Episode 12: Cognitive Gamer Cognalysis: Horizon Zero Dawn

Show Notes

This episode contains a deep dive into the cognitive ins and outs of the Playstation 4 game Horizon Zero Dawn. Much of the analysis, though, could be applied to most open-world games. We'll consider narrative, skill transfer, and types of knowledge.

Game References

Assassin's Creed: Origins, Horizon Zero Dawn, Player Unknown's Battleground, Watch Dogs

Research References

Crossman, E. R. F. W. (1959) A theory of the acquisition of speed-skill. *Ergonomics*, *2*, 153–166.

Gunzelmann, G., & Anderson, J. R. (2006). Location matters: Why target location impacts performance in orientation tasks. *Memory & Cognition*, *34*(1), 41-59.

Madigan, J. (2017). Don't do your best: Goal setting and Horizon: Zero Dawn. Retrieved from http://www.psychologyofgames.com/2017/10/dont-do-your-best-goal-setting-and-horizonzero-dawn/

Newell, A. & Rosenbloom, P. S. (1981). Mechanisms of skill acquisition and the law of practice. In Anderson, J. R., editor, Cognitive skills and their acquisition, pages 1–55. Lawrence Erlbaum Associates, Hillsdale, NJ.

Seijts, G. H., & Latham, G. P. (2001). The effect of distal learning, outcome, and proximal goals on a moderately complex task. *Journal of Organizational Behavior*, *22*(3), 291-307.

Sweller J., Ayres P., Kalyuga S. (2011) The Goal-Free Effect. In: Cognitive Load Theory. Explorations in the Learning Sciences, Instructional Systems and Performance Technologies, vol 1. Springer, New York, NY

Transcript

Hello! This is Episode 12 of the Cognitive Gamer podcast. I am your host, Steve Blessing. It is time for another cognalysis! These episodes contain a cognitive analysis of a particular game. Remember, it's not a review, assume I really like the game or else I wouldn't talk for 15 minutes about it! Rather, it's a deep dive looking at some of the cognitive ins and outs contained within the game. This time, I'm looking at Horizon Zero Dawn, an open world, third person shooter on the PlayStation 4. However, much of what I'll say will be applicable to most games of that type, and even to games in general. So, if you haven't played it, you should still be able to enjoy the podcast and get something out of it. I won't have any real spoilers in this podcast. If you have a

PS4, I encourage you to pick it up and play if you haven't already. I imagine it's going to end up on a lot of people's best of 2017 lists.

I'm going to talk about 4 issues here, many of which echo back to previous Cognitive Gamer episodes. First, we have to talk about narrative, the topic of the tenth episode. Next, we'll touch on spatial navigation in these sorts of games, harkening back to episode 2. Then, we'll slide into talking about strategy use, and end with a discussion on different types of memory that get used and how to distinguish between them, the topic of the last podcast.

First up, let's talk about narrative. Horizon Zero Dawn is overflowing with it. There's the main storyline about this post-apocalyptic earth that is roaming with mechanical dinosaurs that you have fight, of course, but there are also these wonderful side stories that you encounter, and some great environmental storytelling that happens via the way the world is constructed and some of the artifacts that you find along the way. The creators and storytellers of Horizon Zero Dawn have done a tremendous job at imbuing this game with a great sense of story. I loved uncovering the major story pieces as you traveled around the world. That's obvious, though. These types of games are expected to have this type of narrative, told through cutscenes as you course your way through the game. I personally like these types of games, in some measure because of these stories. I've played through most of the Assassin Creed games, and I did Watch Dogs 2 earlier this year, but Horizon Zero Dawn I thought did a particularly good job of delivering the story, though I wasn't a particular fan of the dialog prompts. My wife might have gotten a little bored with me as I caught her up as to what Alloy had found out about her world. I found the story about how the world came to be this way very engaging.

But, the creators of Horizon Zero Dawn didn't stop at just having this larger story. There are smaller stories that all hang off this larger story. One incredibly touching piece is a story told through these Banuk figures that can be found at various places on the map. If you read the text that accompanies each figure, a tragic tale is told. There are a handful of these sorts of story threads that can be followed by finding artifacts throughout the game. These threads all connect back up to the main story. As one more example, I recently played through the DLC for the game, the Frozen Wilds. There is a side quest in that story called The Claws Beneath. In this side quest, you learn the story of this one particular Banuk hunter. It doesn't advance the main story, but it adds to the overall narrative tapestry that allows the player to feel that this is a real world.

As we said back in Episode 10, humans can't help but to connect events together in order to create a story. That helps us to remember things better. We do this even when events shouldn't be connected. But, here in Horizon Zero Dawn, everything hangs together so nicely, and all the events do hook back up, that it creates a very satisfying, and memorable, whole. The main story, while perhaps derivative of other post-apocalyptic stories out there, does a great job giving a reason for the existence for these robotic dinosaurs. Some of it probably does rely on your previous knowledge of these sorts of tropes, but then it also adds a dash of Greek mythology into the mix, and there's all this world building that goes on between the Banuk versus the Carja versus the Nora tribes. It all combines to create a memorable experience. To compare and contrast a bit with the Assassin's Creed series, which I do like, but I think we can all agree here the story is a bit of a mess, particularly if you try to connect it between games. Whereas I can give a pretty good accounting of Aloy's story and the world she lives in, I think I would be pretty

hit or miss to give you as detailed of an accounting of any of the Assassin's Creed games I've played through. And that's even with them attempting to integrate the tale of the Assassins and the Templars within our own history.

Narrative, then, is a big piece of Horizon Zero Dawn. Another big piece, not only of Horizon Zero Dawn but any open world game, is that you have navigate through the space. Given the fidelity of today's games, it's not too different than what needs to happen in real life. And, I'm not even talking about virtual reality here. But, that would obviously bring it even closer to what we do in the real world. In these open world games you have either a third person or first person view of the world. To be clear, third person is when you have an over-the-should view of your character, like in Horizon Zero Dawn, and first person is when what you see on the screen is what your character would see, like in Doom. Some games allow you to switch perspectives, like Player Unknown's Battleground added a little while ago. In addition to this main view, most open world games give the player a traditional map that can be accessed. It's an interesting cognitive issue as to how people reconcile what they see either in first or third person view versus what is on the map.

Let's start with some terminology. What we see in first person view, and this would also apply to the third person view of these games, would be called egocentric. That is, we see things in relation to our on-screen avatar's position. That means we describe objects relative to where we are. The enemy is either to our left or right, that object is either above or below us, or the location I need to get to is either in front of us or behind us. Compare that to how we use a map. Maps have what is called an allocentric orientation, which is an absolute way to position objects. We would say something is to the north or south of us, or maybe to the east or west. Those are all absolute directions. On a typical map, north is always to the top. But, when we are looking out in the world via our avatar's eyes, or over her shoulder, north could be in front of us, behind us, or to our right or left. How do we reconcile these two views of the world, egocentric and allocentric, in order to navigate around these virtual environments?

As I was finishing up the Frozen Wilds DLC of Horizon Zero Dawn, I thought about this particular question. I was trying to find the last pigment I needed to make a collectable set for the Banuk painter. I had bought the pigment map guide from a merchant, so I knew where it was on the map, high up in the mountains. However, getting Aloy up there proved difficult, partly because I had to figure out the right path to get her to clamber up to where the pigment was located. But, I had to do that by looking on the allocentric map where the pigment was, and reconciling that with what I, Aloy, could see with my egocentric third person view. Eventually I got there, but it was tricky.

Glen Gunnzelman is a researcher who has done some interesting work in this particular area, how we reconcile these two views. In his experiments, for which he actually used the Unreal 3D engine, he set up a scenario not too dissimilar to what you see in these open world games. It was greatly simplified, in order to investigate just this particular issue, but his participants saw a simple scene in first person view on the monitor. The scene contained a number of different objects, 8 to 10 depending on the task. One of these objects was red in color. Off to the side of this view, was a traditional map view of the scene. The participant had to indicate which object

in the map view was the red object in the first person view. Glenn measured how long it took the person to make that judgement.

One main finding of the research, not too surprising, is that the more the two views misaligned, the longer it took people to figure out the correct object. That is, if you are looking south, and trying to reconcile what you see with what's on the map, that takes the longest, because that's the maximum misalignment. The more your egocentric view is to actual north, the easier time you have. Glenn has some really pretty curves in the paper I'll cite in the show notes to demonstrate this particular issue. However, it's not all about this misalignment issue; the context of the scene matters as well. If the red target is arranged in a particular cluster of other objects, that can make it quicker or slower to find, depending on that arrangement. These findings led Glenn to hypothesize a two-stage model of how we do this task, of aligning our egocentric view to an allocentric view. We first extract a description of the target based on the egocentric view, and then we transform that description in order to figure out the allocentric view. That transformation can be aided or hindered by the complexity of the target object in relation to the other objects in the display. Think about this the next time you are trying to figure out where something is in a first- or third-person view game, as you are looking on a map.

Let's turn now to talking about strategy use and Horizon Zero Dawn. After the story, the next cool thing about the game for me is battling robot dinosaurs! And, there are several different types of these machines , and many different ways to bring them down. You can choose to be stealthy or be more aggressive. You can battle them from afar or closer up. You can use a bow, a slingshot, or maybe set some traps. In short, you have a lot of different ways to accomplish this goal. Jamie Madigan, who has a podcast and blog called The Psychology of Video Games, wrote a blog post back in October about Horizon Zero Dawn, strategy use, and goal setting. I'll link to it in the show notes.

One difficulty in playing, and I imagine also in creating, this type of game where there are so many different ways to play, is how best to inform the player of these different ways to play. Horizon Zero Dawn solves this problem in a couple of different ways. When you encounter a new weapon type, you can elect to do a tutorial on that weapon in order to earn some experience points. Also, and this was the main feature of Jamie's article, there are several areas called Hunting Grounds where you are given specific feats to accomplish in order to earn medals, which can be traded for better weapons. Most feats have you do a certain type of kill on a machine, perhaps stealth kills or using a certain type of weapon. In order to earn the best medal, you need to do it in a very short amount of time.

In his article, Jamie points out some psychological research by Gerard Seijts and Gary Latham in which they investigate how giving different task instructions affected performance. There were three groups doing the same, challenging task that involved creating schedules. One was told to complete 10 schedules in 24 minutes, another was told to do their best in 24 minutes, and the third group was told to find as many strategies as possible in 24 minutes. It was this last group that performed the best at the task. This reminds me of another study, this one done by John Sweller and his colleagues. They describe something they call the Goal Free effect, and it's similar to what Gerard and Gary found. John noticed that if he gave say a geometry problem, and told students to find as many missing angles and segment lengths as they could, they learned the

subject better than if they gave students a particular goal, such as to find this specific angle. They explained their findings by what they called cognitive load. That is, when asked to find a specific angle, you tend to have to work backwards in order to find this angle, and then find this angle, and it creates more cognitive load, mental effort in working memory, than if you just told the student to find all the missing angles. In the end, you are doing the same work, finding missing angle values, but the reduced cognitive load in the goal free problems allows the student to learn the task more efficiently.

If you take these findings together, the piece about motivation and cognitive load, the argument is that you should encourage players not by directing them to do a specific task, like take down 10 machines in 5 minutes, but rather to ask them to figure out as many different take down methods as possible. That will encourage the players to try many different strategies in order to do the task at hand. They will then naturally maximize their efficiency at the task, once they hit upon the best strategy.

I was reminded of this myself as I was playing through the hunting ground that came with the Frozen Wilds DLC. The task was to quickly kill as many machines as possible, and these machines came in waves. You had only a short number of minutes to go through all the waves in order to earn the highest medal. I wasn't doing so good at the task. I was about ready to give up, but in the middle of one trial I ran out of my preferred arrow, and had to switch up weapons. I tried my blast sling, a weapon I didn't usually use. It was great in this context! With just a couple of bomb lobs, I was taking down the machines in no time. I restarted the trial, used my blast sling, and earned the blazing sun mark for the trial. There's a related phenomenon in problem solving that goes by the great German word Einstellung, or mental set. I'll talk about it on a later podcast, but it has to do with not seeing a simpler solution when one is available, because you are busily pursuing a more rehearsed, but more inefficient, strategy. I was definitely experiencing Einstellung when doing this hunting trial, staying in my mental rut of how I usually attacked these machines.

The last point I would like to make in this cognalysis relates to how we store knowledge and how we acquire and use skill. If you remember from last time, most psychologists distinguish between two main memory types, what I call declarative knowledge, or knowledge of what things are, and procedural knowledge, our knowledge of how to do things. By this point, most of my knowledge of how to play games with twin stick controls is pretty procedural. But, each game is slightly different in terms of what the buttons do. I had played Horizon Zero Dawn back in March for enough hours to totally complete the game. I had gotten pretty good at battling the machines, switching and crafting ammo when I ran out, and changing out weapons when needed. For those of you who are mathematically minded, if you graph either time or error at learning a new skill, like playing a game, those graphs all follow a curve referred to as a power curve. It has a very particular form, referred to as the power law of learning. Descriptively, you see a lot of improvement early on, and then that improvement levels off as you get more and more practice. Or, in mathematical terms, the logarithm of the reaction time for a particular task decreases linearly with the logarithm of the number of practice trials taken. Back in March, I was pretty far along this power curve for Horizon Zero Dawn. We'll talk more specifically about the power law of learning in a later podcast, but part of it does have to do with this transition from declarative knowledge to procedural knowledge. And again, this shows up whenever you learn a new skill,

from video games to board games to playing an instrument to programming a computer, to cigar rolling (yes, there was a famous study about learning to roll cigars).

I was reminded of this when I played the Frozen Wilds DLC soon after it came out last month, some 7 or 8 months after I finished the main game. As I said, I was pretty good at playing Horizon Zero Dawn back in March or so. When I picked it back up, I had to relearn a few things. I was quite smooth at guiding Aloy, but now it just wasn't quite as good. I imagine you've all had this experience. But here's the cool thing, you quickly come back up to speed, and indeed, if you plot this out, you will quickly get back on the same power curve you were following when you initially learn the skill. You may seem like you've gone backwards, but in the end, there's a lot of what a cognitive scientist would refer to as a learning savings when you get back to doing the skill. Think about that when you return to playing a game you haven't picked up in a while. Or again, you can think about it with any skill, from playing the violin to doing proofs in geometry.

That ends our Cognitive Gamer Cognalysis on Horizon Zero Dawn. Again, if you haven't played it yet, I encourage you to do so. Next time on Cognitive Gamer we will talk about what psychology can tell us about the design of games. As always, I welcome any comments or questions you may have, so please email me, steve@cognitivegamer.com and also visit my website, cognitivegamer.com. Also, you can like me on Facebook, Cognitive Gamer, or follow me on Twitter, @cognitive_gamer. If you haven't done so already, I'd appreciate it if you took the time to give this podcast a rating and a few kind remarks on iTunes or wherever you listen to Cognitive Gamer. Like with victory points at the end of a game, higher numbers are better when it comes to reviews, so I appreciate those 5-star ones. Until next time, remember to think about what you play, and have fun doing it.