Game Dev Dialogs episode 3: Games and Cognitive Biases

Lisa: Welcome to Game Dev Dialogs, Episode Three. I'm Lisa Takehana, a game designer at Google Assistant. Our guest today is Ian Schreiber. Ian is a co-founder of Global Game Jam, the largest in-person game jam in the world, and an assistant professor at Rochester Institute of Technology. He has worked on video games as a programmer and designer and has written three books on game design, with the latest one coming out this year. Hi, Ian. Thank you for being here today.

Ian: Hi. Thanks for having me.

Lisa: To start us off, can you tell us how you got into game design?

Ian: I've been designing games since I was, like, maybe six. I just knew that I had ideas for games that I wanted to exist that didn't. My parents told me, "If you want to make games--make these games that you want, then you better learn how to program." And I went all the way through getting an actual bachelor's in computer science, and I still didn't know how to make games. I became a programmer, just at a medical database company. I figured at least I have this skill that I can sell for money.

And then about four years into that, I accidentally fell into the game industry, as a game programmer. There was just an online game that I had played a lot over, you know, lunch breaks, coffee breaks. Was part of the community and everything. And the developers reached out to me and was like, "Hey, Ian, you know, we have an opening over here, if you'd like to make games professionally." I'm like, "Oh, really?" Then, after a few years, there were the inevitable studio closing and layoffs, and I was seeking mostly new programming gigs, since that was where I was, you know, experienced. And they actually hired me at Cyberlore Studios. And so I kind of hit the reset button on my career, and took on game design.

Lisa: I know one of your lectures was on cognitive biases in game balancing, which is what we'll be talking about today. And before you get deep into these fascinating topics, can you tell us what game balancing is?

Ian: Game balance is one of those things that game designers talk about a lot. It's a term that's used a lot in the industry. But there's no real industry standard definition for what it is. When I'm teaching this, I define this as--a game is balanced if players perceive the game as fair. And so that has two parts to it. Is it actually fair? And it is perceived as such? Those two things don't always align. Sometimes it can be mathematically balanced, but it feels like it's unfair and weighted against you. Or the opposite. And what fairness actually means depends a lot on what kind of game you're making, right? Fairness in a PVP game, where, you know, players are playing against each other, you're talking mostly about, do players have an equal chance of winning at the beginning of the game, assuming equal skill and about equal luck and whatever

else? Or does anyone have an unfair advantage just because they happen to pick a certain character or start in a certain location on the map or something like that? With single-player games, balance means very different things. A lot of times you're talking about progression. You're talking about, you know, does the game feel too hard or too easy for the target audience? And that's gonna vary based on who the target audience is, right? It's very broad. But generally, I think it comes down to the perception of fairness.

Lisa: I know a lot of this will really kind of depend on the type of games that we're talking about, but what are the critical variables in balancing a game?

Ian: Generally, designers have what we call, you know, design knobs, like, little variables and values that we can tweak in order to change the play experience. Some common ones would be how much the outcome of the game is determined by randomness versus player skill--or versus other things, like, just simple persistence--how much time you put into it, the length of a game, on average--you know, does the game feel too short or too long, the overall difficulty level, how hard is this… There's no globally correct values for any of these things. It all depends on the game and the desired play experience and the target audience. So, for example, the desired difficulty for a game made for five-year-olds is gonna be very different from a masocore, like, *Souls*-like game, where you've got very experienced players who are looking for a challenge.

Lisa: You mentioned perception of fairness, and I think this overlaps with social psychology and behavioral economics. But how do these things exactly relate to what you mentioned, in regards to perception?

Ian: What's mathematically true and what people perceive as true are sometimes different. And this is one of the things I love about game balance as a subfield of game design--is that there is this mathematical, technical, analytical element to it, of getting all the numbers right and coming up with formulas so that this equation is balanced on both sides. And then there's this squishy, messy, human psychology part of understanding how do people perceive and experience games, and what do they think about it? if a player has a certain experience, how are they going to perceive that, in terms of, how fair the game is? How do you manipulate player thinking in order to think that your game is fair, whether it is or not? How do you predict and control player behaviors based on your understanding of psychology?

Lisa: What are some cognitive biases that designers should consider when balancing a game?

Ian: Understanding expected values, and how those are related to--you know, to fairness. When you have a random element within a range, what is it going to give you on average, right? So, if I roll a six-sided die--a d6--you know, the expected value is three and a half. That's the average value that I would get from that. And so if I were going to, say, roll one d6 and gain that much gold, I would balance that normally by saying, okay, that's gonna give you an average of three and a half gold per roll.

But sometimes expected value is perceived differently than it actually is. There's a great set of exercises that Squirrel Eiserloh put together that I love to access in my classes. So here's a

gambling game. You pay $1 to play, and that money is lost regardless of what happens. And then you roll a 20-sided die. And on a roll of 19 or 20, you win $15. The question is, would you play this game? Is this game in the player's favor? What's the expected value of the outcome of this game? 90 percent of the time you lose, and your result is -$1. And then 10 percent of the time, you win, and you get $15, minus the dollar you paid to play, so it's 14. You're up 14. And so you can multiply that out, and you'd get a result of +0.5, meaning you have an expected value of 50 cents in favor of the player. So, every time you play, sometimes you'll lose $1, sometimes you'll win, you know, $14. On average, you're gaining 50 cents per play. So, of course, the answer is yes, this game is in your favor, you should absolutely play, you can make money.

So, let's try a different game. The second game, you pay $1,499 to play. The rules are the same, but you win $15,000. If you math it out, the expected value is actually +$1 per play, so this is twice as profitable as the first game. But most people do not want to play it, because you're paying almost $1,500 to play this game. That's a lot of money to lose. The stakes are just too high, you know, to risk $1,500 for the possibility of winning $1 per-per game. So, we think of balance in terms of expected values, but expected value is not just the answer to everything, right? So, these are cases where you can have mathematically identical games, or mathematically favorable games, that still no one would want to play, because of all these other different kinds of things.

Another cognitive bias that we run into a lot is selection bias. This happens a lot with PVP games. And I call this a bias and not a fallacy, because this is a mnemonic that our brains use to make sense of the world, and most of the time it works really well. Bias is just a certain way that we think. And that doesn't necessarily mean that it's wrong. A fallacy is something that you think is true, but it really isn't. Fallacies are never true. Biases may or may not be true.

What it comes down to is, if I were to ask you, which of two things is more likely to happen, you're gonna say, "Can I remember these things happening?” And whichever one I can remember more easily or more frequently, I'll assume that that actually happens more frequently." So this is actually a pretty good algorithm for your brain to decide which of those things is more likely to happen. Except when it isn't. 'Cause sometimes it's easier to recall rare events than to recall common ones. You know, cars are ridiculously more dangerous than planes. Planes are so safe. You know, commercial aircraft are flown by people with far more training and experience than your average car driver. Planes have multiple failsafes and safety mechanisms. And yet most people fear flying more. One of the reasons is, plane crashes are so rare that when they happen, it's international news. And so most people have heard of far more plane crashes than car crashes, which leads to us having -this selection bias that we think that planes are much more dangerous, simply because mass media makes it much easier to see things that are rare.

Another bias you see a lot is self-serving bias. That's where you tend to make assumptions that are favorable to you. If you are told, for example, as a player, that you will win 75 to 80 percent of the time in some random die roll contest, you actually expect to win about 95 percent of the

time. But if you tell someone that you're going to lose 75 to 80 percent of the time, and you actually win the 20 to 25 percent that you're supposed to, you're totally okay with that. No one feels like they won more than they we're supposed to. Right? No one's going to complain to you that the random number generator is broken because I won too much. But if I lose too much, then I'm definitely gonna complain about it.

There's also a related thing called attribution bias, which is your tendency to blame bad outcomes on bad luck, but if you have good outcomes, then you take personal credit for that. So, if there's a totally random event that happens that's in a player's favor, they will attribute that to their skill at the game. But if there's a random setback, players blame externally. "Well, I'm just unlucky. It's not that I made any bad choices." Sometimes players may even accuse, like, the computer or their opponents of cheating, because I'm perfectly willing to accept a streak of good luck in my favor, but I will not be willing to accept a streak of bad luck that runs against me.

There's an interesting phenomenon called anchoring. if you're not sure of what the correct value of something is, you tend to latch on to the very first number that you see, and then put everything else in terms of that number. So, for example, if you're playing a new RPG and the first enemy you run into has 500 hit points, that immediately gives you the sense of scale of the game, and you'll be putting other enemies' hit points in that general range. This tends to throw people off a lot on things like--that have exponential curves, like idle games, where, you know, maybe, if you spend a long amount of time in the early phases of that game--and I'm used to, you know, getting, like, you know, 100 cookies an hour or something, and then by the end of this, I'm making, you know, quadrillions or something. It'll kind of throw people off for a little bit until they adjust.

A couple of fallacies that you see a lot in games: Gambler's Fallacy and the Hot-Hand Fallacy. The Gambler's Fallacy starts from the reasonable assumption that if you're dealing with a random system, the results should kind of look random. That's our expectation. If you give someone a rigged die and a not-rigged die, and they're able to roll both of them, they will probably pretty intuitively identify which one is fair and which one is not. But the downside is that people also expect random numbers to bounce around a bit more than they do. So, sometimes you will get long, random streaks that--you know, just through the laws of statistics, you would expect that. And these long streaks look wrong, even though they actually happen with a fair frequency. And this can really wreck your perception if you're doing an online game with completely random and completely fair random number generation. 'Cause if you could imagine, for example, like, say, a coin flip at the very beginning of a game of *Hearthstone* or *Magic the Gathering*, that determines who goes first or second, imagine that it is a truly fair flip--and you've got millions of players. Statistically speaking, you would expect one in every 1,024 players to get all ten of their very first ten games that they've ever played in this game--every single one, they go first. Or every single one, they go second. And those players are certainly going to be convinced that the random number generator is broken, and they're gonna complain about it loudly, even though really, they were just, you know, seeing the experiment of an actual random process.

The Hot-Hand Fallacy is kind of the reverse of that. If I've won five--a game five times in a row,

some people will say, "Well, the dice are really hot. You know, you should keep going, and you should bet bigger, because, you know, the dice seem to be favoring you." Really, they're not. It's completely random each time. So, those are the two fallacies of assuming that random numbers have memory, and that the past can be used to predict the future and that you'll either say, "There is a streak, therefore I am due to get something different," or "There is a streak, therefore I expect it to continue."

Lisa: These types of game balancing and probability also show up in casual games as well. I used to design Match 3 games, and of course, all of the different ratios of all the different pieces dropping, those are all essentially like dice rolls.

Ian: Pretty much any game that has any kind of random number in it. You'll see it in MMOs and RPGs, with random ranges of damage--you know, all kinds of things.

Lisa: The thread that kind of ties all of these different biases together is we are emotional when it comes to reacting to these outcomes. And I wanted to ask you: if we design without considering these cognitive biases, what happens?

Ian: If we design without considering these things, what happens is that your game is mathematically fair, it's balanced perfectly in a spreadsheet, all of your numbers and all of your metrics say that your game is fair and it's working properly, and your players are complaining that your game is broken, your RNG is broken, and they hate it, and they call it unbalanced even if you have mathematical proof or clear analytics showing that it's not. So that's why you have to take these into account, 'cause otherwise there's gonna be a big mismatch between what you designed and what your players are experiencing.

Lisa: Is there a conflict between mathematical fairness and perceived fairness?

Ian: Especially when you run into cognitive biases, often there is a difference. And then it's critical for designers to understand both, because we're not just designing games to be played by algorithms that are assessing our game mathematically, they're being played by humans. And you have to understand, as a designer, how do cognitive biases work? When are they likely to be good heuristics for the player, where they'll help your player to play your game more effectively, versus, when do they backfire, and they're going to give your players false expectations, because they don't understand math. And then what can you do to put some heuristics in your game to guide the player, so that they understand better about how the game is actually working?

Lisa: What are some games that tackle player cognitive biases well?

Ian: Sid Meier gave a wonderful keynote at GDC in 2010, where he talked about the design of *Civilization Revolution*, and where they ran into a whole bunch of cognitive biases in playtesting and what they did. And mostly what they did was, they showed numbers to the players, and then they changed the math in the game to be biased in order to conform to cognitive biases. So, they might tell you that something is, for example, a four-to-one advantage in your favor,

which would mean I would have an 80 percent chance of winning. They know that if you actually have an 80 percent chance of winning, you expect to win 95 percent of the time, and then behind the scenes, they would actually roll against 95 percent. So, the game would actually lie to you. Sid actually took some flack for that, because he essentially condoned lying to the player in order to reinforce a player's flawed perceptions of mathematics. Players really like that game. It was a really fun game, and it definitely felt good to play. But it also reinforced flawed perceptions that made fixing these perceptions harder for the rest of us, going forward.

Sometimes you can just brutally beat the player over the head with their flawed understanding until they get it. Competitive, ranked poker is a very popular game. And yet, if you do not understand probability and psychology, you will lose very, very badly in poker.

Another example is just exposing the numbers to the player, so that they can see it in real time. *Tetris* is one of those games that definitely has a lot of cognitive biases. Everyone is convinced that there's--you know, the long line pieces--the AI never gives them to you until just after you need it, and it's very evil. Right? Unless you look at the actual stats. And the arcade version of *Tetris* actually kept track of stats, where it would show you exactly how many of each piece type were dropping. And it would update those in real time. And so you really couldn't say that the RNG is clearly biased against you, because it wasn't. And there's other games like that that do things like that, where, you know, it'll expose the stats to you, so that you know that the computer is playing fair, and it's not just biased.

Automated matchmaking in a lot of online competitive games--kind of works this way. You're trying to give the player a fair match, so that they can have fun, close, challenging games, without realizing that they actually suck at the game. If you are really bad at this game, but I'm pairing you up with someone else, who's also really bad, you'll probably have a fun and close and really interesting play experience.

There's also places that go over to the dark side, and say, you know, "Screw it. We're going to just, you know, use these as known exploits in people's brains in order to make money." Like, the entire gambling industry kind of does this. So, there are other kind of dark side ways to do this that I don't want to get into here.

Lisa: Even if you don't touch upon it in detail, it is good to know that it exists. Related to that, what do you think is a designer's responsibility to the player, in terms of game balance, to make sure that we are ethical in the decisions that we make?

Ian: One of the most painful lessons I learned early on as a designer is that--I started out, and I was thinking--"A fun game is a balanced game, and a balanced game is a fun game, and this is the secret." That is not actually the case. The designer's job is not to make the game balanced. So, the game designer's responsibility is to the player. It's to make a game that meets the design goals, whatever those design goals are.

Usually, we use a term like--a very soft, squishy term like a game that's fun, a game that's compelling, a game that's engaging--you know, whatever. But you can have other design goals,

right? If it's an educational game, then you might have a design goal of a game that actually changes player behavior or imparts knowledge or something like that. If you have an art house game, its design goal might be to make the players see the world in a different way. But whatever your design goals are, balance is just one tool in service of that.

Balance provides guide rails to make sure that the player stays within a certain bound, so that the player can be guaranteed to have a certain experience. So, the designer's responsibility is really to keep the vision of the game, and balance is just a method that can sometimes be used to reach that vision. ‘Cause sometimes you actually want a game that is intentionally unbalanced. There are some games that need to be unbalanced intentionally, and this is important. My two favorite examples of this--one is a card game called *The Great Dalmuti*.

This was a Richard Garfield game. It was based on an older folk game that has many different names, including *President* and *Landlord* and several others. It's patently unfair. Some people are automatically disadvantaged or privileged at the very beginning of the hand. Like, this game is unbalanced by design. And that's part of the point. This is a game that models real life, where people start off in privileged or underprivileged positions. It's kind of a way to play around with those systems of power imbalance in the real world, from within the safety of a game. And there's all kinds of interesting play that can come from that. Sometimes the person at the top completely crashes and burns and goes all the way to the bottom. And it's an extremely satisfying moment to see--you know, to see the king become a pauper.

There's another game called *We Didn't Playtest This At All*. The name of the game already sets the expectation that this is gonna be completely unbalanced. And it totally is. That's okay, because -that's the expectation that's set up. If you're playing a game with that name, you are entering into the space of saying, "I'm gonna have a completely random and chaotic thing that's just gonna do random stuff," and that's the expectation. And it is a wonderfully chaotic game. And it's usually over very, very quickly.

Lisa: Taking a step back here and kind of looking at the larger picture of your contribution to the game design community, as a professor of game design and a creator of Global Game Jam, you're helping to shape the future of the video game industry. What are you seeing that inspires you, and what are some things that even worry you?

Ian: But I'd say the answer to both of those questions is the treatment of women and minorities in the industry. It worries me, because we really still aren't there yet, in terms of treating everyone equally and providing a positive work environment for everyone who wants to make games. At the same time, it gives me hope, because the game industry, as a whole, acknowledges that this is a problem, and we're at least having these discussions.

One word that gets thrown around a lot is meritocracy, the idea that we want to create systems that reward people based on merit. And when you look into these, there's usually a lot of very human biases there. And it's not a bias in terms of random numbers, like I was talking about before. There are other cognitive biases that are also in play. Finding ways to design systems that help you fight against those biases are really important. You can also design systems that

are themselves biased, which can lead you down a really bad, you know, dark fallacy path, where, you know, if I'm creating, say, an AI to try and judge people's merit for different things, but I put in biased data, then I'm gonna get a biased result.

Lisa: To close this off, if there's one thing you wish you could see in games or in a game, what would it be?

Ian: I would love to see an industry that, overall, treats its people better. I want to see a time when people who don't love games decide to choose game development as their career, because it provides such great working conditions. I want to see an industry where layoffs don't happen every two to three years, on average. I want an industry where, you know, people come in and they love it so much that they are here for life, you know, and burnout is not a thing that people are consistently talking about. I want an industry where I get to attend retirement parties for my colleagues on a regular basis.

If you're asking about video games, and what I want to see in a game, I just like seeing things that surprise me. I like seeing new things.

Lisa: Thank you so much, Ian. Where can people go to learn more about your work?

Ian: I'm ianschreiber@ on Twitter. If you want to see more about design, I've got actually two full college-level game design classes that I've put up online for free. One is called gamedesignconcepts.wordpress.com. The other is gamebalanceconcepts.wordpress.com. I've also written three books: "Breaking Into the Game Industry," "Challenges for Game Designers," and then I've got a third book on its way that's supposed to release in the third quarter of this year, that's just called "Game Balance." And all of them are with me and my co-author, Brenda Romero.

Lisa: Thank you so much for coming, Ian.

Ian: Thank you so much for having me.

Lisa: This has been Game Dev Dialogs. Thank you all for listening.