes**
  - Role, Flow, Strength
  - Limitations, Exceptions, Perceptions

- **Develop a Sense of Balance**
  - Use Emotions to know when something needs to change
  - Use early stages to train your mental model

- **Make the Hard Choices**
  - Use Reason to determine what specific change to make
  - Evaluate changes rigorously
  - Don’t take the easy way out

- *Make the time between shots for Sniper Rifle 0.7 seconds!*
Special Thanks to all the Halo fans out there making great screenshots!
Probably the most useful slide in the whole talk
Bye!

THE END!