Set This Game in Ord e r

Session Title

Speaker Name
Speaker Title & Company

Methods for Organizing Mechanics and Levels

Nathan Fouts,
@MommysBestGames

Hi I'm Nathan Fouts from Mommy's Best Games and I'd like to us to "Set This Game in Or…der"!
(The initial slide is intentionally mis-aligned to make you want to set it in order! :)

My Plan

- Discuss the problem of level organization
- Difficulty Curves
- Level Design mind-sets
- Example games with lots of levels

- Possible solutions
- Off-the-shelf software and tools
- Custom/Specialty software

I went independent back in 2007. We've made a lot of games over the years and they've mostly all been shooters. A few may have heard of Shoot 1UP, but the biggest scale game we had done so far was Serious Sam DD XXL. For all those games I could mostly count their levels on my fingers, though SS DD had 21 levels so.. I'd need a little extra help, but could mostly keep track of things in a simple and document and in my mind.

In 2013 I started work on what would become our biggest game yet, Pig Eat Ball. It's a classically styled action-adventure game, with dozens and hundreds of levels, similar to Super Mario Galaxy. In that each world and new area would reveal new gameplay, new art, new puzzles to dig into. It's got a start, and end, and a story, and it's all hand-made. How was I going to keep track of all this stuff?

THE PROBLEM: How to Get Organized

- How to manage of lots of mechanics and levels?
- Multiple people working on hundreds of levels.

At Mommy's Best Games we are spread around the US and working together over the internet. On rare (and fun) occasions some of us are able to work for a while in the same office. But usually it's "asynchronous development".

This is an approach that could work for any game with dozens of possible new mechanics being introduced: powerups, guns, enemies, interactable objects, fundamental player mechanics

Level Management Problems

- **Difficulty Balancing:**
  - good difficulty across lots of levels.
- **Mechanics Introductions:**
  - Managing when ideas are introduced in a hours-long game.
- **Mechanics Changes:**
  - Manage a giant list of levels and be able to shift them around based on enemy or gameplay changes.
  - If the code changes, or a bug is fixed, how do we know what levels to test?

How to keep track of when these items introduced for a game that is hours long and has hundreds of levels and mechanics?
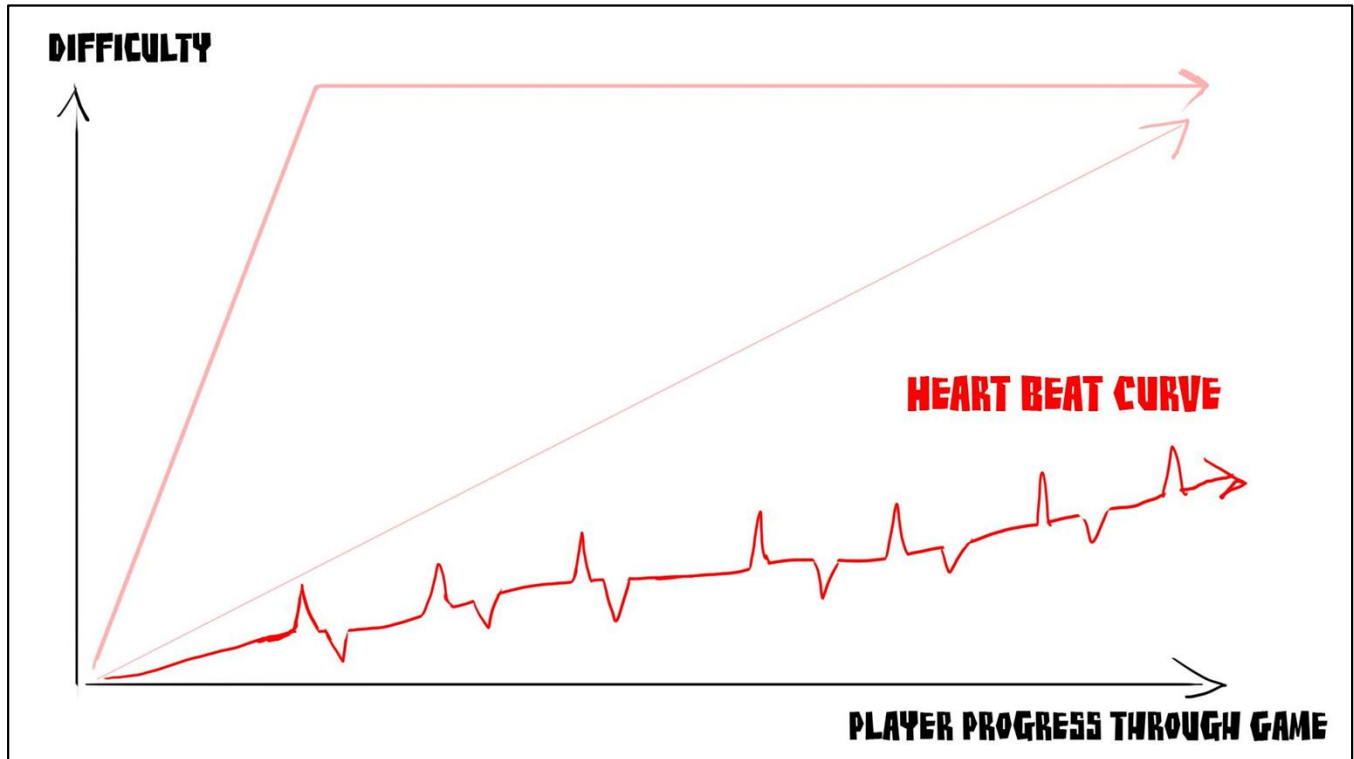
As levels get rearranged or re-themed, enemies/mechanics could be getting put into levels *before* their proper tutorial levels have been shown.

When an object, powerup, or enemy is changed, and specifically needs to be tested in the game how are you finding all the levels that have it?

First,
Let's Explore some "Design Mindsets"

and *Difficulty Curves*

- A typical difficulty curve maps how hard the game gets, versus how far into the game the player has gotten.
- They player gets further, and the game gets harder.
- I propose a different method, instead of a smooth difficulty curve, here is my "heart-beat curve".
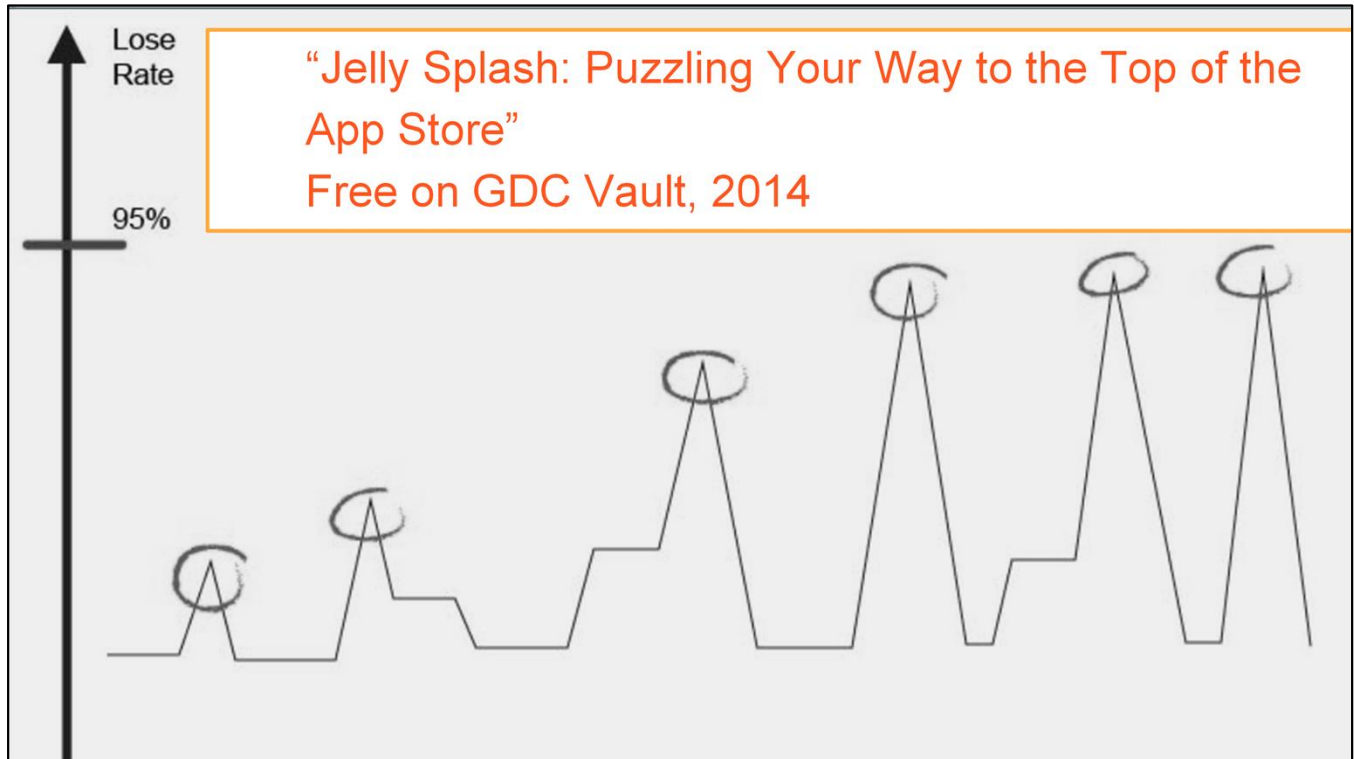
The Fouts 'Heart Beat' Difficulty Curve

1. Mechanics Intro
Easy, Playful

2. Mix, Match, Twist the Mechanic

3. Mid-boss Fight Tough, Exciting!

4. New Mechanic Relief, Easy, Fun!

- My "heart-beat" difficulty curve explained.
- Introduce a new mechanic, in a very easy level in which the player can play and experiment with your new mechanic.
- Using the new mechanic, make a few more levels, that challenge the player to use this mechanic. Present twists on the mechanics—new ways to think about using this mechanic.
- Present a boss/mid-boss level that really spikes the difficulty. This gives the player a rush after they complete the level.
- Instead of continuing on the curve, drop the difficulty way back down, with a level that introduces a new gameplay mechanic in an easy level.
- This creates a bigger, dramatic drop in the difficulty from the boss level to the new mechanic level. The player gets more relief and satisfaction.
- This method naturally works well with mechanics-based games, that have lots of shorter levels (or segments) and lots of mechanics.
- For further reading, check out the Chinese/Japanese concept of "Kishōtenketsu", or "4-act-storytelling" used by Nintendo games https://en.wikipedia.org/wiki/Kish%C5%8Dtenketsu

"Jelly Splash: Puzzling Your Way to the Top of the App Store"
Free on GDC Vault, 2014

- Another difficulty curve method.
- http://www.gdcvault.com/play/1020001/Jelly-Splash-Puzzling-Your-Way
  - Jelly Splash: Puzzling Your Way to the Top of the App Store
  - Florian Steinhoff
  - GDC Vault, free, from Wooga, 2014

Puzzle
vs
Skill Difficulty
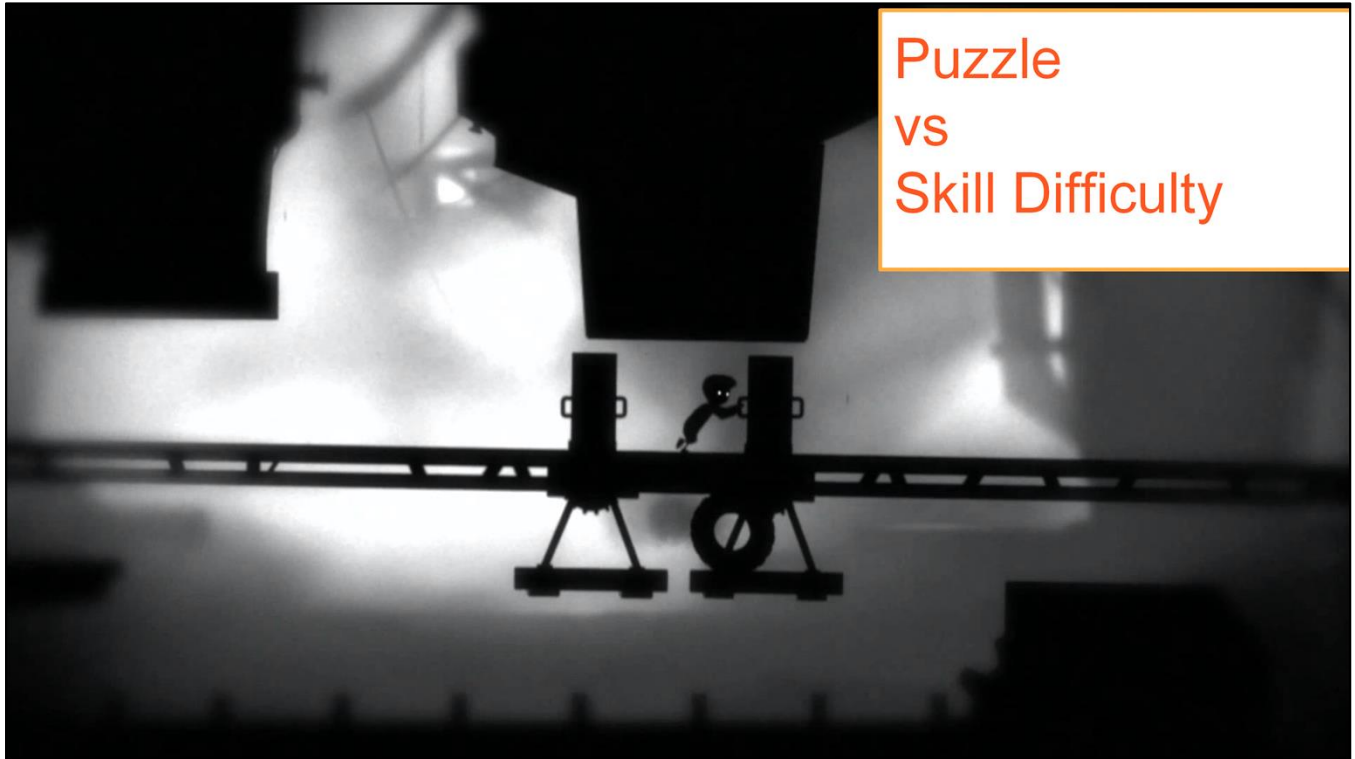
Things I try to keep in mind, when making our difficulty curve for our games. Some games are purely skill-based, some are purely puzzle-based.

- Puzzle difficulty: How hard it is for someone put the pieces together in their mind, to find the solution.
- Skill difficulty: How hard is it for someone execute controlling the game's avatar.

Environmental Story-telling

Let's talk about different mindsets for designing levels.

- Story-based, environmental storytelling
  - Check GDC vault "What Happened Here? Environmental Storytelling" from 2010!
- Coming across a scene and imagining what happened there.
  - "Invites interpretation of situations and meaning according to players' views and experience
- Examples: Bioshock, Hyper Light Drifter, Skyrim, Zelda Breath of the Wild

Set-Piece
Design

- Right next to environmental story-telling is "set piece", in which giant one-off areas are constructed, probably story-related to create a unique, interesting situation. Big games like this include Call of Duty series, Platinum games, and more.
- It's basically a framing of the mechanics from your game, in a new area.

Transcendent Level Design

- Lead the player "into the zone".
- Transcendent state with their mind, body, and player character act as one.
- Bullet-hell shmups, shmup player said:
  - "The moment when apparent chaos becomes perfect order in your mind." - Erik Voskuil
- Other examples: Rez, Thumper, Wipeout series
  - Wipeout Fusion had a 'Zone mode' in which you auto-accelerate and go faster and faster, looping the same track.

Mechanics-driven / Modular Design

- Puzzle/Action games.
- View game objects as tools for puzzle creation.
- How do these 'tools' work together? Includes enemies, powerups.
- What can each object do for player?
- Examples: Mario series, Super Monkey Ball, Rayman series, Shovel Knight, Escape Goat,

Lotsa Levels

- More games with dozens of levels/mechanics.
    - Pig Eat Ball, Ape Escape 2, Marble Saga: Kororinpa, Zelda games (Wind Waker)
- Breaking down level mechanics till we have the "simplest" and best level
- Get multiple levels centered around exploring a single mechanic.
- Combining the new mechanic later with other, previously introduced mechanics.

- Have a game with lots of levels? Teach every significant object, enemy, mechanic.
- Brings life and refinement to your game.
- Many games with late mechanics that need introductions.
- Fluzzard gliding, world 2- area 2, Super Mario Galaxy 2
  - Tilt controls to go left and right, and push forward to dive.

You need to teach every significant enemy and every item. Everything deserves a proper setting and introduction as they will bring more life and refinement to your game.
Many games have late mechanics and enemies that still need to be introduced properly.

- Design example: Ape Escape 2 and the spinning hula hoop.
- Allows player to go up slippery hills. (level 4) Spin right thumb-stick to get it going: moves you very fast, able to go up walls.

- A good dozen times it's needed in the game.

- Classic "tutorial holo-deck" option before 'real' level with hula hoop needed.

- Great level, called "Viva Apespainia!", it's got spanish tiled roofs everywhere that are too steep to climb. Use the hoop to spin and dash across them.

- Which brings me to our current game in development, Pig Eat Ball.
- It's a grand action-puzzle adventure, hundreds of levels.
- *Pig Eat Ball* is like if *Pac-Man* got fatter while you ate.
- You can get stuck in the maze, but still need to eat all the balls to beat a level.
- The result is each level can becomes a bit of a puzzle.

Pig Eat Ball: Polarity Cats

Taking damage will make the player barf, and in a "survival" level, the player has a limited number of hits before a level is failed.

The later levels are tougher. They are "survival" levels in which breaking the cats in the proper order will help you complete the level without taking damage.

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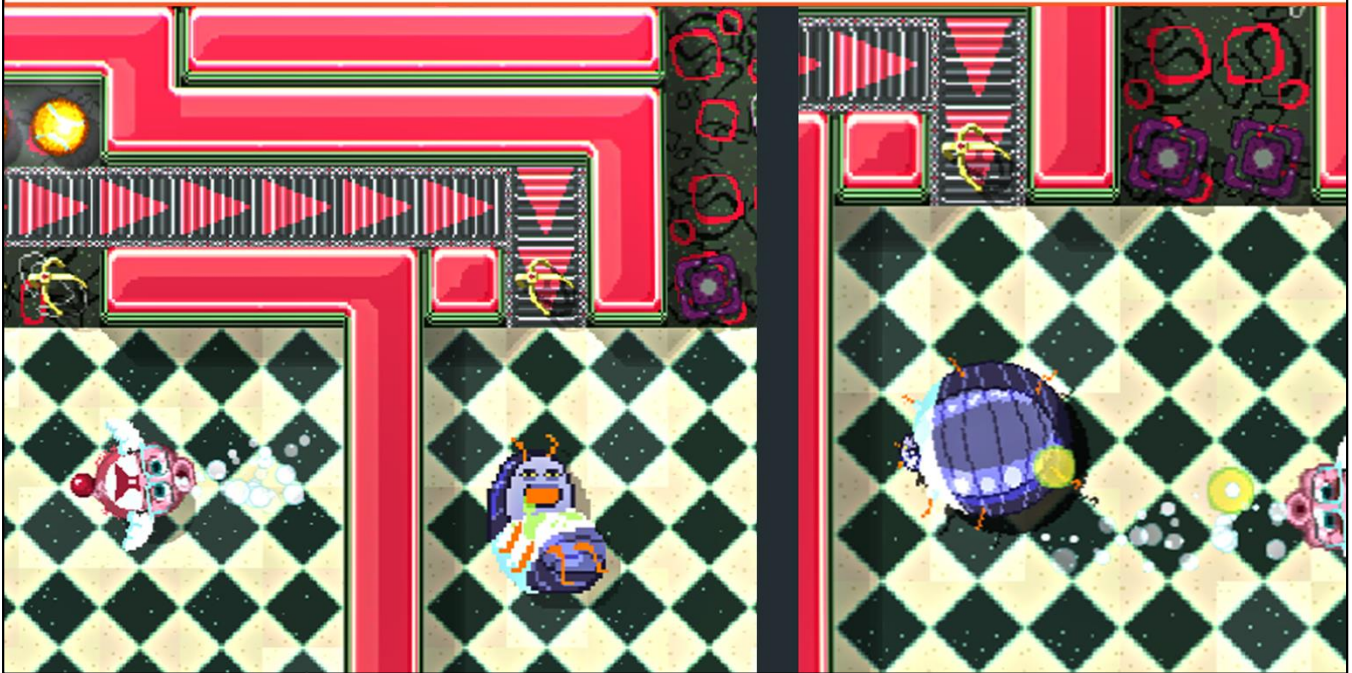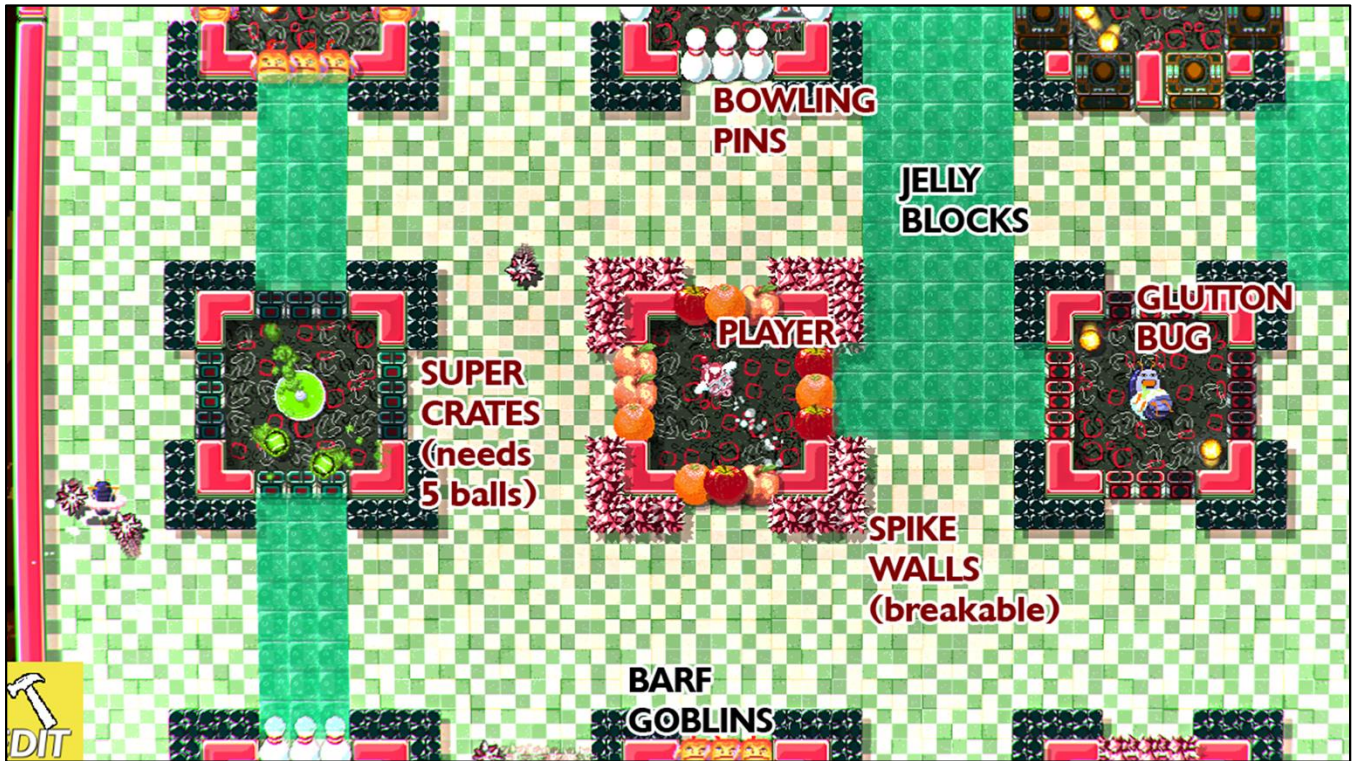
Pig Eat Ball: Glutton Pillbug

The Pillbugs in Pig Eat Ball universe serve a lot of purposes. They can attack and make trouble for the player with the simple 'wandering Pillbugs' but they are also specialty Pillbugs such as this one, the Glutton Bug.

This is his intro level and on the left, he's waiting and hungry to eat. The player has nothing they can do other than cause some balls to move down the conveyor belts.

The balls move down the belts and then the Glutton bug gobbles them up. Once he's eaten all 10, he transforms into a specialty, giant ball that can knock over bowling pins. This allows the player to eat more balls to beat the level.

BOWLING PINS
JELLY BLOCKS
GLUTTON BUG
PLAYER
SUPER CRATES (needs 5 balls)
SPIKE WALLS (breakable)
BARF GOBLINS
DIT

- Here is another level in which the Glutton bug is now part of a bigger puzzle. It's hard to notice since we're zoomed out, but the Glutton bug is on the right. It's critical to have the player introduced to complicated gameplay objects in safer, simpler levels before thrown into something like this, otherwise they're just going to throw their hands up in frustration.

- The Level editor ships with game. Advanced and Beginner versions.
- Shareable levels. Daily challenge levels, 10-level challenge.
- Modelled after Mario Maker, but with some quirks changed.

There is a single-player adventure mode, and a 4-player party mode. But there is also a very useable level editor shipping with the PC version of the game. Here's a look at how the level editor works.

    a.   Here you can see a few of the gameplay objects. There's around 200 gameplay objects possible, and what ends up happening is you'll probably pick a few to add to your level.

    b.   During production we stuck with themes for sets of levels to iterate on gameplay mechanics and build concepts.

    c.   We found we needed some extra help keeping track of all the levels and what level had what objects so we built some extra tools within the editor and game.

Let's Talk About Tools and Solutions

- Paper
- Windows Search
- Google Docs/spreadsheets
- Analytics
- Custom: Level search and library tools
- Custom: Level rearranging and library tools

Consider…
"Better Tools
Can Help You Make Better Games"

- It's tough to build house without tools. Possible. But very tough.
  More people can build that house with tools, than without.
- You are probably using Unity, Unreal, etc. to make your game.
  It's great huh? Those are GIANT TOOLS.
- Take a few weeks to make some important tools,
  even for your indie game!

Level Managing Solutions: Paper

- Write down level names, mechanics, layouts on paper.
- Easy to rearrange.
  Cheap, accessible.
  Quick to change.
  See spatial layout that mimics game layout.
- No computer search-ability.
  No easy back-up method.
  Hard to share.
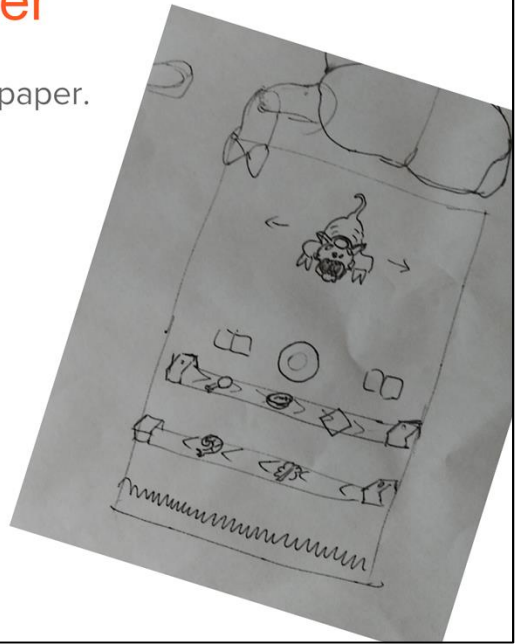
Shows level name, level num, goal type, general gameplay contents of level.

Automatic level-updating help explained later.

# Paper work: "Semispheres", by Radu Muresan, Also used 'Inkscape'
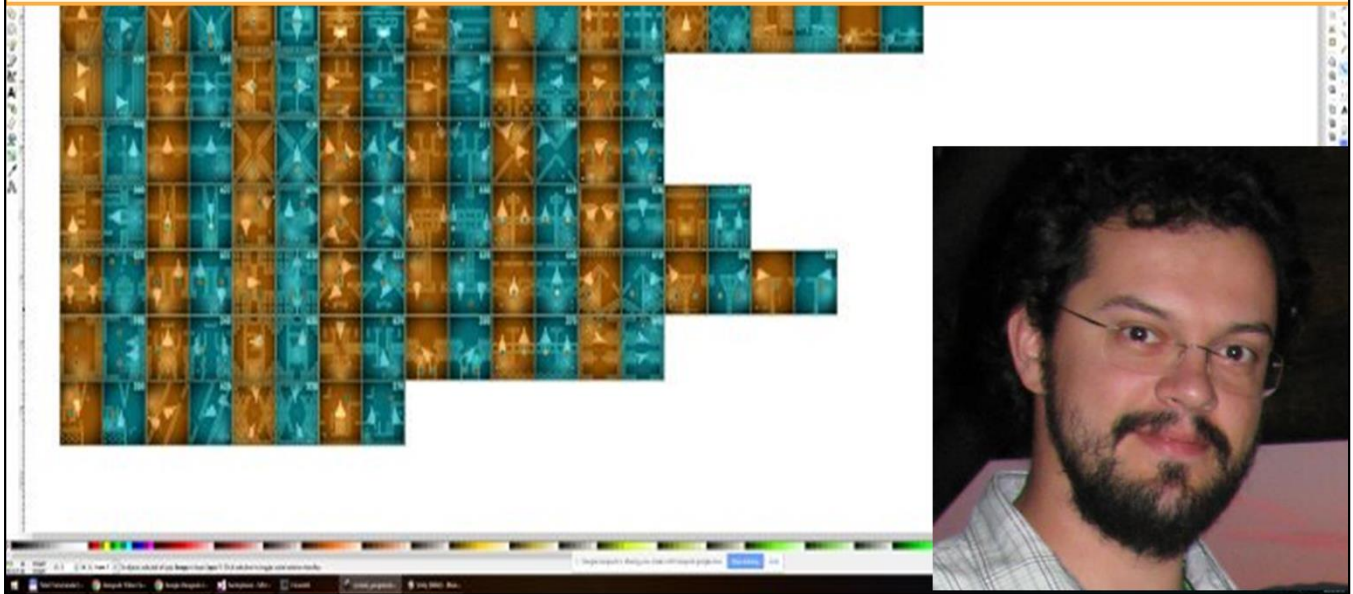
I talked with Radu Muresan from Vivid Helix. On his game Semispheres his game had around 60 levels and many mechanics. Near the end of development, but still in the process of making levels, he started printing screenshots of his levels. He went to a local copying shop and printed out cards with his levels. He then marked notes and was able to rearrange them physically on the ground.

To digitize this method he moved to a program called Inkscape (not Inkspace—this was a Ink Scape), and he was able to do about the same thing and rearrange level pictures to help sort out the order of his levels. He found ordering levels this way helped him sort out his difficulty curve balancing issues.

Solutions: Windows Search (tried it for Pig Eat Ball)

- Allows you to search your levels by keyword.
- Requires levels stored in text form, with keywords for objects
  - Eg. "glutton_bug_2956" is the name of the object to find a "glutton bug".
- Requires index-rebuild of your folder system. Can take hours.
- Not quick to update. But available for free to all Windows users.
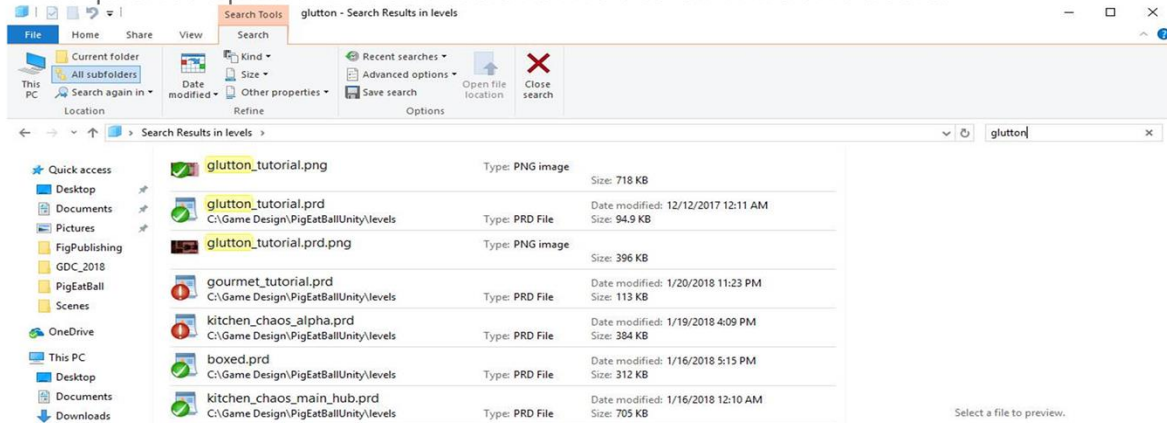
I tried a method of Windows Search on Pig Eat Ball. It was only okay, but it was still fairly useful.

- Allows you to search your levels by keyword.
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First change the search system over to 'indexed'.
Allow it to rebuild the system (takes hours), add a new file extension, allow notepad to open it.
Search system can now see search words inside files like "trashcan".
Very slow to rebuild but offers tons of data with no special code.

Level Managing Solutions: Google Docs

U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
Clams	Level file name	Level in-game name								Clams	Level file name
Clam 1	shooting_gallery	Shooting Gallery	20/30/--	45/60/--		50				Clam 1	jello_tutorial
ALPHA	catch_too	Catch, Too	10/20/40	30/35/40		25			ALPHA	ALPHA	glutton_tutorial
#0	obstacle_course	Obstacle Course	10/20/--	25/33/--	3	20				#0	chewy
											boxed
Clam 2											
ALPHA	arkanoid_other	Pork-anoid	55/60/60	45/60/75							
#1	slip_n_slide	Slip and Slide	35/45/60	25/35/50		38				Clam 2	fanning_out
	mpeightball_single	Eight Ball	10/20/--	30/42/--		25			ALPHA	ALPHA	pie_tutorial
										#1	pig_pie
Clam 3	dart_defense	Pin Cushion Pig	10/20/--	45/52/--	3	45					pie_dodge
ALPHA	supercrate_tutorial	Must Be This La	35/45/60	50/55/--		38					
#2	dart_quest	Darting About	10/20/--	55/70/--	3	40				Clam 3	**bad_cooking.prd
	mp_dartboard	Dart Dash				MISSING	not fun		BETA	BETA	big_fizzy_drink.prd
										#2	**hot_zones
											hot_potato
Clam 4	what_a_card	What A Card	10/20/--	40/50/--		30					
BETA	card_maze	Shuffled	35/45/60	35/45/60		50				Clam 4	strawman.prd
#3	belt_cards	Straight Flush	35/45/60	35/45/60					BETA	BETA	straw_organ
										#3	swept_away
											straw_maze

- Spreadsheet categorization of our levels
- Google docs sharing between team and level designers
- Manually updated by each designer.
  - Annoying and prone to error.

A very accessible, free method to organize objects and levels is Google Docs.
One big feature is that it is fully online and easy to share with designers over the web.
I know lots of devs use this and we use it some for Pig Eat Ball as well.

Shows level name, level num, goal type, general gameplay contents of level.

Automatic level-updating help explained later.

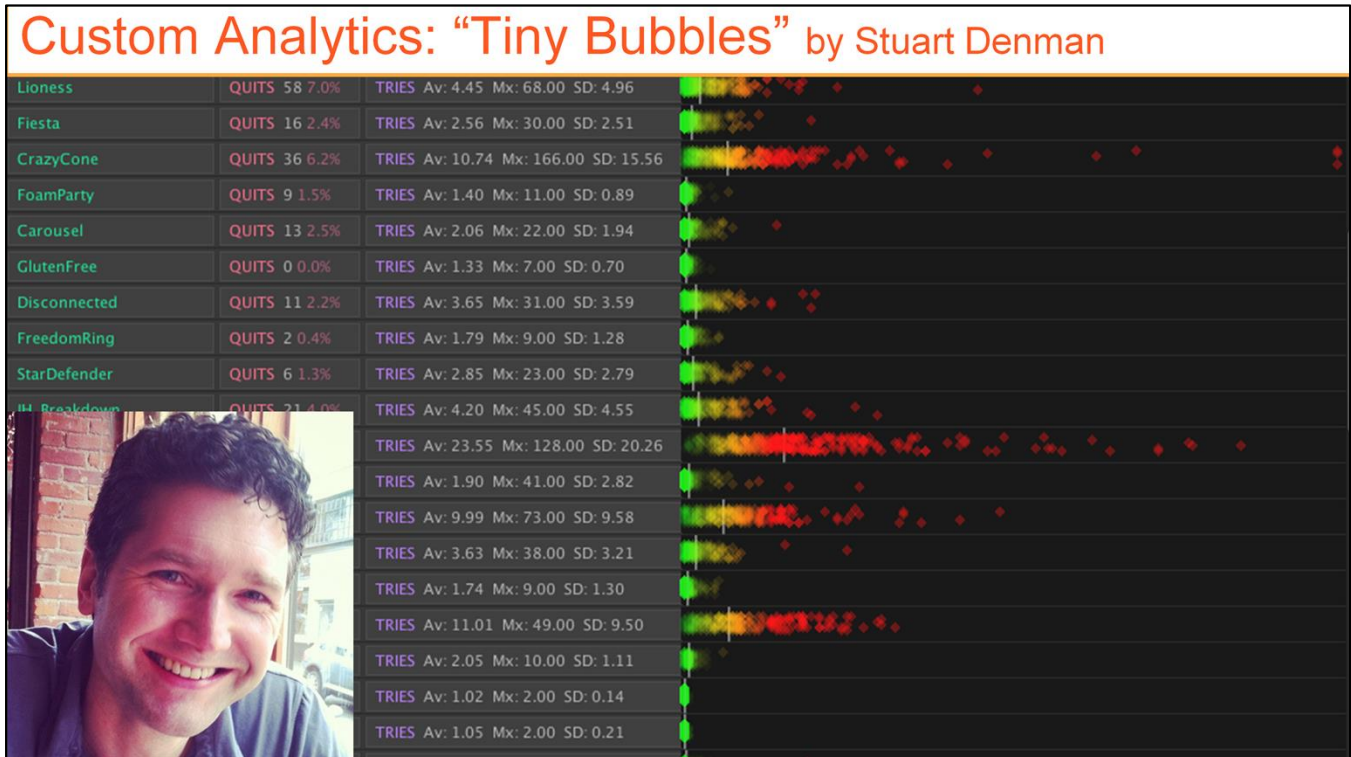# Google Spreadsheets method: "King Rabbit"
by Rare Sloth, Austin Borden

	A	B	C	D	E	F	G
	FOREST 1	**FOREST 2**	**FOREST 3**	**FOREST 4**	**FOREST 5**	**HELL 1**	**HELL 2**
	Wood/Metal Crate	Spiderwebs	Fire Turret	Love Lock	Demon Spider	Demon Reaper	Demon Bomb
	Breakable Ground	Gold Bomb	Reaper	Fire Spider	Explosive Reaper	Demon Crate	Explosive Spider
	Bomb/Breakable Wall	Fire Crown	Spike Crown	Demon Turret		Holy Water	Explosive Demon Reaper
	Saw	Ground Shield	Poison spider				
	Pressure Plate	Poison Turret	Love Potion/Puddle				
	Saw	Spikes					
	Bone Crate White	TNT Crate					
	Bone Crate Gold						
	Rotating Saw						
	Fire Pit						
	Lever						
	Rabbit Hole						

The team from Rare Sloth has a series of puzzle games on iOS. They feature a rabbit on traversing through all sorts of tricks and traps. The latest game King Rabbit has 512 levels so they have a lot to deal with!

To introduce levels they use a google spreadsheet to see what objects and ideas will be in each world.

The other very useful thing they do is, they made some custom grid-base rearranging level tool, in their software to allow them to quickly and simply shift levels around based on user feedback what levels are too hard and too easy and so on.

Custom Analytics: "Tiny Bubbles" by Stuart Denman

Level	QUITS	TRIES			
Lioness	QUITS 58 7.0%	TRIES Av: 4.45	Mx: 68.00	SD: 4.96	
Fiesta	QUITS 16 2.4%	TRIES Av: 2.56	Mx: 30.00	SD: 2.51	
CrazyCone	QUITS 36 6.2%	TRIES Av: 10.74	Mx: 166.00	SD: 15.56	
FoamParty	QUITS 9 1.5%	TRIES Av: 1.40	Mx: 11.00	SD: 0.89	
Carousel	QUITS 13 2.5%	TRIES Av: 2.06	Mx: 22.00	SD: 1.94	
GlutenFree	QUITS 0 0.0%	TRIES Av: 1.33	Mx: 7.00	SD: 0.70	
Disconnected	QUITS 11 2.2%	TRIES Av: 3.65	Mx: 31.00	SD: 3.59	
FreedomRing	QUITS 2 0.4%	TRIES Av: 1.79	Mx: 9.00	SD: 1.28	
StarDefender	QUITS 6 1.3%	TRIES Av: 2.85	Mx: 23.00	SD: 2.79	
IH_Breakdown	QUITS 21 4.0%	TRIES Av: 4.20	Mx: 45.00	SD: 4.55	
		TRIES Av: 23.55	Mx: 128.00	SD: 20.26	
		TRIES Av: 1.90	Mx: 41.00	SD: 2.82	
		TRIES Av: 9.99	Mx: 73.00	SD: 9.58	
		TRIES Av: 3.63	Mx: 38.00	SD: 3.21	
		TRIES Av: 1.74	Mx: 9.00	SD: 1.30	
		TRIES Av: 11.01	Mx: 49.00	SD: 9.50	
		TRIES Av: 2.05	Mx: 10.00	SD: 1.11	
		TRIES Av: 1.02	Mx: 2.00	SD: 0.14	
		TRIES Av: 1.05	Mx: 2.00	SD: 0.21	

Stuart Denman is working on a bubble-based puzzle game called Tiny Bubbles.
It will be out soon on Steam and mobile. You pop bubbles and color them to create cascades.

The game has lots of levels and Stuart wrote a custom analytics analyzer. He can see quits, and tries.
He sends the number of wins and tries to database. Then he can pull 30 days or whatever from the database to analyze.
He plots the data out as seen here, with green being everyone beat it fine, and up to red with people have trouble.
Lots of red dots all together mean the level is certainly hard.
But just a few red dots means there could be something wrong with the explanation of the puzzle.
He found his analytics analyzer easy to make and more useful than Unity's off the shelf funnel.

# iPhone Dropbox: "Where's My Water", Disney Mobile, Lead: Tim FitzRandolph
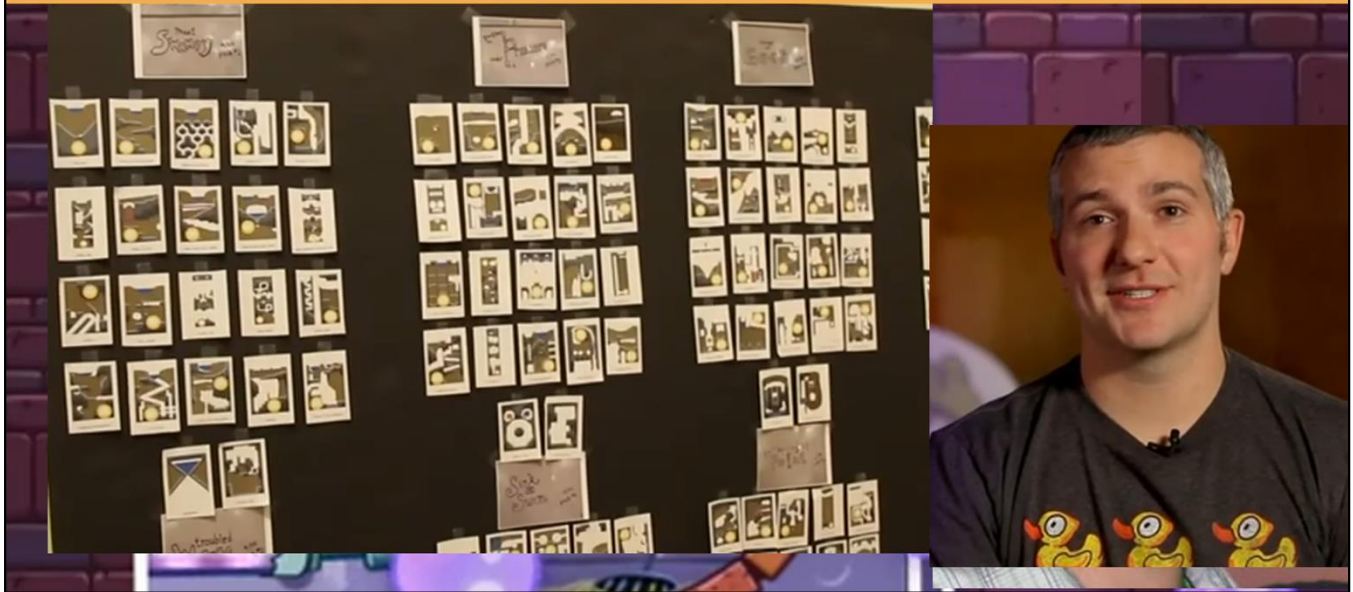
I talked with the Game Design Director for the Where's My Water series at Disney Mobile. They had several hundred levels to keep track of.

- The levels in the WM games consisted of 2 files: a PNG image depicting the basic layout of the level (where is the dirt, rock, any water that starts in the level, etc), and an XML metadata file (where are the spouts, switches, pipes, etc). We would print out thumbnails of the PNG part and put them up on boards to visualize the levels and discuss the proper level pack ordering, etc. Each level also had a name of course (internal filename and eventually user-facing name). - We also did things like tag the thunbnails with colored sticky dots to identify which mechanics or player skills were used in the level to help visualize the player's experience of playing through the levels sequentially.

- - The levels themselves were made in-game with a special build of the game that had a level editor. It was entirely custom, with tools for placing the objects in the levels, and quickly toggling between editing and playing in order to easily test the levels. We had a special build that could pull files from Dropbox (instead of the files baked into the app), so that a designer could also change aspects of the level not exposed in the editor (such as the PNG image, or brand new level data features that existed in the XML but not in the editor GUI), by changing them on their computer, saving the files to dropbox, and then refreshing the level on device and seeing those changes.
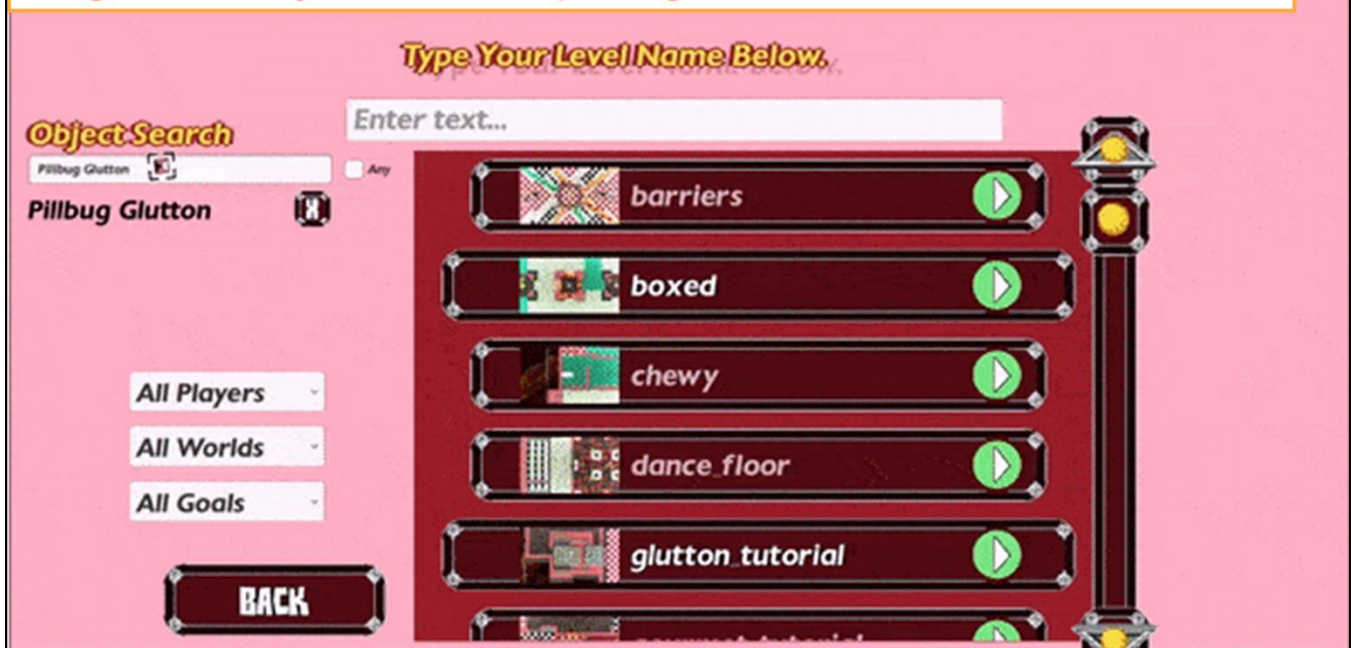
Video: https://www.youtube.com/watch?v=jWzT0oyqzxA
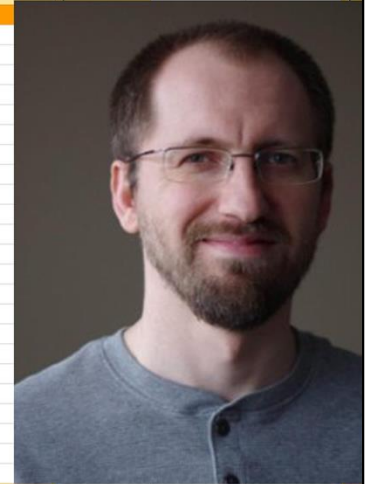
Object Look-up : Pig Eat Ball
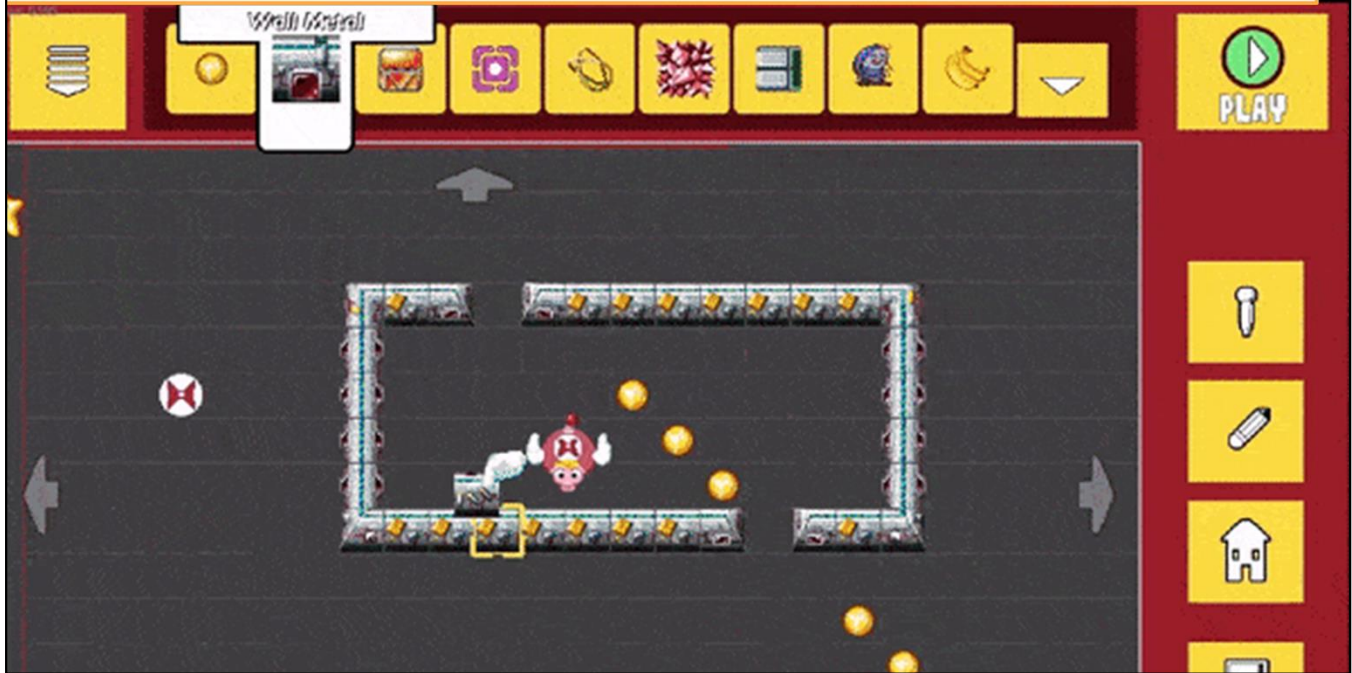
- Filter levels by World, Game-Type.
- Search levels per-object, "glutton bug", "jelly block".
- Requires custom code.
- Works on levels on-load to optimize them next time.
  - Builds searchable list as level loads.
  - Counts all objects.
  - Saves to 'search file'.
  - Looks through these search-files to check if objects are in certain levels.

In-game Object Look-up: Pig Eat Ball

Type Your Level Name Below.

Enter text...

Object Search

Pillbug Glutton ☒

☐ Any

Pillbug Glutton ☒

All Players

All Worlds

All Goals

BACK

- barriers ▶
- boxed ▶
- chewy ▶
- dance_floor ▶
- glutton_tutorial ▶

- Can combine filters.
- Done by searching all levels ahead in a pre-process state, counting all objects, storing off information.

Level Data Spreadsheet Export: Pig Eat Ball, John Meister

Level	Floor Unlock Tube	Door	World Node w/G	Level Node	Wall Spikes	Inter-Level Warp	Wall Screen	Bleacher Chair	Pillbug Tennis	Cake Quest NPC	Spacebreak	Guard Talker	Un
tennis_courts_a	420	20	1	6	22	3	25	72	4	1	84	5	18
tennis_courts_b		20		3	189	1			13	1	45		3
tennis_courts_c	247	3		2	28	1	111		5	1			4
tennis_courts_d		99		3	19	1	8		6				
squeeze_tut2													
cubicles													
other_side					2								
level1	38												
level2													
boost_tutorial		1											
mp1_single													
spikeballs					49								
static_cling					4								
wrecking_ball					28								
banana_intro					207								
mp_crates_single													
pac_tutorial													
pacguy						2							
level5													
level7new													
level6													
mp_star_single													
level8					4								
longhaul					105								
pacspikes					93								
spikedrive					34								
bladewheel													
not_cake_sort	48				2		93		2				2
new_screen					5		152		8				
level10					9		103						
escort_mission							18						

I'm in Southern Indiana, and I work with John Meister over in Lexington Kentucky. His company Super Soul is responsible for the Unity port of Pig Eat Ball and did all the wonderful custom tools I'm detailing.

We added a "google spreadsheet export" ability to the game and it's super. No longer do you have to worry about spreadsheets being out of date or not being updated by designers.
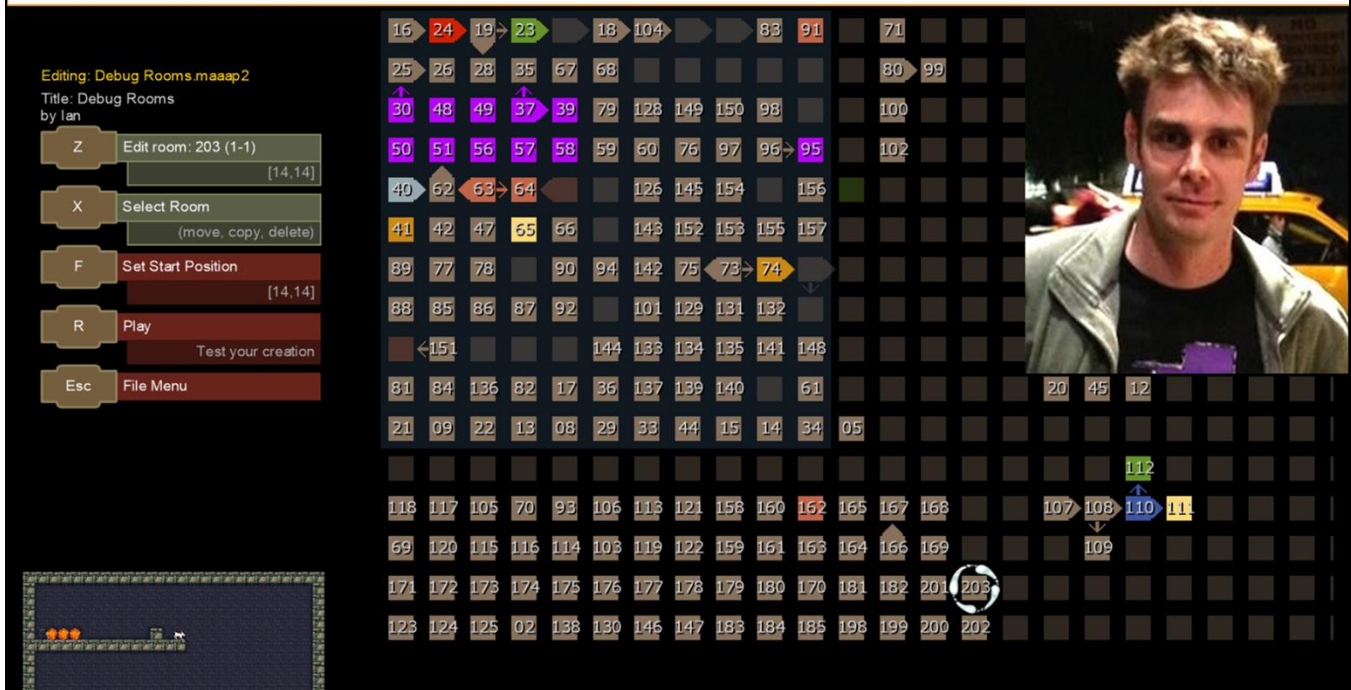
Ian Stocker from Magical Timebean and his Escape Goat 2 uses custom level rearranging software to figure out the ordering.

His game takes place on a grid, so he uses a grid in view to place levels. Then he has a 'dead zone' off to the side, as a work place to drop levels and then bring them back in when needed. He found this method to be fairly flexible, but he said it wouldn't scale very well to hundreds of levels.

Level Library: Candy Crush Saga, Jeremy Kang

I talked with Jeremy Kang from King about their work on Candy Crush. He gave a great talk at GDC that is available on the vault about their design process.
"Level Design Saga: Creating Levels for Casual Games"
https://www.gdcvault.com/play/1023799/Level-Design-Saga-Creating-Levels

There were a couple of insightful nuggets in the talk about their internal tools.
I talked with Jeremy about their software. They have an internal level editor does a lot of things for them like viewing all the levels as a thumbnail, getting an overview for each level, seeing designer ratings. This helps the team get a handle on how hard the level is and where to place it.

They also use Google Docs to maintain a Level Library and a Beat Chart, which is a view of when objects and concepts are introduced and used.

# "Game Design Thinking" Tools, Katharine Neil

- Game Design talk on GDC Vault:
  "For When Spreadsheets and Flowcharts Aren't Enough"
  - https://www.gdcvault.com/play/1024644/Game-Design-Tools-For-When
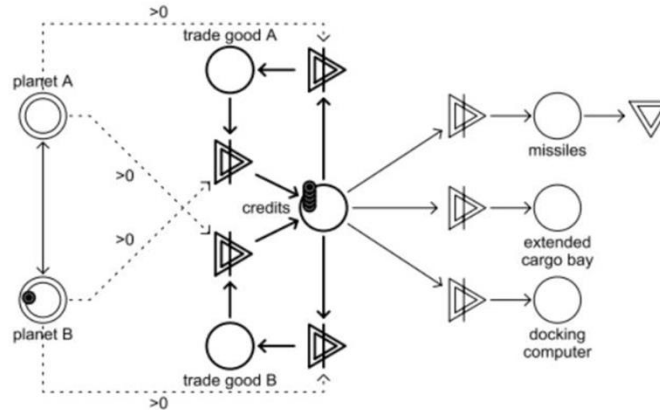
Game design tool that supports game design *thinking* not just production.

Does My Game Need This?

- You cannot count your mechanics/enemies/objects on two hands.
- Bigger teams can allocate a few weeks to a middle-programmer/scripter to make this.
- Smaller teams under 5 people consider only if their project has dozens of mechanics.
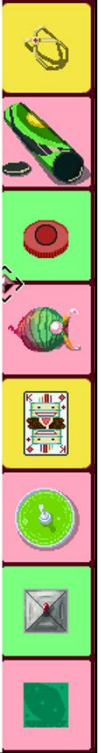
Do you need a searchable level database that updates in real time?
Can you count your mechanics on two hands without forgetting anything?
Bigger teams should be able to allocate a few weeks to a middle programmer/scripter to be able to implement this.
Smaller teams (under 5 people) consider spending time on this if your projects grow in complexity.

Recap

- Level Design Mind-sets

- Difficulty balance, and the "Heart-beat" Difficulty Curve

- A few Custom Tools can be good!

Taking Action

- **Getting started:** Google Spreadsheets, Inkscape, Trello, Paper, Windows Search

- **Bigger things:** Custom software, level rearranging tools

- "Take control of your difficulty curve!"

THANK YOU!

Mommy's Best GAMES

- Nathan Fouts
- @MommysBestGames

- All Details, Links, Games:
  tinyurl.com/MBG-Talk2018

- Please back **Pig Eat Ball on FIG**!
  tinyurl.com/peb-fig
  Hi-fives incoming if you do ☺
- Steam, PS4, Xbox One

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