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Artificial Intelligence in Call of Duty: How NPCs Think, React, and Adapt

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Abstract

Artificial Intelligence (AI) is the core technology behind many modern video games, helping them feel realistic, interactive and engaging. In the Call of Duty franchise, AI controls Non-Player Characters (NPCs) allowing enemy or ally forces to move, react and make decisions in a realistic human-like manner. Such behaviors are built with the help of decision trees, pathfinding algorithms, and adaptive difficulty engines that enable NPCs to act, navigate complicated environments, and react to player behavior in a manner which is unpredictable. Developers achieve this by using a combination of programmable logic in conjunction with animation and large collections of behavior control rules. These rules control how NPCs react realistically to a vast assortment of battlefield situations.

The objective of this study is to examine how AI systems in Call of Duty are used to produce realistic behavior in NPCs (Non Players Characters). The present paper is a qualitative study consisting of a combination of technical documentation, academic literature, and gameplay observation to understand how Call of Duty manages to generate these real-life NPC behaviors. The results show that the AI framework of the game can enable human team behavior, coordination and a real-time understanding of the environment. NPCs are capable of flanking, taking cover, coordinating with other teammates, and adapting to changing conditions of real-time combat, among other things. This contributes to a more realistic and engaging player experience.

Moreover, the paper indicates that AI methods of creating NPC behavior in Call of Duty are similar to those used in the robotics domain, military simulation training, and autonomous vehicles navigation-where real-time decision making is essential. Overall, this paper shows that AI is not a subsidiary technology but a core component that generates depth, realism and emotion in the gameplay and helps create a convincing first-person shooter experience.

Introduction

Artificial Intelligence has influenced almost every aspect of the modern world. Its influence goes beyond core technical fields like robotics, research and space technology, to areas which are a part of our everyday lives like entertainment and video games. In modern video games, artificial intelligence plays a key role. Before the introduction of AI, early video games had simple graphics and characters that exhibited limited, fixed and repetitive movements that made gameplay boring in the long run. Today, however, game creators rely on AI to create computer controlled characters which act and respond almost like human players. For example, enemy soldier characters in the game "Call of Duty" react to player actions, take cover and make attack decisions in a human-like manner. This greatly enhances the depth, unpredictability and thrill of the gameplay. In modern games, AI almost creates the illusion of a living world where NPC's (non players characters) are able to adapt and respond to evolving situations, much like humans (Yannakakis and Togelius, 2018). These AI led innovations have gone a long way in making modern video games more exciting, engaging and addictive.

A stellar example of these modern AI enhanced games is the game "Call of Duty". It is one of the most realistic and innovative games of the first shooter genre. It boasts of realistic battle scenes and cinematic presentation of the narrative. Call of Duty extensively employs AI to make Non-Player Characters (NPCs) (soldiers, allies, enemies) think and respond during combat in a manner similar to human behavior. In order to achieve human-like decisions, these realistic characters use artificial intelligence systems like decision trees, pathfinding and adaptive difficulty systems (Isla, 2005). These AI systems control moves made by NPCs such as taking cover, executing an attack and reacting to changes in the combat environment.

Decision trees guide NPCs to respond to the events happening around them, while the pathfinding algorithms like the A* algorithms assist them in navigating complicated environments (Red Blob Games, 2023). Adaptive difficulty systems keep an eye on the performance of the players and adjust the level of difficulty to maintain the challenge and tension of a game (Hunicke, 2005). A combination of all these features, make the players feel that they are in an actual combat situation where they are fighting intelligent human beings rather than pre-programmed machines.

Although the ability of NPCs in the Call of Duty to adapt and think dynamically is part of a bigger trend in game development, it stands out as an important step forward. These systems reflect how AI is being increasingly utilized in the real-world applications such as robotics and self-driving vehicles, which also depend on environmental mapping and real-time decision-making. The aim of this paper is to examine how AI systems in Call of Duty create realistic NPC behavior. The study focuses on how NPCs think, respond and adapt to actions by the player, making the game feel more natural and engaging. Figure 1 demonstrates how AI in gaming has evolved from 1992 to 2019, progressively leading to games with more advanced features.

Figure 1. Evolution of Game AI from 1992 to 2019
(Adapted from Yannakakis & Togelius, 2024).

Figure 1: Evolution of game AI from 1992 to 2019.

Literature Review

Early AI in First-Person Shooters

Early first-person shooters, such as Wolfenstein 3D and Doom, relied on hard-coded scripts rather than real-time decision making. According to Yannakakis and Togelius, 2018, early CPUs weren't built for complicated AI algorithms. Developers needed to keep enemy NPCs simple, primarily due to longer data cycles and reduced memory in early computer technology. NPCs were often coded with finite logic, which detected the player, moved towards them, and repeated identical attack patterns, making the gameplay feel dense.

These enemies had no appeal to tactical positioning, player strategy, or environmental awareness, making them predictable and easy for the player to exploit. During this time, hardware was unable to uphold standards for advanced AI integration; it could not support dynamic pathfinding, environmental analysis, and adaptive decision layers, forcing game designers to focus on speed and consistency over complexity. These setbacks set the stage for future innovation, calling developers to recognize the shortcomings of early AI, acting as a motivator for tactical and multilayered FPS games in later generations.

Tactical AI Evolution in Modern Shooters

With the improvement of hardware capabilities over time, enemy characters in first-person shooter games were able to move beyond simple linear scripts and respond more effectively to tactical situations. Games such as Halo introduced AI programmed non-player characters that could recognize different combat situations and decide whether to advance, shoot, or retreat. Halo's AI used spatial analysis and behavior systems, which adjusted the enemy behavior depending on how players acted and interacted with the environment, and that contributed to making the encounters more believable (Isla, 2005; Robison, 2024)

This was an innovative development that was a decade ahead of its time, and it made Halo one of the best games of that period, prompting other companies involved in game development to make use of this technology.

Meanwhile, games such as F.E.A.R. pushed the concept of tactical intelligence by introducing Goal-Oriented Action Planning (GOAP), a planning system that enabled NPC behavior to be determined by the goals of the situation rather than a set of behavioral rules. GOAP in F.E.A.R. gives the enemies the capacity to select objectives and to create action sequences dynamically based on the current game state, such as taking cover as an enemy, moving, or putting the gamer to silence, as opposed to following a script (Orkin, 2005; Developers.dev, 2025). According to Isla, GOAP enables enemies to be on the move, reload, seek cover, set priorities, and counter the action of the player according to their location and the environment around them.

These two games exhibited not only AI led innovations but also showed how AI can be responsive to player tactics and not merely movement detection, which brought about reactive fighting and uncommon attack maneuvers. Champandard (2014) explains this shift in the design of AIs as early tactical systems were the first to include enemy characters whose actions were determined by specific goals. All these original thoughts created a deep impact on other games such as Call of Duty, which improved this knowledge to create more real-life and simulated battles.

Core AI Architecture in Call of Duty

Call of Duty was one of the first major shooter games to make use of the layered decision architectures that allow NPCs to assess combat decisions and react in a rational, organized way. These actions are controlled by decision trees that take into account a variety of variables like the distance of the player, availability of weapons, the health of the NPC, and visibility. According to Champandard (2014), sequential decision structure enables the NPCs to have clear programmable logic, while still allowing their behavior to change in a stable and controlled manner through the use of finite state machines (FSMs). After making a decision, any subsequent moves to attack, retreat, chase, or patrol are governed under finite state machines (FSMs). The FSM's ensure that these behavior switches remain smooth and predictable. Alongside these systems, AI in Call of Duty also has a special brain layer that continuously analyses the dangers and calculates which target should be given priority during combat situations.

The source of information for these layers includes sound, line-of-sight line, and proximity, among others, giving the impression that the NPC's are tracking the player as time goes by. As Boon (2023) points out, behavior trees, and perception systems, promote the cohesion of enemies which makes them seem reactive, intentional and aware of their situations. This makes the game look realistic and allows it to engage more deeply with the players. Other studies by Epic Games (2024) also show how significant these layered AI systems are in achieving realism in NPC decision-making.

How AI Designs NPC Behaviors

Modern shooters use layered systems within NPCs that translate game designers' intentions into moment-to-moment actions. The layers are encoded with explicit instructions, such as taking cover when health depletes below a certain threshold or advancing while the player is reloading or retreating; the defined rules are structured into behavior trees where Champandard emphasizes these trees organize the conditions hierarchically, allowing predictable logic while remaining flexible for rapid iteration. Animators take NPC movement sets and synthesize them with the AI's decision layers to ensure smooth transitions during necessary animations, such as ducking, peeking, walking/running, or reloading, all while being context-appropriate. According to Boon, designers are required to construct the animation layer simultaneously with the AI logic. If they don't, characters merely end up moving rigidly or becoming trapped in strange cycles.

Developers incorporate machine learning into this process as well, modifying aspects such as how quickly NPCs react, how precise they are, how aggressive they feel, and even when they choose to do something. The whole situation makes NPCs seem more realistic. Behind the scenes lies a basic behavior tree underlying everything, but snipers, assault units, and medics get their own unique branches. Therefore, all varieties of adversaries behave differently, and every encounter feels fresh depending on who you run into.

Pathfinding & Navigation (A, NavMesh, flow fields)

Navigation in modern first person shooter games relies on structured movement systems that help non player characters move convincingly through complex environments. Instead of relying on fixed routes, developers use well established approaches such as the A* algorithm. As discussed by Yannakakis and Togelius (2018), this method evaluates multiple possible paths using cost based heuristics allowing characters to select routes that balance distance, obstacles and potential environmental risks rather than simply choosing the shortest path. This can be expanded by introducing the concept of Navigation Meshes (NavMesh) which divides game levels into interconnected polygons that NPCs can smoothly navigate within which allows them to climb, crouch, move around rough terrain and squeeze through tight spaces without being limited by strict waypoints.

The NPCs dynamically re-calculate the routes when the environmental conditions change, i.e. destroyed cover, debris, changed geometry of maps etc, to maintain the tactical efficiency and fluidity. Flow-field navigation provides a solution to large-scale encounters by being scalable. According to Red Blob Games (2023), flow fields create direction vector maps where the group of NPCs are assigned to pursue common goals, preventing collisions and enhancing coordination as well as evenly allocating the movement load among the units. All of these systems make the tactical realism higher and do not make the NPC behavior look mechanical and predictable. Figure 2 demonstrates the Hierarchical Navigation (High-Level + Local Avoidance).

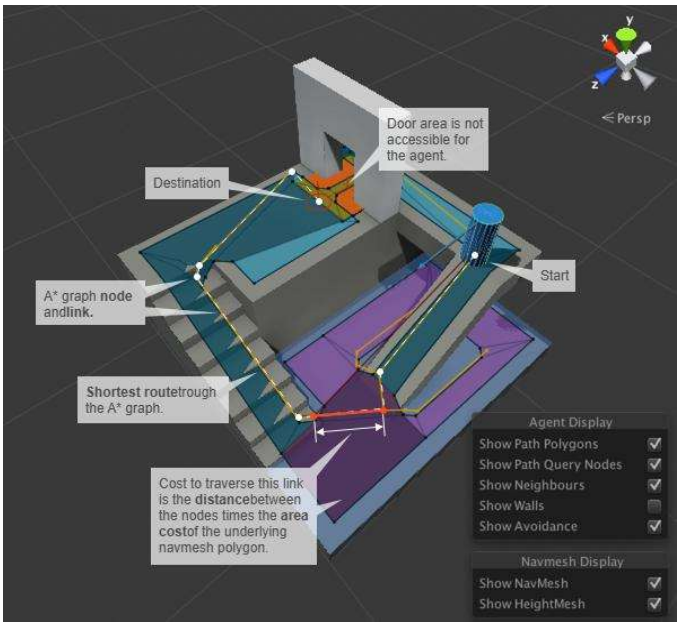

Figure 2: Hierarchical Navigation (High-Level + Local Avoidance)

Adaptive Difficulty & Player Modeling

The systems of adaptive difficulty are necessary to keep the player engaged in contemporary shooter games. These are systems that adapt the NPC behavior according to real-time evaluation of the player performance. According to Burelli and Yannakakis (2021), adaptive AI is data-based: it considers a set of measurable data, including accuracy, time-to-kill (TTK), elimination rate, reaction time, and the rate of the deaths of the players. Upon sensing that a player feels like they are struggling, the system can mute the aggression of the NPCs, expand the reaction time or make them easier to deal with. On the other hand, experienced players provoke more accuracy, more intelligent passages, and closer distance to create a higher level difficulty.

Such adaptations are based on modeling players where the AI figures out patterns like favorite weapons, movement behaviors, hiding places or tactical cycles. Based on these observations, NPCs predict the choices of the player and generate responses to those choices. According to Yannakakis and Togelius (2018), adaptive adjustment maintains emotional tension, which does not allow frustration due to too much difficulty or boredom due to too little.

Realism & Player Psychology

The role of AI in the FPS games has a significant effect on the psychology of the players because it determines immersion, tension and emotional involvement. Yannakakis and Togelius (2018) claim that the perception of AI quality lies in the believability of its interpretation rather than through its technical complexity of the NPC behavior to the player. Some of the behaviors like flanking, ducking behind fire, cover use, and taking advantage of environmental elevation to

manipulate the NPCs can be said to be purposeful and smart, which increases player investment. Such uncertainty heightens the tension and makes victories accomplished and not produced.

A smarter AI pushes the players to change strategies, try new ones, and constantly reevaluate their surroundings, which are elements of replay value directly. Nonetheless, a balance should be taken with realism. In some cases when the NPC is shown as impeccably accurate, immediate reaction, or group behavior that is coordinated perfectly, players might feel frustrated and feel unfairly treated. On the other hand, poorly developed AI which does not complicate the player leads to boredom and lack of interest. Effective game AI therefore aims at believable imperfection and thus NPCs act intelligently but not more intelligently than humans (Yannakakis and Togelius, 2018).

Limitations & Trade-Offs in Modern AI

Developers purposefully sacrifice full processing resources for player experience in light of recent advancements in AI. In order to preserve steady frames and prevent game crashes, developers impose limitations on decision complexity such as NPCs function dynamically in real time. Lighter systems such as behavior trees that carry out AI effectively every frame are favored by these limitations (Champandard 2014.Because of the technical overhead and the loss of designer control over pacing and balance, memory for long periods and sustained training are similarly constrained. Although these trade offs appear to be detrimental players gain from them since a large amount of AI can make the game feel too difficult and frustrating, striking an equilibrium between technology efficiency and amusement. In-game, AI is defined less by intelligence and perfectionism but rather ability to support optimal, smooth, balanced gameplay for increasing replay value and bringing emotionally satisfying gameplay.

Future Directions in Game AI

Modern shooters improve the realism of NPC's by building on the features of existing game AI systems, rather than replacing them with new systems. Adaptive AI and player modeling both allow NPC's to adjust their behavior over time, across multiple play sessions. This helps them to engage effectively with different players while still keeping the gameplay balanced and fair (Yannakakis & Togelius, 2018). A further analysis of games like Halo 2 shows that layered decision systems help NPC's behave realistically, while still remaining predictable enough for fair play (Isla, 2005).

The way these games are designed affects how players feel during combat, creating moments of stress or confidence without making the game frustrating, ensuring an engaging experience. Future AI advances will focus on making NOC's even more realistic and responsive, while keeping player enjoyment as the main priority.

Methodology

This study uses a qualitative approach to examine how Artificial Intelligence (AI) is used in Call of Duty to create realistic Non-Player Characters (NPCs). Three main methods were used: a review of existing research, analysis of AI systems used in first-person shooter games, and direct observation of NPC behavior during gameplay. The goal of this methodology is to understand how NPCs think, move, and react to players in combat situations.

This study commences with a systematic literature review of peer-reviewed academic articles, technical reports, and conference papers that have been obtained via databases such as ACM Digital Library, IEEE Xplore, SpringerLink, and ScienceDirect. These sources give the theoretical foundation of AI methods that are popular in FPS games, i.e., pathfinding algorithms, adaptive difficulty, environmental awareness, and decision-making systems. To supplement the academic literature, industry-based sources, including Game Developers Conference (GDC) talks, developer blogs, interviews, and official Activision design statements, were consulted to get practical information that is not present in academic literature.

Besides the literature overview, a qualitative technical analysis through game plays was performed using *Call of Duty: Modern Warfare* (2019) and *Call of Duty: Warzone*. NPC behavior has been systematically monitored in various combat situations, with the emphasis on the decision-making patterns (attack, retreat, cover-seeking, and flanking), spatial navigation, interaction with other NPCs, and player responsiveness and responsiveness to environmental changes.

The analysis focuses on three main aspects of it, namely: (1) decision-making logic, (2) spatial navigation and environmental mapping, and (3) reactive combat behavior. Triangulation of observational data with scholarly models and developer commentaries was used to evaluate the contribution of AI design to perceived realism and experience of the players.

One drawback of this work is that it was not possible to gain access to proprietary AI source code; hence, it was analyzed based on observable behavior and secondary documentation. In spite of this limitation, the triangulated method offers a consistent and systematic insight on AI-based NPC realism in closed-source FPS systems.

Results

Overview of Observed AI Behavior

In *Call of Duty: Modern Warfare* (2019) and *Call of Duty: Warzone* (2020), it was observed that there are three primary AI patterns: decision-making, navigation and movement, and adaptation to player performance. Such actions were not one-time events but were replicated in various missions and situations that happened in combat, meaning the behaviors were programmed into the AI of the game rather than being a scripted event.

Decision-Making and Tactical Responses

The information which *Call of Duty* NPCs consider in real time involves the position of the player, his distance, and his health; hence, they can dynamically change their course of action. According to developer documentation, decision trees are used to process these variables instead of hard-coded fixed scripts (GDC Vault; Champandard, 2014). Decision and behavior trees update several times in a second, and NPCs are able to alternate actions in case of a condition change. This causes easy transition of opening fire, retreating, healing, taking cover, or tossing grenades. Another common example of an AI behavior system presented by Infinity Ward developers is one based on a threat score, where targets are ranked based on proximity, received damage, and exposure (Activision Blizzard, 2023). This makes sure the enemy makes choices on whether to strike the first target rather than resorting to predetermined target regulations. Though such decision systems may seem complicated on the field, the action is controlled by a small set of chain rules which can be rapidly updated with no adverse effects on performance. These observations indicate that NPCs dynamically change their behavior when faced with the combat state of affairs, as opposed to repeating their behavior.

Micro Case Study 1: Enemy Squad Flanking Behavior

Background

This was witnessed when on a campaign operation in the Call of Duty: Modern Warfare (2019). Throughout the encounter, the player was holding back Tozourame cover position over a long period of time, firing a multitude of shots at a set point.

AI System Involved

The artificial intelligence tool that controlled the behavior of the enemies was based on the use of a decision tree, threat scoring systems and a squad level communication logic to evaluate the actions of the player and allocate responses (Millington and Funge, 2009; Buckland, 2005).

Observed NPC Behavior

The suppressing fire was initiated by one unit of the enemy which basically reduced the retaliatory power of the player since the fire was held on his position. At the same time, a second unit later turned aside and moved forward in another direction, finally attacking the player laterally. It is worth noting that the enemy NPCs did not advance directly, but they applied a tactic of maneuvers (Millington and Funge, 2009).

Outcome

Due to this type of flanking action, the player had to leave the original cover position and change. This communication proves to be AI-inspired tactical decision-making based on the strategy of players instead of a fixed or predefined attack pattern. The case points out how the reasoning by squads allows adaptive combat in real time scenarios (Buckland, 2005).

Navigation and Movement Intelligence

NPCs use extensive large environments that are not governed by movement paths already stored in memory, and instead rely on efficient pathfinding systems, which compute, adjust, and re-compute paths on the fly. Research in navigation of games has shown that game navigation typically uses A+ Pathfinding to calculate useful routes around stationary obstacles (Red Blob Games, 2023). This helps the NPCs to reach objectives without going through impeded or dangerous portions of the world. As NPCs re-calculate routes on demand, they are able to update as the world alters, e.g., when the world is affected by explosions or players.

The experience of Infinity Ward developers can also inform why the navigation systems are created on the basis of the tactical movement paradigm, with the NPCs being more concerned with safety and covers rather than the shortest path (Activision Blizzard, 2023). The animation and movement systems are accompanied by the output of navigation functions; hence, such processes as turning, crouching, and sprint are expressed in flowing rather than mechanical forms. This kind of combination of navigation logic and animation hybrid helps NPC movement to be seeming and feel natural, unlike planned.

Micro Case Study 2: Dynamic Route Adjustment in Warzone

Background

This action was witnessed in a battle on the Call of Duty: Warzone in an urban setting. There was a wall demolished by the player in the course of the engagement, changing the point of view and the area available to move around in the space greatly.

AI System Involved

The NPCs used the NavMesh-based navigation systems with dynamic path recalculation algorithms, which enabled them to update movement paths as the environment changed with time (Tozour, 2002; Millington and Funge, 2009).

Observed NPC Behavior

After the wall was destroyed, enemy NPCs did not enter the modified territory, instead going around the structure that had been destroyed. Others instead, the enemies chose other avenues that gave them cover and retained the tactical edge. These corrections were made without any apparent reluctance, lack of crashes or maneuvering errors (Tozour, 2002; Millington and Funge, 2009).

Outcome

The movement of the enemy was believable, purposeful, and rational, and supported the feeling that it was being acted out in a specific way, rather than an attempt to respond to something established in advance. In this case, there is an argument that the current game AI navigation systems have the capability of dynamically adapting to environmental changes which makes the game more immersive and closer to real-world combat (Tozour, 2002).

Adaptive Combat and Difficulty Adjustment

NPCs adapt their level of aggression dynamically depending on objective indicators of player The aggressiveness of NPC changes dynamically through objective measures of player performance. As it has been explained by the developers, adaptive difficulty systems monitor factors like player accuracy, time-to-kill, and time-to-survive to implement changes in NPC behavior (Activision Blizzard, 2023). Unfavored performance also leads to more coordinated attacks, closer NPC positions, and quicker responses, whereas bad performance results in delayed flanking, diminished accuracy, or slower activation.

These adjustments are not acute, and they are not reflected in immediate sufferings. Instead, they help in maintaining the challenge and interest without kicking around the gamer. This behavior is incurable with developer comments on adaptive difficulty and implies that real-time NPC behavior has personal player modelling.

Summary of Results

Overall gameplay investigation revealed that *Call of duty* NPCs constantly evaluate circumstances, examine their surroundings and alter their behavior in response to players providing gaming quality. Through decision making systems, navigation systems and balanced adaptive difficulty, NPCs behave, move and interact like humans. When taken as a whole these results show that Call of Duty's AI systems function as a cooperative system rather than as separate entities enhancing the realism and interest of combat.

Discussion

AI Enhances Realism and Immersion

High-quality AI in *Call of Duty* is mainly used to make the game more enjoyable over time, rather than just improving visual realism or increasing difficulty. Developers at Activision have stated that enemy behavior is designed with replayability in mind, using adaptive movement and changing levels of aggression so encounters do not feel the same each time a mission is played (Infinity Ward, 2019). This approach helps reduce the feeling that enemies are simply following a fixed script.

NPCs that react differently to player decisions tend to feel more believable, which helps maintain tension during gameplay. When players notice that enemies respond to their actions instead of repeating predictable patterns, they become more focused and cautious. This often leads to a stronger sense of involvement in each encounter. Because of this, replaying a mission rarely feels identical to a previous attempt. Small changes in player choices and AI behavior can significantly alter situations unfold, allowing a single mission to offer several distinct gameplay experiences and encouraging players to return. Figure 3 below demonstrates a diagram showing balance Among Realism, Difficulty, and Performance in Game AI.

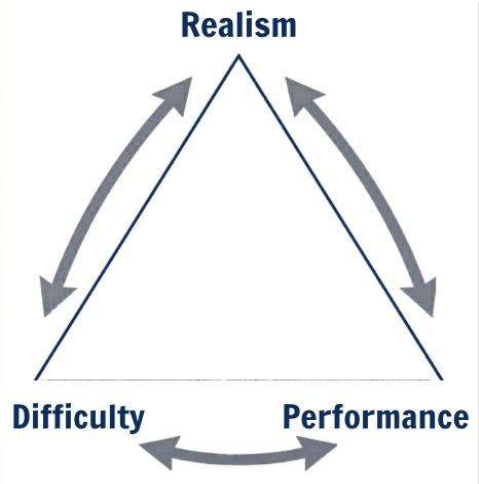

Figure 3: Balance Among Realism, Difficulty, and Performance in Game AI

Tactical Behaviors Shape Player Strategy

Adaptive AI changes the way players approach combat by forcing them to plan ahead instead of relying on trial and error. Rather than moving through encounters on autopilot, players must pay attention to enemy behavior, adjust their routes based on how they prefer to play, and experiment with different weapons to see what works best in each situation. Moving too quickly or carelessly often results in ambushes, which encourages a slower and more deliberate style of play.

This shift was highlighted at the Game Developers Conference, where the Call of Duty development team presented NPCs that demonstrate more flexible combat behavior than in earlier versions of the series. These enemies were shown to adapt their positioning and tactics in response to player actions, making encounters feel less predictable (GDC, 2019). Which stated that when AI behavior relies too heavily on scripted responses, engagement can quickly drop once players recognize and exploit those patterns.

Decision Trees and Pathfinding with Adaptive Difficulty

Behavior and decision trees are regarded as the most influential technical aspects of game AI. They are valued not just for their relatively simple integration, but efficiency in memory usage and for providing the best results. In modern difficulty systems, they create an experience which is suited to the player's skill level, ensuring the challenge level is doable but still requires strategic thinking and tactical adaptations. Subtle changes in NPC behavior like positioning, choice of weapons, and range of attack ensure that player interest is maintained even while replaying the same level. When players now complete a mission, they feel a strong sense of accomplishment as it would have taken them multiple attempts and several adjustments to respond to the changing NPC behavior. This can increase replay value while ensuring that a player does not get stuck on one part for an extended period of time.

Psychological Impact of Game AI

It has been noticed that Call of Duty can create strong emotional responses through its grueling and adaptive AI, as players view NPCs as life-like, creating feelings of urgency, fear, and pride in completing the tasks. Studies on player experience shows that adaptive and human-like AI leads to higher emotional engagement because it ensures that players constantly evaluate risks rather than rely on memorized patterns (Yannakakis & Togelius, 2018). Due to these emotional impacts, players frequently speak about NPCs as if they have personalities, associating their behavior with the routes that they take and the weapons they choose to use. Player engagement research proves that game AI that successfully evokes emotional responses can keep players "cognitively and emotionally invested" for longer time spans (Sweetser & Wyeth, 2005). Longer engagement can improve replay value and increase overall enjoyment for the players as they remain interested in reacting to and overcoming the changing strategies of the NPC's.

Trade-Offs in Realistic NPC Behavior

With advanced NPC systems and adaptable behavior, designing enemies that react to and counter every move of the player becomes technically challenging. Developers across multiple *Call of Duty* titles note that AI challenges present in NPCs are constantly adjusted to maintain both realism and fairness as shown in the official behind-the-scenes documentary for *Modern Warfare* (Infinity Ward, 2019). Real-time skill level adjustments prevent players from feeling overwhelmed and allows them to devise strategies for completing missions. NPCs may be intentionally dumbed down by purposeful missed shots, slower reaction times and less aggressive behavior until a balanced level of challenge is found. This allows players to make progress through repeated attempts without completing missions too easily in the first few attempts itself. Finding this balance takes optimization on the technical level and extensive playtesting to ensure NPCs have time to adapt to different levels of player skill. Capping NPC skill and difficulty levels supports player engagement and prevents unnecessary strain on the game's hardware leading to a more stable performance.

Technical Limitations

With integration of advanced AI systems, it takes significant CPU usage and memory to run the NPC methods multiple times a second. In games like *Call of Duty*, NPCs attack hordes, tracking the player and various actions for sometimes hundreds of NPCs, which would not allow the game to run on a large majority of gaming consoles or desktops. These systems are well optimized where one behavior tree can be used for multiple NPCs of the same category or group. Developers at Infinity Ward have stated AI does not store player data across encounters or missions. Instead, NPC‘s operates on short-lived state machines and local line of sight, since storing long term data would put unnecessary pressure on memory limits on most consoles (Isla, 2005; GDC AI Architecture talks). Since most players use budget consoles and lower spec PCs, developers often limit and optimize AI systems, so that they can run well across a range of

consoles and PC's. This makes the game readily available to a significantly greater number of people. Activision Blizzard has repeatedly noted that *Call of Duty* must continue to support old generation consoles like PlayStation 4 and Xbox One. This is because their users represent a majority of active players, many of whom don't upgrade to newer hardware frequently (Activision Blizzard, 2022; Sony Interactive Entertainment, 2023). Because of this, Activision is required to keep AI systems lightweight as many players use dated hardware that does not support AI that remembers player actions across missions.

Ethical Considerations

As games get better at tracking player behavior, developers also face ethical concerns about how this data is used to adjust NPC behavior. Activision has explicitly stated that it avoids long-term adaptive behavior and limits how much NPCs can learn from a player over time to create the gameplay experience (Yannakakis & Togelius, 2018; Activision, 2020). This choice is intentional due to ethical issues. If they continued to use long-term adaptive behavior, NPCs would adapt to the stress, fear, or habits of the players, and would intentionally push difficulty or tension to maximize the play time of the players. Long term adaptive AI would force psychological manipulation without informed consent. For example, in the long run, if AI learns that anger or reckless play keeps a player engaged, it might repeat situations that reinforce these emotions. This is similar to the reinforcement loops seen in gambling. Over time, this could raise stress, and burnout, or make anger feel "normal" during gameplay, which may spill outside the game. As a result, ethical guidelines caution against AI systems that lead to excessive stress aggression or addiction-like behavior (King et al., 2019). With this set of concerns, the extent of NPC adaptation by AI has been capped to adjust to ethical parameters. AI governed NPC's can still respond to players in the moment but within boundaries which prevent manipulation.

Replay Value and Engagement

Developers put great effort into advanced AI integration with NPCs because it directly affects the length and depth of player engagement. With the challenge level, it forces the player to replay a singular level multiple times over, while being engaged through NPC adaptation. As players replay missions over and over, it adds more hours they have played to their account, which does two things. First, they get content for what they paid for. The more replays, the longer they spend on a game, making players happier with their purchase. Second, they gain credibility. When leaving a game review, most video game distributor platforms like Steam list the review content and how many hours the reviewer has played the game at time of review. A reviewer with more hours would most likely enjoy the game, which means they leave a good review and appear to be "experts" due to their playing time. Reviewers with lots of hours are also filtered to the top of the list, so new players view these reviews as a credible and reliable source of how the game plays, potentially making more players purchase the game, increasing overall sales and popularity. Table 1 below shows the impact of advanced AI architecture on player psychology and engagement.

Table 1: Impact of Advanced AI Architectures on Player Psychology and Engagement

Behavioral Effect on Player	Psychological & Narrative Benefit	Psychological & Narrative Benefit
Dynamic Difficulty Adjustment (DDA)	Continuously calibrates challenge based on player's real-time performance metrics (accuracy, TTK).	Maintains the "Flow State"; prevents frustration in novices and boredom in experts.
Squad-Based Coordination Logic	Encourages players to view NPCs as intentional agents rather than individual targets.	Enhances tactical immersion and the perception of a "living" battlefield.
NavMesh-Based Tactical Flanking	Forces the player to abandon static cover and constantly re-evaluate spatial surroundings.	Breaks repetitive gameplay loops; increases cognitive engagement and replay value.
Environmental Perception Layers	NPCs react to player sound, light, and debris, making the environment feel reactive.	Heightens tension and stealth-based immersion; validates player agency in the world.
Goal-Oriented Action Planning (GOAP)	NPCs prioritize survival (retreating, healing) or aggression based on the game state.	Evokes emotional responses (urgency, pride); NPCs are perceived as having "personalities".

Future Directions in Game NPC Behavior

With AI governed NPC behavior marking a large presence in modern games like *Call of Duty*, AI is becoming one of the fastest growing and most impactful tools in the gaming industry. Right now, AI progress depends heavily on the power of consumer hardware. However, with industry advances like cloud gaming becoming accessible for a large base of players, it removes the need for constant hardware upgrades for better AI. This shift could make it easier for gaming companies to bring more advanced AI systems into gaming.

Conclusion

AI serves as a necessity in the Call of Duty franchise, setting a standard for players and other shooters to integrate the latest technology for enjoyment and computational efficiency. While Call of Duty did not invent the concept of AI, it normalized its usefulness and set a baseline; once that happened, other games had to implement AI to maintain relevance with today's industry standards. The latest games like Battlefield 6, ARC Raiders, and Helldivers II use systems similar to those of Call of Duty. All of these games featured on top-selling charts and gathered the most user playtime on release out of any other games released during this time. With CoD's dominance, AI became a production pillar rather than just a technical aspect. Activision dedicated entire teams to AI and planned this technology pre-production rather than as

an add-on. It has created job opportunities amongst game studios, where AI programmers and designers (separate from gameplay developers) have been increasingly hired to tune NPC behavior and work with complex systems.

To meet CoD's innovation standard, engines integrated AI tools such as Behavior trees, Nav Meshes, and Perception systems as default systems, available in Unreal Engine and Unity, two of the most popular game engines. This advancement is labeled as structural influence, where tools evolve to meet standards based on industry-dominating games like Call of Duty.

Call of Duty was one of the first in the franchise to operate at a scale where NPCs are tuned based on player activity (player telemetry), NPCs adapting to engagement, and aggression being changed after the initial launch. These methods normalized the Live-service AI tuning and tending to AI bugs months after release. This marks a change from static to AI, like in Halo 2, to AI living as a live system, which is seen in other flagship games like Apex Legends and Destiny.

Activision didn't just change standards within development; they changed what players expect AI to do. In players' minds, enemies should be reacting to movement and not just existing; the NPCs should be applying pressure through various game strategies and playstyles, and games without AI are viewed as low quality by the general fan base.

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