In this Deep Dive I wanted to break down some core fundamentals of combat design to further study and analyze what makes a great combat system. I chose Horizon Zero Dawn for this because Guerrilla Games did something fantastically unique with their combat and enemy design and I really wanted to highlight the combat systems complexity and why this game was received with such high praise. Of course, the narrative of Horizon Zero Dawn was a big reason for its success but the gameplay cohesively forms well with this narrative and the combat specifically brings a strong USP to the title and makes it stand out from just being a strong narrative game. I'm going to first start by going over some core elements needed to make any action combat system work well for players and how these elements are found within Horizon Zero Dawn. I'm then going to break down specific and unique elements found within the combat system of Horizon Zero Dawn that set it apart from similar games in the Action/RPG genre.

According to the PENS model, the most important player "Needs" for game satisfaction within the Action/RPG genre are Competence and Autonomy (Rigby, 2007). Autonomy is relating towards the players freedom of expression, something absolutely needed in an RPG; players need to feel like they are able to play their own way. Competence is relating to mechanic mastery, the player wants to feel like they are good at the game and effective at completing the tasks within it. Autonomy is found within Horizon through character skill trees, equipment customization, and weapon loadouts. With all three of these systems working together, the player is given a wide range of expression with how they want to play the game and enter combat. Some players might want to set traps, some might want to sling explosives, and some might want to play matador and melee attack charging robots. But at the root of this comes Competence. Players need to learn the mechanics and rules of the game early so that they can begin their progression of mastery (Rigby, 2007). Horizon Zero Dawn does this well by slowly revealing new mechanics over time such as overriding machines and introducing different weapon types, and they also taught the fundamentals well within their tutorial. Eric Boltjes actually commented on this in his GDC talk 'Horizon Zero Dawn': A Game Design Postmortem (2018) and reflected on how Guerrilla Games started production on the tutorial, which centered around a lot of stealth mechanics. Later in the game though, most players begin to not use any of these stealth mechanics and instead took most encounters head on. Although Horizons' tutorial was not very replicative of the actual gameplay experience, it taught the player some core lessons on how difficult fights will be and that they should be approached with caution and tactics.

From here, what keeps players engaged within gameplay is the 'Flow.' If you're part of Game Development, you've probably heard about Flow Theory but Flow is essentially the balance of keeping the player interested by challenging them just slightly above their skill level. This means we can't give the player the best armor or weapons in the game at the beginning otherwise they

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are too strong and nothing is challenging. In this graph (Figure A) we can see that too much difficulty will lead to anxiety and too much skill will lead to boredom, both pushing the player away from the game. Mihaly Csikszentmihalyi (1990) said it perfectly himself,

> *When goals are clear, when above-average challenges are matched to skills, and when accurate feedback is forthcoming, a person becomes…so involved in an activity that nothing else seems to matter; the experience itself is so enjoyable that people will do it even at great cost, for the sheer sake of doing it.*
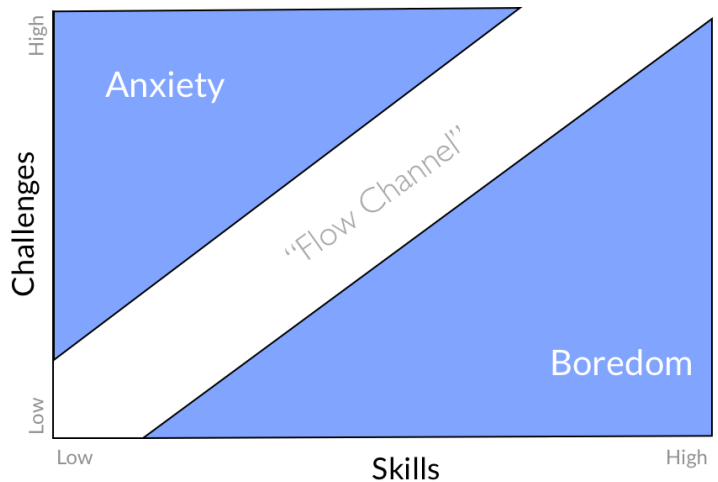

Figure A. Flow Theory Graph

This is what many games like Dark Souls do so well, and this can be seen within Horizon whenever a player comes across a new machine to fight. There is usually a strong challenge whenever a player finds a new machine enemy within Horizon, because not only is this new foe dangerous, but it also has unique weaknesses that are foreign to the player. Although Csikszentmihalyi's Flow doesn't directly relate to game design we can attribute the core points very easily to games. This table (Figure B) was taken from the article "Toward an understanding of flow in video games" (Cowley, 2008) and it easily draws the connections between Flow Design and Game Design. Challenging but tractable tasks within an encounter; Feeling of full control over the mechanics and controller; Immediate feedback on actions through effects and animations.

Table III.   Eight Elements of Flow and Corresponding Game-play Elements

Flow Elements	Game-play Elements
A challenging but tractable task to complete	The complete gaming experience (including social interaction during game-play).
Full immersion in the task, no other concerns intrude	High motivation to play, no imperative to do otherwise; empathetic to content.
Feeling of full control	Familiarity/skill with controller, genre conventions, game-play mechanics.
Complete freedom to concentrate on the task	Telepresence [Steuer 1995] and an environment dedicated to gaming.
The task has clear unambiguous goals	Missions, plot lines, levels; any explicit outcome of a successful play session.
Immediate feedback on actions	Well-timed, suitable rewards and penalties: contingencies [Hopson 2001].
Being less conscious of the passage of time	Focusing on another, temporally-independent environment.
Sense of identity lessens, but is reinforced afterward	Embodiment in game avatar; sense of achievement after play – e.g.,"Hi-Score"

Figure B. Flow Elements corresponding to Game-play elements -
Table III adapted from Cowley (2008)

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However, according to Raph Koster (2012) "Flow is not fun! Flow is subconscious and meditative. Fun comes from Triumph." Koster (2012) tells us in his GDC talk 'A Theory of Fun 10 Years Later,' that fun is just a neurochemical reward to encourage us to keep trying- to push players to accept the challenge within flow. In the scope of Combat Design, we want to focus on staying within the Flow channel but recognize that true fun and excitement comes from the challenge. This doesn't mean that everything *should* be a difficult challenge like in Dark Souls, unless that's the game we are building, but periodically there must be challenge to excite the player and keep them invested. As mentioned above this is seen in Horizon mainly through introduction of new enemy types. These enemies are awe-inspiring and foreign and unique, but most importantly, they are dangerous and challenging.

As mentioned in Csikszentmihalyi's Flow Theory, feedback to the player is important. Feedback meaning, conveying to the player what just happened. This can come in the form of camera shake, sound, animations, etc. Especially with animations, all of these need to be timed perfectly within the feedback or else the player won't register the connection. Don Norman (2013) in 'The Design of Everyday Things' mentions that feedback must happen within a tenth of a second. The feedback must also be informative. Hitting a machines' weak spot in Horizon must sound and look different than hitting an armor plate. Don Norman also talks about Signifiers and Affordances being key within any design. Specifically with Horizon Zero Dawn, there are many signifiers that convey specific details to the player. A Signifier communicates appropriate behavior to the player (Norman, 2013). So with Horizon, hitting a weak spot on an enemy gives a green arrow while hitting an armor plate gives a red arrow. This signifies to the player that their action did more damage or less damage, respectively. There are also attack alerts to the player. When an enemy is winding up an attack, not only is the player signified from the enemy's animation and wind up, but they are signified by the flashing exclamation point above their head. "Affordances determine what actions are possible." (Norman, 2013) Similar to signifiers, affordances inform the player on what is possible but without directly telling them.
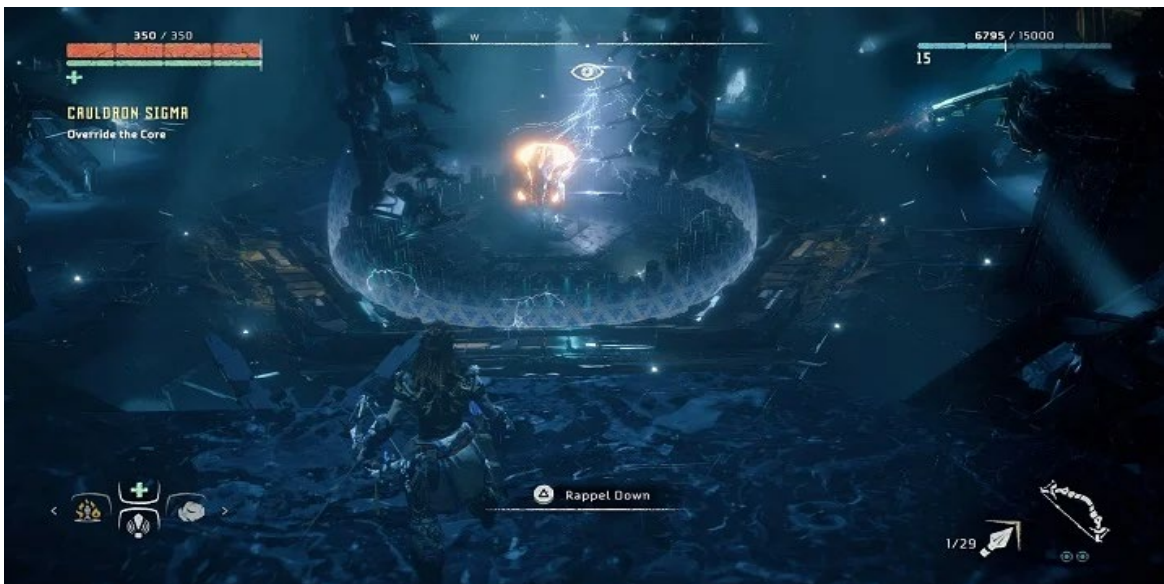

Figure C. Cauldron Sigma Boss fight – picture taken from
https://guides.gamepressure.com/horizon_zero_dawn/guide.asp?ID=38719

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Take a look at this boss arena for example (Figure C). There is a wide-open space for the player to maneuver through with sprinting and dodge rolling. The arena affords the player the knowledge of these capabilities. Again in Figure C, look at the electric field in the center. The player knows they should not go towards that or they will take damage, despite never being given a tutorial prompt about it.

When looking at combat design, combat is just another system within the game so it must follow the same rules of good system design. Two elements that typically are not thought of within systems design are behaviors and relationships. Tracy Fullerton (2014) breaks down behaviors as "the potential actions that an object might perform in a given state." In terms of combat and Horizon Zero Dawn, what is amazing is that each machine type really does have its own behavior. Richard Oud (2018) goes into more detail on this in regards to animating the machines and giving them similar characteristics to the animals they portray and sometimes just their own unique personalities. The Watcher enemy type is curious, the Grazers move in packs, the Sawtooths hunt and stalk the player. Not only do they have their own personality and behavior but they react to the main character Aloy differently. The relationship towards the player depends on if the machine is a prey type class or predator. Grazers and Striders will only attack if attacked first, otherwise they run away. Scrappers and Sawtooths, on the other hand, will immediately run towards the player and try to pounce on them. Sawtooths tend to search for the player longer than other enemies as well. This builds the relationship between the player and the machines. On top of this relationship the player is able to override certain machines so they can fight for her or even use them as a mount. This further develops a bond between Aloy and the machines which not only adds more depth to the game systems, but creates a more immersive experience for the player. There is more to do with the machine enemies than just fighting them. The player can hunt them for spare parts to use within the economy system, they can be used as allies, they can be used for faster travel. Having a relationship between player and objects creates a true system for the player to utilize and explore (Fullerton, 2014).

Good combat design has a lot of contingencies and within Horizon Zero Dawn, Guerrilla Games does so many things right. Firstly they give the player a variety of weapons all with different combat ranges (Rogers, 2014). The player has a close-range weapon in the form of their spear, a few mid-range weapons with the slings, long-range with the bows, and they also implemented traps to lure their enemies into. This wide assortment not only aids to the autonomy as mentioned before but allows the player to really attack at any distance or angle they might find themselves in. Especially in an open-world game, players can enter an encounter from almost any angle and almost nothing is linear (Rebouche, 2018). The player needs to have a tool for each instance. Guerrilla also knew that dodging was just as important as attacking (Rogers, 2014). Dodging is a core pillar of Horizons combat and it was necessary that this dodge traversed a large amount of area. The machines that the player fights are huge and unless Guerrilla implemented invincibility frames, the dodge had to create enough space between the player and the enemy's hitbox. Players are also rewarded for playing the game correctly and this feature is really what makes Horizon Zero Dawn so incredibly fun (Rogers, 2014). The core way of defeating the machines within Horizon is to break off destructible parts and hit weak spots on the enemy (Boltjes, 2018). If the player breaks off certain parts, they can get better loot

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rewards; but also dismantling weapons allows the player to pick up the weapon and use it against the enemy. This reward of letting the player use the enemy's weapon against them is such an exciting moment and really makes the player feel powerful and special. But it is only given if the player plays the game, correctly which is an important part of teaching the player that they are improving their skills and becoming a master.

All of these elements are great but what can really tie combat together is the level and the encounter space. One of the big challenges of Horizon Zero Dawn is that it is open-world and therefore the player could have a combat encounter almost anywhere within the map. Blake Rebouche (2018) refers to this when creating quests within the open world of Horizon and the difficulties of open-world. But I think they did this well by creating more verticality within the levels with high and low positions and incorporating aerial combat. This also allows the player to tactically choose how easy or difficult they want an encounter to be. **S9** Fighting from a higher position makes targeting enemies easier since there is more of their body exposed (Barclay et al., 2016). The reverse is also true, being in a lower position than the enemy makes it more difficult. Pete Ellis (Barclay et al., 2016) mentions that challenge and difficulty can also be created through the level space, not just the enemies. Many quests within Horizon take place in the open-world but some also take place in linear enclosed spaces called "Bunkers." Bunkers allowed the developers to create a more forced challenge onto the player by giving the developers more control over the environment where the combat encounters take place. Some tools Pete Ellis mentions can create these challenging levels are through enfilades, low vs high cover, and screen space (Barclay et al., 2016). All three of these really boil down to how they affect enemy tracking. Low cover allows the player to track enemies easily while high cover will break that line of sight. By splitting enemies up a large distance almost the same as the screen width, it forces the player to only look at one enemy to attack but at the cost of losing vision of the other enemy. Both of these allow for enemies to engage in an enfilade, or flank maneuver, which forces the player to quickly react and change positions (Barclay et al., 2016). This breaks up the linearity of just staying in one position fighting enemies in front of them. They now need to reposition and put themselves in a risky situation since they haven't had time to strategize their movement. This same tactic can be used by the player as well though, moving to the side of an enemy and flanking them, giving the player an open target to attack. These are some tactics that were thought out in almost each bunker level within Horizon.

Another common level design tactic used for combat within Horizon is playing around "No Man's Land'' and large open arenas. No Man's Land is essentially the large open space between the player and the enemies (Barclay et al., 2016). If either the enemy or the player walks through this open area, they become an easy target. This doesn't really come into play in Horizon when the player is fighting machines, but it plays a big role when the player is fighting other humans. In Figure D, the player is fighting their first encounter against humans at the end of the tutorial chapter. Notice that the positioning between the player and enemy favors the enemy as they are on a high ground the player can't reach. At the same time, they don't have as much cover as the player does. This is giving the player a feeling of danger due to the high ground, but in reality, the player doesn't have much to worry about since it is easy to hit their target. There is also a large No Man's Land area that is used to give the player enough time to defeat hard hitting

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melee enemies. The melee enemies come charging through the No Man's Land, making them an easy and available target for the player. This is effective because this encounter is intended to be easy. The player is still learning the ropes and this is their first encounter with humans. Later in the game we have these same charging enemies attack the player in a flanking maneuver so they are not so easily defeated. When fighting machines though in

Figure D. Nora Proving combat encounter

Horizon Zero Dawn, the player doesn't fight so much with cover but with dodge rolling. This means the player needs large open spaces to move freely. Open arenas are easy to manipulate to create stronger difficulty by adding debris and other elements that constrict the area. So, when creating the perfect combat encounter, knowing what kind of enemies will be in the encounter followed by creating the level and space around it, is the most ideal. Due to the enemies requiring more space to fight against, they lend themselves as being the perfect enemy for the open-world of Horizon. Rarely are human enemies found within the open-world, and when they are, they are found within encampments with plenty of cover.

Lastly, I wanted to talk about the enemy design specifically within Horizon because combat is boring without impactful enemies, and Guerrilla Games really delivered on some phenomenal and unique robotic enemies. Eric Boltjes (2018) mentioned that from the beginning one of the big unique selling points for the game was the robotic enemies. Through prototyping they found that these robots had destructible parts and weak spots within their design. The feedback given to the player from breaking off a piece of a robot is great but it doesn't stop there. Right down to the animations of the enemy we get more feedback and more realism. Once a machine has taken enough damage they start to limp as if they are broken. The animations are also crafted so that you can feel the different weights each machine enemy has (Oud, 2018). This adds personality and character to these different enemies which is good when looking back towards Tracy Fullertons' comments on behaviors (2014). Dismantling the machines was a truly unique part of Horizon and taking away the machines abilities by destroying different parts of it and weak points. This was something Boltjes mentioned, that they wanted the machine combat to feel very tactical and there were multiple solutions to defeating an enemy (2018). Each machine enemy truly was unique with their weak spots but this actually ended up causing a lot of issues, and not all of them really got resolved. Two major problems that came from this enemy design was 1) the sheer complexity of understanding each of the 30 machines' weak points and how best to combat them, and 2) just being able to hit these fast-moving creatures in their weak spots. Guerrilla Games did implement the focus ability and bestiary to help the players study

and learn before combat the different weak points, and then using the focus in combat highlighted the different weak spots for the player to better know what they should aim for. Although these are great stepping points, I'm not sure they really make the game as truly accessible to all players as originally intended (Boltjes, 2018). To help with the fast pace and small target points, they also tried to tone down animations to make targeting easier (Oud, 2018) and implemented the concentrate ability to slow down time; but as a player I found myself using this ability constantly. I would never shoot an arrow without having time slowed. Because the player relies on this feature so heavily, again I'm not sure they hit their accessibility mark.

Although Horizon Zero Dawn might not be the easiest game, it truly has one of the most unique combat systems in the Action/RPG genre. Enemies with destructible pieces and weak spots is something not really seen in any recent game. Typically, there is just one weak spot being the head, but Horizon took it a step further by giving elemental weakness to certain parts that would trigger explosions or EMP fields to stun surrounding enemies. This unique pillar of the combat led to multiple different weapon types that add to the autonomy for the player and the tactical combat available within Horizon.

Horizon Zero Dawn has one of the best and unique combat systems of the past 10 years. The PENS model informed us on Competence and Autonomy as needs for players within this genre and Horizon delivered with their arsenal of equipment and learning curves. Flow and fun are different but they relate to challenges needed to engage players and give exciting moments of joy and Horizon delivered through their unique and dangerous machines. Feedback, Signifiers, and affordances are all absolutely necessary for any design to give knowledge to the player and Horizon was able to deliver especially within their feedback of the machine enemies. Behaviors and Relationships create cohesion within systems and Horizon connects the player to the machines in more interesting ways than simple fighting. Combat ranges, dodging, and rewarding players are pivotal to an enjoyable and effective combat system and Horizon made each of these available, balanced, and exciting. Dismantling a rocket launcher and shooting it at a robot dinosaur is an amazing feeling that can only be found within this game. Level design of combat arenas through vertical positioning, enfilades, and open areas adjust difficulty and dissipate linearity and Horizon delivers on this within both their open-world areas and bunker levels. Finally, Enemy design was absolutely pivotal in creating Horizons combat system of destruction and weaknesses to deliver unique gameplay. Horizon Zero Dawn is well praised and critically acclaimed and it's not just for the narrative. Its combat is truly a work of wonder.

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