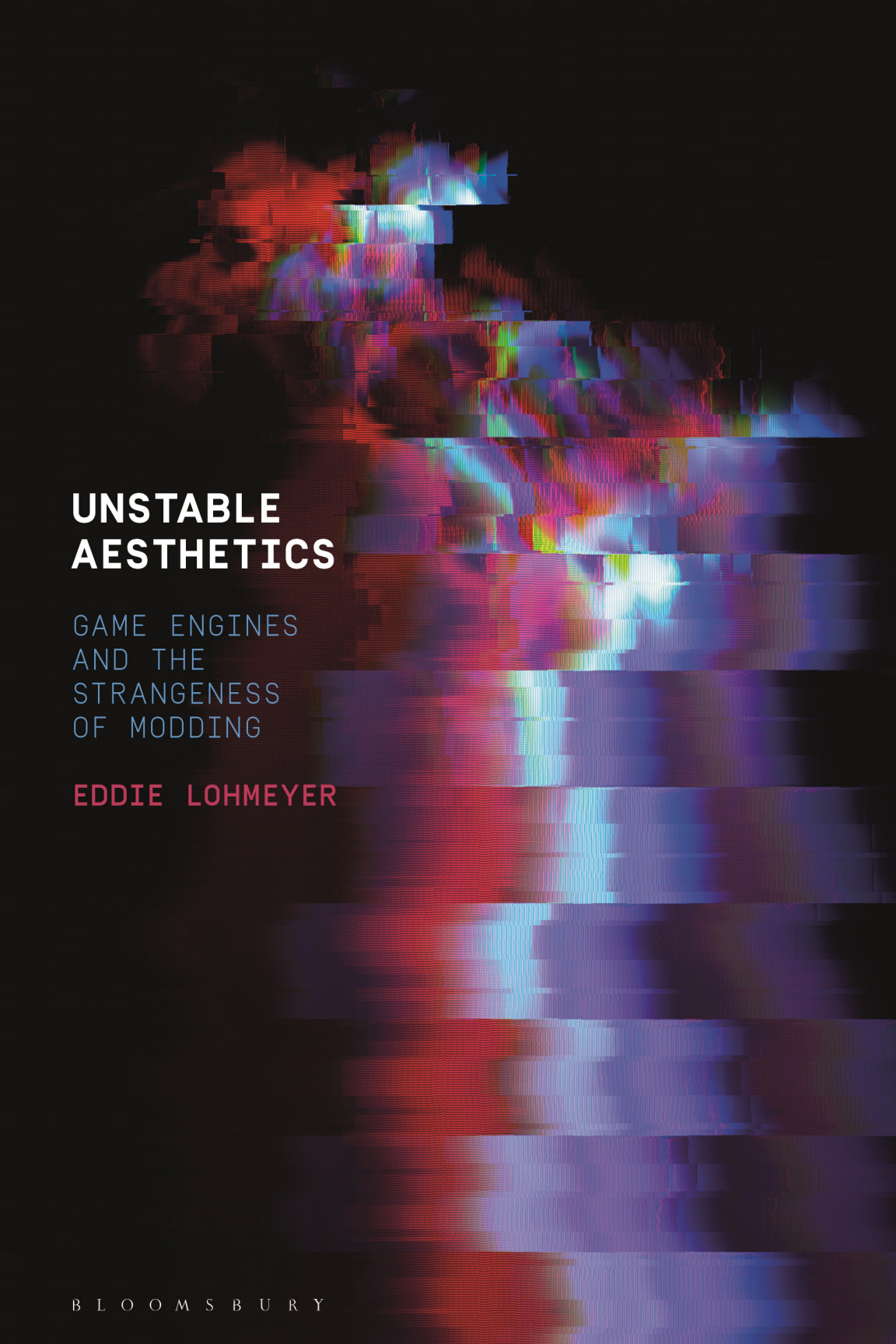




# UNSTABLE AESTHETICS

GAME ENGINES  
AND THE  
STRANGENESS  
OF MODDING

EDDIE LOHMEYER

B L O O M S B U R Y

# Unstable Aesthetics



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*Game Engines and the Strangeness of Modding*

Eddie Lohmeyer

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*To Bandit and Lou.*



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# PR35S\_5T4RT!

## The Mechanisms of Art Modding

At the 1995 Ars Electronica Festival in Linz, Austrian artists Orhan Kipcak and Reini Urban exhibited their work *ArsDoom*, a modification (or mod) made to the game engine of the popular first-person shooter *Doom* developed by id Software in 1993. Forgoing the game's hellish environments, the artists designed a custom map that painstakingly replicated the festival's Brucknerhaus exhibition hall using AutoCAD and rendered the 3D space using the *Doom II* (1994) engine. Within this virtual reconstruction of the Brucknerhaus, Kipcak invited fellow artists to submit work to be showcased within the gamespace. He then encouraged participants, both remotely and at the festival, to log on to *Doom's* online network to play as famous artists—Joseph Beuys, Jeff Koons, Nam June Paik, and others—and destroy the artworks on display using custom weapons such as a paint brush gun and a bullet-firing crucifix. Instead of battling demon hoards or skirmishing in multiplayer deathmatches, participants within the *Doom* map-cum-museum took on the role of critic: they kept works intact that they enjoyed, while desecrating ones they found distasteful.

Similarly, throughout 2016 thousands of viewers watched a Twitch livestream of artist Brent Watanabe's *San Andreas Streaming Deer Cam*: a modded version of *Grand Theft Auto V* in which an autonomous deer wanders in the game's fictional state of San Andreas and interacts with nonplaying characters (NPCs), vehicles, and other forms of the artificial intelligence (AI). Using the RAGE (Rockstar Advanced Game Engine), Watanabe programmed the deer's actions based upon the game's pedestrian AI to generate the animal's often unpredictable behaviors. In one instance, the deer unwittingly finds itself the subject of a police manhunt, while in the next, it breaks into a high-security military base. Although created nearly twenty years apart, both *ArsDoom* and *San Andreas Streaming Deer Cam* confronted the public with novel modes of aesthetic participation through the strangeness of modding practices. In these bizarre reconfigurations of commercially successful video games, players and spectators interacted with an entertainment medium

in ways that were perceptually unfamiliar, prompting novel affective engagements with widely played video game technologies of the time.

Drawing from the kinds of uncanny disruptions made to popular video games in *ArsDoom* and *San Andreas Streaming Deer Cam*, this book examines historical episodes of art modding situated around the introduction of the game engine as a software framework for developing and rendering gamespaces. I look at modding, the alteration of an existing video game system's software or hardware components, as a novel aesthetic practice employed by gamers, programmers, and artists between 1995 until present. Although the canon of game art spans techniques beyond modding to include performative interventions, sculpture, and the appropriation of video game objects, I focus on modifications to show how artists during this period explored relationships among abstract forms, engine technologies, and our bodily engagements with video games.

These historical instantiations of modding are situated around a recent archaeology of the game engine as a technical artifact and serve to better contextualize the unique confluence among popular gaming systems and experimental forms of making that unfolded throughout the 1990s and continue in contemporary art scenes. During this era, engines came to describe the underlying code that carries out technical procedures related to rendering graphics as well as performing physics and AI in video games. Modding arose during a unique period of video game history in which cultural perceptions and attitudes toward the medium developed around game engines and their ability to render 3D gameplay. Popular engines that powered first-person shooters such as id Software's *Doom* (1993) and *Quake* (1996) organized different kinds of gaming identities within a new perceptual regime: vectors of movement through actionable 3D environments. Through the lens of modding aesthetics, I demonstrate that the engine was a computational technology that allowed artists to playfully manipulate and disorder gameworlds through open-source architectures.

The contemporary media artists highlighted in this book—Cory Arcangel, JODI, Julian Oliver, Krista Hoeffle, Orhan Kipcak and Reini Urban, Anne-Marie Schleiner, Brent Watanabe, and Tom Betts—approached modding from tangential artistic fields such as net art, video, performance, experimental music, sculpture, and installation. They reconfigured game engines to generate abstract sequences through a range of modding techniques: hacking the ROM chips on Nintendo cartridges to produce experimental video, deconstructing code into psychedelic glitch patterns, collaging together environments and assets to

produce surreal gameworlds, and writing generative algorithms that fracture the game's AI. Their attraction to modding arose from previous experimentation with digital media in the hacker, DIY culture of the 1980s and 1990s, and strategies of appropriation more broadly within traditions of the avant-garde. These key junctures in video game history point to how artists intentionally dissected the engine's technical operations to unveil illusions of action and movement within algorithmic spaces. They were invested in the material nature of video games as well as the player's sensory experiences of computers as cultural and aesthetic objects. Like many interventions throughout the twentieth-century avant-garde, artists sought to deconstruct consumer media technologies toward subversive and ironic ends. This fold among commercial engines and modding highlights a common history among art and video games as well as the necessity to better understand modding cultures: an area within game and media studies that has not received the critical attention it deserves.

Theorists have recently begun to address the cultural significance of video games as works of art. This scholarship has largely focused on the discursive construction of game-based art, or rather the ways video game systems, tropes, and cultural references are reappropriated and deployed as radical and counter-hegemonic interventions within the contemporary art world. Discussions of game art often assign modding practices a representationalist label, situating abstraction, unconventional play experiences, and spectatorship in relation to previous art movements. These considerations for modding's position within broader art historical narratives are not without significance. The chapters in this book likewise trace modding practices across genealogies of the avant-garde to find common ground among video games and art. More so, this work not only contextualizes game art and avenues play within art histories but also articulates the possibilities for deconstructive techniques like modding to simultaneously work within capitalist regimes while interrogating the kinds of social inequalities that gaming cultures perpetuate.

However, recent scholarship that historicizes game art has overlooked what I see as a critical aspect to our understanding of modding practices: the material constellations among game engine technologies that artists use to generate abstract sequences and the possibilities for our embodied engagement with their forms. Scholars have approached art modding histories only through a surface examination of game technologies and the forms they produce, without reflecting on how the technical affordances of modding both catechize and *modify* our sensory engagement with video games, self, and the world. Why were

artists invested in appropriating game engines to question standard perceptions and operations of play within popular video games? In what ways did they alter the technics of engines to produce new kinds of aesthetic participation within the dominant frameworks of technoculture during this time? How do these disruptive techniques engage bodily experiences, revealing the ways that video games often influence, guide, and enhance our perceptions of algorithmic spaces?

This book argues that artists hacked, glitched, broke, and otherwise reconfigured game engines working from within a hegemonic field of commercial gaming technologies and subcultures. More so, they held an aesthetic aim of making strange conventional attitudes toward play by destabilizing the sensory faculties in a variety of viewing and playing bodies. Within these historical episodes of art modding, I focus not only on the engine technologies that artists worked with to generate plays of abstraction but also on the ways in which participants interfaced with art mods in materially embodied sites of play. The unstable aesthetics that modding engenders unfolds from a co-constituency among human and nonhuman bodies, or rather, the ongoing reciprocations of experience among players, spectators, gallery-goers, as well as the vibrant ontologies of game engines. In these works of art modding, game engines continually *modify* the body's phenomenal presence in the world, while our interfacing with controllers and screens give meaning to the engine's technical procedures and abstract variations they produce. As I argue, modding aesthetics reside in the liminal spaces of interaction among system and bodies, or what I refer to throughout this book as the *strangeness* of art modding. Here, "strangeness" refers to those modes of cognition that reside beyond normal experiences of video games. In these moments, artists sought to defamiliarize standard perceptions of gamespaces into experiences of radical difference, apprehension, and instability: affective oscillations and dizzying modes of play elicited through the liveliness of technical forms. They abstracted commercial engines to prompt *aimless* encounters with games. By this I refer to modding's disruption of a player's flow: their perceptions and actions that optimize pleasure and reward within a gamespace. I also consider a double meaning of aimless as an intervention in the ability to aim a weapon within the first-person perspectives generated by modern engines.

Throughout this book, I assert that our sensory entanglements with art modding are fundamentally *mimetic*. Here, I establish mimesis not as a concept of verisimilitude, representation, or naturalism as it is often understood in Western visual culture, but rather as an affective modality through which dynamic forms

are playfully mirrored within in the body. For instance, in JODI's (Joan Heemskerk and Dirk Paesmans) *Untitled Game* (1996–2001) the artists abstracted the first-person shooter *Quake* into series of frenzied pulsating and swirling forms. For players and spectators of *Untitled Game*, this phantasmagoria of lines, shapes, and colors outputted by the altered engine works to arouse certain kinesthetic pathways, pushing and pulling upon the senses. The strangeness of modding, or mimetic operations that incite a spectrum of disquieting as well as pleasurable sensations, develops within the interrelatedness among human and nonhuman things. Bod(ies), engine, screen, the color red, jagged lines, gallery wall, the Picture Processing Unit of an old Nintendo, an onlooker mesmerized by violent glitch patterns, act upon each other within broader material entwinements. By situating these modding experiments within aesthetic traditions of mimesis, I elucidate a richer phenomenology of video games that incorporates the vibrant correspondences among players, spectators, and systems.

This approach accounts for a vital understanding of how bodies experience digitally constructed spaces produced by engines, whether sensations of moving laterally across a scrolling landscape or sprinting through the perspectival rendering of a 3D map. Through a deep dive into the technical operations of engines and the ways artists tampered with gamespaces, this book deploys modding aesthetics within a more inclusive and expansive media landscape. By understanding the nuanced ways artists break engines and unravel player expectations of gamespaces, we can gain a deeper appreciation for our situated experiences of video games.

## Technicities of Modding

Artists, hackers, and programmers experimented with modding during a period that gave rise to new formations of both player and developer through video game technicities. Jon Dovey and Helen Kennedy describe technicity as the imbrication of technologies, identities, attitudes, and habitual practices that scaffold our knowledge of video games. Technicities of cyberculture that emerged throughout the 1980s and the 1990s gave dominant meaning to video games through the authority of developers as well as consumer markets that circulated hegemonic truths regarding the social identity of gamers. Gendered technicities of the 1990s often presumed that the developer and the player were technically proficient males and that gameplay was predicated on mastery,

productivity, and competition within capitalist regimes of the game industry. Technicities are not inherent to game technologies themselves but instead result from cultural processes brought into relationship with games. Our experience and knowledge of video games are in continual flux, contingent upon historical and social contexts and changing impositions of power. Dovey and Kennedy argue that when flows of power organize dominant technicities, they also invite subversive counter identities and cultures to develop from within hegemonic fields. As an example, they examine the ethos of the hacker and cyborg conceived during the 1980s, two marginal identities through which computer technologies could be reappropriated toward critical and often utopic forms.<sup>1</sup> Similarly, John Carmack and John Romero, the programmers and designers of the popular first-person shooters *Doom* and *Quake* were often described as “social misfits” with automated cyborgian work habits, coding all night with machine-like efficiency.<sup>2</sup> Judy Wajcman argues that within a history of computers since the mid-century, high-tech spaces such as military bases and university research labs have been traditionally coded as masculine. These spaces, historically reserved for technically savvy male programmers, worked to reinforce gender inequalities by disallowing computer access to underprivileged groups. By the late 1980s, dominant traditions of the male programmer and/or hacker whose autonomy, technical agency, and skill developed in these tech-centric spaces were reinscribed as “gamer” and “player” identities.<sup>3</sup> In the wake of early video game culture, these masculine-coded programmer/hacker identities shifted from marginalized “loner” subcultures to central formations of technicity.

Such identities were embodied in cracker communities of the mid-1980s: groups of hackers throughout West Germany, Poland, the Netherlands, and Scandinavia who modified and distributed Warez, or pirated software. Crackers modified games to disable copy protection for systems like the ZX Spectrum, Commodore 64, and Amiga, sharing “cracked” copies across national and international borders. Alex Wade has observed that cracker communities disrupted national and international “logistical barriers” by distributing modded games via networked bulletin boards and postal systems throughout continental Europe and behind the Iron Curtain where they were not officially sanctioned.

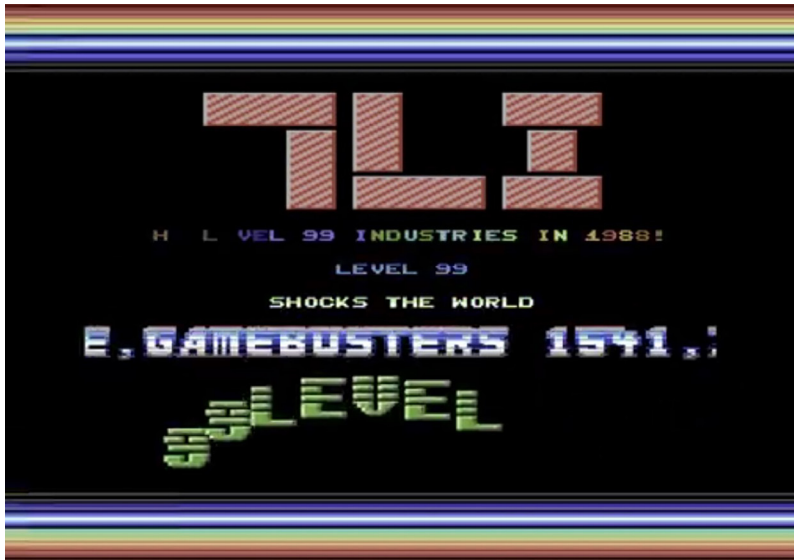
<sup>1</sup> Jon Dovey and Helen W. Kennedy, *Game Cultures: Computer Games as New Media* (Maidenhead: Open University Press, 2011), 63–6.

<sup>2</sup> See Dovey and Kennedy’s description of Romero and Carmack as “cyborgs” in Dovey and Kennedy, *Game Cultures: Computer Games as New Media*, 70–1.

<sup>3</sup> Judy Wajcman, *Feminism Confronts Technology* (University Park, PA: The Pennsylvania State University Press, 1991), 152–3, 155.

Working on personal computers from their bedrooms, many crackers were young gamers with programming skills who altered existing titles to include quick-loaders, cheats such as unlimited health and lives, and disk compression which reduced the file size of larger games.<sup>4</sup>

Crackers also produced unique animations at the beginning of modified games known as crack intros. These short audiovisual sequences included splash screens, music, and digitized voice patterns that identified the hacker's work and demonstrated their technical prowess. Patryk Wasiak argues that crackers served as key cultural actors whose shared knowledge and expertise helped solidify Europe's vibrant demoscene. By the late 1980s, crack intros took on the form of "demos": elaborate demonstrations of computer graphics and sound that were distributed as executable files (Figure 0.1). These demos served as a mode of communication among computer subcultures within a broader global demoscene in which gamers showcased their mastery of code, often vying for the most spectacular intro sequence.<sup>5</sup>



**Figure 0.1** Crack intro sequence from the early demoscene. Screenshot.

<sup>4</sup> Alex Wade, *Playback: A Genealogy of 1980s British Videogames* (New York, NY: Bloomsbury, 2016), 56.

<sup>5</sup> Patryk Wasiak, "Playing and Copying: Social Practices of Home Computer Users in Poland during the 1980s," in *Hacking Europe: From Computer Cultures to Demoscenes*, ed. Gerard Alberts and Ruth Oldenziel (London: Springer, 2014), 129, 144–5.



Throughout the same decade, novel perceptual practices developed from popular titles such as *Moon Patrol* (1981) and *Scramble* (1981), which introduced players to engines that utilized parallax scrolling, or when different background layers move horizontally or vertically at varying speeds, providing illusions of depth while navigating laterally through 2D gameworlds. By the early 1990s, games like *Catacomb 3-D* (1991) and *Wolfenstein 3D* (1992) could render 3D, texture-mapped environments, allowing players to explore immersive gameworlds through a first-person viewpoint. Historically, the introduction of engine technologies that portray illusions of virtual space, also territorialized new modes of visuality: technicities related to the player's *perceptual* literacy and the bodily coordination of looking and moving an avatar within algorithmic forms of depth.

By the early 1990s, engines developed "extensibility" that allowed for new modes of gameplay, further influencing the formation of modding communities. With the introduction of *Doom*, players could use the engine to record and play back speed runs, completing a map in the fastest possible time, as well as their skills in deathmatch competitions. These early machinima demos, or short films generated in real time using a game engine, were shared widely as .lmp files across networked communities of skilled players within the demoscene. Although the *Doom* source code would not be released until 1997, the game was originally designed by Romero and Carmack to be modifiable using WAD files (an acronym for Where's all the Data?): package files that include custom sprites, levels, skins (the appearance of an avatar), and weapons. Players used external tools to create their own game assets included in the WAD file that once interpreted by the *Doom* engine could vastly change the appearance of the game.

With the release of *Quake* in 1996, players produced a rich variety of user-generated mods within the game's real-time 3D environments using .pak files which like WAD files, functioned as a repository for player-made textures, graphics, items, and sound effects. A wealth of *Quake* mods were distributed within a cultural economy of online gaming communities as downloadable .pak files for players to use. Like her predecessor the cracker, the *Quake* modder was often not only an expert player but also a proficient coder who was integral to the emerging demoscene of the early 1990s. Groups of *Quake* players or clans used their technical knowledge to film and edit machinima footage of their gaming expertise in the form of .dem (demo) files that highlighted multiplayer deathmatches as well as speed runs, such as Anthony Bailey's *Quake Done Quick*

series. Each .dem file recorded not only player input but also the movement of all objects in the gameworld. In turn, this allowed *Quake* clans to experiment with producing narrative machinima recorded with an in-game camera that included scripted dialogue and avatar choreography in real time. For instance, the Rangers Clan used the *Quake* engine to create *Diary of a Camper* (1996), a short film about a player who is ambushed after strategically holding their position in an advantageous area of the map, otherwise known as “camping” in gaming culture. Likewise, the ILL Clan created longer machinima such as *Apartment Huntin’* (1998), which chronicled two blundering lumberjacks in search of a new place to rent. Other modifications included David “Zoid” Kirch’s popular capture the flag game mode developed in late 1996, featuring the Grappling Hook: a unique item allowing players to fast travel throughout a map by launching the hook and using its rope to swing and propel to various platforms. Around the same time, Robin Walker, John Cook, and Ian Caughley created the influential Team Fortress mod, which pitted specialized player classes—demolition expert, sniper, medic, heavy weapons specialist, and spy—against each other in deathmatches or capture the flag.

Game modders of the 1990s and the range of innovations they produced with existing engines highlight the fluid nature of technicity. Cultural attitudes, identities, and perceptions that arose from modding and the early demoscenes indicate the unique historical fabric from which artists manipulated and experimented with game systems. Here, I don’t claim that artists engaged strictly in counterhegemonic practices to resist the commanding ideologies and capitalist frameworks that undergird gaming industries. Rather, I believe they were drawn to repurposing the material affordances of engines within this dynamic era of game development, working within consumer cultures to reconfigure our phenomenal relationship to video games, often through tactics of subversion and irony. As I argue throughout this book, artists experimented with engines to create new modes of bodily experience by reshaping standard modes of play into *aimless* encounters.

## Aimlessness and the Formation of Sensory Experience

In the context of video game play, I use the concept of “aimlessness” to refer to a disruption of a player’s flow, sensual modes of play channeled toward competition,

reward, and mastery, but also consider the double meaning of aimlessness as an intervention in the ability to aim a weapon within the simulated perspective of first-person shooters: a genre that developed from engine technologies of the early 1990s. Brian Schrank discusses this “break in flow,” a term coined by psychologist Mihaly Csikszentmihalyi to describe one’s engagement in a gratifying, “optimal experience,” through what he calls “radical formal” strategies within histories of art.<sup>6</sup> He draws a relation between Renaissance painting, conventional gameplay, and our movement through gamespaces. Formal elements within Renaissance painting such as anatomical precision, linear perspective, and the reduction of scale as objects diminish toward a vanishing point, lead the eye through an illusory representation of depth. To Schrank, video games operate similarly in that they introduce a perceptual regime that guides our actions and optimizes the potential for reward, or the flow of the player’s experience.<sup>7</sup>

Dominant technicities within the gaming industry dictate flow as an expectation for games to appeal to consumer desires and result in pleasurable experiences. Developers mobilize flow by designing games to assess player skills and adjust difficulty in response to their progress or establish rules and mechanics to motivate continual play. Often, a game is rewarding when flow emerges among a player’s skill set and appropriate challenges that they can potentially overcome without getting too frustrated or conversely, too bored. Developers situate normative expectations of play around perceptual formulae through which flow becomes operational. In first-person shooters such as *Doom* and *Quake*, Cartesian perspective within 3D space functions as a set of coordinates through which player experience is optimized. Flow is realized in instances of action and movement guided by the player’s point-of-view perspective: engaging in firefight, jumping, running, and solving puzzles to proceed to the next level or map. In instances of flow, navigation of 3D space works to technically and socially condition the competitive player into what Emma Witkowski calls the “balanced body”: a body that adapts and responds through physicality (pressing buttons) and bodily composure when interacting with the game’s affective forces.<sup>8</sup>

<sup>6</sup> See Mihaly Csikszentmihalyi qtd. in Brian Schrank, *Avant-Garde Videogames: Playing with Technoculture* (Cambridge, MA: The MIT Press, 2014), 32.

<sup>7</sup> Ibid.

<sup>8</sup> Emma Witkowski, “On the Digital Playing Field: How We ‘do sport’ with Networked Computer Games,” *Games and Culture* 7, no. 5 (2012): 359–60.

In these historical episodes, I argue that the player's sensory experiences, revealed in the strange interactions with art mods, result from a severance of flow. Artists intentionally practiced what Josephine Bosma refers to as "cargo cult coding" in her discussion of JODI's game mods. The "cargo cult" was a ritualistic belief system adopted by the people of the Melanesian islands in which they mimicked characteristics of Western colonists in hopes of bringing good fortune and wealth to their communities. In programming circles, the term indicates a type of "ritual" coding that does not have a functional outcome. In the case of JODI's work, cargo cult coding serves as a way of appropriating specific computational effects without abiding by the standard logic and protocols of a game system.<sup>9</sup> Throughout the 1990s, these formal interventions undertaken at the level of the engine's code, worked to shift the player's experience away from reward, pleasure, and mastery within a perspectively coherent gamespace toward aimlessness: interactions with the system that interrupt flow and the ability to aim, rechanneling goal-driven play toward sensory engagements with abstract forms.

Aimless play is a product of the material and social conditions in which artists modify games. In his aesthetic theory, Jacques Rancière describes what calls the distribution of the sensible, or the knowledge frameworks and impositions of power within a given historical order that shape visibility and artistic production: the possibilities for what can be seen or what one can do or make. The distribution of the sensible produces various affects, perceptions, and sensations that cut across society, providing common experiences of art, while also dividing aesthetic participation among groups and individuals into the circulation of different temporalities, spaces, processes, and movements.<sup>10</sup> Here, the relationship among politics and aesthetics refers to participatory roles taken up by society within works of art. A viewer in MoMA's galleries will experience perceptions that are different from witnessing, for instance, a work of graffiti art along a busy city street or a livestreamed deer frantically making sense of San Andreas' environments. Specifically, Rancière describes an "aesthetic regime" or modes of experience that operate outside art historical movements, classifications, genres, and museum collections. In the aesthetic regime, our experiences of contemporary art forms—nonart objects,

<sup>9</sup> Josephine Bosma, "Jodi and the Cargo Cult," in *INSTALL.EXE-JODI*, ed. Tilman Baumgaertel (Basel: Christoph Merian Verlag, 2002), 91.

<sup>10</sup> Jacques Rancière, *The Politics of Aesthetics: The Distribution of the Sensible*, ed. and trans. Gabriel Rockhill (London: Bloomsbury, 2015), 4–7.

performative happenings, and game mods exhibited online—work within a social milieu of different perceptual operations: a “heterogeneous power” removed from previous categories of looking and making.<sup>11</sup> I use Rancière’s aesthetics to describe the sensory experiences that emerge through modding techniques of this period. Beginning in the 1990s, modding embodied a sensory regime through which new art forms, technicities, and communities of practice originated. More so, this unique distribution of the sensible that modding illustrates accounts for subjectivities and identities with both novice and expert computer literacies. In examining modding’s disruptions to normal play, my aim is to highlight sensual engagements with game technologies that make bodies meaningful beyond territorialized play experiences within masculinized and exclusionary constructions of “gamer” and “player.” Like the vibrant activity of patrons in a 1980s arcade, the public reception of modding in museums, galleries, and streamed online involves a multiplicity of unstable experiences for players, spectators, and nonhuman entities taken up within complex material assemblages.

## Video Games and the Avant-Garde

In discussing works of modding, I draw a relation among video games and key histories of the avant-garde. Consumer technologies and experimental art practices have held a close connection throughout art movements of the twentieth and twenty-first centuries. Artists have often employed technologies contemporaneous with the era to critique mass commodification and conformity within capitalist structures. In this historical affiliation among technology and art, I define “art modding” as a technical and phenomenal operation through what Matteo Bittani suggests is the augmentation of existing software to deconstruct the entertainment value of games. In its deconstructive capacities, modding affirms non-normative modes of play through unplayability (or what I call aimlessness), foregrounding abstract sequences produced via interruptions made to the engine’s internal workings.<sup>12</sup> Artist Anne-Marie Schleiner aptly refers to modding practices as *parasitic* in that they exploit and borrow from a commercial host engine, generating raucous channels of noise

<sup>11</sup> Ibid., 18–19.

<sup>12</sup> Matteo Bittani, “Game Art: (This) is not a Manifesto, (this) is a Disclaimer,” in *Gamescenes: Art in the Age of Videogames*, ed. Matteo Bittanti and Domenico Quaranta (Milano: Johan & Levi, 2006), 9.

within an entertainment system commodity. Yet, in the complex relationships among developers and modders, or rather, industrial practices and volunteered, affective labor, this parasitism sometimes resembles, as Schleiner mentions, “mutually beneficial, symbiotic evolution,” a concept I return to in the book’s conclusion to articulate modding’s historical development. Within an ongoing cycle, grassroots communities of players and programmers customize game engines while industries subsequently adopt and work such changes into future releases, in turn, providing modders new ground for experimentation.<sup>13</sup> In 1999, Minh “Gooseman” Le and Jess Cliffe developed the first-person shooter *Counter-Strike* (2000): a modification of Valve’s *Half-Life* (1998) in which players face off against each other as either counterterrorist agents or enemy militants, completing objectives such as bomb defusal and rescuing hostages. By 2000, Valve acquired the intellectual property to *Counter-Strike* as modding communities experimented with altering the game’s Goldsource engine (also called GoldSrc), itself a revamped version of the *Quake* engine. In a parasitic invasion of the game, Schleiner along with artists Brody Condon and Joan Leandre created their well-known mod *Velvet-Strike*, allowing players to spray anti-war graffiti from their guns, a performative intervention against the Bush administration’s War on Terror as well as increasing numbers of post-9/11 anti-Arabic and anti-Muslim *Counter-strike* mods. Players were encouraged to make their own protest tags that could be shared and downloaded as WAD files (the format used in *Quake*). Modding’s status as a hungry parasite or symbiotic creature serves to perpetually renegotiate the boundaries among professional and amateur labor, standardization and experimentation, as well as commodity and art.

John Sharp looks at modding through the ways artists conceptualize and produce works of game art based upon the material affordances of systems. Modding takes up strategies of appropriation that unfold at the intersection of games and art histories of the twentieth century. Artists use video games “as tool sets and cultural tropes rather than as a medium or craft unto itself.”<sup>14</sup> In this way, the 8-bit clouds borrowed from *Super Mario Brothers* (1985) that scroll against a minimal sky in Cory Arcangel’s *Super Mario Clouds* (2002), is a playful rearticulation of Duchamp’s infamous *Fountain* (1917) or the debris

<sup>13</sup> Anne-Marie Schleiner, *The Player’s Power to Change the Game: Ludic Mutation* (Amsterdam: Amsterdam University Press, 2018), 13–14.

<sup>14</sup> John Sharp, *Works of Game: On the Aesthetics of Games and Art* (Cambridge, MA: MIT Press, 2015), 14.

of advertisements and consumer imagery in Rauschenberg's combines. Mary Flanagan also positions video games within the twentieth-century avant-garde through concepts of play or what she calls avant-garde game design: the reuse of mainstream gaming practices and tropes as a form of political and social subversion. Flanagan considers the radical appropriation of popular games as activist interventions that draw from counterhegemonic movements within histories of art.<sup>15</sup> Brian Schrank looks at ways video games shape contemporary art landscapes and how they reciprocally influence the production of games within our current technoculture. Instead of thinking about what defines the contemporary avant-garde and how video games are positioned within its contours, Schrank asks how video games emerge from contemporary art practices and allow artists to deploy a range of formal and political strategies. Following Hal Foster and his historicizing of the neo-avant-garde throughout the 1960s and 1970s, Schrank illustrates that there is no all-encompassing theory of an "avant-garde" but rather a dispersion of artistic techniques and communities through which novel gaming practices emerge.<sup>16</sup> Alexander Galloway proposes one such avenue for games within the contemporary art world through what he calls counter gaming, or when artists undermine normal gameplay through abstract modifications to existing software. He suggests that modding at once interrupts the game's flow while foregrounding the system's materiality and unit operations.<sup>17</sup> More so, Brendan Keogh has focused on the embodied exchanges among player and system through the lens of abstract games such as Stephen Lavelle's *Slave of God*. The player's navigation throughout a chaotic nightclub of pulsing colors and music highlights the "irreducible symbiosis of . . . gestural signification and audiovisual engagement," or the sensory unification among touching a control input and perceiving the sights and sounds on screen.<sup>18</sup> Although recent scholarship addresses modding aesthetics as a trajectory within contemporary art discourses, it sidesteps what is at stake for the player's *phenomenal relation to game engines* and the illusory spaces they produce. Current conversations in media and game studies have largely ignored modding as a singular aesthetic technique composed of linkages and connections within the heterogeneous terrain of industry production, avant-garde communities of

<sup>15</sup> Mary Flanagan, *Critical Play: Radical Game Design* (Cambridge, MA: MIT Press, 2013), 1–2, 10.

<sup>16</sup> Schrank, *Avant-Garde Videogames: Playing with Technoculture*, 3.

<sup>17</sup> Alexander Galloway, "Counter gaming," in *Gaming: Essays on Algorithmic Culture* (Minneapolis: University of Minnesota Press, 2006), 107–9.

<sup>18</sup> Brendan Keogh, *A Play of Bodies: How We Perceive Videogames* (Cambridge, MA: MIT Press, 2018), 110–11.

practice, and contemporary attitudes toward gaming culture. Therefore, I work to validate modding as not just a unique strategy within histories of art, but rather through the ways its technical operations affirm a specific regime of sensible experience. That is, my interest is not so much in what art modding *is*, but the possibilities for *what it can do*: the hallucinatory and dizzying intensities that materialize among bodies and engine and catechize preconceived experiences of gamespaces.

## Unstable Aesthetics

The archaeology of game engines I examine throughout this book, positions modding aesthetics within the boundaries of a dynamic media history that triangulates not only the mechanisms of different engines and the algorithmically constructed forms they render but also our embodied entanglements with computational media. This approach provides a broader conception of media aesthetics, braiding together various phenomenological traditions to account for modding's vital materialism. Drawing from Jussi Parikka's definition of media archaeology, I examine the engine as a software framework through an "analysis of the historical layers of media in their singularity—a conceptual and practical exercise in carving out the aesthetic, cultural, and political singularities of media."<sup>19</sup> Modding's early developments throughout the 1990s and 2000s illustrates a singular media platform that afforded gamers, artists, and programmers novel possibilities for destabilizing gamespaces by altering technical procedures native to game engines: binary space partitioning, lightmapping, pathfinding for bot artificial intelligence, among others.

This archaeological approach highlights key histories and theories of animation. The inclusion of modding within animation discourses in film and media studies considers how engine mechanisms generate lively forms of abstraction through both the artist's manipulation and player's input. Glitches and other technical disruptions as well as the engine's extensibility and the suturing together of different game assets, express the vitality of moving video game forms and the minute ontologies that govern their computational procedures. A framing of modding aesthetics through media archaeology and

<sup>19</sup> Jussi Parikka and Garnet Hertz, "CTheory Interview: Archaeologies of Media Art," *ctheory.net*, April 1, 2010.



animation studies provides for a more inclusive definition of a game engine. I define an engine within these historical instances as *a technical framework for hardware and software that generates video game forms through a range of computational mechanisms*. Therefore, each chapter focuses on a specific game engine with this definition in mind: Nintendo Entertainment System, Id Tech 1 (*Doom* engine), *Quake* engine, Id Tech 3 (*Quake III Arena* engine), and the *No Man's Sky* engine (2016).

The work of Matthew Kirschenbaum serves as a cornerstone to an archaeological investigation of engines, specifically his concepts of forensic and formal materiality. For Kirschenbaum, forensics is an examination of a media object's individuality and interior processes at the level of code, digital inscription, and "where individual bit representations deposit discrete legible trails." It includes the material surfaces, components, design, and labor that make up digital media. Forensics correlate to media's formal materiality and the interrelated layers of hardware and software that influence user experience. These computational layers, although self-supporting, indicate as Kirschenbaum says, "something of the procedural friction or perceived difference, the torque, as a user shifts from one set of software logics to another." This describes how the push and pull of formal processes that work to naturalize user experiences at the level of interfaces are governed by underlying structures of code and inscription.<sup>20</sup>

By examining the fold between forensic and formal materialities, I trace the procedural behavior of game engines to the formal parameters of modifications and the uncanny rhythms of abstraction on screen. This analysis is largely guided by aesthetic traditions of defamiliarization. Kirschenbaum suggests that forensic processes have a defamiliarizing effect in that they unveil deep strata of inscriptive operations. Such computational processes are often seen as fundamentally alien and removed from our routine experiences of operating systems.<sup>21</sup> A similar understanding of defamiliarization is echoed in the Soviet formalist thinking of literary theorist Viktor Shklovsky. In his 1917 essay "Art as Technique," Shklovsky observes that the purpose of art lies in its capacities to expel "the automatism of perception" which clouds the very means by which we come to know works of literature, film, or video games. Shklovsky sees defamiliarization as a countering of habitual perception, imbuing familiar conventions with a sense

<sup>20</sup> Matthew Kirschenbaum, *Mechanisms: New Media and the Forensic Imagination* (Cambridge, MA: MIT Press, 2012), 10, 13, 20.

<sup>21</sup> *Ibid.*, 20, 133.

of strangeness, or *ostranenie*. He refers to this strangeness as “baring the device,” or the way artistic techniques are self-reflexively foregrounded, making a work unfamiliar by calling out its artificial construction. Through defamiliarization, meaning and satisfaction are perceived through their lingering and *slowness*: the continuity in space and time through which the unfamiliar emerges.<sup>22</sup> This formalist aesthetic describes how the player’s attention is drawn to the engine’s proceduralism through a lingering contemplation of its minute operations.

Specific to modding, defamiliarization is often expressed through aesthetic strategies of collage and glitch. In using the term collage, I refer to the ironic and often politically radical ways in which twentieth-century avant-gardes have combined seemingly unrelated images, objects, and commodities as a commentary on consumer culture, mass conformity, and the broader art world. Modding reflects a form of collage through the disjunctive arrangements of assets, textures, and environments that often disrupt the diegetic space of the game. Kipcak and Urban’s use of the *Doom* engine to transform a gun into a cross, or Cory Arcangel’s ROM hacking techniques in *I Shot Andy Warhol* (2002) (a modification of the NES game *Hogan’s Alley*) that include caricatures of rapper Flava Flav and the Pope, composite recognizable in-game objects and environments with user-generated content external to the game’s narrative world.

Along with concepts of collage, I look to recent scholarship in glitch studies and consider how artists employ technical errors to unravel engine procedures. In relation to modding, glitch is articulated through what artist Rosa Menkman calls its *moment(um)*, or the possibilities for a glitch to generate novel perceptions through the entropy of dominant technical frameworks, yet within the phenomenological moment through which glitch is experienced. Menkman sees glitch as an unpredictable rupture or unknown breach within the standard transmission of data in a system. It is a moment in which a computer or media device experiences an unannounced break in functionality, whether technical or social, that eludes codification among our everyday interfacing with technology.<sup>23</sup> Menkman’s understanding of glitch is particularly helpful in the formal analysis of art modding as it reveals the forensic materiality of game engines. When a video game is corrupted by an artist’s hack that transforms a

<sup>22</sup> Viktor Shklovsky, “Art as Technique,” in *Russian Formalist Criticism: Four Essays*, ed. Lee T. Lemon and Marion J. Reiss (Lincoln, NE: University of Nebraska Press, 1965), 18, 22.

<sup>23</sup> Rosa Menkman, *The Glitch Moment(um)* (Amsterdam: Institute of Network Cultures, 2011), 8, 9, 26, 28.

recognizable gameworld into erratic sequences of broken tiles, palettes, textures, and frames, it unveils the system's alien processes that operate at levels beneath comfortable and expected modes of gameplay.

As I've mentioned, art modding elicits sensory entanglements among different players and spectators that embody a disquieting strangeness: *a feeling of things being off or not quite right* emerging from the game's unstable state. Drawing from Freud's theory of *unheimlich*, a broad and debatable concept that refers to the uncanny, eerie, and oddly familiar, Mark Fisher conceptualizes the strange through vectors of experience that let us "see the inside from the perspective of the outside" through "that *which does not belong*." Strangeness occurs when we perceive the familiar through the lens of that which exists beyond normal experience. Fisher relates strangeness to a kind of montage (or more broadly, collage) in that multiple things are juxtaposed that typically do not exist together.<sup>24</sup> In STRT/SLCT's machinima installation *WE BUILD WORLDS* (2018–19), Krista Hoeffle arranges footage of alien planets in *No Man's Sky* with layers of grids and psychedelic color fields. In his mod, *ioq3aPaint* (2002–10) Julian Oliver augments the *Quake III: Arena* engine to render painterly images, fusing recognizable fragments of the game's deathmatches with ghostly frames from the movement of bots. Modding's strangeness unfolds as an assemblage of the game's diegesis, technical disruptions, and artist-produced assets that through their disparate groupings evoke experiences that exceed our standard interfacing with video games. Modding reveals its uncanny nature through an inversion of the inside to the outside, a perception that exposes the engine's internal procedures as they bleed into the game's familiar interface. Fisher points out that the strange is not always unsettling and there is "an enjoyment in seeing the familiar and the conventional becoming outmoded."<sup>25</sup> Just as mods portray games in states of disarray, they also produce vectors of sensory pleasure through, as I argue, our mimetic faculties.

The strangeness of modding is perceived through intensive operations of mimesis and the way players and viewers *feel* the distortion of gamespaces. This book situates mimesis within media phenomenologies that highlight our sensory attunements to art modding. Observing modding practices through phenomenological traditions of mimesis allows for a rethinking of representation, figuration, and the illustrative through embodied modes of experience.

<sup>24</sup> Mark Fisher, *The Weird and the Eerie* (London: Repeater Books, 2016), 10, 11.

<sup>25</sup> *Ibid.*, 13.

Walter Benjamin's work on mimesis serves as my conceptual framework. As a historically contingent, phenomenal interaction between self and material world, mimesis works to playfully generate interrelated qualities perceived in the *difference* of things, forging novel associations and linkages where none previously exist. Miriam Hansen conceptualizes Benjamin's mimetic faculty not as a form of representation and recognition of sameness among a thing and its referent, but instead as a playful, "relational practice" of generating similarities, a "mode of access to the world involving sensuous, somatic, and tactile, that is, embodied, forms of perception and cognition."<sup>26</sup> This could be, for instance, the way we recognize the face of an elderly woman in the bark of a gnarled oak, a film dissolve between a full moon and a dilated pupil, or, as Benjamin observes in children's play, "the child plays at being not only a shopkeeper or teacher, but also a windmill and a train."<sup>27</sup>

As an affective exchange among body and world, mimesis informs the aesthetic processes through which gamespaces take on appearances of other things through perceived similarities. In *ArsDoom*, a paintbrush is strangely associated with a gun, just as the medieval architectures of *Quake* in JODI's *Untitled Game* morph into oscillating fields of moiré patterns. These kinds of mimetic interactions operate outside the colonizing boundaries of representation though the intensities that emerge among players, spectators, gallery-goers, engine, and the abstract rhythms of mods.

Mimesis reflects an affective reciprocation between embodied participants and altered game engines through which human and nonhuman phenomenologies materialize. In making familiar gamespaces strange, modding elicits a range of mimetic behaviors through what I call *gamic apperception* and *gamic proprioception*. The former articulates an embodied awareness of the engine's strange technical ruptures, baring the perceptual schema through which we habitually play. It operates as an act of intuiting one's own perception of the modded game's dysfunctionality. Similarly, gamic proprioception serves as the body's affective attunement to movement and spatial grounding within actionable gamespaces. This describes an individual's sensory capacities to locate and orient themselves within the game through balance, muscle coordination, and

<sup>26</sup> Miriam Hansen, *Cinema and Experience: Siegfried Kracauer, Walter Benjamin, and Theodor W. Adorno* (Berkeley, CA: University of California Press, 2012), 147.

<sup>27</sup> See Walter Benjamin, "On the Mimetic Faculty," in *Selected Writings, Volume 2: 1927–1934*, ed. Michael W. Jennings, Howard Eiland, and Gary Smith, trans. Rodney Livingstone and others (Cambridge: Belknap, 1999), 721–2.

vestibular functions. By disordering one's spatial understanding of a gamespace, art modding often works to unravel the body's proprioceptive equilibrium. Gamic apperception coextends to gamic proprioception in that both constitute a bodily awareness of spatial orientation within gamespaces, and I focus on the interrelatedness of these concepts to illustrate our mimetic engagement with art modding. Embodied feedback from art modifications concretize both an apperceptive attentiveness to the game engine's materiality and proprioceptive instability from its formal abstractions.

The aesthetic of mimesis I deploy echoes a braiding of media materialist and phenomenological traditions. In particular, the work of Maurice Merleau-Ponty on the chiasmus of our embodied presence in the world accounts for a richer development of mimesis. Merleau-Ponty interrogates the Cartesian duality among mind and body by describing our embodiment as an incorporation, a reversibility among human subjectivity and material objectivity. This chiasm or crisscrossing highlights the co-constituency among body, perception, and world, which belong of the same "flesh." Just as the body opens to the world through the senses, objects and processes likewise act upon and modulate our situated presence. The body at once perceives and is perceivable. That is to say, the centrality of our embodied involvement proceeds from the ongoing valence among human and nonhuman agents. Bodily experience emerges from a continual transition among subject and object, person and thing, player and engine.<sup>28</sup> Speaking to the nuanced imbrication among body and digital technologies in works of media art, Mark Hansen offers a similar framing of mimetic experience, suggesting that our interfacing with digital art engages the body's creative capacities to "experience itself more than itself" and generate embodied forms of instability, experimentation, and difference outside of rational cognition. When the body perceptually frames digital information, it negotiates its own affectivity and "gives body" to digital artwork by transforming disembodied information into something that possesses human meaning.<sup>29</sup>

By interweaving phenomenological and materialist thought in the work of Merleau-Ponty, Elizabeth Grosz, Gilles Deleuze, Cristina Albu, Miriam Hansen, Henri Bergson, and Walter Benjamin among others, I frame the body's mimetic interactions with art modding as a process of perceptual concretization. Viewers and players make sense of and interpret the material rhythms and

<sup>28</sup> Maurice Merleau-Ponty, "The Intertwining-The Chiasm," in *The Merleau-Ponty Reader*, ed. Ted Toadvine and Leonard Lawlor (Evanston, IL: Northwestern University Press, 2007), 395, 402.

<sup>29</sup> Mark B. N. Hansen, *New Philosophy for New Media* (Cambridge, MA: MIT Press, 2006), 6–7, 12–13.

temporalities of game engines just as a modification works upon the sensorium through the uncanny surfacing of its forensic operations. Mimetic plays of the senses through which similarities and connections are produced among game assets, abstract forms, and worldly objects, occur within the strange space of interaction among bodies and game system. Just as modding works to catechize our bodily experience, we also extend embodied meaning to video games as an art form. More so, I conceptualize modding's strangeness through discourses in object-oriented ontology and speculative realism in the work of Ian Bogost, Jane Bennett, and Katherine Behar among others, who have inquired into the vital being of things outside anthropocentric frameworks. In its phenomenal encounter with the body, art modding possesses a unique agency and ontological status, or as Jane Bennett observes, "the moment of independence (from subjectivity) possessed by things" that expresses "an active, earthy, not-quite-human capaciousness."<sup>30</sup> This thinking extends to recent conversations in object-oriented feminism (OOF) and foregrounds material entwinements among game engines and other things (people, gallery, pixels, screen) that enable active and meaningfully embodied processes of being in the world. Through its own alien perception, the modded engine interprets human code and controller input, in return, outputting frame rates of abstract forms. Just as our bodies inquire into the unfamiliar nature of modding, game engines look back; they *perceive us*.

In Chapter 1, I examine scrolling game engines for the Nintendo Entertainment System (NES) through two modifications made to *Super Mario Brothers* (1985) created by artist Cory Arcangel: *Super Mario Clouds* (2002) and *Super Mario Movie* (2005). Arcangel's techniques consist of hacks to NES game cartridges and rewriting the game's read-only memory (ROM) so that it exhibits glitchy, time-based animations when inserted into the NES console. Here, I provide an analysis of the NES' split architecture and the ways its 6502 processor and Picture Processing Unit (PPU) generate scrolling 8-bit gameworlds on the horizontal axis. Through Arcangel's work, I show that fundamentally, an engine is the structure of code that coordinates interrelated operations among software and hardware such as rendering graphics and physics. By taking away the player's ability to move laterally in *Super Mario Brothers* (1985), Arcangel recontextualizes the scrolling operations of the game's engine, engaging the body in dynamic arrangements of glitch. In disclosing the strange interobjectivity of

<sup>30</sup> Jane Bennett, *Vibrant Matter: A Political Ecology of Things* (Durham, NC: Duke University Press, 2010), 3.

the NES architecture through glitch aesthetics, Arcangel's mods destabilize our spatial awareness within the two-dimensional space of the 8-bit platformer genre through what I call *embodied nonplay*. In using this term, I refer to the player's inability to control the game through a disruption of their serial interfacing with the system. Situating Arcangel's work within traditions of pop art, I argue that his creative reuse of the NES as a *démodé* commodity, especially his integration of fragmented game icons, modulates the body's spatial sensitivity to scrolling gameworlds.

Chapter 2 examines Orhan Kipcak and Reini Urban's *ArsDoom* and the discursive formation of the game engine beginning in the early 1990s. Through a technical reading of John Romero and John Carmack's *Doom* (1993), I consider ways in which the *Doom* engine proffered a new epistemology of modding practices for constructing and animating gameworlds. The *Doom* engine solidified contemporary knowledge of an engine as a reusable platform for 3D asset creation that is separated from the content it renders. As an art modification, *ArsDoom* operates through strategies of institutional critique in histories of the avant-garde, while eliciting pleasurable forms of embodied vision within 3D environments. I argue that by altering *Doom*'s familiar interface into unusual experiences of destroying artworks in a simulated gallery, *ArsDoom* produces mimetic operations through which objects behave and appear as something *other* than their in-game representation.

Chapter 3 extends a history of 3D game engines to the popular first-person shooter *Quake* (1996) and its repurposing by artist collaborative JODI for their work *Untitled Game*: a series of fourteen mods developed between 1996 and 2001 that transform the game's 3D spaces into gyrating and pulsating abstractions. JODI's use of glitch produces anamorphic forms—warped, yet geometrically accurate spaces—that destabilize the normal perception of perspectival rendering in *Quake*'s 3D environments. Here, I situate the perceptual fluctuations elicited from *Untitled Game* within avant-garde traditions of the structural flicker film prominent throughout the late 1960s and the early 1970s, referring to JODI's work as *flicker mods*. As with the stroboscopic frames of the flicker film, *Untitled Game* produces a threshold experience that simultaneously elicits a perceptual awareness of the mod's stimulating effects while inciting a range of affective responses. Though kinesthetic illusions of rotating, flickering, and somersaulting forms, JODI's mods work to attune the body's self-sensitivity toward navigating anamorphic space.



Chapter 4 attends to concepts of pathfinding and bot AI in works by artists Julian Oliver and Tom Betts, who both utilized the *Quake III: Arena* engine (Id Tech 3) to generate automatic glitch sequences. Specifically, I focus on Oliver's mod *ioq3aPaint* created in different versions between 2002 and 2010, which employs the engine's AI system and a "redraw" glitch to visualize painterly abstractions of trailing frames and motion blurs. In 2002, Betts also used the engine to create his mod *QQQ*: a generative system that takes advantage of a multiplayer deathmatch server to render continuously mutating glitches in real time. Thinking beyond the representationalist label of high modernism that Oliver and Betts' mods are often assigned, I frame the aesthetic importance of their work within kinetic and conceptual art movements throughout the 1960s, namely the generative systems and techniques of artists Jean Tinguely and Hans Haacke. Like Oliver and Betts' mods, Tinguely's Meta-matic machine sculptures and Haacke's installations utilizing natural and physical elements, articulate complex systems that give rise to aesthetic engagements through their autonomous operations. In Oliver and Betts' work, the autonomy of glitch disrupts our experience of arena deathmatch play by distributing perception across a visual field, turning our gaze to the engine as an abstract generative system. This spatial disruption in *ioq3aPaint* and *QQQ* produces an embodied encounter through which the game's violence is transposed into a nonrepresentational *violence of sensation*.

The book's final chapter explores open world game engines and contemporary modding practices through the machinima installation *WE BUILD WORLDS* (2018–19) created by the artist group STRT/SLCT (Krista Hoefle and Eli Kahn). In the work, Hoefle appropriates player footage of exploring the procedurally generated universe in *No Man's Sky* and glitches the game's strange alien worlds, producing abstract color fields that seep out of a reoccurring grid structure. Through an aesthetic of disorientation, Hoefle positions the viewer in an autonomous perspective that shakes and pans as it traverses alien planets and observes unfamiliar flora and fauna. These projected sequences are synchronized to Kahn's vibrant musical compositions. The artists combined the projected machinima with playful forms of sculptural interaction: fluorescent tentacles, a soft sculpture of a spacecraft, papercraft gems, and neon grids illuminated via blacklight. Drawing from feminist materialisms and specifically, object-oriented feminism (OOF), I argue that the spatially disorienting experiences of *WE BUILD WORLDS* disrupt hegemonic modes of video game play by eliciting an awareness of the game engine as a feminist-oriented *object*. This critical form of spectatorship produces empathy for a game engine as a technical thing of



*exploitation* in its materially situated and embodied relations with humans. Here, I employ the concept of *mirrorless affect*, modified from Cristina Albu's term "mirror affect" within contemporary art histories. When Albu's mirror affect refers to embodied interactions with works that reflect the presence of self and those around us, then *mirrorless* affects disassociate the body from standard interfaces, play experiences, and identification with the game by failing to reflect corresponding player input. By disclosing the strange agency of a game engine, *WE BUILD WORLDS* catalyzes proprioceptive disorientations that generate radical difference through our embodied experiences with others.

In the book's conclusion, I suggest that modding's continuation into the present is expressed through its historical *intractability*, or rather the disordering of space as something difficult for the player to control or comprehend, a space that is uncooperative, awkward, and unruly. Here, I look at the work of artist, curator, and activist Anne-Marie Schleiner, particularly her mod *Velvet-Strike* (2002) designed and performed in collaboration with Joan Leandre and Brody Condon. Drawing from Schleiner's concept of ludic mutation, I suggest that art modding's intractability emerges from a symbiotic relationship among game industries and communities of practice who find new ways to repurpose engines and disrupt impositions of power by feeding abstract noise into existing systems.

## A (Scroll) Down Memory Lane

### Nonplay and the Vitality of 8-bit Engines in Cory Arcangel's *Super Mario Bros.* Mods

*My real experience with video games was watching other people play. That's why a lot of my work isn't really about playing. It's about watching video games.*

—Cory Arcangel, Interview with Mary Heilmann

Since the early 2000s, Cory Arcangel's work has investigated the relationship among the art world, digital media, and technicities of the Information Age. Working with video, game mods, installation, performance, and experimental music, his projects range from hacking Nintendo cartridges to produce animations, creating large color field C-prints with simple gradient tools in Photoshop, to arranging Arnold Schoenberg's infamously complex atonal *Drei Klavierstücke, Op. 11* using notes hit by cats walking on piano keys in YouTube videos. Arcangel's practices often work through a Warholian pop sensibility, at once appropriating popular technologies while playfully subverting our habitual interactions with digital media. Initially, Arcangel approached game modding through musical composition. In 2000, he graduated from Oberlin College Conservatory of Music, where he studied classical guitar and majored in music technology. At Oberlin he met fellow collaborators Paul B. Davis, Joseph Beuckman, and Joe Bonn, forming the Beige Programming Ensemble. Working under the label BEIGE, together they released *The 8-Bit Construction Set* (2000), an album produced in its entirety using 8-bit sounds captured from retro game systems. Not unlike John Cage's experimental compositions, Arcangel's musical approach foregrounds the use of readymade technologies to generate soundscapes and parallels a critical exploration of video games as an artistic medium.

With his game mods, Arcangel attempts to defamiliarize expectations of play often by limiting the player's control and disrupting flow, compromising their chances of winning. His mod *Super Slow Tetris* (2004), a hacked NES cartridge of *Tetris* (1984), confronts players with a version of the classic game in which it takes roughly eight hours for blocks to fall and finish a round. Players can move blocks right and left but the excruciating fall time makes for nearly impossible gameplay. In some mods, Arcangel removes player interaction entirely, presenting his work as time-based animations. In *Super Mario Clouds* (2002) (SMC), Arcangel rewrites the source code for *Super Mario Bros.* (1985) (SMB) using a hex editor, removing the PRG-ROM from the game cartridge and burning new code onto the chip so that the game's iconic blue sky and scrolling clouds are the only remaining graphics. In *Super Mario Movie* (2005) (SMM), Arcangel in collaboration with Paper Rad collective used similar ROM hacking techniques to program a tragic machinima in which Mario contemplates his existence within a deteriorating gameworld.

Christiane Paul, the curator of Arcangel's 2011 *Pro Tools* exhibition at the Whitney Museum of American Art, argues that his works investigate the braiding of different knowledge frameworks: tech industry expertise and the punk, DIY ethos of the 1980s.<sup>1</sup> This DIY attitude is evident in the documentation on Arcangel's website and in his zine *The Source*: a collection of instructions and code for his works. These how-to manuals allow one to replicate SMC or *Pizza Party*, a program that automatically orders Domino's pizza using command line at reoccurring times throughout the week. More so, Arcangel's work often elicits a nostalgic remembrance for the recent past through the repurposing of démodé technologies. He grew up in the 1980s among a growing popularity for video games and personal computers, technologies that would come to exemplify dominant technoculture along with the development of the internet in the early 1990s. In an interview with artist Mary Heilmann, Arcangel says that growing up he owned an Apple IIGS and Commodore 64, yet was not an avid gamer. Instead, his fascination with the cultural practice of gaming stemmed from *watching* a friend play an NES. As Arcangel mentions, his game mods and particularly the SMB hacks are largely about the aesthetic work of spectatorship. They engage a mode of embodied perception through a kind of *nonplay* that lacks player input from controllers.<sup>2</sup>

<sup>1</sup> Christiane Paul, "Cory Arcangel: Pro Tools," *Whitney Museum of American Art*, 2011, 1.

<sup>2</sup> Cory Arcangel, interview by Mary Heilmann, *Interview Magazine*, March 21, 2011, <https://www.interviewmagazine.com/art/cory-arcangel>.

As the focus of this chapter, I look at Arcangel's unconventional reuse of the NES as a platform for time-based abstractions that questions two-dimensional gameplay in the platforming genre. Arcangel's *Super Mario Clouds* and *Super Mario Movie* exploit an affective modality of nonplay by eliciting a nostalgic longing for the obsolete NES system. The artist's NES mods point to a broader definition of a game engine beyond its conventional understanding with the development of games like *Doom* (1993) and *Quake* (1996). The introduction of the NES platform in the mid-1980s indicates that an engine is not just software for developing advanced graphics, special effects, and 3D space. Rather at its essence, an engine is the underlying code that correlates and systematizes operations across a platform: rendering graphics, physics, and interpreting relationships between in-game objects and states. Arcangel's *SMB* mods indicate that games of the NES 8-bit era were in fact efficient and inventive engines that animated gameworlds through a unique coordination of code and hardware. Using the NES as a generative framework for artistic production, Arcangel's *SMB* mods defamiliarize the player's embodied perception of scrolling video games by removing the ability to control lateral movement through 2D space. Arcangel employs the scrolling capacities of the NES engine not for player navigation but rather to engage the body with animated forms of graphic abstraction. His ROM hacking techniques destabilize play experiences of 2D platforming through a dismissal of a controller, what I refer to in this chapter as *nonplay*, by eliciting modes of gamic apperceptivity and revealing the speculative ontologies of the NES architecture. In *SMC* and *SMM*, Arcangel presents the NES as a *démodé* commodity, a strange, out-of-fashion object that bares retro game icons and system glitches. Through fragments of commercial images, Arcangel's mods attune the body's proprioceptive response to *SMB*'s two-dimensional gameworld, evoking a melancholic longing for the recent past through kinesthetic impressions of scrolling and strobing graphic tiles choreographed by the NES engine.

## NES Engines and Arcangel's ROM Hacking

In 1980, the Japanese video game company Nintendo achieved success with their hand-held console *Game & Watch* and a year later produced several arcade games including the wildly popular *Donkey Kong* (1981). At this time, Nintendo president Hiroshi Yamauchi and engineer Masayuki Uemura began executing

plans for the Famicom, short for Family Computer: a cartridge-based console intended to compliment the domestic space of the Japanese family room. Launched in Japan in 1983 with a colorful, toy-like appearance, the Famicom emerged among the US video game industry collapse of companies like Atari, Coleco, and Magnavox, largely a result of market saturation and competition from the home computer. By 1985, the red and white Famicom model was launched in North America and reworked into the aesthetically restrained grey and black Nintendo Entertainment System. In his book *I AM ERROR*, Nathan Altice investigates the material affordances of the Famicom and its technical protégé the NES, looking at the hardware, software, and cultural reception of those systems.<sup>3</sup> I draw upon Altice's work on the Famicom/NES platform to demonstrate an archaeology of early game engines as software for rendering dynamic 2D gamespaces, and to better contextualize Arcangel's ROM hacking process.

The Famicom/NES was a prominent console among the 8-bit generation, with "8-bit" designating the binary possibilities for values processed by the CPU. Employing an MOS 6502 processor, the NES includes two types of ROM with each game cartridge: the PRG-ROM that stores the game's source code and the CHR-ROM that includes graphics data. The inclusion of two separate ROM chips for each game's code and graphics palette was a design choice made by Uemura that would allow programmers to decide on how to best allocate memory to either the CPU or the console's Picture Processing Unit (PPU), responsible for transferring graphics into video display. The NES CPU houses a Ricoh 2A03 8-bit processor with a MOS Technology 6502 core that clocks at 1.79 MHz. The 6502 core processor includes a 16-bit address bus that can access and transfer 64KB of memory among system components within what is called the CPU's memory map. The memory map allocates only 2KB for the internal RAM while remaining memory addresses are designated for the PPU, the Audio Processing Unit (APU), game cartridge ROM, and the controller. Because game data is transferred to the NES via cartridge, additional memory is set aside for processing and storing arrangements of graphic tiles as well as color palette information for background scenery.<sup>4</sup>

The architecture of the PPU includes a separate address bus that accesses up to 16KB of memory for graphics data in the form of palettes and tables.

<sup>3</sup> Nathan Altice, *I Am Error: The Nintendo Family Computer/Entertainment System Platform* (Cambridge, MA: The MIT Press, 2017), 3, 6.

<sup>4</sup> Altice, *I Am Error*, 27, 31.

Within each game cartridge, 8KB of memory are stored in the CHR-ROM as pattern tables comprised of 8×8 and 8×16 pixel grids of graphic tiles, while 8KB are used to store background palette data in the form of attribute tables as well as background pattern tiles or name tables. As Altice explains, the “split architecture” of the NES mirrors the division of separate ROM chips within each game cartridge. The CPU carries out the game’s source code, while the PPU routes and displays pattern tables as graphics. The CPU can communicate with the PPU, telling it to arrange graphic tiles or swap out palettes, but it cannot retrieve these graphic tiles directly. The NES can only render game data from the code stored within the PRG-ROM as it does not have a proprietary operating system. The source code for each NES game engine, or rather, the PRG-ROM code, is compiled using assembly language. Written using a hexadecimal base 16 numerical system that uses values 0–9 and A through F, assembly code includes lines of three-letter mnemonic along with a number value. The letter portion serves as instructions for the CPU to carry out while the number represents a specific address. Altice suggests that because the organizational structure of assembly language bears a relation to the CPU architecture, it afforded programmers the ability to meticulously control NES hardware and generate new game physics and worlds.<sup>5</sup>

Designed by Shigeru Miyamoto, Nintendo released *Super Mario Bros.* in 1985, which would become one of the most influential and well-designed video games in the medium’s history. The success of Miyamoto’s fantastical narrative, in which plumbers Mario and Luigi travel through the Mushroom Kingdom and battle surreal creatures to save Princess Toadstool from the evil King Koopa, is largely based on the game’s side-scrolling “platformer” design. Miyamoto along with programmers Toshihiko Nakago and Kazuaki Morita created the *SMB* source code to utilize the full capacities of the NES split hardware architecture. The game was intended to showcase the possibilities for rendering a dynamic, 2D gameworld on an 8-bit system. Nintendo previously explored the platformer design with arcade games *Donkey Kong* and *Mario Bros* released in 1983. Both games allowed the player to jump up and across multiple tiers or “platforms” but did not reveal the gameworld through a horizontally scrolling screen. The innovative design of Miyamoto’s *SMB* introduced players to sequential levels that revealed obstacles and enemy encounters through the engine’s scroll. Altice notes that Nakago and Morita were able to program

<sup>5</sup> Ibid., 32, 50–1.

the complex graphic sequences in the *SMB* engine with only 40KB by using compressed metatiles, or multiple tile combinations that are grouped as one object. As an example, Mario, Luigi, a Goomba, cloud, and pipe are all metatiles comprised of unique pixel arrangements and colors. The *SMB* engine was designed to move graphic tiles based on grouping objects as types. The game's source code executes the positioning of metatiles based on categories such as "enemies" or "player objects."<sup>6</sup> Here, compression plays a fundamental role in how *SMB* utilizes repeatable sections of metatiles for different level designs. Varied worlds in the Mushroom Kingdom appear as such because palettes are swapped out for combinations of graphic tiles so that levels have their own unique styles: underwater worlds, lava-filled dungeons, and so on.

With NES engines, the PPU RAM cannot store multiple pattern tiles. Compressing metatiles saves memory requirements by handling larger, integrated graphic patterns, which are unrolled throughout the game's longer 2D levels. An efficient NES engine assigns rules and physics to specific groups of object types. For instance, as metatiles, Mario and Luigi both activate an extra life if they jump and hit the bottom of a box containing a 1UP, or certain enemies die if Mario jumps on their heads. Nagako and Morita developed *SMB* so levels are rendered through processes that group and control tiles, what Altice refers to as set decoration, area object data, and enemy object data.<sup>7</sup> The set decoration algorithm continually reveals the background and foreground terrain of each level: clouds, sky, hills, buildings, plants, and so on. The engine renders area object data consisting of pipes, bricks, and power-up blocks: items that Mario interacts with in the gameworld. These objects make up the platforming elements of the game. Enemy object data refers to the way enemies (Goombas, Koopa Troopas, Buzzy Beetles) obstruct Mario's movement through scrolling space.

The engine's ability to scroll in coordination with player movement is executed by algorithms that define two thresholds along the horizontal axis of the screen. The primary threshold is located at 80 pixels from the left side of the screen, while the second threshold is at 112 pixels from the left side of the screen. Once the player moves the furthest pixel on Mario's left side past the first threshold, the engine begins to render the scrolling gameworld. As Mario accelerates, his metatiles remain within the 32-pixel area between both

<sup>6</sup> Ibid., 123–4.

<sup>7</sup> Ibid., 127.

thresholds. When Mario hits top running speed, he remains constant with the rightmost threshold.<sup>8</sup> These scrolling mechanics play a fundamental role in how Arcangel uses the NES split architecture to produce his abstract game modifications.

Arcangel's *SMC* holds a canonical status in ROM hacking communities and media art histories more broadly. It is in the permanent collection at the Whitney Museum of American Art and was exhibited at the Whitney Biennial in 2004, again in 2009, and at Arcangel's *Pro Tools* show at the Whitney in 2011. Art criticism often situates *SMC* within discourses of pop art and landscape painting through the appropriation of the game's iconic clouds as an entertainment commodity. In his DIY tutorial *The Making of Super Mario Clouds* (2002–03), Arcangel provides commentary, source code, and step-by-step instructions for reproducing the mod. As Arcangel describes, he “took an old Super Mario Brothers Nintendo video game and erased everything but the clouds.”<sup>9</sup> In conjunction with the 2004 Whitney Biennial, Arcangel released an instructional “documentary” video of his ROM hacking process also titled *The Making of Super Mario Clouds*. At 76 minutes, Arcangel films his *SMB* hack utilizing an intentionally shaky camera while framing certain minutiae of everyday life in his apartment: an electric guitar, a tartan-upholstered couch, wire cutters, a VCR, speakers, and a mess of old NES cartridges.

In the initial lines of his code Arcangel includes various disses from pop culture references, in particular the observation by hip hop group Grand Nubian that “punks jump up to get beat down”: a reference to other artists who according to Arcangel, “think they can step up to my style.”<sup>10</sup> Arcangel reasons in the code's comments that the disses are a citation to the 1980s cracking scene in which bedroom gamers and programmers would often leave insults within flashy intro animations when distributing pirated software. As with previous NES game developers, Arcangel mentions that he used assembly language because it allows for precise control over the NES system. He initially establishes code for the compiler, or the operations that convert the source code into machine level code so that it can be interpreted by the NES hardware. The sequence also tells the compiler to work with the PRG-ROM using a file titled “clouds.hex.” The next sequence of code informs the cartridge ROMs to operate once the NES reset

<sup>8</sup> Ibid., 153.

<sup>9</sup> Cory Arcangel, “The Making of Super Mario Clouds,” in *Cory Arcangel: Beige*, ed. Raphael Gyga (JPR, 2006), 106.

<sup>10</sup> Ibid., 106–7.



button is pressed. The code then loads the colors used for the clouds and sky for the PPU, using the palettes blue, light blue, black, and white. Arcangel upholds that he removed only the PRG-ROM while keeping the CHR-ROM intact, stating that “since I do not touch the graphics from the original cartridge, the clouds you see are the actual factory soldered clouds that come on the Mario cartridge. There is no generation loss, and no ‘copying’ because I did not even have to make a copy. Wasss up.”<sup>11</sup> Lastly, the code interprets the background pattern tiles for the “cloud.hex” file, loads the graphics settings for the clouds, and renders their scrolling movement. More so, Arcangel documents his process of physically modifying the cartridge, removing the PRG-ROM by clipping the legs from the chip and melting the connecting wires with a soldering iron. He then attaches a 28-pin socket so that a new PRG-ROM chip can be inserted. The source code is loaded onto a new 27C256 chip using an EEPROM burner and placed back into the cartridge through a hole cut in the plastic (Figure 1.1).<sup>12</sup>

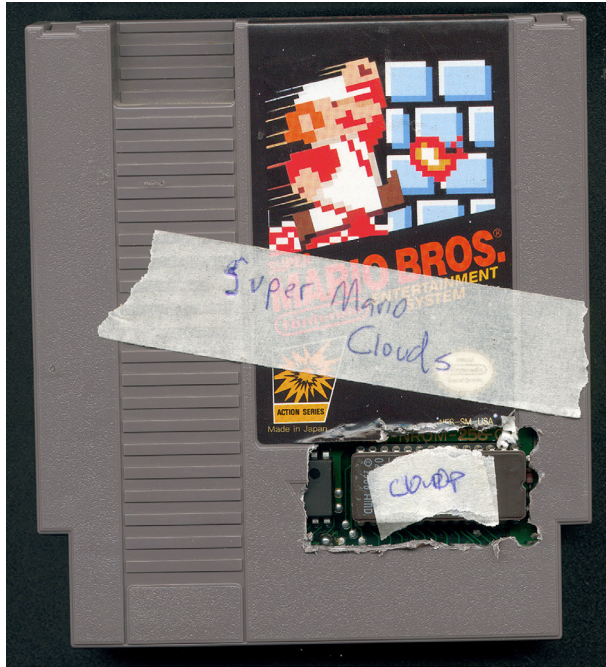
Yet, however much Arcangel’s documentation appears to provide a DIY framework for rendering sky and fluffy clouds sans the remainder of the Mushroom Kingdom, he ambiguously plays with the fidelity of the clouds to their source material in *SMB*. In his analysis of SMC aptly titled *Everything but the Clouds*, Patrick LeMieux questions the integrity of Arcangel’s clouds and the artist’s claim to appropriating their original graphic data. Looking at Arcangel’s code and framing devices in the SMC video documentation, LeMieux argues that the artist’s DIY ethos intentionally contradicts his artwork. Instead, SMC uses the NES architecture to repurpose the existing cartridge ROM and generate a type of “home brew game” through an asignifying rupture of the original cloud icons.<sup>13</sup> LeMieux further points out that Arcangel’s *The Making of Super Mario Clouds* instructional video is meticulously staged with affectations that mirror the artist’s persona.

In the video, glitch patterns of magnetic tape interference roll down the screen and an intentionally blurry camera masks important steps in the artist’s ROM hacking process. To LeMieux, Arcangel’s documentation foregrounds conceptual techniques of erasure within histories of the avant-garde, much like Robert Rauschenberg’s well-known erasing of a Willem de Kooning drawing in 1953. Yet, in his examination of Arcangel’s source code compared to the original

<sup>11</sup> Ibid., 109.

<sup>12</sup> Ibid., 107, 109, 114.

<sup>13</sup> Patrick LeMieux, *Everything but the Clouds*, directed by Patrick LeMieux (New York: Platform Games at Babycastles, 2017), Digital Video, <https://vimeo.com/241966869>.

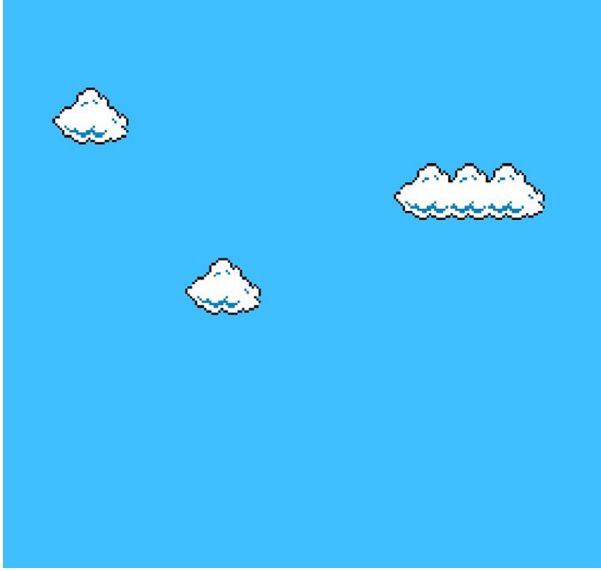


**Figure 1.1** Cory Arcangel, *Super Mario Clouds*, 2002. Hacked *Super Mario Bros.* game cartridge. Courtesy of Cory Arcangel.

*SMB* code, LeMieux reveals that *SMC* is a different entity: it bears no relation to the game's original scrolling palettes and tile patterns. LeMieux even goes as far as to brilliantly recreate *SMC* using Arcangel's tutorials, producing a mod in which everything but the clouds are *erased*, except for one small gold coin within the frame. As LeMieux points out, by assembling an entirely new series of clouds rather than borrowing the readymade status of the original tiles in *SMB*, Arcangel merely uses the representation of the *SMB* clouds as pop icons within a commodity aesthetic.<sup>14</sup>

Through their continual scrolling, Arcangel's clouds become analogous to Warhol's grids of Campbell soup cans: repetition and seriality transform the familiar commodity image into abstract forms. If the erasure of a work always possesses some trace of the original, then Arcangel's scrolling clouds playfully question the conceptual practices of erasure and appropriation by having

<sup>14</sup> Ibid.



**Figure 1.2** Cory Arcangel, *Super Mario Clouds*, 2002. Screenshot.

us question if a palimpsestual residue of the CHR-ROM remains on screen (Figure 1.2).

LeMieux's analysis does significant work to question the status of *SMC* as a readymade object and the authenticity of Arcangel's ROM hacking. My interest here isn't so much the fidelity of Arcangel's clouds as it is how he employs the generative properties of the *SMB* engine and NES hardware within an economy of aesthetic production. In an interview with John Bruneau, Arcangel discusses the economy of NES modding: "I like these systems not cause [*sic*] of nostalgia, but because they are cheap and easy to work. Also they are the perfect middle ground between analogue and digital video."<sup>15</sup> Similarly, in an interview with curator Eryk Salvaggio, Arcangel elaborates on the aesthetic affordances of the NES platform:

at this point most of my interest in the game is in the 16X16 sidescrolling graphical limitations . . . I don't love the games so much, but I really love the systems. I love the look that the old Systems have. For one, the NES directly accesses the TV's colors. So you tend to get these really bright colors on older TV's, much brighter than cable, or VHS tapes. This kinda thing also looks good

<sup>15</sup> Cory Arcangel, interview by John Bruneau, "John Bruneau's Interview with Cory Arcangel vs The Stefanix of \_SWITCH," <http://artfail.com/arcangel/>.

even as a glow cast on a room. Like my cloud cartridge was really made for a TV I have in the corner of my apt, so at night it makes my living room glow that slurpy blue of the sky in the game. Second, I really like the idea of scrolling. Even more than movies, games tend to frame narratives in such a way that people really believe that the game world extends beyond the borders of the screen. All you have to do is move the joystick left or right to see it.<sup>16</sup>

Here, I would argue that Arcangel's hacking of the *SMB* cartridge points to a unique economy of modding predicated on NES engines (a game's source code) and the system's split architecture. As LeMieux tells us, Arcangel's clouds *are not the SMB clouds*. They are something different that relay a pop superficiality reminiscent of the original. Instead, Arcangel employs the technics of the NES to question the body's habitual relationship to the 8-bit scrolling platformer. In this case, the modded NES generates new forms of sensual engagement by defamiliarizing our perception of game icons through an affirmation of their difference. Moreover, Arcangel's *SMC* and *SMM* work to destabilize player movement within 2D space through the abandonment of a controller. I now look at how the technical operations of Arcangel's mods engage the body's sense of gamic apperception by revealing the speculative ontologies of the NES architecture.

## Speculative Ontologies of an 8-bit World

The body's aesthetic investment in Arcangel's mods serves as an interaction with the speculative reality of an 8-bit world, or what I refer to as the unit operations within the cartridge and system that disclose the vital energies of the mod's abstract arrangements. In examining the body's interaction with the nonanthropocentrism of an NES, I draw upon the metaphysics of early twentieth-century philosopher Alfred North Whitehead as well as recent conversations in object-oriented ontology and speculative realism that stem from his work. Whitehead's philosophy aims to interrogate anthropocentrism as the assumed epistemological framework within contemporary traditions of Western thought, or rather the ways in which we've come to know ourselves and the world through a limited human worldview. Whitehead suggests that

<sup>16</sup> Cory Arcangel, interview by Eryk Salvaggio, "Cory Arcangel Doesn't Even like Super Mario Brothers," April 2003, <http://turbulence.org/Works/curators/salvaggio/arcangel.html>.

we must exceed the “bifurcation of nature”: the sensory modalities through which we understand the material world and the unseen material reality that undergirds worldly appearances.

Whitehead abandons this binary in favor of a neutral ontology among things and processes in the world. He argues for a vibrant and inclusive metaphysics in which “the red glow of the sunset” and its “molecules and electric waves” possess the same ontological framework.<sup>17</sup> Material reality is not so much constructed of things as it is of unique processes, differentiations, and variations. In this way, a body is not reduced to a subject apprehending an object separated from one another, but rather both possess the same ontological status through their becoming; the processes that shape a thing into being: human, NES, silicon, and scrolling cloud.<sup>18</sup> We perceive an interrelatedness among things that works beyond human-centered epistemologies.<sup>19</sup> Human coexistence with other material forms consists of unique processes, yet is simultaneously composed of “drops of experience, complex and interdependent.”<sup>20</sup> Through Whitehead’s work, I frame modding aesthetics as the correspondences among body and the engine’s technical procedures; or rather, the ways in which “drops of experience” among player, pixel, spectator, 6502 processor, PPU, cartridge, and a blue color palette affirm novel forms of human (and nonhuman) embodiment.

In *SMC* and *SMM*, Arcangel defamiliarizes our experience of movement and space within the 8-bit platformer, drawing attention to the strange ontological vibrancy of the SMB engine and NES split architecture. Through glitches that foreground a nonhuman phenomenology of the NES and its material operations, Arcangel’s mods elicit an apperceptive response by exposing the vitalist energies and relationality of the NES’ working components. Stemming from Whitehead’s speculative philosophy, Ian Bogost’s work has sought to deterritorialize the long-held philosophical attention given to anthropocentrism by considering the vital being of everyday things like rock formations, computer hardware, a habanero pepper, and a black hole, or what he calls an alien phenomenology. This expresses the way things cohabitate and experience each other within

<sup>17</sup> Alfred North Whitehead, *The Concept of Nature* (Amherst, NY: Prometheus Books, 1920/2004), 29–32.

<sup>18</sup> Alfred North Whitehead, *Process and Reality* (New York: Free Press, 1929/1978), 22–4, 56–8.

<sup>19</sup> Alfred North Whitehead, *Science and the Modern World* (New York: Free Press, 1925/1967), 87–90.

<sup>20</sup> Alfred North Whitehead, *Process and Reality*, 18.

material linkages that work outside of human knowledge.<sup>21</sup> Expanding upon theories of object-oriented ontology in the work of Graham Harman and Levi Bryant, Bogost develops an alien phenomenology from the problem of “correlationism,” a term coined by Quentin Meillassoux to suggest that material things exist only in their relationship to humans.<sup>22</sup> Instead, an alien phenomenology draws from an outright abandonment of correlationism. It is not concerned with human utility and access to worldly objects. Rather, it is a mode of speculative inquiry that aims to unveil the ontological complexity among material things while working to decenter human epistemologies. This anticorrelationist thought is approached through what Bogost calls a metaphysics of ontography: a strategy of revealing the interobjectivity of things and their complex operations without classification or definition. Bogost tells us that “Like a medieval bestiary, ontography can take the form of a compendium, a record of things juxtaposed to demonstrate their overlap and imply interaction through collocation.”<sup>23</sup>

The strangeness and incomprehensibility of objects are unveiled through their ontographic relationships, but also through what Bogost calls metaphorism, or the ways we perceive the vitality of things through analogies to other material objects, instruments, and processes. In this way, metaphorism uses anthropomorphic thinking to imagine a thing’s material actions, offering a corrective to human-centered experiences of the world.<sup>24</sup> Here, I frame our embodied involvement with Arcangel’s mods through an alien phenomenology, at once offering an ontographic mapping of the NES architecture and describing its operations through the uncanny nature of metaphor. In this case, aesthetics is not limited to the viewer’s subjective experience of Arcangel’s floating clouds but rather is a reciprocation of material operations among things: PRG-ROM, eye, silicon, PPU, “cloud.hex,” 28-pin socket, 14-bit address bus, kilobyte, metatiles, palette, CHR-ROM, white, front-loading cartridge socket, sprite, pattern, control deck, reset button, 72-pin cartridge, gallery, pixel, engine, slot, plastic, blue, cloud, and so on. Arcangel’s ROM hacking process and documentation portray the NES system’s lively constitution through, as I argue, a kind of anthropomorphic metaphorism. The SMB engine, MOS 6502 processor, and

<sup>21</sup> Ian Bogost, *Alien Phenomenology, or What It’s Like to be a Thing* (Minneapolis, MN: University of Minnesota Press, 2012), 34.

<sup>22</sup> Quentin Meillassoux, *After Finitude: An Essay on the Necessity of Contingency*, trans. Ray Brassier (London: Bloomsbury Academic, 2017), 5.

<sup>23</sup> Bogost, *Alien phenomenology*, 38.

<sup>24</sup> *Ibid.*, 64.

PPU all possess unique modes of object perception that *see* the gameworld from different vantage points.

The body perceives Arcangel's scrolling clouds through an apperceptive intuiting of the NES platform's inner workings and the potential ways in which an antiquated game system functions as an engine of abstraction. Yet, within the NES split architecture, the system's constituent parts perceive the moving clouds in a multiplicity of ways. Metaphorically, we can think of the modified PRG-ROM, the "cloud.hex" data, as a vessel that stores a series of commands dictating the rules by which SMC operates. We might imagine it is a sacred text or code of law written in a mystic language, delivered to the CPU from a spiritual realm. The CPU is the system's brain, interpreter, and high priestess who carries out this code of law, sending data to other hardware components, instructing her various delegates. When the cartridge is inserted, the CHR-ROM operates as a storehouse filled with relics and offerings. These items are transported to a separate room within a temple or NES console, where the PPU chip, our resident shaman and conjurer, arranges and blesses the relics through various incantations, summoning a spirit vision, or a video signal for display. The CPU high priestess gives orders to the PPU shaman from their distinct sanctums, guiding him on how to arrange relics in specific ways. Yet, both priestess and shaman closely work together to summon an otherworldly phantasmagoria: moving sights and sounds projected into the sky. Clearly, in this performance of an alien phenomenology, I analogize the NES to the rituals of an ancient temple and consider the various object perceptions of its parts. My aim is to examine Arcangel's use of the NES to generate forms separated from *SMB*'s source content, unveiling the system's forensic environments and opening aesthetic experience to speculative realities hidden from human perception. Each part of the NES engine and hardware abides by its own technical duties yet exists within a web of complex and dynamic interobjectivity. I now look at how Arcangel's *SMM* mod communicates its own alien phenomenology and makes strange our habitual encounters with 8-bit platforming through an aesthetic of glitch.

## The Vitality of Glitch

In the context of Arcangel's mods, I define glitch within a more inclusive media landscape as an aesthetic of error, or when a media object enters a non-normative state of disruption. Recent conversations in glitch art revolve around



issues of purity. Media art communities see glitch as an unpredictable rupture in a system's operations, generating novel and unexpected results. Anyone who regularly uses a computer or plays video games has more than likely witnessed the spontaneous generation of a glitch. A glitch can take the form of a crashed game system or compression errors that occur when streaming Netflix, a momentary suspension in functionality that portrays dynamic abstractions hidden beneath the interface. Some artists consider glitch through what Curt Cloninger calls "wild" in its pure form and attempt to capture a trace of these fleeting noise artifacts.<sup>25</sup> On the other hand, artists such as Arcangel, JODI, and Julian Oliver establish software constraints to execute a possible range of glitch patterns. This intentional form of glitch is what Rosa Menkman refers to as "domesticated," or when a noise artifact is produced through a computational tool and aided by human intervention.<sup>26</sup> Alexander Galloway reinforces a broader definition of glitch in his discussion of gameplay and the material actions of both system and player. He calls one area of this player-system interaction "nondiegetic machine acts," or operations carried out by the system that are essential to gameplay but are not included in the game's narrative world. These acts consist of loading times, power-ups, statistics, as well as crashes and glitches. Galloway refers to these errors as disabling acts: instances when the system ceases to function properly and breaks down the gameworld, spontaneously generating "wild" glitches.<sup>27</sup> Yet, as Galloway illustrates, disabling acts become recontextualized through techniques of counter gaming in which artists subvert gameplay through the production of glitch.<sup>28</sup>

Regardless of the purity of glitch and how its technical abstractions come into being, I consider glitch within a broader aesthetic field consisting of multiple techniques and practices. Rosa Menkman aptly reinforces this view by describing glitch as "a procedural activity demonstrating against and within multiple technologies," or what she calls a critical transmedia aesthetic. This approach seeks to discover a medium in decay and ruin, unfamiliar and neglected, whether accidental or intentional, that disorders the normal registers through which consumers interact with media technologies. At the same time,

<sup>25</sup> Curt Cloninger, *One Per Year* (Brescia: Link Editions, 2014), 77.

<sup>26</sup> Rosa Menkman, "Glitch Studies Manifesto," in *Video Vortex Reader II: Moving Images beyond YouTube*, ed. Geert Lovink and Rachel Somers (Amsterdam: Institute of Network Cultures, 2011), 342.

<sup>27</sup> Alexander Galloway, "Gamic Action, Four Moments," in *Gaming: Essays on Algorithmic Culture* (Minneapolis, MN: University of Minnesota Press, 2006), 28.

<sup>28</sup> Galloway, "Counter gaming," 107–9.



this aesthetic questions the ways a user perceives forms of genre and interface, as well as their assumptions about a media object's functionality.<sup>29</sup> When media enter a critical state through errors in feedback or encoding/decoding, it catalyzes what Menkman calls a "destructive generativity" and the subsequent creation of unexpected media forms and novel sensory engagements among the user and the system.<sup>30</sup> A concise understanding of glitch is perhaps best summarized by Olga Goriunova and Alexei Shulgin in describing it as "when *something obviously goes wrong*." Glitch is a singular event that exposes a medium's underlying materiality and "the ghostly conventionality of the forms by which digital spaces are organized."<sup>31</sup>

Within this glitch aesthetic, the abstract forms Arcangel produces reveal the strange phenomenology of the system's components through embodied operations of mimesis. In *SMC*, glitch engages the viewer through an apperceptive lingering, a moment when perceptive faculties draw awareness to the game's non-normative state. Arcangel uses the *SMB* engine and NES as a generative site for animated forms and his scrolling clouds position the viewer at a phenomenal moment when "something obviously goes wrong." The absence of Mario as a controllable avatar and the standard vistas of the Mushroom Kingdom serve as a form of glitch. The game is thrown into an unfamiliar state except for the iconic, albeit "home-brewed" (to borrow LeMieux's phrasing) clouds and blue sky. The graphic restraint of Arcangel's knockoff brand clouds highlights the material processes of modding and the vitality of the NES system. The clouds and absence of the gameworld have us consider object relations at work and the mechanisms within the NES that render the scrolling clouds as unique and interrelated.

Arcangel's *SMM* was produced in 2005 as an experimental video sequence with the art collaborative Paper Rad, known for their colorful, lo-fi zines, comics, and video as well as their affiliation with punk and "retro-tech" subcultures of the 1990s. Arcangel not only wrote the *SMM* engine using the same ROM hacking techniques in *SMC* but also programmed a separate music engine that employed the NES APU to produce an original soundtrack accompanying the video's animations. Using the custom music engine, Paper Rad's Jacob Ciocchi composed an 8-bit techno rave soundtrack that utilizes all the notes from the

<sup>29</sup> Rosa Menkman, "Glitch Studies Manifesto," 344.

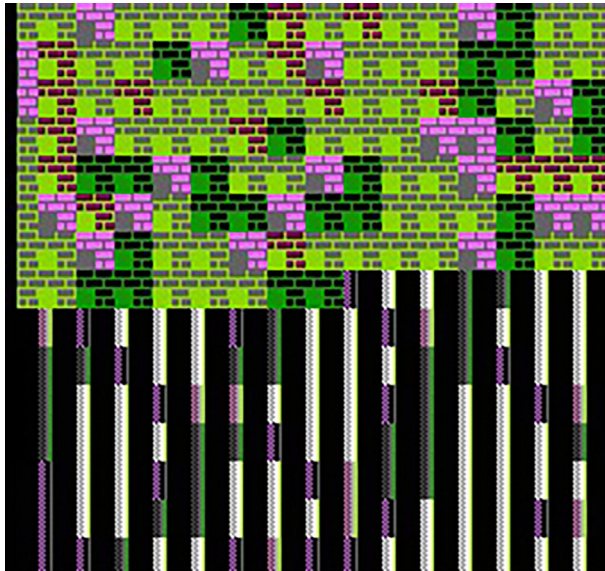
<sup>30</sup> *Ibid.*, 339, 341.

<sup>31</sup> Olga Goriunova and Alexei Shulgin, "Glitch," in *Software Studies: A Lexicon*, ed. Matthew Fuller (Cambridge, MA: MIT Press, 2008), 110, 114.

original *SMB* engine. Arcangel programmed the video's stroboscopic visuals using the original palettes and tiles stored in the CHR-ROM (or so he claims).<sup>32</sup>

In its self-reflexivity of video games, the video follows the iconic Mario who in an existential moment of despair, embarks on an adventure across a rapidly deteriorating gameworld. As Mario's reality falls apart, the internal operations of the system bleed through in the form of abstract glitches that aggressively flicker and pulsate (Figure 1.3). As I argue, Arcangel's glitch aesthetic elicits an apperceptive response in showing the speculative world of the NES system. Through its stroboscopic color grids and rows of alphanumeric values, *SMM* conveys both the figural disintegration of the game's diegetic space and the vitality of glitch forms that Arcangel produces through repurposing the NES. In their perceptual entanglements with *SMM*'s animations, the viewer *feels* the minute ontologies of an 8-bit rave party at work.

In her analysis of the grotesque stop-motion films of the Quay Brothers, Suzanne Buchan examines the filmmakers' technical approach and their surreal tableaux that at once elicit affective pleasures as well as sensations of the



**Figure 1.3** Cory Arcangel and Paper Rad, *Super Mario Movie*, 2005. Screenshot.

<sup>32</sup> Cory Arcangel, *Artist Cory Arcangel Discusses Super Mario Movie*, performed by Cory Arcangel (Washington, DC: Smithsonian American Art Museum, 2009), <https://www.youtube.com/watch?v=oDDCoa71-yY>.

uncanny. The Quay's animated compositions embody a kind of disjointed collage through arrangements of nonanthropomorphic entities (insects, screws, meat), puppets, dolls, and fantastical machines. Through their interactions, the Quay's inanimate, yet lively objects demonstrate a powerful vitality. The combinations of ordinary and extraordinary things—puppets, automata, Rube Goldberg-like mechanisms—familiar and unfamiliar, form material instantiations of intensive pathological states. To illustrate the Quay's stop-motion techniques and the vigor of their strange forms, Buchan uses the concept of vitalism to suggest that the spectator experiences the Quay's cinematic worlds through a force beyond animism. Their puppets, dolls, strings, scissors, and maps do not possess an anima or soul but instead operate through a vitalist will: a nonhuman and nonanthropomorphic energy composed of organic and nonorganic matter.<sup>33</sup>

In their film *Street of Crocodiles* (1986), a reference to a collection of short stories by Polish writer Bruno Schulz, the Quay's use montage, lingering close-ups, miniature sets that distort scale and spatial continuity, and macro lenses to express vague, metonymic fragments of literary and artistic references. Embodied in the eerie movements of their "Schulz" puppet and baby dolls, the Quay's present the viewer with filmic portmanteaus that work through multiple significations within the "psycho-topographic" spaces of their animated film (Figure 1.4). Buchan describes the viewer's experience of the Quay's vitalism as a "moment of apprehension," a term that parallels my understanding of gamic apperception, that being, a sense of grasping at something without "affirmation of that intellection" and what follows is unknown. Apprehension serves as a dynamic of defamiliarization. It is the inability to comprehend the actions and consequences existing within the dissociative spaces of the Quay's cinematic worlds.<sup>34</sup>

Just as the Quay's stop-motion expresses the vitalist will of inanimate objects, Arcangel's ROM hacking exposes the vibrancy of glitch forms produced by the NES. In a scene in *SMM*, Mario meets a small mushroom and both jump upon a floating "1UP" symbol, riding it across a violently glitching landscape. Announced in an intertitle, Mario joins the mushroom on a vision quest, a "spirit rave" which leads their travels to a dance party at a haunted castle with a demon-shaped facade. As they take off, the surrounding computational landscape appears to degenerate through Arcangel's meticulously programmed

<sup>33</sup> Suzanne Buchan, *The Quay Brothers: Into a Metaphysical Playroom* (Minneapolis, MN: University of Minnesota Press, 2011), xx, 33.

<sup>34</sup> *Ibid.*, 68–70, 93.



**Figure 1.4** The Quay Brothers, *Street of Crocodiles*, 1986. Still. Vitalist energies of the Schulz puppet and dolls in *Street of Crocodiles*.

glitches, consisting of “J,” “Y,” and “O” flashing upon the screen as well as scrolling rows of colorful blocks amid a strobing background. As Mario’s spirit rave progresses, the scrolling visuals become increasingly chaotic as block combinations flash sporadically across the frame. Eventually, grids of 0s and fragments of spotted mushroom tiles are introduced into the pulsating blocks which now shift violently up and down. The glitch patterns form irregular rows of blocks, appearing as a tunnel through which Mario begins to scroll, giving the illusion that his body, the mushroom, and “1UP” platform are accelerating through a 2D wormhole (Figure 1.5). The psychedelic flight comes to an end as Mario and mushroom land in front of the demonic castle. This sequence illustrates how Arcangel’s orchestrated glitches evoke an apperceptive response while revealing the alien phenomenologies of the NES. The vitalist energies of erratic tiles sensually engage the body with the system’s operations and abstract video output they generate. The engine instructs the CPU to scroll lurching forms of tiles and palettes, the PPU displays these chaotic arrangements, and the APU plays the soundtrack in synchronization with the glitches. Each gives a glimpse into the unique object perceptions of the NES and position themselves and their material experience as distinct ontological nodes within the broader interconnectedness of things.



**Figure 1.5** Cory Arcangel and Paper Rad, *Super Mario Movie*, 2005. Screenshots. A sequence of glitched tile patterns and Mario's flight through the deteriorating gameworld.





Figure 1.5 Continued.

## The Démodé Object, Pop Art, and the Repetition of Smiling Clouds

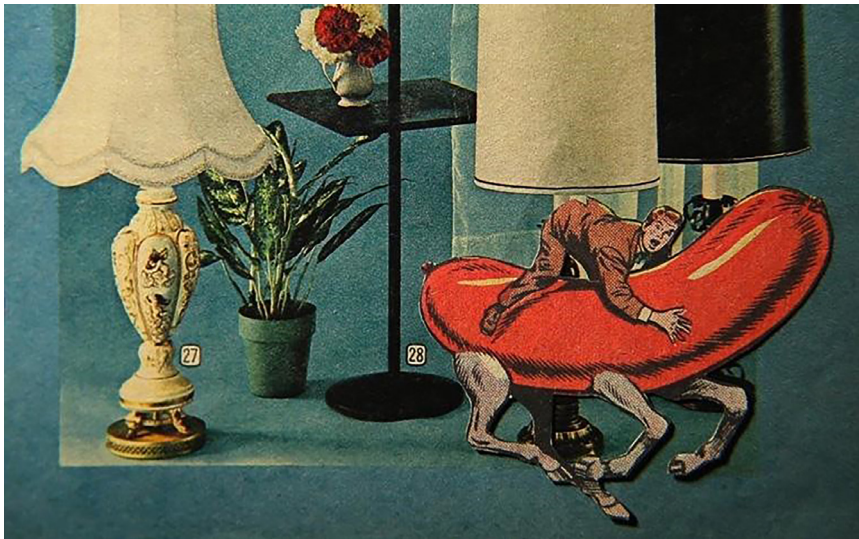
In moments throughout *SMC* and *SMM*, glitch not only elicits the uncanny through its spectral forms but also works upon the body's proprioception through nonplay. Arcangel's configuration of his mods as time-based animations and not as interactive games played through a controller attune the viewer's proprioceptive sensitivity to the side-scrolling mechanics of the 8-bit platformer. Through an inability to control Mario and prompt the CPU to scroll the game's landscapes on the horizon, Arcangel's mods coordinate bodily affectivity with the démodé video game commodity. To think through concepts of the démodé commodity in Arcangel's work, I draw parallels among the artist's attraction to pop culture and the collage films of Lewis Klahr. Klahr's films possess a certain dreaminess of postwar consumer culture once lost, utilizing stop-motion and appropriated fragments of late 1940s *Cosmopolitan* magazines, *Jimmie Olsen* comics, pornography, recipes, and ads for liquor and perfume. Klahr's collage films work to deconstruct the utopic narrative of American consumerism through, as he refers to it, a *reanimation* of the recent past. Like the broken game icons scattered throughout Arcangel's mods, Klahr's pop culture remnants evoke sensuous engagements through their nostalgic forms, or rather, the viewer's empathy for animated scraps of retro print media. In his own writings, Klahr refers to his films not as animation but stop-motion collage which produces a "kinetic interface between the personal and the cultural," and explores the representation of history and memory through the vantage point of the present.<sup>35</sup> Here, Klahr's reanimations express a kind of haunted return of the commodity object. Tom Gunning has discussed the "cultural interface" of Klahr's work through the early twentieth-century avant-garde's fascination with the démodé commodity: a perception of the past revealed through appropriation void of historical thickness. As Gunning describes, the démodé is a return of an object recently forgotten and antiquated that produces a strange recollection. As a once desirable commodity now drained of its market value, the démodé object still possesses a remainder of its libidinal investments through our nostalgic longing.<sup>36</sup>

<sup>35</sup> Lewis Klahr, "A Clarification," in *The Sharpest Point: Animation at the End of Cinema*, ed. Chris Gehman and Steve Reinke (Toronto: XYZ Books, 2005), 235.

<sup>36</sup> Tom Gunning, "Lewis Klahr's *The Pharaoh's Belt* and the Amnesia of Modernity" (conference paper, *Der Blick der Moderne*, Vienna, June 1996), 5, 7.

Klahr's *Pony Glass* (1997), a melodrama in three acts, portrays Superman's friend Jimmie Olsen begin a love affair with the beautiful Lucy Lane, who breaks his heart after leaving him for another man. Overwhelmed with confusion and desire after he kisses a young man, Olsen embarks on a series of homoerotic encounters. He begins dressing as a woman and starts a love affair with his boss Perry White, head editor at the Daily Planet, which leads Olsen to explore his homosexuality with other male suitors. Klahr excavates the pages of comic books, domestic interiors from home magazines, illustrations of classical statues, pornographic centerfolds, as well as food and vanity advertisements to stylize Olsen's sexual delirium (Figure 1.6). Klahr expresses the anxieties of Olsen's sexual crisis through material reanimations that subvert the dominant heteronormativity of the postwar era. Just as Klahr employs a commodity aesthetic of 1950s mass consumerism, Arcangel recontextualizes the NES as a *démodé* object of 1980s video game culture. When Klahr reanimates and subsequently deconstructs mid-century culture through his comic book cutouts, Arcangel uses the NES' 8-bit aesthetic to access our libidinal desires *to play* by highlighting the system's familiar pixelated forms and placement in gallery.

The *démodé* aesthetic of Arcangel's NES mods is indebted to a tradition of pop art within histories of the neo-avant-garde. Arcangel's work bears the



**Figure 1.6** Lewis Klahr, *Pony Glass*, 1997. Still. Cut out *démodé* commodities animated through stop-motion techniques in *Pony Glass*.



influence of Andy Warhol, especially in the way he sought to blur the distinction between low-brow consumerism and high art. Arcangel positions himself as a Warhol for the Information Age in the way he abstracts popular video game forms through strategies of appropriation and repetition. His NES mod *I Shot Andy Warhol* (2002) pays homage to Warhol's fascination with the public consumption of glamour and celebrity. Hacking an old cartridge of the NES game *Hogan's Alley* (1984), Arcangel modified the game so that players using the NES Zapper light gun shoot at caricatures of Warhol while avoiding those of Flavor Flav, the Pope, and Colonel Sanders. The mod itself is a citation to Valerie Solanas' attempted murder of Warhol in 1968, yet toys with the fetish of celebrity stardom, requiring the player to eliminate the Warhols—the “bad guys”—while saving the lives of beloved Flavor Flav, Sanders, and the Pope. Benjamin Buchloh argues that Warhol's stylized images of Marilyn Monroe, Elvis Presley, and Elizabeth Taylor retain their aesthetic appeal not through the enduring myth of those celebrities' stardom, but through “the tragic condition of those who consume the stars' images in scopic cults.”<sup>37</sup> Warhol discusses the tragic consumption of the celebrity image in relation to his experimental films:

I made my earliest films using for several hours just one actor on the screen doing the same thing: eating or sleeping or smoking: I did this because people usually just go to the movies to see only the star, to eat him up, so here at last is a chance to look only at the star for as long as you like no matter what he does and to eat him up all you want to.<sup>38</sup>

To Warhol, public obsession with celebrity image results from its reproduction and seriality in various media. The mass-reproducibility of consumer culture echoes Warhol's repetitive and serialized forms: Campbell's soup cans, Marilyn Monroe, Brillo boxes, Mao Zedong, skulls, Coca-Cola bottles. Warhol describes this aesthetic of repetition by stating that “I don't want it to be essentially the same—I want it to be *exactly* the same. Because the more you look at the same exact thing, the more the meaning goes away, and the better and emptier you feel.”<sup>39</sup> Here, Warhol doesn't employ repetition to overcome and thus reintegrate traumatic experience into the symbolic order

<sup>37</sup> Benjamin Buchloh, “Andy Warhol's One-Dimensional Art: 1956–1966,” in *October Files: Andy Warhol*, ed. Annette Michelson (Cambridge, MA: The MIT Press, 2001), 28.

<sup>38</sup> Andy Warhol, “Nothing to Lose,” interview by Gretchen Berg, *Cahiers du Cinéma*, English ed. (May 1967): 39–43. Qtd. in Buchloh, “Andy Warhol's One-Dimensional Art: 1956–1966,” 28.

<sup>39</sup> Andy Warhol and Pat Hackett, *POPism: The Warhol '60s* (New York: Harcourt Brace Jovanovich, 1980), 50.

as in Freudian psychoanalysis. Rather, as Hal Foster argues, Warhol's use of repetition illustrates "an obsessive fixation on the object in melancholy." The colorful rows of Marilyn Monroe in *Marilyn Diptych* (produced after her death in 1962) or grids of gruesome car crashes in the *Death and Disaster* series, simultaneously diminish the gravity of trauma while generating an affective encounter with the traumatic image.<sup>40</sup>

In repurposing the NES system, Arcangel uses the repetition of game icons similar to Warhol's grids of Marilyns and Taylors. In *SMC*, the continually scrolling clouds against an otherwise blank sky work to deplete the game's market significance. Yet, *these are not the original Super Mario Bros. clouds*. They are a representational play of the original clouds that like Warhol's Marilyns elicit a melancholic longing for the recent past. This repetition is evident in *SMM* when Mario falls from his "?" box and the engine vertically scrolls smiling cloud faces, or later in Mario's journey, the horizontal scrolling of spotted mushroom fragments, smiling clouds, and skulls that appear on the bottom of Bill Blaster cannons from the original game (Figure 1.7). Similarly, *SMM* plays with the obsolescence of the *démodé* NES through a kind of Warholian repetition in its narrative structure through a reoccurring intertitle screen. Arcangel programs intertitles that narrate and provide dialogue for Mario throughout his psychedelic journey. The poetic 8-bit intertitles progress into entropy as Mario advances through his crumbling reality and reflects upon the material ephemerality of the NES. For example, the initial intertitle reminds us that

AS A VIDEO GAME  
GROWS OLD  
ITS CONTENT AND  
INTERNAL LOGIC  
DETERIORATE

And later in the journey, as the gameworld falls apart even more, Mario's spirit guide (in a garbled mess) explains that

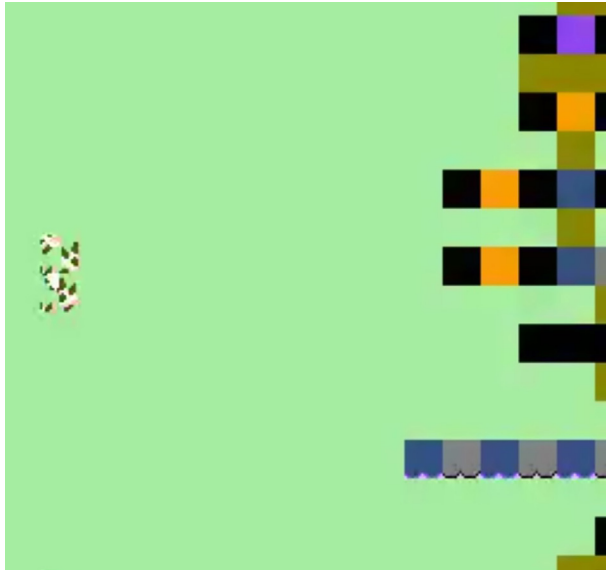
YOU'VE  
BEENIN SOMEONES CLO—  
SET FOR TWENTY YE RS  
OF COURSE THE DATA  
I S MELTI N GGG

<sup>40</sup> Hal Foster, *The Return of the Real: The Avant-Garde at the End of the Century* (Cambridge, MA: MIT Press, 1996), 132.



**Figure 1.7** Cory Arcangel and Paper Rad, *Super Mario Movie*, 2005. Screenshots. The scrolling repetition of game icons.

In other sequences, Arcangel inserts melancholic reminders of obsolete media from the 1980s. When Mario enters the rave party in the demon castle, he bears witness to a short match of *Pong* (1972) between flickering blocks composed of various numbers, bricks, and 1UP tiles.



**Figure 1.8** Cory Arcangel and Paper Rad, *Super Mario Movie*, 2005. Screenshot. Mario transforming into the energy of the NES system.

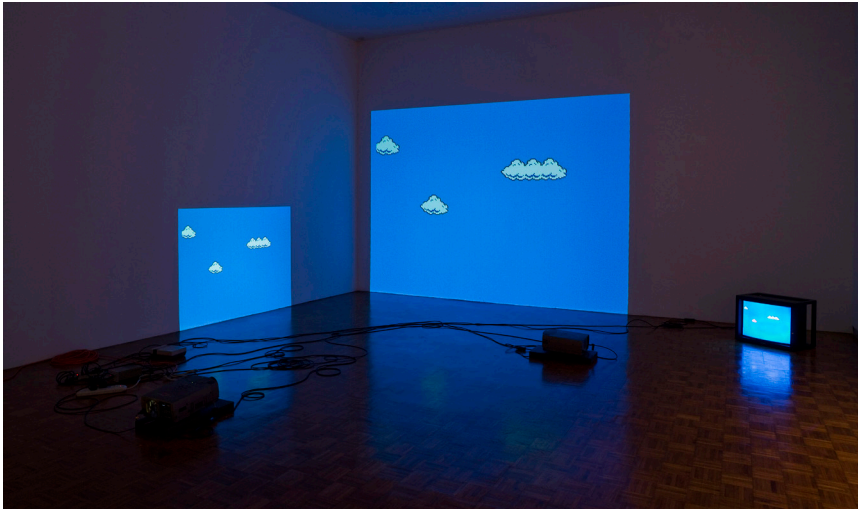
The ball is missed by one of the playing blocks, which causes Mario to project onto a large flickering mosaic of his own face. In this moment, Mario exclaims that “this world is strobing me out,” to which his mushroom spirit guide replies, “you are confronting your energy.” This strobing image of Mario’s face then begins to scroll vertically, similar to a rolling picture on an older CRT television. In this sequence, Arcangel produces the video’s most aggressive instantiation of glitch as Mario’s vision quest reaches a state of nirvana, a moment of transcendence as his body transforms into a frenzied block of tiles. Mario becomes pure “energy”: both avatar and “Mario’s” market value are immanent in the system’s operations (Figure 1.8). As this kinetic block of tiles fades into letters, bricks, and spotted mushrooms jumping wildly across the screen, an intertitle repeats “THE DATA ITS . . .” followed by incomprehensible strings of letters. It is here that Mario transitions into pure data subsumed to the flows of serial communication. Glitches promptly transfer to a white screen which gives way to the initial frames of World 1-1 in *SMB*: the first image the player sees when starting the game. Arcangel comments that the white screen references the NES when a game crashes and Mario’s journey in *SMM* serves as a prequel to the player booting up *SMB* and beginning in the first world.<sup>41</sup>

<sup>41</sup> Arcangel, *Artist Cory Arcangel Discusses Super Mario Movie*.

Yet, what do we make of this 8-bit acid trip that Arcangel meticulously programs? I argue that through its narrative, *SMM* reflects upon the vital materiality of the NES and its unique architecture that exists outside of representational modes of play. Arcangel reminds us that although an NES sits in a closet for two decades and falls into obsolescence in the wake of advanced game systems, it still possesses a residue of our wistful desires to reengage with the 8-bit aesthetic of *SMB*. Throughout *SMM*, Arcangel speculates the existence of a gameworld after years without play. The internal rules and mechanics dissipate, leaving Mario lost to a gamestate without structure or constraints. Through playful and sardonic reflexivity, Arcangel suggests that without a player to move Mario procedurally across the Mushroom Kingdom, he obtains enlightenment and becomes self-aware of his materiality as data. Arcangel portrays the NES as a vital being with its own thoughts and memories, perhaps previous play sessions, resets, and crashes, that form Mario's dreamlike journey. And just as quickly as Mario finds his center, a kind of cosmic bliss and understanding of his own interobjectivity, the system crashes and its normal operations are restored. Perhaps the white screen isn't so much a crash as it is a *power-on* or *reset*: a player dusting off the NES and returning Mario to the thick present of the system's operations. When Arcangel first exhibited *SMC* at the Whitney in 2002, viewers perceived the clouds through several modes of display: a large projection whose edges ran to the floor, a smaller projection with the same configuration, and *SMC* showing on an older CRT television played through the NES console, haphazardly placed in the gallery among a maze of wires (Figure 1.9). In 2005, Arcangel and Paper Rad showcased *SMM* at Deitch Projects in New York by projecting the film as a continuous loop within a darkened gallery. Next to the screening, the artists included a series of alternate glitch patterns, or "secret scenes" projected onto a stack of large blocks.<sup>42</sup> Here, the perceptual conditions Arcangel creates through the exhibition of his mods stimulate embodied behaviors through repetition, at once reproducing trauma as the obsolescence of the NES, while generating novel affects through the body's strange encounter with the *démodé* object. With each passing cloud or glitched Bill Blaster upon multiple screens, *SMC* and *SMM* not only articulate a bodily operation of mimesis through which game icons are experienced via nonplay but also simultaneously drain the commodified significance of the game icon to produce what Kirk Varnedoe has called of pop art: "pictures of nothing."<sup>43</sup>

<sup>42</sup> Ibid.

<sup>43</sup> Kirk Varnedoe, "Pictures of Nothing: Abstract Art since Pollock, Part 5: Satire, Irony, and Abstract Art" (lecture, National Gallery of Art, Washington, DC, May 4, 2003).



**Figure 1.9** Cory Arcangel, *Super Mario Clouds*, 2002. Installation view, Whitney Museum of American Art, New York. © Whitney Museum of American Art / Licensed by Scala / Art Resource, NY and Cory Arcangel.

## Proprioceptive Nonplay and Engines of Difference

As I have mentioned, the player's inability to control *SMC* or *SMM*, works upon the viewer's proprioceptive sensitivity to 2D gameworlds. Arcangel's insistence on the repetition of the deconstructed video game image leaves a kinesthetic impression upon the body through the continual flickering and scrolling of abstract compositions. Nonplay serves as an embodied occurrence through which gamic proprioception is mobilized. Unpacking the relationship among proprioception and video game play, Eugenie Shinkle draws from neurophysiologist Sir Charles Sherrington's definition of the term from 1906 as the body's "sixth sense": a concept taken from the Latin word *proprius* meaning "one's own." This refers to the sensory mechanisms dictating both conscious awareness of movement and presence and unconscious processes of reflexivity, posture, motion, and balance.<sup>44</sup> Shinkle sees proprioception as a kinesthetic activity evoked through gameplay.<sup>45</sup>

<sup>44</sup> D. I. McCloskey, "Proprioception and Related Somatosensory Mechanisms," in *Proprioception, Posture, and Emotion*, ed. Garlick (University of New South Wales, Australia: Committee of Postgraduate Medical Education, 1982), 14–22.

<sup>45</sup> Eugenie Shinkle, "Video Games, Emotion and the Six Senses," *Media, Culture & Society* 30, no. 6 (2008): 907, 911.

In Arcangel's mods, proprioceptive nonplay stems from the capacities of the NES to modulate the viewer's perception of movement through 2D space. Scrolling abstractions of tiles and palettes upon TV screens or gallery wall mirror a kinesthetic response in the body from an inability to control the game and guide our perception through 2D landscapes. James Ash suggests that images possess a geographic status: they both produce and are composed of material space. An image possesses a unique spatiotemporality that exists outside the historical conditions of its production, yet through continuous social and technical development reorganizes spatiality through different media that represent the image's existence. In video games, our phenomenal response to space constitutes what Ash calls an affective materiality, or the sensory possibilities among player and image within the thick present that exceed the discursive boundaries of the game's production and play. Video games often emphasize the braiding of technology and bodily experience as a player's kinesthetic behavior via a controller (pressing buttons, moving a joystick) is reflected in space represented on screen. Player kinesthesia is mapped to controller inputs and virtual movement is negotiated on screen resulting in multiple forms of spatiality. An existential space emerges from our perception of the game's interface, as well as an ecological space, an "affective territory" charted among video game, bodily movement, and corresponding activity on screen.<sup>46</sup>

What do we make of nonplay in Arcangel's mods and the player's inability to map their spatial movement onto avatar and screen? In *SMC* and *SMM*, I suggest the existential and ecological spatialities that Ash describes surface from within an affective circuit among the NES' operations and abstract graphic output, as well as from the viewer's proprioceptive capacity to intuit lateral 2D movement. With Arcangel's mods, it isn't a question of how player input produces affective materiality, but instead the way embodied perception frames expressions of line, shape, and color through the flatness of the screen. Arcangel continuously experiments with the reception of abstract 8-bit forms upon different material instantiations of screens: CRT televisions atop roller carts, various-sized wall projections, and clusters of sculptural blocks. In his 2012 *Masters* exhibition at the Carnegie Museum of Art, Arcangel simply displayed *SMC* on a 55" LED HDTV placed upon its original box and in a row of TVs showing his other video works. Each TV station included a generic

<sup>46</sup> James Ash, "Emerging Spatialities of the Screen: Video Games and the Reconfiguration of Spatial Awareness," *Environment and Planning A* 41, no. 9 (2009): 2106, 2108.





**Figure 1.10** Cory Arcangel, *Super Mario Clouds*, 2002. Installation view, *Masters* exhibition, 2012–13. Carnegie Museum of Art, Pittsburgh. Courtesy of Cory Arcangel.

chair for viewers to sit and gaze at the passing clouds, placed within a section of the gallery whose checkered wallpaper produces dizzying moiré patterns (Figure 1.10). With these forms of display, it is the *lack of* controlling Mario or prompting the CPU to scroll along the horizontal or vertical axis that generates spatiality and excites kinesthetic activity in a circuit among image, screen, and body. In his metaphysics, Henri Bergson examines the ontological relationship between material image and embodiment, arguing that perception, through our recognition of an object, creates a circuit among different layers of memory in states of expansion and contraction. Perception coordinates with memory when we recollect the past or speculate on the future. This could refer to a superficial recollection acted out through stored motor habits, or in deeper recollections through dreams or fantasies, images relayed back and forth between perception and pure memory: the virtual construction of the past and future in the duration of the present as “a thousand repetitions of our psychical life.”<sup>47</sup> Duration holds together the past and present, between perception and memory. This co-constituency among perception and memory

<sup>47</sup> Henri Bergson, *Matter and Memory*, trans. Nancy Margaret Paul and William Scott Palmer (London: G. Allen &, 1912), 127, 161, 186, 207.



serves as a translation of material rhythms. The body's temporal rhythms contract different material *vibrations* into a human mode of perception: a hummingbird's wings, a sunrise, and the scrolling *SMB* engine.

In his philosophy of cinema, Gilles Deleuze borrows Bergson's concept of the image and its relation with temporality to theorize film after the Second World War and its departure from conventional Hollywood editing and narrative. Deleuze conceives of cinema through a posthuman lens and a decentering of the body as a privileged spectator. Instead, the body constitutes an image among many on a plane of immanence. The universe itself serves as a type of cinema: an assemblage of continuously self-refracting images that compose the vital ontologies of material things. Deleuze theorizes that the formal experimentations of postwar film reconfigure the sensory-motor schema of earlier Hollywood narrative through images that, like Bergson's layers of memory, are virtual constructions of time, of pure duration. For Deleuze, films of the Italian Neorealists or French New Wave are composed of *time-images* that take the form of a flashback in which a character's memories are synthesized into the present moment.<sup>48</sup> Time-images deconstruct the causal, linear narratives of classical Hollywood and work upon the senses through pure sequences of sight and sound, occurring before any action can signify them. They produce dreamlike connections among images and the intermediary of the senses through what Deleuze calls an any-space-whatever: a composition whose forms operate beyond the filmic milieu in which they are represented.<sup>49</sup> This refers to arrangements of light and shadow or a shot of an empty, demolished street in post-Second World War Rome.<sup>50</sup> In the presence of time-images, Deleuze articulates embodied perception through spiritual automation, or the capacity for cinema to think and possess a material existence beyond human thought. Both brain and cinematic apparatus serve as spiritual automata in a circuit among director, film, and spectator, through which cinema produces an affective *shock*.<sup>51</sup>

Through the démodé NES, Arcangel's mods produce time-images that engage the viewer's proprioceptive sensitivity via processes of spiritual automation. The continuous scrolling of Arcangel's homemade clouds in *SMC* project an any-space-whatever: virtual images circulating between the viewer and the *thinking*

<sup>48</sup> Gilles Deleuze, *Cinema 2: The Time-Image*, trans. Hugh Tomlinson and Robert Galeta (Minneapolis, MN: University of Minnesota Press, 1989), 22.

<sup>49</sup> *Ibid.*, 4–5.

<sup>50</sup> Gilles Deleuze, *Cinema 1: The Movement Image*, trans. Hugh Tomlinson and Barbara Habberjam (Minneapolis, MN: University of Minnesota Press, 1986), 121.

<sup>51</sup> Deleuze, *Cinema 2: The Time-Image*, 161.

NES and its working components. Our aesthetic reception of Arcangel's clouds generates a sensory shock through the 2D rhythms of line and shape. With Mario's psychedelic journey in *SMM*, the viewer experiences sequences of any-space-whatevers through abstract forms of glitch: arrangements that give way to the machinic duration of the system. These moments of nonplay produce a kinesthetic impression of the gameworld and in turn, our proprioceptive excitation gives rise to new perceptions once again taken up in a dialectic automation among the mechanisms of the thinking NES.

In this exchange among viewer and flow of time-images, our embodied perception of fragmented game icons catalyzes an affective shock when we reach back through various circuits of memory. Sifting through the cultural debris of Arcangel's mods, memory pulls from the virtual a nostalgic remembrance of gaming's past, synthesizing with the perception of the *démodé* NES in the present. In this sense, Arcangel's repurposing of the NES platform serves as an *engine of difference*. The artist's reconfiguration of the NES finds resonance in the pop aesthetic of Robert Rauschenberg's combine paintings. Rauschenberg's combines, formed of found commercial objects and seemingly random taches of paint, sought to challenge the viewer's reception of postwar America's commodified urban landscape. Branden Joseph argues that Rauschenberg's use of collage and appropriation of commercial images from the spectacle of American consumerism produces difference as a positive, affective force through a multiplicity of signification. As Joseph argues, Rauschenberg's work generates an affirmative difference through the *instability* of collage that works outside signifying relationships among image and language, creating perceptual disorder. His combines open signifying fragments to something beyond signification, difference outside of visual signifiers that lack a stable form.<sup>52</sup> In a similar way, Arcangel employs the 8-bit engine to produce affirmative difference that exceeds representation and the commercial signification of the NES as an entertainment platform. His modding experiments utilize the commercial economy of the NES, providing a more inclusive definition of a game engine outside its discursive construction with the development of first-person shooters in the early 1990s. Arcangel's mods at once generate the capacity for new thought, perceptions, and intensities through radical difference, while imbricating the body within the phenomenal strangeness of the NES. The artist shows us that *SMC* and

<sup>52</sup> Branden Wayne Joseph, *Random Order: Robert Rauschenberg and the Neo-avant-garde* (Cambridge, MA: The MIT Press, 2007), 22, 157–8, 166.

*SMM*, as well as the démodé NES system and its unique components, are vital forms, *entities* in themselves. They possess their own perceptions, existing not for our viewing, but coexisting in a shared experience of the world. In this mimetic encounter with Arcangel's hallucinogenic fragments of the Mushroom Kingdom, our nostalgic longing for a past now gone transforms the NES and its 8-bit engines into something-other than what they are.

## Slaying Machines

### Embodied Mimesis in *ArsDoom*

*The beholder lives in a phenomenology of violence and destruction. . . . Wherever the beholder looks his/her gaze is ready to destroy.*

—Tobias Bernstrup and Palle Torsson, SYNWORD

In part, the discursive formation of a game “engine” emerged in the early 1990s with the programming and design innovations of John Carmack and John Romero. While at id Software, their work on *Doom* (1993) altered the computer gaming industry by conceiving of an engine as software for running essential operations of a game: physics, graphics rendering, AI, and audio output, among others. The *Doom* engine, also known as Id Tech 1, introduced novel forms of world building through 3D spaces in which players could openly explore. The game established the concept of an engine as a *computational platform for content creation, yet also entirely separate from its content*. In other words, the engine is a technology to be repurposed. Its software architecture can work with different assets, sprites, textures, environments, and mechanics of play. As I mentioned with Arcangel’s ROM hacking, an engine broadly describes the technical movement of video game forms within algorithmically constructed spaces. Yet *Doom* introduced a singular reusable engine capable of running a multiplicity of games each with original content. This concept shifted the epistemological and ideological underpinnings of the game industry throughout the 1990s and remains embedded in the language of contemporary technoculture.

The *Doom* engine was a catalyst for new modes of embodied perception within 3D environments, but also introduced novel forms of networked play, distribution via shareware, and invigorated modding communities who altered its extensible architecture to create new gameworlds. Artists gravitated toward *Doom* because this modularity allowed for experimentation with the medium.

They could replace game textures, characters, and weapons with abstract designs and mechanics. As I touched on in the book's introduction, Orhan Kipcak and Reini Urban exhibited *ArsDoom* at the 1995 Ars Electronica Festival in Linz, Austria, and used the *Doom* engine to simulate the festival's Brucknerhaus exhibition hall. They then invited festival artists to exhibit digital representations of their work and subsequently allowed patrons to interact by shooting images of the art and artists.

In this chapter, I use *ArsDoom* to examine the cultural fabric from which the game engine developed and the modding practices it afforded beginning in the early 1990s. The engine introduced a novel territory of aesthetic practices for constructing and animating digital forms. I argue that as an interactive mode of institutional critique working within traditions of the avant-garde, *ArsDoom* produces a mimetic operation of embodied vision within 3D space. By reconfiguring *Doom* as bizarre expressions of play, the 3D environments of *ArsDoom* are mirrored within the player through a mimetic receptivity to the mod's strange forms. In the player's experience of *ArsDoom*, mimesis serves as a feeling of *things becoming something other than their representational status in the game*: a paintbrush-gun, splatters of blood-paint, a museum-battleground, and so on. Running and shooting along vectors of line within the Brucknerhaus interrogates our spatial awareness of 3D space by generating abstractions of action and movement as varying intensities of play. In appropriating *Doom* and transforming its familiar levels into a festival killing ground, *ArsDoom* elicits an embodied form of mimesis that unveils the engine's modular and extensible architecture, or the ways it renders a bricolage of things, textures, environments, and mechanics. As I demonstrate, this modularity works to question institutional flows of power by generating playful affinities between the first-person shooter and the politics of the contemporary art world.

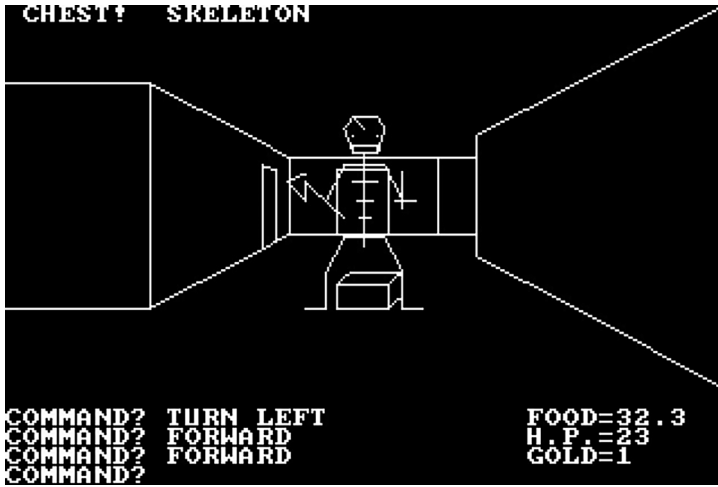
## Developments in Game Engine Technology

In his discussion of game engines, Henry Lowood argues that a history of *Doom* isn't limited to its specific origin as a discrete software artifact. Rather, *Doom* exists through a genealogy of the engine's organizational structure designed by Carmack to be separate from game assets. The engine's architecture evolved from Carmack and Romero's work on previous 2D games at Softdisk beginning in 1990. While at the company, both programmers jointly developed titles such

as the vertical scrolling shooter *Slordax* (1991) for MS-DOS. Improving upon the *Slordax* engine, Carmack and designer Tom Hall presented Romero with the 2D platformer *Dangerous Dave in Copyright Infringement* (1990): a parodic knockoff of *Super Mario Bros.* for the NES. With *Dangerous Dave*, Carmack produced a horizontally scrolling engine in MS-DOS to compete with popular 8-bit console titles. In 1991, Carmack, Romero, Hall, and artist Adrian Carmack left Softdisk and founded id Software where they began developing titles for Softdisk and game publisher Apogee. Using Carmack's horizontal scrolling engine, id produced *Commander Keen in Invasion of the Vorticons* (1990) for MS-DOS, the first title in the *Commander Keen* series. As Carmack and Romero developed additional *Keen* games, they employed the same software code, which they called the *Keen* engine. During this time, id experimented with licensing the *Keen* engine to other developers and allowing them to produce their own games. Although this model failed with the *Keen* engine (only Apogee bought the license to produce *Bio Menace* in 1993), the idea of selling engine architecture as a product separate from the game would influence the development and success of *Doom*. As Lowood mentions, the emergence of the game engine did not occur solely through Carmack's development of *Doom*, but rather through a field of technical practices surrounding the game's production. Decisions by id to produce a software engine independent from the gameworld and with functionality to create multiple games that shared similar physics and graphics helped shape our contemporary knowledge of a game engine.<sup>1</sup>

As id developed more *Commander Keen* games using their reusable engine, Carmack explored how to program a 3D graphics engine. David Kushner provides a rich historical account of id Software's technical developments, particularly Carmack's software innovations leading up to the *Doom* engine. Only a handful of computer games throughout the 1980s had successfully rendered a 3D point of view albeit with low fidelity, notably Richard Garriott's role-playing fantasy *Akalabeth: World of Doom* (1980) programmed on the Apple II and consisting of wireframe dungeon mazes (Figure 2.1). In 1982, Paul Allen Edelstein at Sirius Software developed the first-person perspective maze game *Wayout* for Atari's 8-bit home computers, the Apple II, and Commodore 64 which allowed for 360-degree player movement.

<sup>1</sup> Henry Lowood, "Game Engine," in *Debugging Game History: A Critical Lexicon*, ed. Raiford Guins and Henry Lowood (Cambridge, MA: The MIT Press, 2016), 204–6.



**Figure 2.1** Wireframe environments from *Akalabeth: World of Doom* (Richard Garriot, 1980). Screenshot.

Flight simulators of the time situated the user within the 3D perspective of a plane's cockpit. Software engineer Bruce Artwick developed a flight simulator at his software company subLOGIC and licensed it to Microsoft for IBM's PC in 1982 as *Microsoft Flight Simulator*. Similarly, by 1990 Chris Roberts while at Garriott's company Origin Systems programmed the wildly successful 3D space combat simulator *Wing Commander*. Carmack observed that maze games and flight simulators were slow and did not allow players to move quickly and fluidly though 3D space. His aim was to develop an engine that could render polygons at a faster speed, in turn, allowing the player to move at a pace equal to earlier 2D arcade titles.<sup>2</sup> Hardware limitations of the time meant that rendering 3D graphics with numerous polygons would use considerable memory and slow the frame rate, especially in the case of overdraw, or when the same pixels are rendered multiple times over a series of frames.

With *Doom*'s development, Carmack dealt with a problem in computer graphics since the 1960s: hidden-surface algorithms, or the procedures that calculate which surfaces are occluded based on a given perspectival viewpoint. In his genealogy of computer graphics, Jacob Gaboury suggests that an ontology of simulated objects rendered by a computer is not limited to representational appearance. A computer graphic is both a material image and an object

<sup>2</sup> David S. Kushner, *Masters of Doom: How Two Guys Created an Empire and Transformed Pop Culture* (New York: Random House, 2004), 68.

comprised of surfaces as well as the underlying operations that produce them. Gaboury proposes an alternate epistemology of the simulated image-object that focuses on not only the portrayal of a computer graphic on screen but also visual occlusion, or those parts of the image that are not seen on the interface.<sup>3</sup>

Carmack first addressed hidden surfaces by creating an engine that would only draw a percentage of polygons within the frame, specifically vertical trapezoids which created a 3D space with walls but no textured ceiling or floor. He experimented with a programming technique known as ray casting, which reduces memory and processing by tracing “rays” of pixels from the player’s perspective to surfaces in the gameworld. The engine draws vertical columns of pixels and applies textures based on the distance from the player to an in-game surface, giving the illusion of depth among a series of 2D planes. To showcase the engine’s ray casting, Carmack and Hall designed *Hovortank* (1991): a fast-paced vehicle combat game in which the player uses a tank to gun down monsters in a nuclear apocalypse. Kushner emphasizes that *Hovortank* was vital to establishing the first-person shooter genre through its combination of quick gameplay and point-of-view camera.<sup>4</sup>

At this time, Carmack also experimented with texture mapping or drawing pixel patterns onto surfaces to produce realistic environments. By the end of 1991, he developed an engine for id Software’s fantasy first-person shooter *Catacomb 3-D*, which utilized texture mapping for its slime-covered dungeon walls in vibrant 16-bit Enhanced Graphics Adapter (EGA) graphics display. A significant example of an early, character-driven first-person shooter, *Catacomb 3-D* featured the spell-casting hand of a wizard in subjective point of view, preceding the common trope of a character’s gun-wielding hand which would appear later in *Wolfenstein* and *Doom* (Figure 2.2). Carmack improved upon the existing code for *Catacomb* to produce *Wolfenstein 3D*, a game based on a concept by Hall and Romero that reimagined the earlier Apple II title *Castle Wolfenstein* designed by Silas Warner in 1981. In 1992, id released *Wolfenstein 3D* and distributed its episodes as shareware.

The controversial game allows players to move frantically through the labyrinthine hallways of a Nazi castle, killing German soldiers and attack dogs while gathering spoils of war (Figure 2.3). It quickly gained a cult following among gaming communities not only because it immersed players into a new exploratory world, one where they could open doors and discover hidden

<sup>3</sup> Jacob Gaboury, “Hidden Surface Problems: On the Digital Image as Material Object,” *Journal of Visual Culture* 14, no. 1 (2015): 44–5.

<sup>4</sup> Kushner, *Masters of Doom*, 68.





Figure 2.2 The rendering of first-person perspective in *Catacomb 3-D* (id Software, 1991). Screenshot.



Figure 2.3 Fast-paced navigation in *Wolfenstein 3D* (id Software, 1992). Screenshot.

rooms, but also because it offered seductive violence and gore that had not yet been experienced in a PC game. Carmack sped up the engine by rendering in-game assets as flat 2D sprites and upgraded the 256-color display to the newly developed VGA (Video Graphics Adapter).<sup>5</sup> By 1993, he created an engine and

<sup>5</sup> Ibid., 75–82.

licensed the technology to Raven Software for the development of the first-person fantasy RPG *Shadowcaster*. The *Shadowcaster* engine included light values, which changed depending upon player perspective, as well as textured ceilings, floors, and doors.

When *Doom* was first uploaded in December of 1993 by Jay Wilbur at id Software to an FTP (File Transfer Protocol) server at the University of Wisconsin-Madison, the game's cultural impact was unprecedented and its graphics engine, shareware distribution model, networked play, and open-source architecture helped spawn a multiplicity of gaming subcultures. Initial efforts to upload the game caused the Wisconsin server to crash when thousands of gamers attempted to download simultaneously. Id released *Doom* for MS-DOS as shareware with the aim that players would openly distribute the game themselves. Shareware distribution avoided advertising and retail expenses, and instead employed gamers to market *Doom* at a grassroots level. It sold roughly one million registered copies upon initial release and close to nine million players downloaded the shareware version. Playing *Doom*, especially multiplayer deathmatch, became both an addictive cultural pastime and a hindrance to workplace productivity. Employees at major tech companies like Intel and students at universities such as Carnegie Mellon slowed networks with increased traffic from deathmatch play, resulting in policies that banned *Doom*.<sup>6</sup> At Microsoft, the game's popularity made such an impact that by 1995 the company developed a port of *Doom* known as *Doom95* to advertise its Windows 95 operating system as a legitimate PC gaming platform along with their DirectX technology for rendering 3D graphics. More so, the extensible architecture of *Doom* allowed players to create and share their own maps and custom in-game items using WAD files, a development I touch on in the following section.

## *Doom* and Epistemologies of Modding

Throughout 1993, the development of *Doom* was situated around the speed of Carmack's engine. Id Software needed to structure an action narrative and quick gameplay based on the engine's ability to efficiently draw multiple polygons for each frame. Both Carmack and Romero held a fascination for demons from late night sessions playing *Dungeons and Dragons* with Hall and Adrian Carmack. To mirror the technics of Carmack's engine, they needed a game that expressed

<sup>6</sup> Ibid., 123–30.

conflict among advanced technology and the supernatural, deciding loosely on gameplay in which players use high-tech weapons to combat the forces of hell. The team conceptualized the story of a space marine (often known as Doomguy) who must destroy encroaching spawns of hell—cyberdemons, imps, zombies, and lost souls—within a series of Martian installations owned by the Union Aerospace Corporation. Naturally, the object of *Doom* is to “run and gun”: eliminate all enemies using weapons such as a shotgun, chainsaw, rocket launcher, and the BFG (Big Fucking Gun), while escaping each map by obtaining keycards to open locked areas.

As game developer Jean-Paul LeBreton notes, *Doom*’s “run and gun” design harks back to the mechanics of early 2D arcade shooters such as *Berzerk* (1980) and *Robotron: 2084* (1982). The modern FPS is structured on the player receiving damage often from unavoidable enemy fire and then finding an area to heal via medical kits, armor, or recharging stations. Instead, *Doom*’s play operates through the mantra of “maneuverability as defense.” Because the engine allows the player to move swiftly and in multiple directions within 3D space, they can dodge hordes of enemies without losing damage (Figure 2.4).

Here, agility often determines the player’s skill level.<sup>7</sup> In *Doom*, these mechanics of play are foregrounded over narrative. As Carmack has stated about



**Figure 2.4** Run and gun tactics within the 3D gamespace of *Doom* (id Software, 1993). Screenshot.

<sup>7</sup> Jean-Paul LeBreton, “Coelacanth: Lessons from Doom,” *Vector Poem*, February 28, 2010, <http://vectorpoem.com/news/?p=74>.

id Software's first-person shooters, "Story in a game is like a story in a porn movie; it's expected to be there, but it's not that important." Instead, Carmack and Romero were interested in using the engine to build a world and engage the player in perceptual operations of moving through "one contiguous world, a seamless world" with massive angular spaces and walls with different heights.<sup>8</sup>

The engine architecture of *Doom* comprises algorithms that render maps, player and enemy movement, special effects, and calculate physics and collision detection. More so, its networking component allows for up to four players in a multiplayer deathmatch. As I mentioned, the *Doom* engine refers to the game's reusable source code which was subsequently used to run popular first-person shooters such as *Doom II* (1994), *Heretic* (1994), *Hexen* (1995), and *Strife* (1996). This concept of a modular engine holds true with contemporary software platforms such as Epic's Unreal Engine, initially used to produce the popular first-person shooter *Unreal* in 1998. Through its iterative versions, it remains an industry standard for game development across multiple genres.

The *Doom* engine was programmed by Carmack with additional code written by Romero, Dave Taylor, and Paul Radek on NeXT computer workstations. As much as it appears as a 3D engine, *Doom* is more akin to what is called "2.5D." The player cannot direct the camera up or down and spaces (referred to as sectors) cannot be stacked to produce multilevel structures. Yet, the player can access the game's Automap feature and see a 2D schematic of their position relative to the surrounding level. Still, *Doom* was remarkable in its abilities to render an illusory, texture-mapped 3D gamespace within a technical milieu dominated by computers running 386/486 Intel processors at only 25–33MHz.<sup>9</sup> For each level in *Doom*, the engine renders a basic structure composed of objects: linedefs, sidedefs, sectors, and things. Objects that make up the architecture of the level are connected through vertices that when joined form lines or linedefs. Linedefs are defined by possessing either one or two sidedefs, or "sides" which store wall textures. Groups of sidedefs compose sectors, or the polygons that scaffold each level. Sectors appear as 2D areas, each defined by floor and ceiling dimensions, textures, and a light value. In some sectors, Carmack programmed dynamic lighting in the form of strobing lights. In-game objects that populate these sectors—player, demons, powerups, ammo, and certain obstructions—called "things," are organized within each level according to a 2D coordinate and

<sup>8</sup> John Carmack qtd. in Kushner, *Masters of Doom*, 105–6.

<sup>9</sup> "Doom Rendering Engine," *Doomwiki*, [https://doomwiki.org/wiki/Doom\\_rendering\\_engine](https://doomwiki.org/wiki/Doom_rendering_engine).

object type. Things are rendered as sprites, or 2D bitmap images composed of pixel grids. In the art direction for *Wolfenstein 3D*, Adrian Carmack was limited to animating an enemy's movement for each frame, yet with *Doom*, in-game objects were produced by Carmack and graphic designer Kevin Cloud through digital compositing.<sup>10</sup> The game's enemies were sculpted in clay in different action sequences and recorded as individual video frames. Frames were then scanned with applied color palettes and animated using a utility created by John Carmack called the Fuzzy Pumper Palette Shop that captured video of the clay object in rotation.

Perhaps the most significant advancement in *Doom*'s engine architecture was Carmack's adoption of a programming technique called binary space partitioning (BSP), a process used to greater effect in *Quake* a few years later. BSP is when game geometries are repeatedly partitioned into smaller sets of polygonal planes whose data is stored in a BSP tree. In 3D graphics, the engine retrieves the tree's spatial data and renders the subdivided polygons in order of front-to-back within the view frustum, or the player's field of view portrayed through the game's virtual camera. This front-to-back ordering within the tree allows for the engine to quickly render visible polygons.

Carmack was aware that programmers at Bell Labs used BSP to draw a 3D model by subdividing its planes into smaller areas called leaves and rendering them based on which sections were currently visible. Carmack figured he could employ BSP to render more complex areas of 3D space using a preprocessor called a node builder to organize BSP data: the subdivided polygons or leaves for each level. The engine uses BSP to arrange leaves into nodes within the structure of a binary tree, with each leaf storing a unique area of the level. A root node indicates polygonal data stored for the entire level and its stemming branches include child nodes which store geometries for specific regions of the map. With the division of each node, data for linedefs (which compose polygons) are further divided into segs, or segments. Within each leaf exists a series of convex polygons called subsectors assigned to a unique sector of the level. At its core, the BSP algorithm places subsectors in the correct rendering order by drawing polygons stored within child nodes starting with those closest to the player's immediate point of view. The engine draws a new subsector when the player enters that area of the level. To limit overdraw, each time segs within a subsector

<sup>10</sup> Kushner, *Masters of Doom*, 107–10.

are drawn, they are stored in a list so that the engine does not have to redraw the same polygons

Depending on the player's camera position, the engine uses the BSP tree to draw polygons in the order of front-to-back upon two distinct horizon lines.<sup>11</sup> In his black book for the *Doom* engine, software engineer Fabien Sanglard articulates the 3D renderer's primary functions in Carmack's code:

```
void R_RenderPlayerView ( player_t * player ) {
    R_RenderBSPNode ( numnodes -1);           // root node is last
    R_DrawPlanes ();                           // Draw visplanes
    R_DrawMasked ();
}
```

<sup>12</sup>

These functions correlate to the rendering of segments (`R_RenderBSPNode()`) which make up vertical walls and the game's portals, flats (`R_DrawPlanes()`) which comprise horizontal ceilings and floors, and lastly things (`R_DrawMasked()`) which make up demons, sprites, weapons, and so on. Sanglard illustrates that the "life of a 3D frame" consists of rendering wall segments at either end of the x axis of the screen arranged front-to-back from the player's view frustum. The engine's 3D renderer documents vertical spaces between walls and stores those areas into an array of objects called visplanes. Similarly, sprites are stored into an array of objects called vissprites. From this recorded data (visplanes and vissprites), the engine then renders ceilings, floors, and all sprites, including the current weapon held by the avatar.<sup>13</sup>

Beyond the proprietary functions of the graphics renderer, Carmack designed parts of the engine to be modifiable by players. Kushner points out that by allowing loyal communities of gamers to customize and create their own weapons, skins, and levels, id introduced a novel ideological framework; "a leftist gesture that empowered the people and, in turn, loosened the grip of corporations."<sup>14</sup> After seeing players hack the source code to produce mods for *Wolfenstein 3D*, Carmack created a file subsystem which stored customizable game data known as WADs, first outlined by Tom Hall in his design document the *Doom Bible*.<sup>15</sup> When the engine boots up, it automatically searches for the

<sup>11</sup> "Doom Rendering Engine," *Doomwiki*

<sup>12</sup> Fabien Sanglard, *Game Engine Black Book: Doom* (Self-published, 2018), 197.

<sup>13</sup> Ibid.

<sup>14</sup> Kushner, *Masters of Doom*, 134.

<sup>15</sup> Tom Hall, "Doom Bible" (PDF, id Software, 1992), Appendix A.

WAD file and loads textures, weapons, skins, and sounds into the gameworld without affecting the proprietary source code. Carmack also shared a level-editor program that allowed amateur designers to build their own maps from the ground up.

Because WAD files are unencrypted and easy to distribute, gamers not only produced custom game content but also contributed to a unique modding economy on the emerging web by sharing and playing user-generated WADs. WAD production and distribution prompted grassroots programmers to develop new level editing tools such as Doom Editor Utilities (DEU) created by University of Canterbury students Brendon Wyber, Raphael Quinet, Renaud Paquay, and a network of crowd sourced gaming communities. By early 1994, they released a version of DEU that allowed players to modify nearly any element of a *Doom* level. Players could reposition and change the number of in-game objects such as enemies or powerups, insert new wall textures, or add obstacles such as pools of acid. Michael Nitsche observes that *Doom* introduced a new instantiation of the demoscene in which players experimented with early forms of machinima. With each WAD file, the engine afforded the playback of an in-game recording as a demo lump file (.Imp) which captures all player input data.<sup>16</sup>

Much like the elaborate intro sequences distributed within earlier cracker scenes, demo lumps encouraged players to showcase their deathmatch and speedrunning abilities, or recorded sessions that boasted how quickly an expert player, referred to as a “Doom God,” could complete a level. Players organized competitive modes of gameplay such as Frank Stajano’s *Doom* Honoric Titles (DHT) and Simon Widlake’s Compet-N: both started in 1994 as a way for players to demonstrate their expertise in maneuvering through *Doom*’s 3D environments. Well-known speedrunners George Bell, Steffen Udluft, and Frank “Jesus” Siebers submitted demo files to the DHT to be credited with expert status. A speedrunner could request to play a level from *Doom* or *Doom II* on a specific difficulty setting. If the submitted lump file was deemed authentic, depending on their gameplay virtuosity, players were awarded titles such as “Doom Master,” “Doom Grand Master,” “Doom Tyson,” or the prestigious “Doom God.” Players also introduced new competitions such as “Pacifist,” speedrunning the “Ultra-Violence” difficulty setting without intentionally harming any monsters, or “Reality,” a format invented by Benjamin “Cowboy” Lauterbach in which a

<sup>16</sup> Michael Nitsche, “Machinima as Media,” in *The Machinima Reader*, ed. Henry Lowood and Michael Nitsche (Cambridge, MA: MIT Press, 2011), 118.



player must speedrun without acquiring any damage or using the plasma rifle or BFG to mirror real-life combat scenarios.<sup>17</sup>

In his people's history of the first-person shooter, Robert Yang explores the marginalization of modding practices throughout the 1990s in the wake of the commercial gaming industry. Until only recently, dominant gaming culture and the popular "manshooting" of first-person shooters has been slow to accept minor histories of independent, punk game modifications.<sup>18</sup> In the twenty-seven years following *Doom*'s release, amateur designers created hundreds of WADs, especially ones that infringe upon the copyright of popular Hollywood franchises such as *Batman Doom* (1999) and *Ghostbusters Doom* (2002), both total conversions (TC) of *Doom II*. A TC refers to a WAD file in which most of the game's original environments, weapons, and assets have been replaced. Yang points to Justin Fisher's *Aliens TC* as a central example of an early TC mod. Released in 1994, *Aliens TC* was designed using a modding utility called DeHackEd which allows users to overhaul *Doom*'s executable code and modify graphic components. Working from James Cameron's 1986 film *Aliens*, Fisher produced a game with proximity sensors, hatching alien pods, and acid blood. The game's initial level was designed solely for atmospheric effect without enemies or challenges. Another avant-garde modding approach included the joke WAD: games that were intentionally buggy with unappealing textures and mismatched sound effects, often introducing the player to absurd gameplay or level designs that sought to unveil *Doom*'s graphical limitations. For instance, the joke WAD *Nuts* created by modder B.P.R.D. in 2001 consists of approximately 10,000 monsters crammed into a giant courtyard. When the player attempts to kill this enemy hoard, the engine expresses difficulties in rendering their movement, slowing the frame rate to a crawl and making the mod unplayable (Figure 2.5). At a 2015 VideoBrains talk in London, modder Jazz Mickle aptly summarized the influence of *Doom* in an open letter to John Romero titled "*Doom* is an Art Scene," asking rhetorically: "Do you know you created an art scene? Do you know you created an underground cultural timeline? Do you know you created an art form?"<sup>19</sup>

<sup>17</sup> Doomworld, "A Brief DOOM Demo History," *Doomworld*, <https://www.doomworld.com/10years/demos/demos01.php>.

<sup>18</sup> Robert Yang, "A People's History of the FPS, Part 1: The WAD," *Rock Paper Shotgun*, September 19, 2012, <https://www.rockpapershotgun.com/2012/09/19/a-peoples-history-of-the-fps-part-1-the-wad/>.

<sup>19</sup> Jazz Mickle, *Doom Is an Art Scene*, performed by Jazz Mickle (London: VideoBrains, 2015), <https://www.youtube.com/watch?v=KxYND6K6u8w>.





**Figure 2.5** Thousands of monsters in the joke WAD *Nuts* (B.P.R.D., 2001). Screenshot.

Mickle was referring to the hand-drawn environments of the surreal fantasy WAD *Foreverhood* (2006) and the cel-animation aesthetic of *The Adventures of Square* (2014). Mickle considers these expressive forms of animation akin to photography, television, or the printing press in that *Doom* introduced a new episteme of aesthetic production and modes of participation: a regime of experience in which a game system serves as a vehicle for worldbuilding.

## The Archive of the Engine

To understand how the game engine was central to forming novel modding discourses, I look to Michel Foucault's archaeology of art in his writings on painter Edouard Manet. In *The Archaeology of Knowledge*, Foucault speculates on an archaeology of painting, stating that

it would try to discover whether space, distance, depth, color, light, proportions, volumes, and contours were not, at the periods in question, considered, named, enunciated, and conceptualized in a discursive practice; and whether the knowledge that this discursive practice gives rise to was not embodied perhaps

in theories and speculations, in forms of teaching and codes of practices, but also in processes, techniques, and even in the very gesture of the painter.<sup>20</sup>

In *The Archaeology of Knowledge*, Foucault asserts that an archive is a “density of discursive practices,” a system of interrelated statements that undergird the epistemological framework of a given historical order. An archive describes the material remnants of a historical period through which knowledge and flows of power become visible, transform, or dissolve.<sup>21</sup> In Foucault’s lecture on Manet, he argues that as a collection of “painted statements,” the artist’s work forms a new archive. Through a profound rupture from the classical tradition, Manet’s paintings surpass naturalistic representation, instead focusing on the material properties of the canvas itself. Since the Italian Renaissance, representation has consisted of formal elements that mask or “sidestep” the materiality of the artist’s hand and painted surface through illusionistic depth configured onto a 2D plane. The surface of a painting illuminated by an outside source has been concealed by the conventions of Western painting in its effort to reproduce the real. This illusion is typically achieved through linear perspective to construct naturalistic depth, the modeling of figures by a light source emanating from within the picture plane, and positioning the viewer so that depth unfolds from a centralized viewpoint.

For Foucault, Manet’s work foregrounds the “picture-object,” a reference to the material aspects of painting that call attention to the limitations of the canvas. Manet often worked to expose the picture-object by making apparent the application of color to a physical surface articulated by external light, and constructing depth through symbolic relationships among the subjects within the image.<sup>22</sup> For Foucault, Manet’s formal experimentations implicate the viewer within discursive practices of visibility as they are historically bound to modernity. Such modes of looking indicate the emergence of a nineteenth-century viewing subject organized from the complex relationship between patron, artist, and institution. Manet’s work serves as the foundation for aesthetic reception within an art museum.

My aim here is not to compare Manet’s painterly techniques to 3D space rendered by a game engine as they resemble two vastly different forms of visibility

<sup>20</sup> Michel Foucault, *The Archaeology of Knowledge and the Discourse on Language*, trans. A. M. Sheridan Smith (New York: Pantheon Books, 1972), 193–4.

<sup>21</sup> *Ibid.*, 128.

<sup>22</sup> Michel Foucault, *Manet and the Object of Painting*, trans. Mathew Barr (London: Tate Publishing, 2009), 29, 31.

and cultural production. Rather, I argue that just as Manet's work formed the archive of modern viewing practices, the *Doom* engine constructed an archive through which immersion within and the modification of algorithmically produced space enter into popular technoculture. Both serve as objects of perception that enable novel ways of looking and making. By introducing the game engine as a reusable vessel for content creation, *Doom* was central to organizing a novel politics of formal techniques, media distribution, and sensory experience. The engine afforded an epistemological order through which grassroots modding communities flourished, producing a vibrant network of artists, programmers, and loyal gamers who experimented with new modes of artistic production.

Moreover, the *Doom* engine played a crucial role in organizing a new mode of aesthetic reception toward digital media: a novel sensory regime which immersed players into a perspectively rendered gameworld. Robert Nideffer refers to this unique archive of digital media as a database aesthetic. He explains that the game engine possesses a database interface through which a collection of procedural operations generates gameworlds for the player to interact with. The engine is a cultural object used to organize game data: sprites, wall textures, subsectors, linedefs, and sound effects for the computer to process player input. Yet, because user activity is imbricated in the engine's continual rendering of a game environment, players and developers "inescapably function as indexical pointers to their respective cultural toolkits or databases at all phases of game-engine and game-application production, distribution, and consumption."<sup>23</sup> Nideffer indicates that the player's engagement with the engine's database reciprocally produces a *database of the player*, one that organizes a novel epistemology of perceptual operations and aesthetic techniques.

Beginning in the mid-1990s, artists held an attraction to *Doom* because they could use the engine to appropriate the representational qualities and interactivity of a first-person shooter while subverting the genre's logic through constructing and animating abstract virtual environments. A central affordance of *Doom*'s modular design is its capacity for worldbuilding or rendering complexity and depth within a broader narrative world. In relation to video games, worldbuilding illustrates the mental processes through which a player infers the existence of a more expansive digital environment. Janet Murray describes interactive

<sup>23</sup> Robert Nideffer, "Game Engines as Embedded Systems," in *Database Aesthetics: Art in the Age of Information Overflow*, ed. Viktorija Vesna (Minneapolis, MN: University of Minnesota Press, 2010), 219, 221.

narrative within a fabricated digital world as procedural, participatory, spatial, and encyclopedic. The modularity of the *Doom* engine allows for a gameworld that is procedural in its organization and rendering of data through a pipeline of rules and behaviors. The game engine is participatory in its responsiveness to player input and in its ability to carry out procedural operations, what Murray refers to as interactivity. Player interaction is fundamentally spatial as it involves a perceptual process of moving through space that extends into the broader mythos of the gameworld. Lastly, game engines are encyclopedic in nature. The extensibility of *Doom* allows for the storage, retrieval, and distribution of game data through WAD files, producing a digital repository for levels, textures, skins, weapons, and so on.<sup>24</sup> Artists were invested in the *Doom* engine's worldbuilding capabilities as a way to reconfigure a new politics of the body through mimetic operations of play while critiquing the hallowed ground of art institutions.

### *ArsDoom* and Mimetic Vectors of Play

In the years following *Doom*'s release, aesthetic reappropriations of its engine as a form of institutional critique resulted in the emergence of a subgenre within game art coined by Mathias Jansson as "First Museum Shooters."<sup>25</sup> As with Kipcak's *ArsDoom*, artists fabricated virtual recreations of exhibition spaces for players to run throughout galleries and shoot at monsters, as well as artists and their art. In 1995, Kipcak along with collaborators Reini Urban, Curd Duca, and XRay produced *ArsDoom* as arguably the first large-scale art mod, showcased at the Brucknerhaus for Ars Electronica 1995 in Linz, Austria. Kipcak's work offered a field of discursive practices through which game art held a political stake in attacking art institutional power, influencing others within the modding subgenre. In 1996, Swedish artists Palle Torsson and Tobias Bernstrup created *Museum Meltdown* using the first-person shooter *Duke Nukem 3D* (1996) and its Build engine developed by Ken Silverman at 3D Realms. Torsson and Bernstrup produced a simulation of the Arken Museum of Modern Art in Copenhagen and exhibited the mod within the museum in conjunction with *Borealis 8: The Scream* biennale. In *Museum Meltdown*, players ridded Arken of invading

<sup>24</sup> Janet Murray, *Hamlet on the Holodeck: The Future of Narrative in Cyberspace* (Cambridge, MA: MIT Press, 1998), 71, 72, 74, 79.

<sup>25</sup> Mathias Jansson, "First Museum Shooters," in *The Pioneers of Game Art: From ArsDoom to SimBee*, ed. Mathias Jansson (Akarp: Mathias Jansson, 2015), 8–9.



**Figure 2.6** Palle Torsson and Tobias Bernstrup, *Museum Meltdown II: The Vilnius Vengeance*, 1997. Screenshot.

aliens while desecrating the biennale's artworks using high-powered assault weaponry. In 1997, the artists produced a sequel called *Museum Meltdown II: The Vilnius Vengeance* that pitted players against aliens within the simulated halls of the Contemporary Art Centre in Vilnius, Lithuania (Figure 2.6). The artists completed the *Museum Meltdown* trilogy in 1999 with *Museum Meltdown: Moderna Museet*. Unlike its predecessors, *Moderna Museet* utilized the first-person shooter *Half-Life* (1998) and the Source engine to reproduce the interiors of the Museum of Modern Art in Stockholm. In the mod, participants fight against mutant creatures and enemy soldiers using the stock *Half-Life* crowbar and shotgun. The artists reflect on *Moderna Museet*, stating that the game "is reduced to a central perspective of violence—wherever your crosshair aims, the artworks and all living creatures are targets for your destructive gaze."<sup>26</sup> Similarly, throughout 2005–6 Chris Reilly used the Source Engine and *Half-Life 2* (2004) to model the gallery within the School of the Art Institute of Chicago and included virtual reconstructions of his fellow students' artworks for the school's 2006 undergraduate exhibition. In Reilly's mod installation *Everything*

<sup>26</sup> Tobias Bernstrup and Palle Torsson, "Museum Meltdown: Moderna Museet," *bernstrup.com*, 1999, <http://www.bernstrup.com/meltdown/main.html>.

*I Do Is Art, But Nothing I Do Makes Any Difference, Part II Or: How I Learned to Stop Worrying and Love the Gallery*, participants defended in-game gallery-goers against hordes of zombies, robots, and alien creatures. Players could also earn additional health and ammo by ruining the art using the *Half-Life 2* gravity gun to launch paint cans at student works. Jon Cates observes that first museum shooters engage with violence inherent to first-person shooters by recontextualizing gore as a feature of irony and metaphor within strategies of institutional critique.<sup>27</sup> By allowing participants to destroy artworks within a simulated museum, the genre questions institutional power; namely, the way museums organize aesthetic experience and dictate artists and works to be exhibited. Through the interactivity of video games, institutional power is decentered and rematerialized in the player as an art critic who judges which works are salvaged and which are vandalized.

To better grasp the player's embodied role in *ArsDoom* and its strategies of institutional critique, I examine theories of the mimetic faculty and play in the work of Walter Benjamin. Benjamin's Marxist materialist theory of media is concerned with the way technology conditions the senses in their historical contingency. To Benjamin, expressions of mimesis are tied to a reconfiguration of human perception and experience within the sociopolitical conditions of modernity. Mimesis differs from the Aristotelian tradition of imitating natural forms, instead serving as a material aspect inherent to nature. As a capacity of human beings, mimesis is shaped by social and cultural development. Tracing a deep time of mimetic behavior, Benjamin observes that ancient cultures recognized and produced similarities within nature, "magical correspondences" such as ritual dance and the reading of constellations and animal entrails that provide a microcosm of the broader universe. The natural correspondences that evoke these mimetic responses relate not only to mystical, archaic practices but also to the historical development of language that territorializes signification and social institutions.<sup>28</sup> Within modern industrialist society, Benjamin saw the transformative potential of the mimetic faculty through modes of cinematic technologies. Just as Benjamin believed that technology served to isolate individuals from communal engagement through mass consumption and commodification, he also saw cinema as a palliative measure against capitalism's

<sup>27</sup> Jon Cates, "Running and Gunning in the Gallery: Art Mods, Art Institutions and the Artists that Destroy Them," *artgamestudies.org*, <http://artgamestudies.org/RunningAndGunning.pdf>, 10.

<sup>28</sup> Walter Benjamin, "Doctrine of the Similar (1933)," trans. Knut Tarnowski, *New German Critique*, no. 17 (1979): 65–6.



destructive results. The function of cinema is to perceptually train the body in a mechanized world through what Benjamin calls innervation.<sup>29</sup>

Innervation is bound to Benjamin's concept of the mimetic faculty which he describes through two different forms of mimesis: phylogenetic and ontogenetic. The former refers to a broader archaeology of mimetic development through which representation and signification are organized: astrology, occult ritual, and language. The second, ontogenetic understanding of mimesis, and the tradition of I draw upon throughout this book, describes a modality through which innervation operates, a sensual interaction between humans and objects that emerges from play and generates forms of interrelatedness among the sensuous qualities of material things.<sup>30</sup> Through innervation, cinema possesses the therapeutic potential to reverse the social alienation brought on by capitalist regimes and a failed reception of technology. Within industrial society, technology isolates citizens from natural forms of communication and sentimentality through mass consumption and an overstimulation of the senses. Rather, innervation suggests a neurophysiological channeling among the cinematic apparatus and the perceptual mechanisms of the body. In Benjamin's ideology, innervation describes an embodied, mimetic reception of the world: radical possibilities through which affect and desire are channeled toward utopic realizations of everyday life. Cinema's capacity to elicit affective responses can alter the relationship of the collective masses to society through technological plays of the senses.

Benjamin relates mimesis to children's play through the ways they creatively engage with their environment. Children engage in mimetic behavior by imitating not only subjectivities such as a firefighter, nurse, or astronaut but also material things—the outstretched arms of a sprinting child become the wings of an airplane.<sup>31</sup> These kinds of mimetic responses are in constant variation within industrial capitalist economies through new technologies, commodities, images, and experiences. Miriam Hansen argues that playful expressions of the mimetic faculty serve as a generative perception of relationships among objects, a productive “miscognition” resulting from a disjointed assemblage of people and

<sup>29</sup> Refer to Benjamin's use of innervation in Walter Benjamin, “The Work of Art in the Age of Its Technological Reproducibility, Second Version,” in *The Work of Art in the Age of Its Technological Reproducibility and Other Writings on Media*, ed. Michael W. Jennings, Brigid Doherty, and Thomas Y. Levin, trans. Edmund Jephcott, Rodney Livingstone, Howard Eiland, and Others (Cambridge, MA: Belknap Press of Harvard University Press, 2008).

<sup>30</sup> See Benjamin, “Doctrine of the Similar (1933),” 65–9.

<sup>31</sup> See Benjamin, “On the Mimetic Faculty.”

things.<sup>32</sup> As Benjamin states, “Just as a child who has learned to grasp stretches out its hand for the moon as it would for a ball, so humanity, in its efforts at innervation, sets its sights as much on currently utopian goals as on goals within reach.”<sup>33</sup> For Benjamin, the innervative effects of cinema projects to the masses the spatial and temporal fragments of their social conditions through film editing and the mobility of the camera: its otherness in space and time. Cinema serves to reinvigorate the mimetic faculty and counter the duality of bourgeois subject-object relationships. Rather, the experimental camera techniques in, for instance, Dziga Vertov’s *Man with a Movie Camera* (1929) that document daily Soviet life, or the elastic forms in Disney’s early animations stimulate mimetic responses through a technologically mediated, collective physis, one that opens the masses to new and possible liberatory experiences.

Benjamin’s mimesis lends itself well to the study of video games. Interactive gameplay incorporates material assemblages of players, controllers, systems, and gameworlds through which novel modes of “miscognition,” to borrow Hansen’s term, are actualized. However, I do not adopt Benjamin’s ideology as a way to reform late capitalism through the interactive experiences video games afford. Benjamin’s materialist theories of media are codependent upon the discursive conditions of modernity and there are inherent pitfalls in applying his work to the political and economic complexities of contemporary technoculture. More so, I do argue that Benjamin’s concept of mimesis can be used to think through the nuanced expressions of embodied play that unfold from our engagement with game engines. Mimesis operates as an imbrication of the phenomenal body and game system that attunes the senses to computational rhythms and temporalities, revealing playful correspondences among game assets and material objects.

I focus on Kipcak and Urban’s *ArsDoom* as a landmark development in game art that defamiliarizes the navigation of perspectival space within the first-person shooter through mimetic plays of the senses. By abstracting *Doom*’s gameworld into a destructible version of the Bruckerhaus, Kipcak and Urban draw the act of embodied perception to the engine’s extensibility while engaging forms of “miscognition” through which *Doom*’s familiar interface is made strange. Kipcak’s work on *ArsDoom* was influenced by his skills as an architect and a background in interaction design. In the early 1990s, he began to construct virtual exhibitions

<sup>32</sup> Hansen, *Cinema and Experience*, 150.

<sup>33</sup> Walter Benjamin, “The Work of Art in the Age of Its Technological Reproducibility, Second Version,” 45.



and produce interactive versions of his physical works on the web for the Venice Biennale. At the time, Kipcak created architectural simulations using VRML (Virtual Reality Modeling Language), a file format for rendering 3D vector-based graphics in web applications. In 1993, he adopted *Doom* over VRML because its ray-casting technology and level editor served as an “instrument of visualization,” allowing Kipcak to produce surface-textured interiors and animate sprites in real time. He sought to produce a virtual environment that was at once visually complex and elicited a “spatial haptic effect . . . a high degree of interactivity” for its users.<sup>34</sup> In 1995, Ars Electronica officials urged Kipcak to create an interactive work for the festival and he proposed *ArsDoom* to the festival director Peter Weibel who funded the project. Kipcak used the Id Tech 1 (*Doom*) engine with *Doom II: Hell on Earth* (1994) (also powered by Id Tech 1) and Autodesk’s AutoCAD to reproduce the Brucknerhaus’ exhibition spaces and invited festival artists—Ecke Bonk, Heimo Zobernig, Jörg Schlick, and Peter Kogler, among others—to submit digital copies of their work to be displayed throughout the game level. All participating artists agreed with Kipcak’s terms that works would be digitally reproduced to be subsequently defiled by players.<sup>35</sup> The goal of *ArsDoom* is straightforward: players would use *Doom*’s standard chainsaw and new weapons such as crucifix and paintbrush guns to shoot at the artists and ruin their art (Figure 2.7).

Kipcak collaborated with eight studio assistants to create *ArsDoom*’s concept, characters, and modes of interaction. The mod’s sound designer Curd Duca, who would go on to become a prominent musician within the ambient scene, composed sound effects and the game’s jarring musical score. Reini Urban was responsible for assembling the project’s various architectural modules and modified *Doom*’s level editor so that it could produce angles to accommodate the abstract geometric layout of the Brucknerhaus. Kipcak and Urban took the 3D data from AutoCAD and compiled the architectural designs using the AutoLISP programming language, exporting them to the *Doom* editor (Figure 2.8).

In the editor, the artists designed sprite and weapon interactions among player, artworks, and enemy artists, turning the digital exhibition space, as Kipcak mentions, “into a reserve of aesthetics with rapidly alternating focuses. . . . In the

<sup>34</sup> Orhan Kipcak, “ARSDOOM—art adventure,” *Ars Electronica Archive*, 1995, [http://90.146.8.18/en/archives/festival\\_archive/festival\\_catalogs/festival\\_artikel.asp?iProjectID=8643](http://90.146.8.18/en/archives/festival_archive/festival_catalogs/festival_artikel.asp?iProjectID=8643).

<sup>35</sup> Orhan Kipcak, “Orhan Kipcak (ArsDoom, ArsDoom II) (1995-2005),” interview by *gamescenes.org*, November 4, 2009, <http://www.gamescenes.org/2009/11/interview-orhan-kipcak-arsdoom-arsdoom-ii-1995.html>.



**Figure 2.7** Orhan Kipcak and Reini Urban, *ArsDoom*, 1995. Screenshot. Firing at an enemy artist using a crucifix gun.



**Figure 2.8** Orhan Kipcak and Reini Urban, *ArsDoom*, 1995. Screenshot. Architectural rendering of the Brucknerhaus exterior.

agony of a hermetic world, the visitor, armed with color gun and water hose, slips on the character masks of Beuys, Rainer, Baselitz or Koons.”<sup>36</sup> Kipcak imagined that players would adopt various personas from the contemporary art world when immersed into the game’s first-person perspective. At times, the player can

<sup>36</sup> Kipcak, “ARSDOOM—art adventure,” *Ars Electronica Archive*, 1995.



**Figure 2.9** Orhan Kipcak and Reini Urban, *ArsDoom*, 1995. Screenshot. Shooting projectiles from a TV remote-launcher, a citation to the work of Nam June Paik.

channel Austrian artist Arnulf Rainer and his techniques of painting over existing photographs. Similarly, players embody multimedia artist Hermann Nitsch and splatter blood upon the artworks in reference to his often brutal, ritualistic paintings and performances. In other instances, participants fire projectiles from a TV remote, a citation to the video experiments of Nam June Paik (Figure 2.9). And on occasion, shooting at the paintings causes them to turn upside down, a reference to Georg Baselitz and his technique of inverting works for display. Kipcak and Urban scanned photographs and video to render the game's textures and enemy sprites: large floating heads of participating festival artists. Similarly, footage of Linz's landscapes surrounding the Brucknerhaus were scanned and imported into the map.

During the Ars Electronica festival, *ArsDoom* was exhibited on computers for public interaction and as an installation in which game walkthroughs were projected in stereoscopic vision using an LCD shuttle screen, prism, and mirrored viewing device. More so, festival participants engaged with *ArsDoom* through networked play. They could download the mod's client software and levels to access the game in four-person multiplayer. The virtual Brucknerhaus, digital artworks, and AutoLISP CAD tool were made downloadable as freeware throughout the duration of the festival. Networked play and shared content fulfilled Kipcak and Urban's aim to extend the experience of *ArsDoom* into a kind of "telematic space."<sup>37</sup>

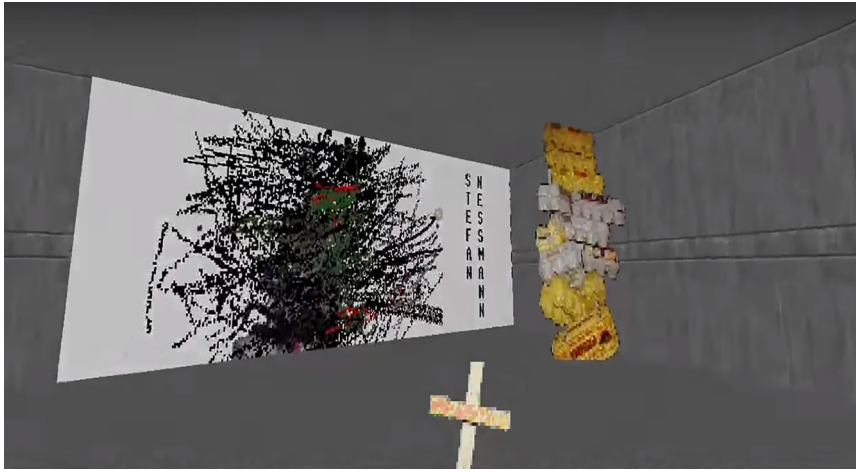
<sup>37</sup> Ibid.

The “miscognitive” apprehensions caused by *ArsDoom*, or rather, trying on the masks of contemporary artists and using their techniques as destructive forms of expression, instigates the body’s proprioceptive sense of moving through *Doom*’s 3D gamespace. As Jacob Gaboury suggests, embodied perception of the first-person shooter indicates a simulation of perspective, reproducing the vision of aiming a weapon within a confined projection of space. In the FPS genre, the player’s actions within space, their capacities to move and fire, are influenced by vectors of line projected from the center of the frame along the player’s field of vision indicated by a crosshair.<sup>38</sup> In *ArsDoom*, this embodied perspective questions the body’s proprioceptive response through relational similarities among entities in the gameworld. That is to say, correspondences between museum and battlefield, paintbrush and gun, TV remote and rocket launcher, blood and paint, player and critic produce an assemblage among body and engine through which spatial perceptions intensify. When the player acts along these embodied vectors, mimetic relations among objects rearticulate *Doom*’s gameworld as abstractions of 3D space. Rapidly firing bullets from a crucifix at paintings and seeing them explode in blood impinges upon the player’s proprioceptive sensitivity: vectors of shooting and running through space are experienced as an ebb and flow of affective forces.

In his discussion of affect and gameplay drawing from the work of Gilles Deleuze and Felix Guattari, Colin Cremin refers to the dynamics of in-game forces as rhizome-play: a co-constituency among player, avatar, textures, NPCs, mechanics, and spaces that produces a field of affective oscillations from our encounters with game systems. Within rhizome-play, the player collides with friction-images, or the invisible forces of game physics: gravity, tactility, slickness, and velocity through which intensities are reciprocated in the body.<sup>39</sup> In *ArsDoom*, friction-images or the sensations of running through the Brucknerhaus, firing surreal weapons, or turning paintings upside down demonstrate the playful cognition that Benjamin and Hansen illustrate. Just as the child whimsically perceives the moon as a ball and reaches for its spherical form, in *ArsDoom* this same perceptual “grasping” as it were, for crucifix-guns, TV remote-rocket launchers and paint-blood, modulates our proprioceptive feedback to perspectival space. The jolt of the mod’s intensities, its trajectories of

<sup>38</sup> Jacob Gaboury, “Perspective,” in *Debugging Game History: A Critical Lexicon*, ed. Raiford Guins and Henry Lowood (Cambridge, MA: The MIT Press, 2016), 364.

<sup>39</sup> Colin Cremin, *Exploring Videogames with Deleuze and Guattari: Towards an Affective Theory of Form* (London: Routledge, 2015), 61, 106.



**Figure 2.10** Orhan Kipcak and Reini Urban, *ArsDoom*, 1995. Screenshot. Destroying an artwork by firing a crucifix gun and painting over its contents in the style of Arnulf Rainer.

slinging and firing strange objects along vectors of the player's aim, *denaturalizes* familiar operations of play within the FPS genre (Figure 2.10). By transforming *Doom* into a metaphorical killing field for the contemporary art world, Kipcak and Urban make apparent certain impositions of institutional power, while revealing the engine's modular architecture.

## The Strangeness of Institutional Critique

For Kipcak, appropriating a first-person shooter and recontextualizing violence as a strategy of institutional critique, presented “obvious similarities between a battlefield and the Artworld.” As he states, “The competitiveness of the art scene reflects the Darwinian nature of videogame landscapes—in a sense, the videogame made the invisible conflicts of the artworld ‘real,’ explicit and visible, albeit in a playful way.” Critics and the Linz media were disapproving of *ArsDoom*’s satire, going as far as to call it a “fascist orgy of violence.” Other media outlets such as *Der Spiegel* and the BBC were more receptive of a first-person shooter as an art form, giving praise to mod’s anarchy as both subversive yet affirmative in its critical position on the politics of contemporary art.<sup>40</sup>

<sup>40</sup> Kipcak, “Orhan Kipcak (ArsDoom, ArsDoom II) (1995-2005),” interview by *gamescenes.org*.

Formal strategies that sought to reveal the politics of collection and display emerged with the avant-garde after the Second World War, predicated on what Arthur Danto calls the institutional theory of art. Danto holds that “To see something as art requires something the eye cannot decry—an atmosphere of artistic theory, a knowledge of the history of art: an artworld.”<sup>41</sup> More so, an object transforms into art only within the art world and the discursive institutional settings that Danto outlines. Outside the context of the white cube, Duchamp’s infamous *Fountain* or Warhol’s displays of Brillo boxes are recognized as commodities. Yet, when exhibited within the austere space of the gallery, they are taken into consideration as aesthetic objects and interrogate the museum’s political structure. What does an institution consider art? Which artists and works are chosen for display to represent cultural histories? Whose voices are heard, and which are ignored?

Boris Groys refers to this dual nature of the Duchampian readymade, an everyday mass-produced commodity designated as art, as a “paradox-object.” This is something that possesses a dual ontology as both nonart outside the museum and transformed into art when exhibited within those institutional spaces. The paradox-object works through self-contradiction and politically intervenes in the art institution’s power to collect and exhibit by “transcending the borders of the art system—while at the same time remaining within these borders.”<sup>42</sup> These subversive-affirmative approaches emerged in an initial movement of institutional critique throughout the 1960s and 1970s with works by Hans Haacke, Marcel Broodthaers, and Daniel Buren. A second development began in the late 1980s and 1990s with conceptual artists such as Fred Wilson, Adrian Piper, Andrea Fraser, and Mark Dion, who expanded the critique of their predecessors, as Brian Holmes explains, through “the systematic exploration of museological representation, examining its links to economic power and its epistemological roots in a colonial science that treats the Other like an object to be shown in a vitrine.”<sup>43</sup> As an example, in 1974 Hans Haacke attempted to exhibit his installation *Manet-PROJEKT '74* at the Wallraf-Richartz Museum in Cologne (it was rejected), a work consisting of multiple documents that sought to unveil the provenance of Edouard Manet’s painting *Bunch of Asparagus* (1880),

<sup>41</sup> Arthur Danto, “The Artworld,” *The Journal of Philosophy* 61, no. 19 (1964): 580.

<sup>42</sup> Boris Groys, *Art Power* (London: The MIT Press, 2008), 3.

<sup>43</sup> Brian Holmes, “Extradisciplinary Investigations: Towards a New Critique of Institutions” (2007), in *Art and Contemporary Critical Practice: Reinventing Institutional Critique*, ed. Gerald Raunig and Gene Ray (MayFlyBooks, London, May 2009), 57.



housed in the museum's collection. One document revealed that the painting was donated by Hermann Josef Abs in 1968, who at the time was chairman of the Friends of the Wallraf-Richartz Museum and had once served as financial adviser to Adolf Hitler. By situating the painting's documented ownership as a paradox-object, Haacke's conceptual work exposes the institution's abhorrent connections between donorship, capital, and politics. Similarly, in his exhibition *Mining the Museum* (1992–3), African American artist Fred Wilson was invited to sift through the permanent collection of the Maryland Historical Society in Baltimore, Maryland, and recontextualize its objects in a series of installations to present alternate histories of minority voices. Displayed within the galleries of the Maryland Historical Society in collaboration with the Contemporary in Baltimore, Wilson's installations deconstruct the museum's traditional focus on collecting and displaying a celebratory past of Maryland's white aristocracy. For instance, in *Metalwork 1793–1880*, Wilson juxtaposes a pair of slave shackles among silver repoussé pitchers and cups, placed within the museum's familiar glass vitrine. While in *Cabinetmaking 1820–1960*, the artist places a whipping post before an audience of ornate wooden chairs. Through ironic rearrangements of museum artifacts, brought into a kind of anthropomorphic dialogue with one another, Wilson unveils museum politics that have historically marginalized the histories of people of color.

Following these critical movements, I suggest that *ArsDoom* evokes sensual operations of mimesis that question institutional politics of display through the game's paradoxical status: an object that is simultaneously a popular entertainment commodity and artwork within the context of *Ars Electronica*. The modification of *Doom* into a simulated museum through which works are exhibited and judged interactively by patrons, reconfigures traditional modes of public participation within the institution, yet remains embedded in the art world's organizational structure. As a video game, *ArsDoom* questions the borders of the art world's acceptance of an aesthetic object within late capitalism. The mod's contradictory status engages the player in a mode of apperception through its subversive expression of the art world's competitive nature. It discloses the engine's technical operations, its extensibility, by transforming *Doom*'s familiar levels into the violent gameworld of the festival.

In *ArsDoom*, gamic apperceptivity operates through novel modes of public participation. Within traditions of institutional critique in the avant-garde, Frazer Ward argues that publicity, drawing from its Habermasian understanding, expresses not only the artistic medium but also the range of "practices of

intervention in economies of cultural production and reception” that construct forms of aesthetic participation. Ward contests that an artist like Haacke or Wilson demonstrate a recognition of the contemporary museum as a space in which multiple and conflicting forms of publicity are braided among historical bourgeois reception and those publics of late capitalism. The institution becomes a site of “performing art’s function as publicity within a prescribed and always already compromised cultural space.”<sup>44</sup> The strangeness of *ArsDoom* is realized in emergent forms of publicity organized from the mod’s interactivity (both within actual space and networked play) as a commodified experience, and more traditional forms of publicity realized through the installation’s physical display within the Brucknerhaus. As Jon Cates points out, *ArsDoom* was a conceptual experiment in deliberately rupturing the values of Ars Electronica. Critics observed that participants were enthralled with the opportunity to shoot the image of the festival’s director Peter Weibel. The public’s desire to destroy Weibel’s image foregrounds, as Cates observes, “the carnivalesque inversion of the social order or hierarchical power structures of the festival.”<sup>45</sup>

By allowing festival goers to destroy Weibel, the artworks, and caricatures of successful artists, *ArsDoom* gestures toward a unique rematerialization of institutional power among the public through an interactive medium. With these mimetic engagements of figurative violence, the player armed with bullet-firing cross, transmutes into critic, curator, and director. In acts of vandalizing images and killing simulated artists, participants decide which artworks should remain exhibited and unscathed, or in the most anarchistic possibilities, judge nothing of value and raze the exhibition. Within this novel form of publicity, the game transformed into bloody galleries of the digital Brucknerhaus, the player’s perceptual awareness is directed toward the engine’s modularity and capacity to render gameworlds in a bricolage of things, environments, and mechanics of play (Figure 2.11). That is, *ArsDoom* operates through what Mieke Bal has said of the perceptual lingering inherent to video installation, or rather, “experiments in the not-yet-existing but thinkable variations of what is considered normal, and its slower mode of functioning in comparison to the frantic pace of everyday life, is a privileged area where such spaces can be constructed.”<sup>46</sup>

<sup>44</sup> Frazer Ward, “The Haunted Museum: Institutional Critique and Publicity,” *October* 73 (1995): 72, 88–9.

<sup>45</sup> Cates, “Running and Gunning in the Gallery,” 11.

<sup>46</sup> Mieke Bal, *Thinking in Film: The Politics of Video Art Installation According to Eija-Liisa Ahtila* (London: Bloomsbury Academic, 2013), 7.



As a pioneering work of game art, *ArsDoom* catechizes the art world's power structures by repurposing the game engine as a paradoxical art form. Within histories of the avant-garde, artists have traditionally adopted and reused contemporaneous technologies to integrate their work into the praxis of the public sphere—Duchamp and his cinematic experimentation with whirling, illusory rotoreliefs in *Anemic Cinema* (1926) or Rauschenberg's interactive performance *Open Score* (1966) at *9 Evenings: Theatre and Engineering*, consisting of a tennis match rigged with a complex system of sound sensors and light control mechanisms. In the act of rearticulating a commercial video game as an art object, *ArsDoom* confronts institutional authority by interrogating the ways a video game organizes aesthetic participation. Operating as a *medium of institutional criticism* through its modularity and extensibility, *ArsDoom* produces novel modes of bodily experience through an unfolding of its parodic gamespace, inviting us to consider the playful relationality among the violence of first-person shooters and the combative ethos of the contemporary art world. In its affirmative difference, Kipcak and Urban's mod territorializes new formations of aesthetic engagement working from standard perceptions of 3D space. And, embedded within the game's familiar vectors of embodied vision, it is the strangeness of *ArsDoom*'s mimetic operations, intensities of the abstract gamespace engendered through a run and gun in the museum, that potentially rematerializes the player, all at once, as critic, artist, and curator of the Ars Electronica Festival.



**Figure 2.11** Orhan Kipcak and Reini Urban, *ArsDoom*, 1995. Screenshot. Splatters of blood-paint across an artwork in the simulated Brucknerhaus.

## “Perspective Engines” and the Strangeness of 3D Space in JODI’s *Untitled Game*

*That’s the whole trick of these games, that they are perspective engines. All the time they create tunnels and illusions of a 3-D space and that’s part of the “kick” you have as the user, that you think you explore and you enter and you move into. In fact, the only thing which is happening, is a perspective which just is drawn all the time—so it’s always about graphical tricks.*

—JODI, Interview with Francis Hunger

At their 2012 exhibition *Street Digital* at the Museum of the Moving Image in New York, Dutch-Belgian artist collaborative JODI (a portmanteau of the artists’ names: Joan Heemskerk and Dirk Paesmans) invited viewers to interact with their work *Untitled Game*, a series of fourteen modifications made to id Software’s canonical first-person shooter *Quake* between 1996 and 2001. By altering the source code of *Quake*’s engine and producing a series of glitches that disrupt the game’s graphical components, JODI’s *Untitled Game* reconfigures the player’s habitual encounter with fully rendered, navigable 3D space as a series of bizarre and often psychedelic abstractions. Instead of slaying demons among the familiar polygons and textures of *Quake*’s hellish environments (although in several of the mods, JODI left the game’s sound effects intact), participants at *Street Digital* were subjected to abnormal encounters with four of the mods—*A-X*, *Ctrl-Space*, *Spawn*, and *Arena*—displayed on large hanging screens within the cinematic presence of a dark gallery. Players controlled the mods using joysticks in attempts to orient their viewpoint (often unsuccessfully) within *Quake*’s levels transformed into perceptually aggressive abstractions. In *Ctrl-Space*, the game was altered into swirling black and white moiré patterns that pulsate with each newly rendered frame. JODI’s *Street Digital* not only introduced participants to novel modes of embodied reception that were at times assaultive to the senses but also staged *Untitled Game* as a perceptual

intervention into our normal experiences of play in real-time 3D space. In this chapter, I look at the aesthetic work of *Untitled Game* through a triangulation of the *Quake* engine's technics to the formal experimentations of JODI's mods and the player's aesthetic investment in their strangeness.

In JODI's work, the strangeness of *anamorphic* space reveals a spectrum of phenomenal experience by impeding standard perceptions of perspectival space common to the *Quake* engine. Here, anamorphosis describes a projected space that is warped, yet appears perspectively correct when viewed from a specific vantage point. Through a mimetic encounter with the anamorphic image, the body becomes both apperceptively attuned to the formal disruption of the gamespace via glitch while proprioceptively destabilized by its warped presence. Specifically, I focus on three of JODI's mods *Ctrl-9*, *I-N*, and *Q-L* that demonstrate the way playing and spectating bodies affectively engage with anamorphic space. First, I look at the historical emergence of the *Quake* engine through a media archaeological tracing of its forensic environments to the spatial disruptions in *Untitled Game*. More so, I examine the ways *Ctrl-9*, *I-N*, and *Q-L* engage a bodily mode of apperceptivity that reveals our automated perception of real-time 3D space through the unpredictable generativity of glitch. Like the avant-garde techniques of the structural flicker film prevalent during the late 1960s and 1970s, JODI's mods produce a threshold experience that draws awareness to the disrupted game's perceptual effects while eliciting a range of sensual responses. I frame the affective fluctuations generated from JODI's work as a *flicker mod*. This apperceptive feedback of the flicker mod coextends to the body's proprioceptive capacities through kinesthetic illusions of movement. JODI's *Untitled Game* modulates our spatial resonance in the world just as it attunes the body's self-sensitivity toward navigating anamorphic space.

## The Work of Anamorphosis

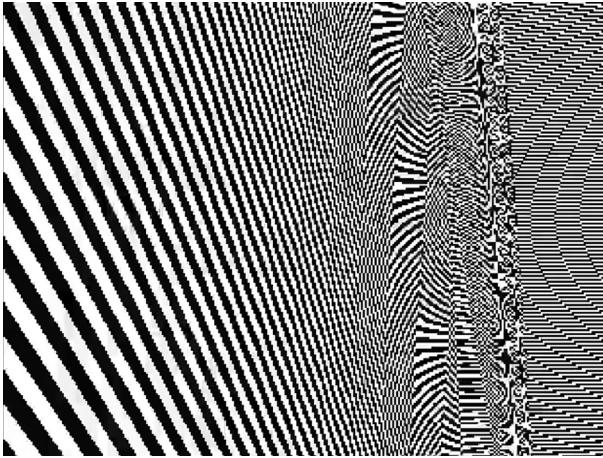
JODI were among the first artists in the mid-1990s to experiment with net art. Forming their collaboration in 1994, they began creating technical interventions that destabilized the comfortable interfaces familiar to users when surfing the web. Both artists were influenced by traditions of video art and Paesmans studied sculpture under Nam June Paik while a student at the Kunstakademie in Dusseldorf. In 1995, they accepted a residency at the CADRE Institute (Computers in Art, Design, Research, and Education) at San Jose State University, a laboratory supporting

media artists who integrate material aspects of the internet into their work. JODI experimented with aesthetic uses of technologies in the dominant framework of Silicon Valley's computer culture, at the time a flourishing tech hub for IBM, Adobe, and Apple. While at CADRE, JODI worked with artist Anne-Marie Schleiner who in July of 1999 curated the online exhibition "Cracking the Maze: Game Plug-ins and Patches as Hacker Art": a seminal project in histories of game art which featured playable mods for commercial titles such as *Quake*, *Marathon Infinity* (1996), and *Unreal* (1998). Schleiner showed JODI's work *SOD* (1999), a modification made to *Wolfenstein 3D* (1992) that abstracted its gameworld into a collage of black and white geometric patterns. That same year, JODI showcased a different iteration of *Ctrl-Space* in "Synreal: The Unreal Modification," an online exhibition curated by the Austrian collective Netbase t0, which highlighted art mods produced using the *Unreal* engine. JODI employed the first-person shooter *Unreal* to produce a similar hypnotic moiré aesthetic witnessed in their technical disruptions to *Quake*.

Before solidifying their relationship as artistic collaborators at CADRE, Heemskerk studied at the St. Joost Academie in Breda, working in both photography and 3D modeling, while Paesmans graduated from St. Lukas in Brussels in the plastic arts and at the Royal Academy of Fine Arts at Ghent before studying under Paik. While at CADRE, JODI explored software modifications through different versions of *Untitled Game*, a work that sought to upend intuitive flows of gameplay by mutating *Quake*'s medieval environments into unforgiving anamorphic interfaces. Throughout the various mods, players are subjected to dizzying moiré effects, flickering geometries, and frustrating paradoxical movements (Figure 3.1).

In an interview with conservator Lisa Adang, JODI note that their earliest *Untitled Game* mods were created at CADRE on a Macintosh Quadra and the 1997 Mac shareware version of *Quake*, which only included the game's initial episode. Constrained to using only extensible portions of the engine (the proprietary code would not be available under General Public License until 1999) Heemskerk designed *Arena* by changing all of *Quake*'s colors to white, obscuring the player's navigation. Yet in *Arena*, Heemskerk left the game's sound effects intact, providing basic auditory cues for moving and fending off enemies within the static white frames of the interface.<sup>1</sup> JODI left *Quake*'s sound effects

<sup>1</sup> See Joan Heemskerk and Dirk Paesmans interviewed by the author, May 30, 2013, Dordrecht, Netherlands in Lisa Adang, "Untitled Project: A Cross-Disciplinary Investigation of JODI's *Untitled Game*," *Rhizome*, Version 2, 2014, <http://media.rhizome.org/artbase/documents/Untitled-Project-A-Cross-Disciplinary-Investigation-of-JODI%E2%80%99s-Untitled-Game.pdf>, 12.



**Figure 3.1** JODI, *Ctrl-Space*, *Untitled Game*, 1996–2001. Screenshot. Psychedelic moiré patterns in *Ctrl-Space*.

in the remaining *Untitled Game* mods and in several versions included glitched and garbled noises coupled with complex visual patterns.

In 2001, JODI circulated copies of *Untitled Game* on a CD-ROM in several net art magazines including *Mute*: a leftist publication focused on the intersections among art and cyberculture. The distribution of these mods on CD-ROM marks what Annette Schindler and Waling Boers see as a disruption within the isolated discourse of net art through JODI's release of a mod that could be played on a PC without internet connection. Sharing *Untitled Game* on a disk indicated JODI's aim to reach a wider community of gamers and modders outside of net artists while shifting focus from the purity of net art toward the capacity for video games to reflect upon contemporary technoculture.<sup>2</sup> By altering the *Quake* engine at the level of code, *Untitled Game* shifts player interaction away from the optimization of pleasurable experience within a perspectively coherent gamespace toward sensual engagements with anamorphic projection.

Since the Renaissance, linear perspective has operated as the central mode of visibility to naturalistically reproduce depth within an image. It is a form of rendering illusory space that corresponds to human perception as objects diminish in scale and recede into the distance, converging at a point along a horizon line. Alongside the historical development of linear perspective, artists

<sup>2</sup> Annette Schindler and Waling Boers, "The Likelihood of Disturbances," in *INSTALL.EXE-JODI*, ed. Tilman Baumgärtel (Basel: Christoph Merian Verlag, 2002), 55.



since the Renaissance have explored anamorphosis as an alternate means of rendering space, one that is stretched and warped yet retains geometric accuracy. Anamorphosis requires the viewer to actively interpret an image’s vantage point by viewing it off-center, producing an optical effect in which the warped image appears as foreshortened and geometrically precise. The best-known example of anamorphic perspective is the mysterious skull in Hans Holbein’s *The Ambassadors* (1533) (Figure 3.2). In the painting, two well-dressed French statesmen stand among a collection of worldly possessions including an astrolabe, books, and musical instruments. In the immediate foreground sits a conspicuously placed skull stretched across the canvas that when viewed from the correct angle reveals a proportioned skull, an icon of *vanitas* or *memento mori*: a visual reminder of death’s inevitable arrival.

The operations of code running JODI’s *Untitled Game* attune the player’s intensive capacities to feel the anamorphic distortion of 3D space. The player perceives *Quake*’s fully rendered, actionable spaces not as a visual regime of



**Figure 3.2** Hans Holbein the Younger, *The Ambassadors*, 1533. An anamorphic rendering of a skull.

Cartesian perspective but rather as an affective modality of anamorphosis. When the player encounters the unique durations, temporalities, and processes that comprise the kaleidoscopic effects of *Ctrl-9*, *I-N*, and *Q-L*, affectivity operates through an aesthetic vector of mimesis in which anamorphic space locates itself within the body. In his discussion of artist Robert Lazzarini's *skulls* (2000), Mark Hansen proposes what he calls an affective topology of space. Lazzarini's installation consists of four warped skulls scanned from an actual human model, stretched and distorted using digital CAD software, and then cast in bone. The warped skulls confront the viewer with anamorphic space that produces an affective "analogy" between the body's sensory feedback and the bewildering spatiality of the skulls exhibited in the gallery. As the viewer moves around the skulls, attempting to locate a vantage point that continually eludes them, the anamorphic rendering of the sculptures correlate to an embodied "form-giving" of intensive space. Just as the viewer must work to decipher the anamorphic skull in Holbein's painting, Hansen argues that Lazzarini's distorted craniums mobilize affectivity as a bodily space that corresponds to the digitally manipulated space of the skulls. Hansen calls this affective modality the digital "any-space-whatever" (ASW), a term borrowed from Gilles Deleuze's philosophy of cinema to describe the virtuality of space, or the potential sensory registers among given objects and environments within the cinematic image. The digital ASW operates through a proprioceptive, nonoptical mode of embodiment. As Hansen states, the digital ASW generates bodily anxiety over "just how radically alien the formal field of the computer is." In these instances, anamorphic perspective actuates the virtuality of the body, producing within it a sensation of distorted space introduced from the computer's modulation of the skulls. Hansen calls this process affective proprioception or the body's own decoding of anamorphic space. This affective modality operates autonomous of perception and serves no relation to vision.<sup>3</sup> Rather, it is an experience of spatiality outside of the figural, pictorial, or sculptural. Visual perception is impeded as the body deciphers the skulls, and space is intuited through an autopoietic response. The viewer must work to maintain their spatial equilibrium, producing a sensual analog to the warped, exterior space.<sup>4</sup>

In their book *Metagaming*, Stephanie Boluk and Patrick LeMieux bring Hansen's concept of proprioception into conversation with anamorphic

<sup>3</sup> Hansen, *New Philosophy for New Media*, 203, 205–6.

<sup>4</sup> *Ibid.*, 229.



video games. When the player interacts with anamorphic rendering, it produces an experience of what they call *memento mortem mortis*. If the stretched skull that looms before Holbein's ambassadors serves as an emblem of memento mori and a reminder of death yet to come, then *momento mortem mortis* reflected in anamorphic games engages the viewer with the unique phenomenology of the gameworld's shifting 2D and 3D perspectives. It operates as a reminder of the boundaries of an anthropocentric phenomenology. In games such as *Super Paper Mario* (2007) with its changing perspectives between side-scrolling and 3D navigation, or the Escherian puzzle chambers where one must teleport through in *Portal* (2007), the player is taken up in the alien rhythms of the game's technical operations that exceed human experience. Anamorphic games reflect a form of metagaming *about* graphical rendering, and more so "about *aboutness* itself."<sup>5</sup> As I demonstrate in this chapter, Hansen's digital ASW and Boluk and LeMieux's *memento mortem mortis* allow us to think about JODI's *Untitled Game* mods as anamorphic games that operate beyond visual perception through a proprioceptive-apperceptive aesthetic. Anamorphosis in *Ctrl-9*, *I-N*, and *Q-L* propel the body toward an affective instability in which it must work to ground itself within 3D space. This act of spatial recalibration always eludes the player's ability to orient themselves. That is to say, modding's uncanny forms exceed our perceptual capacities and engender a bodily awareness of paradoxical space.

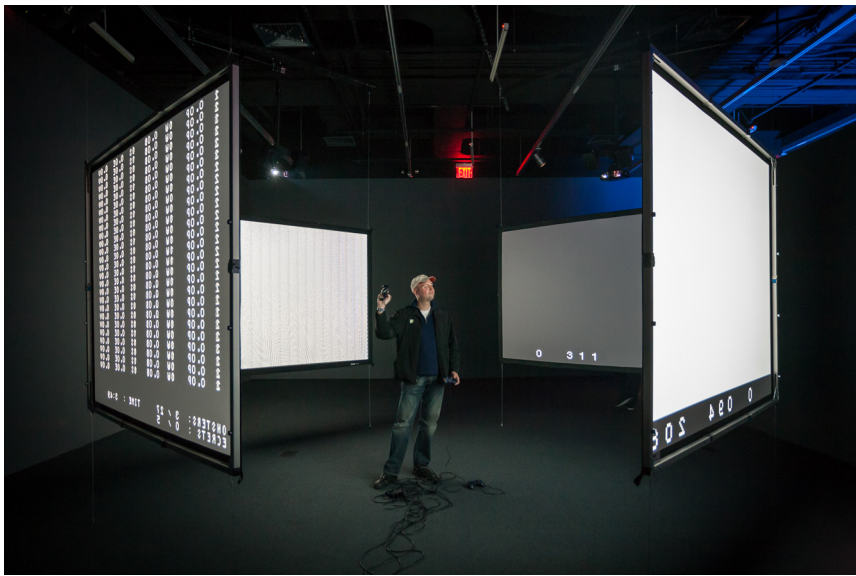
JODI employ the *Quake* engine to render anamorphosis through what I argue are the perceptual mechanisms of glitch and specifically flicker effects. I borrow the term from traditions of American avant-garde film and Tony Conrad's work *The Flicker* (1966): a film composed of black and white frames that continually alternate in rhythmic patterns, generating a hallucinogenic transmission of visual frequencies. Through their formal effects, JODI's *Ctrl-9*, *I-N*, and *Q-L* (among other mods in *Untitled Game*) operate as *flicker* mods, or what artist Axel Stockburger describes as "kinetic screen sculptures" through frenzied sequences of glitch.<sup>6</sup> JODI's first US solo exhibition *INSTALL.EXE* at Eyebeam in Brooklyn featured multiple *Untitled Game* mods situated at computer workstations for users to play. In 2007, JODI exhibited *Untitled Game* at the group exhibition *Show #9* at Pasadena-based gallery And/Or, inviting

<sup>5</sup> Stephanie Boluk and Patrick LeMieux, *Metagaming: Playing, Competing, Spectating, Cheating, Trading, Making, and Breaking Videogames*, <http://staging.manifoldapp.org/read/c5926868-00c4-45f8-8e91-45cfd9140a87/section/fb4e77c9-5347-42a4-9149-dfd009bd864f#ch03>.

<sup>6</sup> Axel Stockburger, "From Appropriation to Approximation," in *Videogames and Art*, ed. Andy Clarke and Grethe Mitchell (Bristol: Intellect Ltd., 2007), 33.

audiences to sit at a yellow table and play selected mods on retro desktop PCs. At the 2010 GLI.TC/H conference and festival at Roxaboxen Exhibitions in Chicago, JODI showed *Ctrl-Space* and *E1M1AP* on dated laptops along a shelf for viewers to stand and play. Yet as I mentioned, at their *Street Digital* show in 2012 JODI transitioned from displaying *Untitled Game* on outdated computers and projected the mods on large scrims in a dark gallery (Figure 3.3). JODI's more recent exhibitions of *Untitled Game* mirror the perceptual environment of Conrad's film played within an underground theater: stroboscopic effects of glitch within the contrasting darkness that works to organize spectatorial experiences through the immediacy of large-scale projections. Like Conrad's film, JODI's use of glitch impinges upon the body's sensory faculties through a threshold experience, producing a strangeness in which the player is perceptually aware of their spatial disequilibrium within 3D space.

In the following section, I unearth a media archaeology of the *Quake* engine and its unique computational techniques that produce the game's real-time 3D spaces. Drawing from Matthew Kirschenbaum, I propose a forensic analysis of *Quake* through what he refers to as a grammatology: a reading of the working



**Figure 3.3** JODI, *Untitled Game*, 1996–2001. Installation view, *Street Digital*, Museum of the Moving Image, 2012. Mods projected onto large scrims. Photograph by Daniel Love. © Museum of the Moving Image and Daniel Love.

components of an inscription technology.<sup>7</sup> Here, I trace the mechanisms of the *Quake* engine to JODI's deconstruction of its code at the forensic level of inquiry, to the formal materiality of *Untitled Game* and the player's mimetic engagement with its abstract spaces. By unveiling how a game engine works, its "engine-ness" we might say, and how JODI upend its standard operations through the rendering of anamorphosis, we can consider how modding practices make strange conventional gameplay of the first-person shooter.

## A Grammatology of the *Quake* Engine

After the release of *Doom II* in 1994, Romero and Carmack began work on a 3D version of a previous 2D game concept called *Quake: The Fight for Justice*, that like *Doom*, was inspired by playing *Dungeons and Dragons*. The game was slated to be a medievaesque RPG with a warrior avatar named Quake equipped with a giant hammer. The comprehensive FAQ document QUAKETALK 95 created by game developer and *Quake* archivist Joost Schuur in October of 1995 provides a detailed library of interviews, articles, and programming logs on the *Quake* engine's development starting in the summer of 1994. In an interview from November of the same year, Romero addresses the advanced rendering the 3D engine stating that:

the technology in quake [sic] will be much better than in doom [sic] . . . the graphics will use 3-D rendered models, unlike the 2-D images in doom [sic] . . . so if you walk around a pillar, you'll see it in full 360 degrees, as opposed to only eight different rotations in doom [sic]. You'll also be able to move in six different directions, and they'll [have] much better animation. We're also adding cool cinematic sequences that take place while you're playing the game. Basically, doom will feel stiff compared to quake [sic].<sup>8</sup>

Carmack began programming a potential 3D engine throughout 1995 but because of technical limitations with rendering and frame rate, both Romero and Carmack changed the direction of *Quake* from a slower, world-exploring RPG to a frenetic, fast-paced shooter in the tradition of *Doom*. Developments

<sup>7</sup> Matthew G. Kirschenbaum, *Mechanisms: New Media and the Forensic Imagination* (Cambridge, MA: MIT Press, 2012), 88.

<sup>8</sup> John Romero, interview by Multimedia Magazine, in QUAKETALK 95, October 22, 1995, <http://rome.ro/?offset=1481382456223&author=51a4f9c2e4b068f76a150e2a>.

on the reworked engine included Carmack as main programmer, Michael Abrash assisting with assembly optimization and algorithms, and additional programming by John Cash. Game design was handled by Romero along with American McGee, Sandy Petersen, and Tim Willits, and art direction by Adrian Carmack, Kevin Cloud, and Paul Steed. The game featured an aggressive industrial soundtrack produced by Trent Reznor of Nine Inch Nails to accompany the chaotic gameplay. Released on June 22, 1996, the final build of *Quake* immersed players into a dark fantasy world as “Ranger” (also voiced by Reznor), a special forces op who must eliminate an enemy code-named “Quake” after being sent through an interdimensional portal via a government teleportation device known as the Slipgate. Using an armory of weapons such as shotguns, nailguns, and rocket launchers, Ranger must travel to alternate dimensions and fight his way through hordes of monsters with the aim of defeating the tentacled “Hell-Mother” Shub-Niggurath (Figure 3.4). As with the game’s grotesque creatures and interdimensional realms, the Hell-Mother’s appearance and namesake were inspired by designer Sandy Petersen’s interest in H. P. Lovecraft’s Cthulhu Mythos.

Carmack developed the unique programming language QuakeC in 1996 to allow for modification and expandability to the engine. According to modder David “DarkGrue” Hesprich in his *QuakeC Reference Manual*, the language has



Figure 3.4 *Quake* (id Software, 1996). Screenshot.

similarities to C, yet QuakeC is compiled with the QuakeC compiler (QCC): a program that turns QuakeC code into a `progs.dat` file for the engine to interpret. When the engine is running, it takes continual instruction from the `progs.dat` file, which is loaded when the game is started.<sup>9</sup> Using QuakeC and the compiler, a player can modify *what* the engine renders and how the game performs by reconfiguring physics, the appearance of weapons and character skins, AI elements, and triggers or invisible areas of the map that interact with player proximity (doors, lights, moving platforms, and monsters). With *Quake*'s initial release, a user could not modify the engine's proprietary source code; however, id Software made it freely available in 1999 through the GNU General Public License. This allowed developers to openly modify *Quake*'s graphics renderer and produce derivative engines, most notably Goldsource used by Valve Corporation to develop the first-person shooter *Half-Life* (1998) and its successor, the Source engine, used for both Valve's *Counter-Strike: Source* and *Half-Life 2* in 2004.

Unlike the 3D space projected onto two-dimensional planes (2.5D) in *Doom*, the efficiency of the final *Quake* engine build and its ability to render a real-time 3D world is predicated on two graphic techniques: binary space partitioning (BSP) and precalculated lighting. The best technical documentation of the engine's development comes from Michael Abrash's "Ramblings in Realtime" written while working on *Quake* with Carmack between 1995 and 1997.<sup>10</sup> In November of 1995, both programmers considered simplifying the source code to speed up rendering and produce arbitrary, real-time 3D environments, or the player's ability to move and look in all directions. The engine was designed to use pre-rendered maps, lowering the CPU requirements needed to run *Quake* on home computers with an average processor speed of 50–75MHz. Abrash explains that for any engine to work properly, it must rasterize the appropriate color at the level of individual pixels, while keeping a consistent frame rate, which for *Quake* was a minimum of 10–15 frames per second.<sup>11</sup> In computer graphics, rasterization is the process of transferring vector-based graphics, polygons used to construct the game environment, to a raster-based image consisting of pixels for video display.

<sup>9</sup> For a detailed explanation of the QuakeC interpreted language, see David Hesprich, *QuakeC Reference Manual*, <http://pages.cs.wisc.edu/~jeremyp/quake/quakec/quakec.pdf>.

<sup>10</sup> See Michael Abrash, *Ramblings in Realtime*, *Blue's News*, <https://www.bluesnews.com/abrash/>.

<sup>11</sup> Michael Abrash, "The Quake Graphics Engine" (presentation notes, *Computer Game Developers Conference*, April 2, 1996).

The problem for Carmack and Abrash was that in 1995, rasterizing algorithms were not advanced enough to quickly process the number of polygons used in *Quake*'s level designs. Hypothetically, if existing engines of the time could efficiently draw numerous polygons, this would prompt developers to build increasingly complex 3D worlds. With more geometries, the engine's graphics renderer fails to draw only the polygons within the player's frustum, or their perspectival line of sight in the game. If a rasterizing algorithm drew every polygon both visible and invisible to the player, the result would produce overdraw and an inconsistent frame rate. Carmack realized that overdrawing would occur in a typical *Quake* level with roughly 10,000 polygons, especially when the specific "painter's" algorithm was used to draw all polygons in the player's view. Because vector-based polygons are often hidden or partially covered by other polygons in a game map, typical rasterizing algorithms of the time would overdraw pixels ten times on average within a frame. This led Carmack and Abrash to develop the final iteration of the engine with two principles in mind. First, they had to efficiently draw polygons within the view frustum and, second, render the appropriate surface textures for each pixel of the visible polygons.<sup>12</sup>

The *Quake* engine is essentially divided into two components: static 3D environments and moving objects such as the player avatar (the weapon Ranger is holding), enemies, doors, platforms, and so on. In the static world, Carmack addressed overdraw through visible surface determination: correctly drawing pixels to geometries and culling or removing nonvisible polygons from the view frustum during rasterization. More so, *Quake* maps are preprocessed into a tree structure via BSP techniques utilized in *Doom*. Carmack designed each map in *Quake* as a singular BSP tree with spatial data stored in its leaf structures that correspond to nodes. In a map's BSP tree, correct visible surface determination occurs by culling geometries entirely outside the player's view frustum, and clipping sections of polygons that are partially outside of the frustum. The rasterization algorithm then only draws pixels for polygons visible (whole and partial) within the player's view. Thus, culling unnecessary polygons outside of the view frustum and clipping irrelevant portions of others, allows for each pixel to be drawn only once.<sup>13</sup>

Carmack used potentially visible sets (PVS) based on precalculated geometries stored within each BSP tree, which made for even less overdraw. In a PVS,

<sup>12</sup> Ibid.

<sup>13</sup> Michael Abrash, "Inside Quake: Visible Surface Determination," *Ramblings in Realtime*, *Blue's News*, <https://www.bluesnews.com/abrash/>.



geometries within BSP leaves are retrieved from a global list that stores polygonal edges, which make up the level architecture. Within a PVS, the engine uses a global list to access convex portions of geometries subdivided among the leaves. Using these prearranged indexes means that the engine can continually retrieve and draw unique sections of the gameworld through front-to-back ordering in the tree, while clipping partially obscured geometries and culling others outside the player's view. Abrash gives the analogy of standing in a house to explain how a given PVS operates. If someone were positioned in a downstairs kitchen, they would not be able to *see* an upstairs bedroom at the back of the house. If this house were a *Quake* map, nonvisible polygons comprising the upstairs bedroom are excluded from the spatial data stored in the kitchen area's unique PVS. At the same time, if one were standing in the kitchen and observing sections of the living room from their vantage point, then visible polygons from the living room are also stored in the kitchen's PVS. If the player is in the corresponding leaf for a section of the map, the PVS for that area contains all the polygons that can become visible based on where they move and look in the gamespace. Thus, the engine only renders the appropriate polygons from a stored edge list based on player visibility for a leaf's PVS instead of processing thousands of geometries, visible and nonvisible, within the map's entirety (Figure 3.5).<sup>14</sup> Spatial data from the PVS is interpreted from the edge list as a series of "spans": sections of pixels on the screen that cover the area of geometries. The rasterizing algorithm applies a specific bitmap of colors and textures to the spans while simultaneously calculating for perspective upon surfaces.

As for moving objects in *Quake*, Carmack and Abrash discovered that dynamic 3D models such as enemies, doors, and lifts encompass multiple leaves within the BSP tree. A given model includes hundreds of polygons with a large portion of them visible. A group of encroaching monsters can potentially span several leaves within a given PVS that change with each of their movements, making it difficult for the engine to order polygons from front-to-back.<sup>15</sup> In *Doom*, enemies were rendered as 2D animated sprites, while 3D figures in *Quake* are designed through connected vertices that form a polygonal mesh. Carmack approached the problem of moving objects through z-buffering, a process in which the coordinates of dynamic models are measured by comparing the

<sup>14</sup> Michael Abrash, "Quake's 3-D Engine: The Big Picture," *Ramblings in Realtime*, *Blue's News*, <https://www.bluesnews.com/abrash/>.

<sup>15</sup> Michael Abrash, "Consider the Alternatives: Quake's Hidden-Surface Removal," *Ramblings in Realtime*, *Blue's News*, <https://www.bluesnews.com/abrash/>.





**Figure 3.5** A PVS of visible polygons arranged within the player's frustum from *Quake* (id Software, 1996). Screenshot.

distance of each pixel that requires drawing, called its *z* value, to the distance of pixels within the static world that the moving object will potentially overdraw. *Z* values for the static world and animated models are stored as memory referred to as the *z*-buffer. Rasterization occurs if the *z* values of moving pixels are closer to the center of the player's frustum than the *z* values of the pixels they overlap in the static world, allowing the engine to order moving geometries among those that construct the map's architecture, regardless of their trajectory or viewed angle.

As Abrash notes, the engine initially rasterizes polygons in the static world and fills only their values in the *z*-buffer memory without comparing them against the values of moving models. Then moving polygons can be quickly drawn when their *z* values are read against those already calculated within the static world. Carmack's adoption of a precalculated PVS for the static world benefited the *z*-buffering process in that moving entities only need to be drawn if they are in a leaf for the current PVS.<sup>16</sup> Moreover, Carmack and Abrash employed *z*-buffering to approach visual effects like explosions and smoke. Instead of rendering weapon effects as sprites, they used large groupings of particles, small *z*-buffered

<sup>16</sup> Abrash, "Quake's 3-D Engine: The Big Picture."

squares that change in scale and color with increasing distance from the player to generate smoke trails, explosions, and blood splatter.

The other technical breakthrough in the Quake engine's development was Carmack's use of a precalculated lighting map. To produce light and shadows, each polygon is assigned light values with a 16-pixel grid and calculated before the polygon is rendered with textures. In computer graphics, conventional lighting methods often rely on Gouraud shading, a technique in which light values are assigned at each polygonal vertex in the gameworld. These values are then linearly interpolated or adjusted across polygonal edges to reflect an impression of depth. Carmack and Abrash did not use Gouraud shading to light the static world because coupling polygon vertices with light values can result in subdividing geometries into smaller forms to produce more realistic lighting, yet increases processing requirements. Gouraud shading also creates lighting overlaps and discontinuities across multiple geometries. However, Gouraud shading was used for moving objects because model meshes are constructed of small triangles and their constant movement obscures any lighting glitches the player may notice.

To light *Quake's* static world, programmers assigned preprocessed light values to each polygonal vertex. A unique lightmap composed of a  $16 \times 16$  grouping of texels (a textured pixel) was produced for each geometry. Here, lighting is generated by taking the values reflected from adjacent light sources in the map and calculating those values for each grid section on the polygon's surface (Figure 3.6). When the game is running, the texture for each polygon is temporarily stored in a buffer as a series of tiles and lighting is produced for each texel by averaging the values of the four closest lightmap areas, creating a tiled surface of lit texels.<sup>17</sup>

To speed up the lighting process, Carmack adopted surface caching so that textured surfaces could be repurposed in each subsequent frame. Surface caching is used to optimize rendering by reducing the amount of memory needed during runtime. Cache itself is typically a memory reserve that, in the case of *Quake's* 3D graphics, stores surface textures and reuses them in the following frames. Because caching requires a considerable increase in memory, Carmack employed mipmapping, a technique that divides surfaces into levels that recede into the distance from the player's viewpoint. Each mipmap surface possesses a

<sup>17</sup> Michael Abrash, "Quake's Lighting Model: Surface Caching," *Ramblings in Realtime*, *Blue's News*, <https://www.bluesnews.com/abrash/>.



**Figure 3.6** A precalculated lightmap for map E2M7 in *Quake* (id Software, 1996). Screenshot.

lower resolution the further they are positioned in the background. Coupled with zero overdraw from BSP ordering, mipmapping allows for the engine to use less memory by sampling only a ratio of textured pixels among different areas of depth in the image. Yet, for *Quake's* dynamic lighting, or values reflected from moving entities, the engine calculates changing light values for nearby geometries. If the engine applies dynamic lighting, lightmapping is used prior to buffering and reflected surfaces are calculated before texture mapping is applied.

With lightmapping and surface caching in mind, Carmack designed *Quake* to support 3D hardware acceleration. In December of 1996, he created a proprietary hardware port called *VQuake* to be used with the popular Rendition Vérité graphics card at the time.<sup>18</sup> The Vérité chipset was adopted because there was not yet a standard 3D API (application programming interface) for computer games in conjunction with video cards. *VQuake* not only improved frames per second but also supported higher resolutions, 16-bit color, dynamic lighting, and bilinear filtering, which reduced the effects of pixilation. More so, it supported anti-aliasing in which jagged areas of geometries are smoothed out and straightened, a process that JODI intentionally disrupt in

<sup>18</sup> Abrash, "Quake's 3-D Engine: The Big Picture."

their *Untitled Game* mods. Soon after the release of *VQuake* in January of 1997, Carmack developed the *GLQuake* port for use with the Open Graphics Library (OpenGL), an API that could interpret 3D graphics hardware across multiple platforms and programming languages. OpenGL allowed for the graphics processing unit (GPU) on a graphics card to render the game instead of placing the work directly onto the computer's processor, resulting in higher resolutions and frame rates as well as options to adjust in-game reflections and shadows. Executable on Windows 95, *GLQuake* included a driver that supported the use of OpenGL with the popular 3dfx Voodoo graphics card of the time.

Of importance to an archaeology of the *Quake* engine is its client-server architecture. While *Doom*'s multiplayer operated through peer-to-peer networking, *Quake* includes a "client" and "server" that typically operate on the same engine as two distinct game modes. When the engine starts, the server and client portions run simultaneously. In a single-player campaign, the client and server communicate player input/output within the engine. During a multiplayer match, the engine's client portion interfaces with a remote server across a network. Abrash explains that the engine's client side serves as *Quake*'s "3D engine" and sends player input via peripherals (keyboard, mouse, joystick, gamepad) for each frame to the server which interprets client input and runs the game for a set timeslice. This timeslice, which includes graphic output, sound, and menu screens, is sent back to the client as game data displayed for the subsequent frame. The *Quake* server side manages the gamestate, physics, and enemy AI. Server data is stored for each map and retrieved from an external database located on the *Quake* disk. On the server side, a player can program new behaviors for enemies and objects as well as introduce new maps, weapons, and game rules using QuakeC and a compiled progs.dat file.<sup>19</sup> At the forensic level, the technics of the engine's architecture—BSP ordering, lightmapping, surface-caching, client-server operations—fold into the formal materiality of JODI's *Untitled Game*, or as Kirschenbaum describes, the player's experience of the mods' "torque" or "friction" and the engine's computational layers at work.<sup>20</sup> In the following section, I trace these forensic operations to the formal qualities of JODI's *Untitled Game*, focusing specifically on the mods *Ctrl-9*, *I-N*, and *Q-L*.

<sup>19</sup> Ibid.

<sup>20</sup> Kirschenbaum, *Mechanisms*, 13.

## The Formal Materiality of *Untitled Game*

In her significant work *Untitled Project*, completed during tenure as Conservation Fellow for Rhizome in 2013, Lisa Adang provides detailed technical documentation for *Untitled Game*. Adang examines JODI's work by emulating the mods on a Mac OS 9 and playing them within the context of their original production and exhibition. Specifically, she looks at the `autoexec.cfg` and `config.cfg` files within the *Untitled Game* root directory and compares their command values to the *Quake* command index produced by the Electrical and Computer Engineering/Computer and Information Sciences departments at the University of Delaware. She cross-references the *Quake* commands to JODI's code and observes how these altered values generate stroboscopic and vertiginous effects. Inside the *Untitled Game* root directory, there are fourteen separate folders with the executable file and game data for each mod. Adang divides these mods, respectively, into three categories based on their abstract forms: Op mods (those that produce illusory, optical effects through contrasting white and black lines), altered movement mods (those that disrupt the player's ability to navigate 3D space), and color block mods (those that obscure the player's visibility with planes of color).<sup>21</sup> The mods I examine (*Ctrl-9*, *I-N*, and *Q-L*) are chosen based on the ways they deploy glitch to produce anamorphic spaces.

The directory for each mod contains an executable file and a subdirectory titled "id1" which holds the `pak0.pak`, `autoexec.cfg`, and `config.cfg` files, the necessary code in QuakeC and game data interpreted by the engine. Adang draws from "The Quake Wiki," a reference website compiled by players and modders to explain the operations of these game files. The executable file for each mod functions as the *Quake* engine. The `id1` directory contains the `pak0.pak` file (package file), which is the required compressed file with the data (maps, skins, models) for a given episode of *Quake* that the executable file loads and runs. The "id1" directory and `pak0.pak` file refers to "Episode 1: Dimension of the Doomed" in *Quake*, an indication that JODI only made modifications to the game's initial episode. The `autoexec.cfg` and `config.cfg` files located in the `id1` directory are used to configure game settings and player controls (known as console commands): key binds, mouse sensitivity, and adjusting pitch and

<sup>21</sup> Adang, "Untitled Project: A Cross-Disciplinary Investigation of JODI's *Untitled Game*," 20, 30, 32–3.

yaw as they relate to the player's movement on the x and z axes.<sup>22</sup> On the *Untitled Game* website, JODI share downloadable versions of the fourteen mods, yet work through strategies of defamiliarization portrayed in their earlier net art, obfuscating the users navigation through a minimal, unintuitive web interface. JODI display the downloadable files through a directory of black and white monochrome webpages, preceded by a loading screen with a glitched animation of "Untitled Game" lettering. Within the site's file directory, JODI include the QuakeC source code (labeled as "progs"), which is the game data compiled into the progs.dat file needed to modify the game. The QuakeC code includes a number of subroutines (located in .qc files) labeled after elements of the game: models.qc, world.qc, zombie.qc, ai.qc, weapons.qc, demon.qc, triggers.qc, ogre.qc, and so on. Adang points out that one can identify JODI's alterations throughout the QuakeC source code through the directory labeled "UNTITLED-GAME" and its corresponding comments. However, it should be noted that these comments are not from JODI and instead reflect the comments in the original QuakeC source code from programmers at id software. Rather, JODI's modifications are considerably more nuanced and embedded among the various QuakeC subroutines. For instance, in the client.qc file, which informs certain player inputs and outputs within the 3D engine, we see a subroutine called "PlayerPostThink" that configures physics such as jumping and player speed. In comparing statements of the QuakeC source code to JODI's modified code within this subroutine, it is evident that the artists have made changes to the game's control flow. In the QuakeC source code a statement reads:

```
if (!(self.flags & FL_ONGROUND))
    self.jump_flag = self.velocity_z;23
```

By comparison, JODI remove the conditional "if" statement from their QuakeC code, leaving:

```
self.jump_flag = self.velocity_z;24
```

Here, the original seems to imply that if the player is not currently positioned on the ground, then when jumping in the air, they will move and rotate at a determined speed along the z axis. By removing this conditional statement, we

<sup>22</sup> "Engines," The Quake Wiki, accessed June 2013, <http://quakewiki.org/wiki/Engines> in Lisa Adang, "Untitled Project: A Cross-Disciplinary Investigation of JODI's *Untitled Game*," 19.

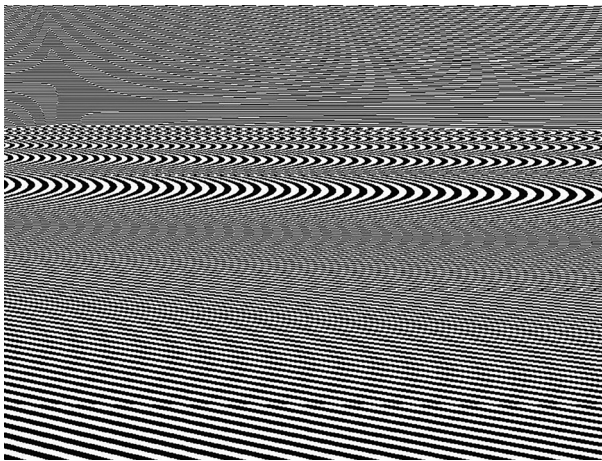
<sup>23</sup> "client.qc," quakewiki, quakewiki.org, accessed May 12, 2020, <https://quakewiki.org/wiki/client.qc>.

<sup>24</sup> Jodi, "progs," www.untitled-game.org, accessed June 2017, <http://www.untitled-game.org/progsx/miscqc.html>.



might speculate that JODI reconfigure the game so that the player is constantly accelerating and spinning through the air. These kinds of minute changes to the QuakeC source code could account for some of the disorienting physics, for instance, in their *Untitled Game* mod Q-L.

In *Ctrl-9*, or what Adang refers to as an “Op Mod,” the player moves through a 3D space constructed of alternating black and white pixels that generate an illusory moiré effect. As the player tries to navigate the level, spatial coordinates of the gameworld become indiscernible, prompting them to maneuver based on perceptual cues from pulsating checkboard patterns (Figure 3.7). In this case, JODI have preserved *Quake*’s original sound effects and control scheme. The player can look and move directionally, jump, and fight within the gameworld’s hallucinatory contours, yet are unable to discern objects or enemies among the abstract sequences that comprise the map’s architecture. JODI have produced this psychedelic effect by taking advantage of the engine’s aliasing qualities, enhanced by the artists’ use of contrasting monochrome forms. By aliasing, I refer to the problem in computer graphics when 3D curves appear “jagged” due to the engine’s inability to render areas at a high enough resolution. Variations in these irregular lines between frames can produce an optical effect of wavy, oscillating polygonal edges. The perceptual phenomenon of aliasing is often lessened through anti-aliasing filters (Gaussian, box, etc.) that smooth out and/or blur jagged lines. In *Quake*, anti-aliasing filters are supported with 3D graphics acceleration.



**Figure 3.7** JODI, *Ctrl-9*, *Untitled Game*, 1996–2001. Screenshot. JODI’s use of aliasing effects in *Ctrl-9*.



In an interview with Adang, JODI explains that in their Op Mods, the engine attempts to draw rows of black and white pixels through scan line rendering: a process used in *Quake*’s visual surface determination. Additionally, z-buffering, or the process through which moving objects and entities are rendered by measuring the distances of moving pixels against pixels in the static map, generates aliasing effects when the engine works to draw monochrome textures to geometries.<sup>25</sup> As the player moves through the abstract gamespace, the ongoing readjustments of their view frustum prompt the engine to draw each new PVS. When the engine scans rows of black and white pixels for each PVS in addition to z values for moving entities, it continually generates undulating moiré patterns.

In the formal materiality of *I-N* and *Q-L*, what Adang calls “Altered Movement Mods,” the player is confronted by disorienting controls and are unable to effectively navigate the gamespace. In *I-N*, the player’s field of vision is obscured by a thick white horizontal line that runs across the width of the screen. When the mod starts, the player’s viewpoint rotates wildly, causing the white line to spin and reveal a flickering afterimage. By adjusting the view angle or moving in a different direction, the player can momentarily stop the spinning camera only for it to erratically start again (Figure 3.8). JODI have also altered sound effects to a series of static hums, blips, and the whirring of electrical frequencies. The spinning camera angle and afterimage of the flickering line are generated by altered command values in the mod’s `autoexec.cfg` file:

`sensitivity 12//Default: 3`

Indicates mouse sensitivity

`r_clearcolor 256//Default: 2`

Sets colors for certain areas outside the map

`cl_rollangle 444//Default: 2`

Indicates how much the screen will tilt if the player strafes.<sup>26</sup>

<sup>25</sup> Joan Heemskerk and Dirk Paesmans interviewed by the author, May 30, 2013, Dordrecht, Netherlands in Adang, “Untitled Project: A Cross-Disciplinary Investigation of JODI’s *Untitled Game*,” 30.

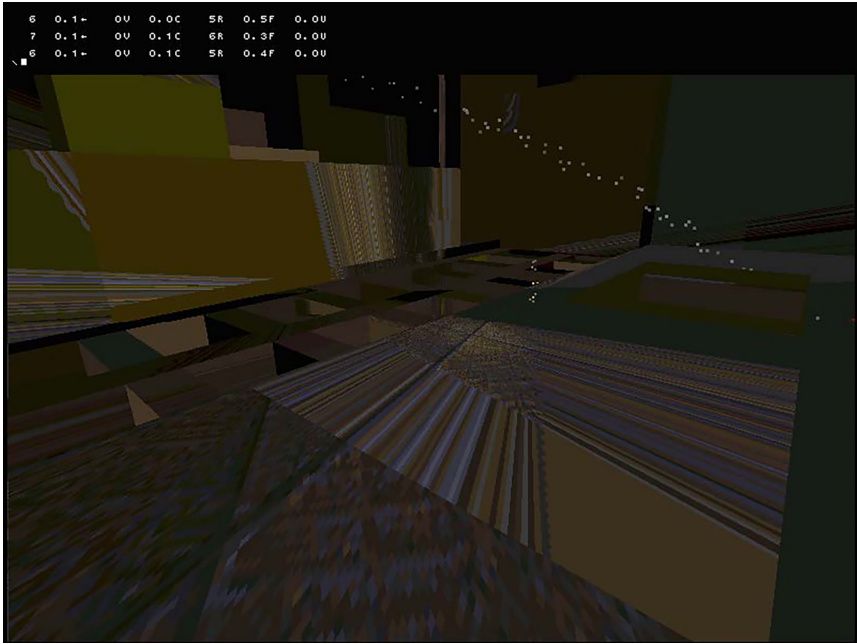
<sup>26</sup> Default console command values for *Quake* have been documented through the University of Delaware’s Electrical and Computer Engineering and Computer and Information Science departments located at <https://www.eecis.udel.edu/~portnoi/quake/quakecom.html>. Default values are compared against command values in the `autoexec.cfg` file for *I-N* located on the *Untitled Game* website: <https://www.untitled-game.org/download.html>.



**Figure 3.8** JODI, *I-N*, *Untitled Game*, 1996–2001. Screenshot. The rotating white line and flicker effect in *I-N*.

As Adang points out in her discussion of “Altered Movement Mods,” the most significant change JODI makes is the increased value of the `cl_rollangle` command to 444.<sup>27</sup> When the player strafes left or right, the screen tilts to such a degree that it frantically rotates their subjective point of view. The increased value of `cl_rollangle` coupled with the mouse sensitivity increased to twelve attests for the erratic feedback from the player’s camera. More so, the formal construction of the white line could be the result of changing the `r_clearcolor` command to 256, in turn, altering areas of color outside the map that are still visible in the player’s immediate perspective. Here, JODI take strafing, the player’s ability to move laterally through space, and ironically rearticulate its strategic importance within expert *Quake* multiplayer communities. Instead of strafing or strafe jumping (jumping with simultaneous lateral movement) to dodge enemy fire, the player’s movement is transposed into sensual engagements with the formal patterns of a flickering screen and rotating white line. More than *I-N*, *Q-L* is perhaps the most spatially bewildering of the *Untitled Game* mods. In *Q-L*, player navigation through the anamorphic gamespace is eroded completely as their view frustum rapidly spins and flips in all directions, at times accelerating forward and backward through walls and enemies (Figure 3.9). In the screen’s upper portion, lines of characters and numbers change based on upon the player’s spatial coordinates. The mod’s kaleidoscopic somersaulting

<sup>27</sup> Adang, “Untitled Project: A Cross-Disciplinary Investigation of JODI’s *Untitled Game*,” 33.



**Figure 3.9** JODI, *Q-L*, *Untitled Game*, 1996–2001. Screenshot. The camera accelerating and somersaulting through walls in *Q-L*.

is possibly attributed to the `cl_rollangle` command, which JODI have changed to 844 from its default status of 2.<sup>28</sup> In what follows, I explore how the formal elements of glitch in *Ctrl-9*, *I-N*, *Q-L*, work to disorient the player's spatiality through an apperceptive-proprioceptive resonance within the anamorphic spaces of *Untitled Game*.

## Flicker Mods and the Modulation of Bodily Space

In our viewing and playing experiences of *Ctrl-9*, *I-N*, and *Q-L*, JODI employ glitch to make strange the player's normal experiences of *Quake*'s 3D architecture through what I refer to as the flicker mod. These abstractions of glitch elicit modes of gamic apperception by revealing the ways our perceptual faculties operate within actionable 3D space. Glitch prompts the body to apprehend

<sup>28</sup> JODI, "autoexec.cfg," [www.untitled-game.org](http://untitled-game.org/autoexecfg.html), accessed June 2017, <http://untitled-game.org/autoexecfg.html>.

its own instability within anamorphic spaces through computational alien landscapes that function beyond the player's capacity to frame the engine's technical procedures.

This is what Rosa Menkman calls the *moment(um)* of glitch: a moment of error that produces the unfamiliar, and an inability to control or understand the algorithmic interruptions at work. This phenomenological encounter with machine error carries an inherent momentum: a noise artifact "turns to glitch when it passes a momentary *tipping point*, at which it could tip away into a failure, or instead force new knowledge about the glitch's techné, and actual and presumed media flows, onto the viewer."<sup>29</sup> In an interview with artist Francis Hunger, JODI reflect upon this instance of the glitch's apperceptive revealing in *Untitled Game* through what they call a "perspective engine":

The starting idea was to find very basic forms like just a line or a square, just black and white, and attach these forms to the behaviour of the code so that we would have a better view on how such a game is driven, what are the dynamics of the game. So it's bringing those games back to the abstract dynamics of it and we were also trying to find out a little bit, how they do create the so-called 3-D space. That's the whole trick of these games, that they are perspective engines. All the time they create tunnels and illusions of a 3-D space and that's part of the "kick" you have as the user, that you think you explore and you enter and you move into. In fact, the only thing which is happening, is a perspective which just is drawn all the time—so it's always about graphical tricks.<sup>30</sup>

In *Ctrl-9*, *I-N*, and *Q-L* glitch unveils the perspective engine grounding the player within 3D space through graphical abstractions. Within the phenomenal moment of glitch that overwhelms the player in *Ctrl-9*, the body's apperceptive capacities intuit the undulating moiré patterns as something that at once proprioceptively unfixes the player from perspectival rendering and makes known the perceptual vectors through which vision operates within the *Quake* engine. JODI's code generates aliasing effects among the black and white patterns that upend the engine's functionality, producing an optical effect that contradicts habitual perception and uncovers the bare-bone mechanisms which make the perspective engine run.

<sup>29</sup> Menkman, *The Glitch Moment(um)*, 30–1.

<sup>30</sup> JODI quoted in Hunger, "Perspective Engines: An Interview with Jodi," in *Videogames and Art*, 152, 156.

In JODI's work, glitch aesthetics are indebted to traditions of twentieth-century American avant-garde cinema, particularly within discourses of minimalism and structural film. P. Adams Sitney articulates the formal qualities of structural film in the work of experimental filmmakers such as Hollis Frampton, Joyce Wieland, Michael Snow, and Tony Conrad throughout the 1960s. The "structural" element of their work relates to the viewer's perception of the film's totality or rather, its overall form and shape which unfolds through duration. To Sitney, structural filmmakers sought to foreground the materiality of the cinematic apparatus, working to arouse affective states within the viewer's brain-body. This near hypnotic mode of spectatorship is evident in the structural "flicker film," a radical instantiation of film form that impinges upon its viewing audience through a direct psychophysiological response to the stroboscopic effect of projecting frames at varying intervals.<sup>31</sup>

This flicker process that denaturalizes film's technical illusion of animating continuous movement is evident in Tony Conrad's *The Flicker* (1966). As I have mentioned, Conrad's film is composed of interspersed black and white frames that generate a range of hallucinogenic effects through their oscillations. The film projects alternating monochrome frames ranging from twenty-four to three frames per second and utilizes forty-seven different patterns. Conrad produced these visual rhythms by taking photographs with the lens cap on for black frames and photographing paper for white frames. He then meticulously spliced the patterns together so that when projected, the film would produce approximately thirty minutes of stroboscopic arrangements. Similar to the way glitch mobilizes apperceptivity in *Quake*, Sitney argues that the predetermined shape of *The Flicker* is built around an apperceptive encounter with the material form of Conrad's film, and conflicts with the "illusionary participation" of narrative cinema. As he says, there is a sense of "transcendentalism that is always grounded in a dialogue between illusion and its unveiling," or rather the sensory shock of flickering variations and the awareness of formal transitions between the projected frames.<sup>32</sup> More so, Sitney situates his critique of Conrad's flicker aesthetic within tactics of defamiliarization in Shklovsky's Russian formalism. The viewer's experience undergoes a process of disassociation or *prolongation* that interferes with film spectatorship.<sup>33</sup>

<sup>31</sup> P. Adams Sitney, *Visionary Film: The American Avant-garde, 1943-2000* (Oxford: Oxford University Press, 2002), 285, 305-6.

<sup>32</sup> P. Adams Sitney quoted in Branden Wayne Joseph, *Beyond the Dream Syndicate: Tony Conrad and the Arts after Cage* (New York: Zone Books, 2008), 297.

<sup>33</sup> Joseph, *Beyond the Dream Syndicate*, 297.

In his minor history of Conrad's work, Branden Joseph examines the phenomenological indeterminacy at play in *The Flicker*, or rather, the balance among the viewer's apperceptive engagement with the film's stroboscopic effects and affective states through which cognitive stability surrenders to the body's autonomic activity. This indeterminacy questions spectatorial autonomy while simultaneously affirming new modes of filmic subjectivity. Joseph explains that the viewer's experience of the flickering black and white rhythms asserts a partial dissolving of subjectivity when taken up in the technics of projector and film. They waver on a threshold between absorption into a circuit of flickering rhythms and the body's affectivity, yet are perceptually aware of balancing at this threshold. That is to say, *The Flicker* engages viewers in a technically conditioned sensory *overstimulation*, what Joseph calls "a transgressive and indeterminate threshold experience . . . an instance of positive feedback that induces wild perceptual oscillations."<sup>34</sup> When *The Flicker* premiered at film festivals and underground theaters throughout 1965–66, it was preceded by an on-screen disclaimer waiving liability for potentially ill side-effects such as seizures and "symptoms of shock treatment." During initial screenings, the film subjected audiences to its stroboscopic effects with perceptual responses ranging from visions of phantasmic colors, geometric patterns, amorphous floating forms, to complex hallucinations. In some instances, audiences found the flickering patterns to be relaxing, while others experienced heightened states of anxiety from the flicker's hypnosis.<sup>35</sup>

JODI's use of glitch in *Untitled Game* draws a parallel to Conrad's work in that both explore the aesthetic capacities of a technical medium through the body's apperceptive reactions. JODI discusses their influence of experimental film stating:

And another film artist Joan and I recently looked at is Stan Brakhage, who seems to be a very important person in experimental film. . . . Our sympathy goes to experimental film, because they managed to stay in their own medium. We use both these fields quite a lot to think about what we are doing or what would net art or digital art be.<sup>36</sup>

As a pioneer of American avant-garde film, Brakhage's work preceded the structural movement, yet like Conrad, his films investigate the materiality of

<sup>34</sup> Ibid., 298–300, 340.

<sup>35</sup> See Joseph's explanation of audience's various perceptual and affective responses of *The Flicker* in Branden Wayne. Joseph, *Beyond the Dream Syndicate*, 341.

<sup>36</sup> JODI quoted in Francis Hunger, "Perspective Engines: An Interview with Jodi," in *Videogames and Art*, 159.

the film strip, projector, and camera and the ways they organize perceptual engagements that contradict dominant film spectatorship and ideologies. It is apparent as to why JODI would find resonance in the work of Brakhage and traditions of experimental film and video art throughout 1960s and 1970s. To recall, Paesmans studied under Nam June Paik and both Paesmans and Heemskerk have expressed a strong influence from the video works of Bruce Nauman.<sup>37</sup> Like the flicker film, JODI's mobilization of glitch evokes a threshold moment that propels the player into a state of apperceptive strangeness. The player recognizes an inability to control movement through 3D space while experiencing a dematerializing of the self within the circuit of game modification and bodily feedback: a loss of control to the incomprehensibility of the code from which anamorphic space is rendered.

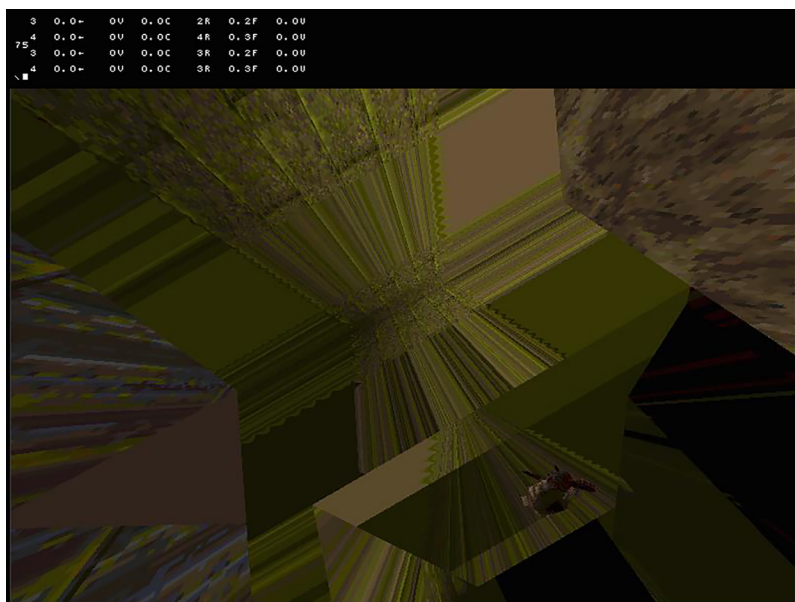
In *I-N*, this threshold describes a boundary between an awareness of the glitch overcompensating for strafing mechanics and the rotating vortex generated from the tilting screen and spinning white line. The rotating line against the map's textured background that scintillates with the frame rate thrusts the player into a liminal space of the stroboscopic output and disrupted efforts to ground themselves within the interface's dizzying gyrations (Figure 3.10). As the player intuits a possible control scheme to stabilize perception, they output an evolving abstract rhythm of line and shape from the redrawing of each subsequent frame that impresses upon the sensory faculties in unpredictable ways. Yet, it is JODI's *Q-L* mod that best demonstrates the apperceptive nature of the flicker effect. On start up, the player is assaulted by a shifting anamorphic landscape and launched backward and forward through walls and enemies while orbiting out of control. They frantically work against *Quake*'s control scheme with an aim to stumble upon a permutation of button mashing or mouse shaking that stabilizes their rapid somersaulting (Figure 3.11). It is difficult to say whether the player has any control over the outcome of the glitch. Like the strafing in *I-N*, what little if any control mechanics initiated by the player in *Q-L* are entirely oversensitive. The engine overcompensates for the player's navigation, causing the view frustum to twirl within a kaleidoscope of abstract forms, further imbricating the body within the agentic presence of glitch. If the structural shape of Conrad's film operates through orchestrated sequences of frames, then glitch in the flicker mod works through the deliberate aimlessness of JODI's code. It produces a

<sup>37</sup> See JODI's discussion of Bruce Nauman in Francis Hunger, "Perspective Engines: An Interview with Jodi," in *Videogames and Art*, 158.





**Figure 3.10** JODI, *I-N, Untitled Game*, 1996–2001. Screenshot. Stroboscopic patterns generated from the rotating screen in *I-N*.



**Figure 3.11** JODI, *Q-L, Untitled Game*, 1996–2001. Screenshot. Spinning and accelerating through polygonal architectures in *Q-L*.

kind of sensory assault, yet through the engine's technics mobilizes the body's affective indeterminacy. The glitch and its potential to generate the novel and unexpected through the engine's disrupted functionality is mirrored in the body as an *affective unpredictability* that counters our habitual engagements with *Quake's* gameworld.

Within the player's threshold experience of *Ctrl-9*, *I-N*, and *Q-L* proprioception is mobilized by the strangeness of apperception. That is, the defamiliarization of 3D space attunes perception, an act of intuiting perception in itself, to the body's intensive process of orientation within JODI's mods. Among the disquieting anamorphic spaces of *Untitled Game*, this apperceptive awareness relates to the player's incomprehension of their spatial bearings within the game engine through affective pathways that work beyond the exteroceptivity of vision. In his discussion of Godfrey Reggio's experimental documentary *Koyaanisqatsi* (1982), Scott Richmond examines how the film's cinematography shapes the viewer's proprioceptive relation with the moving image and yet questions their spatial sensitivity within a broader phenomenal experience of self and world.<sup>38</sup> The film highlights the body's capacity as a mutually informing subject and object, what Maurice Merleau-Ponty calls the chiasmus of embodied experience, through its ability to attenuate and magnify our proprioceptive relation with cinema and material world. The film expresses the reversibility, or the crisscrossing of our status as a subject acting within the world and an object that is acted upon, through illusions of motion in Ron Fricke's brilliant cinematography: abstract spaces within the natural world and industrialized metropolises.

Richmond suggests the kinesthetic sensations elicited by the film affirm the spectator's phenomenal status through disorientations of the body's subjective movement and objective motion within the film's abstract sequences.<sup>39</sup> Richmond articulates the chiasmus between objective filmic motion and our proprioceptive registers through what Merleau-Ponty calls the gap or *écart* of the flesh. The *écart* demonstrates our phenomenal becoming through the unique separation of the body's capacity to sense the world without being entirely and objectively incorporated into the world. In the spectator's encounter with *Koyaanisqatsi*, the film interrogates the *écart* as the body's proprioceptive sensation of self and its material surroundings. Our presence in the film's sequences of extreme acceleration and motion blurring through city streets and

<sup>38</sup> Scott C. Richmond, *Cinema's Bodily Illusions: Flying, Floating, and Hallucinating* (Minneapolis, MN: University of Minnesota Press, 2016), 98.

<sup>39</sup> *Ibid.*, 107.



**Figure 3.12** Sensations of accelerating through abstract space in *Koyaanisqatsi* (Godfrey Reggio, 1982). Still.

desert landscapes produces a threshold of sensual exhilaration and at times, nauseating transgressions felt at the viewer's perceptual limits (Figure 3.12). Yet, different from *Koyaanisqatsi*, JODI's flicker mods *continually* attune the body's proprioceptive sensitivity.

While *Koyaanisqatsi* grounds the viewer in a representational gestalt of cinematic sequences before accelerating through abstract spaces, JODI's flicker mods never fully allow for a grounding of the player's spatial equilibrium. Like Conrad's film, they interrogate our spatial awareness through a continual resonance with abstract forms. In the body's encounter with *Ctrl-9*, *I-N*, and *Q-L*, the écart manifests as a mode of embodied mimetic behavior. It serves as the reversibility of the player's ongoing attunement to worldly space through the objective movement of flickering glitches, and the sensing body's proprioceptive acclimation to anamorphic space. Here, bodily sensation is continually modulated as the player works through an unintuitive control scheme and navigates *Quake*'s disrupted gameworld. At the same time, the flicker mod acts upon our own affectivity and ongoing bodily reception to the engine's disordered rendering.

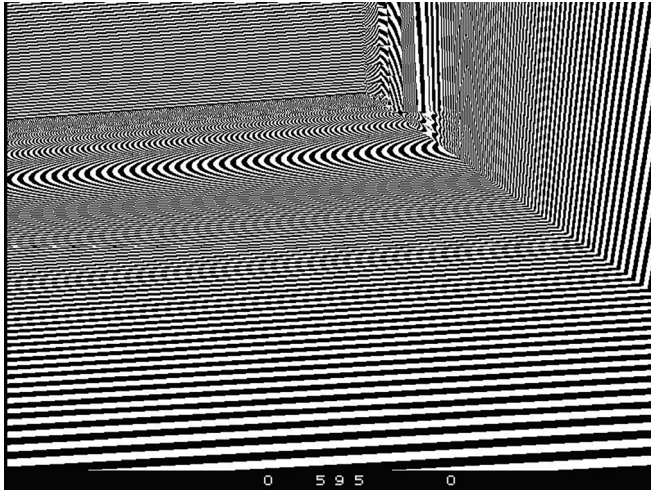
Within the flicker of *Ctrl-9*, *I-N*, and *Q-L*, movement through anamorphosis results in an unfolding, as Richmond describes, of the body's orientation to its

own schema in relation to the broader world. This illustrates the co-constituency between the body's physical arrangement in space and its continual proprioceptive response to the ambient environment.<sup>40</sup> Thus, *Ctrl-9*, *I-N*, and *Q-L* work upon the player's spatial equilibrium through their exteroceptive feedback to glitch, the fingers searching for working controls, minute twitches and jerks, the dilation of the pupils in response to flickering frames, and their proprioceptive faculties: kinesthetic sensations of catapulting, rotating, and undulating through the gamespace. Merleau-Ponty refers to this synthesis between the body's physical comportment and intensive measure of space as bodily spatiality. This concerns the player's situated embodiment in the world as "the deployment of the body's bodily being, the manner in which it comes into being as a body." Merleau-Ponty articulates the imbrication of the exteroceptive and proprioceptive body as the way "I can feel my body's space as vast or minute despite the evidence of my senses, this is because there exists an affective presence and enlargement for which objective spatiality is not a sufficient condition . . ."<sup>41</sup> In *Untitled Game*, bodily spatiality serves as the ongoing development of the player's physical posturing in their interaction with the *Quake* engine and sensual excitations that arise from glitch. JODI's *Ctrl-9* works upon the player's bodily spatiality through the instability of the aliasing effect that contracts and expands illusory forms of monochrome lines, especially when they attempt to locate themselves by walking toward corners of the map's architecture (Figure 3.13). When a player moves too close to a polygonal surface, the black and white forms warp, while retreating in the opposite direction transforms the interface into pulsating moiré effects.

Glitch modulates the body's physical composure within worldly space just as it heightens our proprioceptive response to anamorphic forms: illusory contractions and expansions of line and shape. This comes as a sensation of a *pull* upon the vestibular system that temporarily eschews the player's spatial equilibrium. In *Ctrl-9*, JODI borrow from an aesthetic previously explored in the op art movement of the 1960s and particularly from the work of Bridget Riley. Riley's paintings generate optical illusions through contrasting geometries that appear to vibrate and swell in the viewer's presence. Among the blatant gendering and feminization of op art that solidified through the movement's relationship to popular fashion and the domestic sphere of mid-century culture, Riley's aesthetic techniques worked to interrogate a range of embodied

<sup>40</sup> Ibid., 116.

<sup>41</sup> Maurice Merleau-Ponty, *Phenomenology of Perception*, trans. Colin Smith (London: Routledge, 2005), 172.



**Figure 3.13** JODI, *Ctrl-9*, 1996–2001. Screenshot. Pulsating moiré effects caused when the player moves toward edges and corners of the map in *Ctrl-9*.

responses through what Pamela M. Lee calls a “keenly felt physicality, even a dangerous physicality,” operating through the viewer’s hypnotic reaction to the compositions (Figure 3.14).<sup>42</sup> These kinesthetic illusions in, for instance, Riley’s *Fall* (1963) elicited sensations of “falling or rushing or even concentrated pacing,” situating the viewer in a state of optical-bodily instability: an assaultive stimulation of the eye that caused vertigo in some while exciting a pleasurable “rush” in others. Within the broader visual culture of the 1960s, the reception of Riley’s optical patterns within the art world and their ascribed signification for the feminine body in popular fashion operated through, as Lee says, a sensual mode at once abrasive and vivifying, “shocking only to the point that it offers the viewer a kind of cognitive jolt, like a splash of cold water in the face or the astringent odor of sharply cut grass.”<sup>43</sup>

Just as *Ctrl-9* modulates proprioceptivity as a “keenly felt physicality,” *I-N* and *Q-L* through their more pronounced flicker effect, engage bodily spatiality in cognitive shocks and violent accelerations through algorithmic space. In *I-N*, the stopping and starting of the rotating line and subsequent afterimage are mirrored in the player as a churning or lurching to the left and right: a feeling of becoming unhinged, as if their posture was tilting with the computer screen in physical

<sup>42</sup> Pamela M. Lee, *Chronophobia: On Time in the Art of the 1960s* (Cambridge, MA: MIT Press, 2006), 172–3.

<sup>43</sup> *Ibid.*, 164, 176.





space. Similarly, *Q-L* takes up the body's schema in a violent kinesthesia. As the player's viewpoint spins and accelerates backwards across the level, tearing through the flesh of enemies, they intuit anamorphosis as a harsh intensification of space-gone-awry when the engine implodes upon itself in an attempt to draw a restless frustum (Figure 3.15).

In deconstructing *Quake* and its "perspective engine," JODI's modifications draw attention to the way video game technicities are historically organized around perceptual operations of navigating Cartesian space. By rethinking *Quake's* perspective engine as a strange abstraction of typical 3D spaces in the first-person shooter, JODI affirm our reliance on the engine's technics to render perspective, and its ideologies that produce optimal flow through which players are motivated to act, advance, and overcome obstacles. Within these bizarre exchanges between body and everted perspective engine, flow is channeled toward aimless interactions at once exhilarating and at times perhaps even masochistic. The phenomenal complexity of *Untitled Game* demonstrates aesthetic possibilities for art modding within the historical instantiation of game engines during the mid-1990s. That is, to proliferate sensory entanglements between body and system within the strangeness of 3D space.



## Generative Mods and the Violence of Sensation

*Art is this processes of compounding or composing, not a pure creation from nothing, but the act of extracting from the materiality of forces, sensations, or powers of affecting life, that is, becomings, that have not existed before and may summon up and generate future sensations, new becomings.*

—Elizabeth Grosz, *Chaos, Territory, Art*

Julian Oliver known by his pseudonym Delire, created *ioq3aPaint* as a generative “painting” program that utilizes the graphics renderer and bot AI in the *Quake III: Arena* (Q3A) engine to produce a continuous mutation of glitch effects. The first iteration of what Oliver refers to as a “Game-based Automatic Painting System” started in 2002–3 with *q3aPaint*, a work that used modified bot AI and a “redraw” glitch within the Q3A engine’s z-buffering. The result transformed the game’s recognizable arenas into a morphing terrain of abstract patterns, painterly lines, and taches of color.<sup>1</sup> While artist-in-residence at Georgia Tech in 2007, Oliver developed an updated version of his painting mod called *ioq3aPaint*, which used the improved features of the open-source *ioquake3* engine. The newer iteration extended the work’s generative possibilities by allowing the user to alter color palettes in real time. Oliver’s completed project was shown in a 2010 solo exhibition at the Hannah Maclure Centre in Dundee, Scotland, consisting of prints created from still frames and a real-time demonstration.

Like JODI’s *Untitled Game*, Oliver disrupted the engine’s graphics renderer using console commands and then configured the AI so that bots, enemies programmed to think and act autonomously, hunt each other without player intervention. Instead of fighting against or alongside the engine’s AI, the user transitions from the viewpoint of each bot during combat, employing their machinic perspective, as Oliver says, “to select an ocular host to assist the painting process.” Each painting unfolds through the co-constituted involvement

<sup>1</sup> Julian Oliver, “ioq3aPaint,” *julianoliver.com*, <https://julianoliver.com/output/ioq3aPaint>.

of the engine's redraw operations and the user choosing the appropriate camera shot, or rather the bot's vision of the gameworld. As Oliver states, each painting "is really a user's record of a single moment in a continuous stream of color and gestural information."<sup>2</sup> Occasionally, a user will capture the simultaneous viewpoints of two bots in one frame, producing within the interval a bleeding of abstract figures. This strange ecology of human and bots generates images based on a "hall of mirrors" effect common in glitch aesthetics. This describes when moving objects trail across the screen and draw over older unrefreshed frames. Oliver suggests that the trace of moving bots throughout the arena is a transference of the game's simulated killings into abstractions of violence.

Just as Oliver's *ioq3aPaint* abstracts the Q3A deathmatch into fragmented trails of game assets, artist Tom Betts, known alternatively as Nullpointer, likewise altered the Q3A engine to produce his mod *QQQ* (2002) in the same year. Yet, different from Oliver's rearticulation of Q3A, Betts produces a generative system utilizing a live multiplayer server and modified graphics engine that glitches networked play in real time. These live deathmatch bouts are unknowingly transferred and projected within an installation where viewers witness motion trails left by online players and the deforming architecture of the arena they battle within. Using keyboard controls positioned on a pedestal, the viewer assists in deconstructing the interface by moving the in-game camera and further exacerbating sequences of glitch. These sensual engagements in *QQQ* illustrate a complex field of interaction among the game's networked play, altered graphics engine, remote players, and spectators who bear witness to the palimpsestual frames that continually haunt the interface. To Betts, these traces of player data from the ongoing activity of the Q3A server produce a "constant modulation of the digital landscape . . . an environment in flux, with no end or beginning."<sup>3</sup> In 2003, *QQQ* was included in the seminal exhibition *games. Computer games by artists* at Phoenix-West in Dortmund, Germany, which sought to address the deconstructive potential of game design as an aesthetic practice. Curated by Tilman Baumgärtel, Hans D. Christ, and Iris Dressler, the exhibition showcased *QQQ* along with mods by JODI, Cory Arcangel, Anne-Marie Schleiner, Brody Condon, Arcangel Constantini, and Joan Leandre in

<sup>2</sup> Julian Oliver, interview by Domenico Quaranta, "Delire (Julian Oliver)," in *Gamescenes: Art in the Age of Videogames*, ed. Matteo Bittanti and Domenico Quaranta (Milan: Johan and Levi Editore, 2006), 131.

<sup>3</sup> Tom Betts, "Init() > Startup code," [www.nullpointer.co.uk](http://www.nullpointer.co.uk), <http://www.nullpointer.co.uk/qqq/qqq1.htm>.

a warehouse on the repurposed Phoenix-West blast furnace grounds. In this major exhibition, Betts' *QQQ* subjected audiences to fragmented objects and environments in the *Q3A* gameworld that as Baumgärtel describes, "look like they were formed in a broken kaleidoscope—sometimes in icy blue and white, sometimes in warm shades of brown."<sup>4</sup>

The painterly forms in Oliver and Betts' mods are often critically assessed in the way they critique traditions of modernist painting, replacing the expressive hand of the artist with, as organizers of the 2013 transmediale festival observed of Oliver's *ioq3aPaint*, the "digital brushes" of the game's bots.<sup>5</sup> The images produced from Oliver's mod are often labeled as Pollock-esque in appearance and process. John Sharp has gone as far as comparing the stills and recordings from *ioq3aPaint* to Pollock's gestural techniques in his action paintings.<sup>6</sup> Here, I would argue that this representationalist thinking understates the aesthetic significance of Oliver and Betts' work. It isn't so much a question of how their painterly abstractions fit into a taxonomy of high modernism, but rather the *generative processes* that undergird their production. In this chapter, I situate these art mods within an archaeology of generative techniques present throughout the mid-century neo-avant-garde. In the broadest sense, generative artworks do not refer solely to computational media as one might imagine, but rather indicate how artists employ a dynamic, complex system to produce aesthetic possibilities through automatic processes. Throughout the 1960s, individuals within movements of conceptual and kinetic art sought to reevaluate the Duchampian readymade by setting in motion complex systems abiding by their own natural or physical laws through which multiple iterations come into being. This push questioned the mere appropriation of a readymade as a commodity object whose status as art was predetermined and unchanging. Generative techniques have likewise questioned the logic of authorship in that the artist surrenders some or all their control to the autonomy of a system, countering for instance, the kind of intuitive, gestural command witnessed in Pollock's drip paintings.

To understand the generative processes inherent to Oliver and Betts' mods, I first undertake a thick description of the *Q3A* engine, particularly its groundbreaking bot AI and use of a shader system to apply complex textures.

<sup>4</sup> Tilman Baumgärtel, "On a Number of Aspects of Artistic Computer Games," *medienkunstnetz*, [http://www.medienkunstnetz.de/themes/generative-tools/computer\\_games/](http://www.medienkunstnetz.de/themes/generative-tools/computer_games/).

<sup>5</sup> transmediale Festival, "ioq3apaint," [www.transmediale.de](http://www.transmediale.de), <https://transmediale.de/content/ioq3apaint>.

<sup>6</sup> Sharp, *Works of Game*, 24, 29.

I then examine the aesthetic techniques of two artists working throughout the 1960s—Jean Tinguely and Hans Haacke—to situate Oliver and Betts’ work within kinetic and conceptual traditions of the neo-avant-garde. Specifically, I look at Tinguely’s Meta-matics: machinic apparatuses designed to paint, draw, and in some cases, self-destruct based on chance and instability. In Chapter 2, I briefly discussed Haacke in relation to institutional critique, but here I examine his earlier installations that sought to use natural and physical processes—condensation, ice, air currents, humidity—within generative systems that work outside the artist’s intent. Like Oliver and Betts’ mods, Tinguely’s Meta-matics and Haacke’s use of natural systems point to autonomous operations that engender art through movement and variation. I argue that our aesthetic experience of Oliver and Betts’ mods arise from their generative processes, or rather the way their aesthetic potential is governed within a nuanced system of human and technological agents. Our apperceptive and proprioceptive engagement with Oliver and Betts’ work results from a *flattening* of the 3D spaces and entities in Q3A. These autonomous mechanisms of glitch defamiliarize the game by distributing our perception of three-dimensionality across a visual field of abstraction, while drawing our gaze to the engine as an unpredictable, generative system. As I suggest, this formal disruption of the gamespace produces a mimetic operation in which the violence of the arena deathmatch is felt as a nonrepresentational *violence of sensation* within the body, a concept I borrow from Gilles Deleuze’s writings on the painter Francis Bacon.

### *The Quake III: Arena Engine*

The generative techniques in Oliver’s *ioq3aPaint* and Betts’ QQQ are a result of disrupting the standard protocols of Id Tech 3: the engine used to power *Quake III Arena*. The game was designed by Graeme Devine, Tim Willits, and Paul Jaquays. John Carmack along with Robert Duffy and Jim Dose programmed the engine while Adrian Carmack, Kevin Cloud, and Kenneth Scott headed its art direction. By the time Q3A was in development, Romero had already left id Software to start his company Ion Storm with id colleague Tom Hall. Unlike the previous *Quake* games, Q3A was designed without a single-player campaign narrative. Rather, single-player mode is predicated on the multiplayer deathmatch experience. The player battles AI-controlled bots in a series of arenas while progressing through gothic and futuristic environments, fighting increasingly

harder bots in complex arena spaces (Figure 4.1). The game's multiplayer was designed for networked play with up to sixteen players including "Team Deathmatch" in which two teams of four battle for the most kills; "Tournament" mode where players compete individually against each other; and Capture the Flag where teams attempt to steal the enemy flag while protecting their own.

The Q3A engine is a variant of the *Quake* and *Quake II* engines. Its rendering capacities are based on the hardware acceleration used in *Quake II*, while employing binary space partitioning and the use of potentially visible sets developed in *Quake*.<sup>7</sup> Unlike its predecessors, Q3A introduced a shader system designed in conjunction with OpenGL and specific graphics cards. Different from other engines of the time, especially the contending *Unreal Engine*, Q3A does not include a native renderer and requires a graphics accelerator. According to the Q3A Shader Manual written by Paul Jaquays and Brian Hook, the shader system renders detailed curves and volumes using small text scripts that describe a surface's properties and give instructions for rendering its appearance in a map. Scripts are categorized based on which surface textures require rendering



Figure 4.1 Fighting bots in *Quake III Arena* (id Software, 1999). Screenshot.

<sup>7</sup> For a detailed description the *Quake III* engine architecture see Fabien Sanglard, "Quake 3 Source Code Review: Architecture (Part 1 of 5)," *Fabien Sanglard's Website*, June 30, 2012, <http://fabiansanglard.net/quake3/>.

in each arena map: surfaces for base, castle, hell, and so on. Other scripts handle in-game special effects and environment textures such as the sky and liquids.<sup>8</sup>

Each shader is composed of texture layers and the engine calculates the correct order to superimpose one upon the other. A shader augments the visual appearance of textures on a brush, curves, or a mesh model. Here, a brush (often called a BSP brush) refers to specific geometric templates used to block out and give shape to the level's architecture. They can be standard shapes: a cube, sphere, or cylinder, or predetermined objects like a spiral staircase. Brushes are the fundamental geometries of each map that the engine arranges during the rendering process. When a map is compiled, geometry brushes are converted into static meshes, models composed of vertices to form polygons, and subsequently drawn by the engine. Because they can be cached in video memory and processed by a graphics card, mesh models are efficiently drawn with textures more detailed than BSP brushes. As Jaquays and Hook explain, in addition to surface effects, a shader can also modify the content and perceived movement of in-game objects. The surface effect of a brush may contain, for instance, luminosity and transparency levels as well as RGB color values, yet a shader's content effects how specific textures interact with a player in the gameworld. Content effects include texture layers for elements such as water, fog, mirror reflections, and other nonsolid objects that operate differently when a player moves through them. A shader may also include deformation properties that give movement to the shape of an object. More so, each shader employs blend functions that direct the engine on how to composite texture layers.<sup>9</sup>

In the Q3A engine development, shader scripts afforded the designers maximal accessibility and modularity over the appearance and actions of in-game surfaces. However, the inclusion of multiple shader textures also constrains processing speed as each time a shader effect modifies a texture, the engine must redraw that section of the gameworld. For example, an illumination texture passing through a fog texture will require the engine to redraw those polygons affected by the shaders so that volumetric fog is rendered in the game. To bypass issues of overdraw in the shader system, Carmack and others adopted a technique in computer graphics known as the fast inverse square root algorithm, which uses integer operations to efficiently calculate lighting, color values, and reflections.

<sup>8</sup> See introduction of Paul Jaquays and Brian Hook, "Q3Radiant Shader Manual, Revision #12," icculus.org, [https://icculus.org/gtkradiant/documentation/Q3AShader\\_Manual/ch01/pg1\\_1.htm#what](https://icculus.org/gtkradiant/documentation/Q3AShader_Manual/ch01/pg1_1.htm#what)

<sup>9</sup> Jaquays and Hook, "Q3Radiant Shader Manual."

In his production notes for Q3A, game artist Paul Steed explains that player and bot models were rendered using MD3 files, a format that stores information for character movement and interactions with players and arena environments.<sup>10</sup> Models were constructed using 3D Studio Max R2.5 by Kinetix which at the time was a division of Autodesk, and animated using the “Physique” and “Biped” functions in Kinetix Character Studio. For each model, animations were captured based on vertex movements that compose its structure and physicality, often referred to as mesh deformations in computer graphics. The MD3 format allowed developers to modify the number of key frames per second instead of the fixed ten frames per second used with the previous MD2 format in *Quake II*. Increased frames allow for more intricate animations, an improvement from the unstable and jerky models in previous *Quake* games.

As Steed mentions, the MD3 file allows for the head, body, and legs of each character to be modified separately and blended with independent textures. For instance, a bot may have sprinting movements for the legs and weapon firing animations for the torso and arms.<sup>11</sup> As with the *Quake* engine, characters are lit by Gouraud shading while the maps are illuminated by a precalculated lightmap. Fabien Sanglard explains that at runtime the Q3A engine loads the map and divides its sections using binary space partitioning (BSP). It then calculates visible polygons for the current potentially visible set (PVS) and blends the lightmap with appropriate shaders.<sup>12</sup>

The Q3A engine utilizes a breakthrough AI system composed of bots or enemy characters programmed for combat awareness and to seek out and fight human players at varying tiers of difficulty. To mimic real player behavior, bots were designed with unique personalities articulated through scripted dialogue. When a human player engages in chat with enemy bots, the AI responds by cycling through various taunts and insults related to being “fraggged,” or to be killed, in the arena space. The bot system was developed by industry pioneer Jan Paul van Waveren to be autonomous, or rather, to replicate believable human actions. In other words, bots make their own decisions based on programmed goals they aim to achieve during play. Each bot employs what is called domain knowledge, an understanding of changes that occur within the gameworld, to

<sup>10</sup> Paul Steed, “Putting New Models in Quake III Arena,” ed. Paul Jaquays, [https://icculus.org/gtkradiant/documentation/Model\\_Manual/model\\_manual.htm](https://icculus.org/gtkradiant/documentation/Model_Manual/model_manual.htm).

<sup>11</sup> Ibid.

<sup>12</sup> Fabien Sanglard, “Quake 3 Source Code Review: Renderer (Part 2 of 5),” *Fabien Sanglard’s Website*, June 30, 2012, <https://fabiansanglard.net/quake3/renderer.php>.



reason and carry out a specific string of actions. Van Waveren mentions that bots are programmed to execute goals in a task-oriented hierarchy, with winning as an individual or on a team as the crucial outcome: having the most frags, capturing an enemy team's flag, and so on. Bots follow a path of subgoals to win. These may include aiming and firing at an opposing human or bot, preserving health by eluding enemy projectiles, or obtaining better weapons, powerups, or medkits. Van Waveren explains that bots make decisions to carry out goals and subgoals using what is referred to in computer science as fuzzy logic, a system developed by Lotfi Zadeh at University of California, Berkeley during the mid-1960s that expands upon standard Boolean operations of true/false to include inconclusive statements and partial truths. This logic system informs a bot's decision-making through "fuzzy relations," which calculate its current level of need for using or obtaining an object or achieving a specific goal in the process of "winning." As an example, a value is assigned to a bot's need to pick up and use a railgun weapon. Fuzzy relations establish variables that determine what weapons/items the bot has currently, their quantities, and the bot's health and armor levels, to determine whether they will require a railgun based upon the gamestate and its present circumstances. Drawing from these variables, the bot calculates a decision to acquire the railgun only if it is advantageous toward the main goal of winning the match.<sup>13</sup>

A bot's decision-making is embedded among layers of a larger AI architecture. As van Waveren points out, a bot's capacity to make decisions at any given moment of play is based upon an awareness of the gameworld that increases with each layer of game data. The initial layer in the AI pipeline describes the output of the bot's actions within a broader Area Awareness System (AAS): run, jump, aim, shoot, strafe, crouch, and so on. The AI system was designed to give each bot data for all events currently happening in the game. A bot "senses" the arena after receiving this information as a series of preprocessed variables. Each bot is provided data about how to navigate the map and interact with other players and objects. As van Waveren explains, the AAS works similar to waypoints used in pathfinding for other forms of AI: a system that allows agents to quickly move from one area of a gameworld to another along designated "paths." A waypoint system operates through a series of linked coordinates, or nodes, along which bots move between using

<sup>13</sup> J. M. P. van Waveren, "The Quake III Arena Bot" (thesis, Delft University of Technology, 2001), 4–5, 12, 65.

the shortest possible distances. In the Q3A engine, routes within arenas are precalculated and cached so that they may be easily retrieved for the bot to interpret.

In the AAS, van Waveren employed 3D bounded hulls, convex open areas (within an arena) that allow for a bot or player to move from different points along a vector line. The convex areas have fewer obstacles to impede a bot from navigating to and from points, or what van Waveren refers to as “reachabilities.” A reachability is determined if a bot can move with minimal impediments between two areas of the map; for example, teleporting, riding an elevator, running along a vector, jumping onto an object, or propelling from a jump pad to a second story. Lastly, the AAS employs collision detection, or when an entity can discern boundaries and brushes in the game, by placing bots within bounding 3D boxes that interpret contact with solid objects.<sup>14</sup> From the AAS, bots are given information about the gameworld as it is sampled from the engine’s BSP tree. Spatial data for each map is calculated through the bot’s coordinates using the nodes of the BSP tree to narrow down the areas containing the bot’s bounding box and general location.

If the initial layer of the AI architecture is bot input and the AAS, then the second layer comprises the fuzzy logic a bot uses to achieve gameplay goals and make decisions about how to chat with human players. A third layer is dedicated to a network of nodes used for alternate AI scenarios and a module which affords bots the ability to interpret commands from their team leader and other bots/players. The final layer is composed of the AI brain: the virtual team leader assigned to each bot platoon. Van Waveren explains that the team leader surveys the gamestate and at 10Hz, meaning that at each tenth of a second it receives data from the AAS and decides upon appropriate actions for the remainder of the team.<sup>15</sup>

In conjunction with van Waveren’s AI system, Carmack updated the Q3A engine with novel networking capabilities based on a snapshot architecture that transmits data for each frame of gameplay from the server to client computers using a User Datagram Protocol (UDP). The server receives the updated gamestate at a fixed rate asynchronous with its clients. It then sends the current frame to the client using delta encoding to limit bandwidth, meaning that the engine excludes information from each frame, sending only disparities from the last

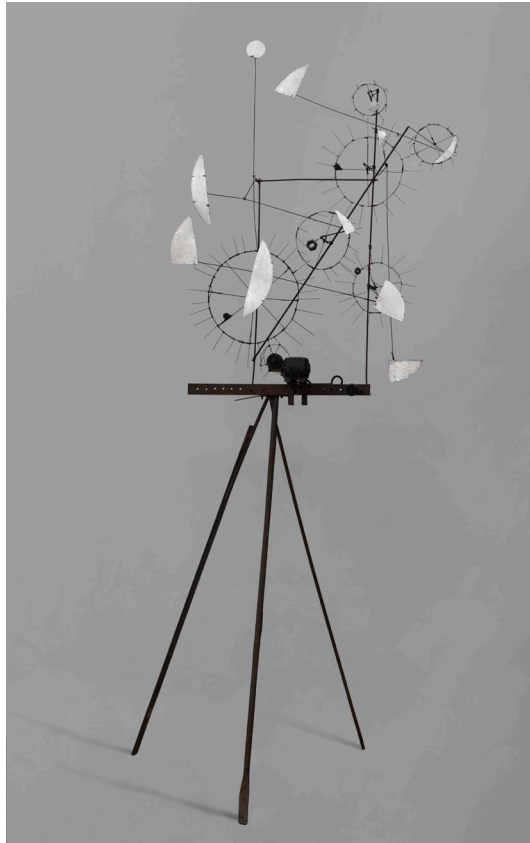
<sup>14</sup> Ibid., 24–5, 34.

<sup>15</sup> Ibid., 22.

frame downloaded from the client. As Sanglard explains, Carmack designed the engine to run a virtual machine that loads three separate machines at any given time among the client-servers. A virtual machine refers to the emulation of a computer's architecture. In the Q3A engine, two virtual machines operate on the client side of the network that communicate the current gamestate with each other. The "cgame" machine performs culling operations and runs the renderer library, while the "q3\_ui" (user interface) operates menu phases in the game. The server side includes the "game" machine, which triggers the bot library and runs the game's AI component. Carmack used virtual machines for client-server operations because they afforded a stable format for modifications. In August of 2005, Carmack released the Q3A engine source code under the General Public License v2.0, which allowed for modding communities to develop derivative engines. Soon after, the icculus.org software incubator created *Ioquake3*, an engine derived from the Q3A source code that sought to remove bugs, improve graphics, and sound through the addition of SDL (Simple DirectMedia Layer) and OpenAL: a cross-platform interface for 3D audio. As I expand upon in the following section, the generative systems of Tinguely and Haacke during the 1960s give precedent to the ways Oliver and Betts employ the engine's bot AI, colors and textures within the shader system, and revamped network to produce abstractions of glitch.

## Volatile Machines and Physical Systems

To understand the generative processes that underlie Oliver and Betts' modifications, I first turn to the Meta-matic sculptures of Swiss artist Jean Tinguely. Throughout 1955–6, Tinguely began creating his Meta-matics as a series of automated machines that could paint or draw abstract compositions. Collecting materials from junkyards near his Paris studio, he constructed each Meta-matic as an assemblage of gears, belts, and electric motors with a pen or brush rigged to a mechanical arm. Positioned in a gallery, each Meta-matic requires a participant to insert a small piece of metal into a slot, causing the device to erratically jolt to life and move the pen spastically across a paper surface. The sculpture produces a scribbled drawing in which no two compositions are alike. Tinguely exercised certain constraints such as using a different colored pen or adjusting the machine's range of motion, and in some cases, a participant could stop, start, or speed up its motor. Yet, once the sculpture was initiated,



**Figure 4.2** Jean Tinguely, *Metamechanical Sculpture with Tripod*, 1954. Tate, London. © 2020 Artists Rights Society (ARS), New York / ADAGP, Paris.

it generated a unique variation of scribbling through its own machinic logic (Figure 4.2).

Pamela M. Lee observes that within discourses of kinetic art, Tinguely's Meta-matics unveil a temporal "worlding" in Heidegger's use of the term. The kinetic processes in Tinguely's work, particularly the explosive, self-destructing machines in his televised spectacle *Study for an End of the World No. 2* (1962), reveal the dynamic relationships between time and technology that emerged during the late 1950s and the early 1960s. His sculptures resemble a microcosm of the hope and perils of computer automation for a traditional labor force of the machine age, as well as anxieties over geopolitical formations of power and threats of global mass destruction. Lee argues that Tinguely's playful experiments with automation foreground a paradoxical stance in his artistic practice. His

sculptures “facilitate artistic ‘expression,’ but at the same time are not necessarily *mechanical* objects, denying their user the freedom mythically alleged to guide the creative process.”<sup>16</sup>

To Tinguely, this ceding of authorial control allowed his Meta-matics to be free through what he calls “the functional use of chance,” or the machine’s unique variations and potential to break down, explode, catch fire, produce scribbles, work perfectly, or not work at all.<sup>17</sup> Calvin Tomkins observes that the Meta-matic and its capacities to generate potential outcomes, to never repeat the same scribble twice, stems from Tinguely’s belief that sculptural freedom can only occur “from accepting the impermanence, the accidents, and the infinite transformations of life itself.”<sup>18</sup> Tinguely illustrates that for each machine’s variations:

Life is movement. . . . Everything transforms itself, everything modifies itself ceaselessly, and to try to stop it, to try to check life in mid-flight and recapture it in the form of a work of art, a sculpture or a painting, seems to me a mockery of the intensity of life . . . I want only to involve myself in the moving object that forever transforms itself.<sup>19</sup>

The bizarre activities of Tinguely’s machines, quakes and shudders when electric motors propel their junk parts into motion, produce a sense of playful interactivity with spectators, a phenomenal encounter, as Lee argues, solidified through techniques of kinetic art during the mid-century. The playful kineticism of Tinguely’s sculptures, the slug-operated Meta-matics or even his *Cyclograveur* (1962), a stationary drawing machine requiring participants to pedal its form like a bicycle, situated aesthetic experience as fundamentally “material and embodied, as contingent and site-determined.” To Lee, kinetic art explicitly addressed the *timeliness* of the audience, whose engagement with the work mirrored its ever-fluctuating configurations.<sup>20</sup>

The audience’s embodied experience of Tinguely’s generative assemblages was best demonstrated in his monumental, self-destructing machine *Homage to New York* that, in 1960 within the sculpture garden of the Museum of Modern Art, was unable to successfully kill itself among throngs

<sup>16</sup> Lee, *Chronophobia*, 90–2, 111.

<sup>17</sup> Jean Tinguely quoted in Calvin Tomkins, *The Bride and the Bachelors: Five Masters of the Avant-Garde* (New York: Penguin Books, 1976), 146–7.

<sup>18</sup> Tomkins, *The Bride and the Bachelors*, 150.

<sup>19</sup> Tinguely quoted in Tomkins, *The Bride and the Bachelors*, 150.

<sup>20</sup> Lee, *Chronophobia*, 95.

of onlookers. Firefighters intervened to extinguish the fire bellowing from the machine before it was destroyed entirely as Tinguely hoped. In its failed suicide, the sculpture produced a range of unprecedented effects once its system of motors and gears were actuated by Tinguely with assistance from experimental filmmaker Robert Breer and Billy Klüver, then an engineer at Bell Laboratories. The machine was constructed as a bricolage of junk parts that Tinguely, Breer, and Klüver collected from dumps and landfills. Its architecture consisted of electrical motors, bicycle and baby carriage wheels, levers, and cranks, which supported a large sheet-metal container housing a roll of paper. Tinguely intended for mechanical arms with brushes to paint across the paper surface as the roll was continually blown out into the audience by a large fan. Yet when the machine started, by its own volition, it rolled the paper in the wrong direction, spinning it back wildly into the belly of the apparatus after Tinguely and assistants had incorrectly installed a belt. Operating on its own logic, the sculpture used its various mechanisms to produce a percussive cacophony. Notably, a large arm beat upon an old washing machine drum. Titanium tetrachloride was released from a child's bassinet to produce thick plumes of smoke wafting in the direction of onlookers. A large meteorological balloon was filled with the aim that its eventual bursting would release of odorous chemicals, an event that never occurred. In another section of the sculpture, Tinguely installed an old piano whose keys were beat furiously with mechanical arms, producing only three notes. Attached to the piano was a small Meta-matic contraption that would paint, unroll, and roll itself back up again. Inside the piano, a gas can was set to pour onto a candle, igniting the sculpture in flames. Tinguely's infamous *Homage to New York* enacted a generative process through the machine's freedom and dynamics, implicating the audience's shock, awe, delight, and fear into the unfolding of the event.

If Tinguely sought to experiment with generative outcomes through the instability of his machines, then Hans Haacke's conceptual artworks explored variation within physical and natural systems. Haacke interrogated the status quo of the museum as a social system throughout the 1970s, yet his earlier projects during the 1960s examined how a work's composition could be derived from variations in its immediate environment: light, temperature, air, humidity, and the spectator's changing position. Haacke clarifies that generativity emerges in his installations when objects are no longer fixed or predetermined, instead becoming constitutive of their environment to produce a broader, complex

system.<sup>21</sup> Each sculpture is a network of interrelated processes that, as Alexander Alberro says, possesses a life of its own much like an organism. Just as Tinguely's machines function as a microcosm of changing social and political conditions of the era, Haacke's installations serve as a correlate to natural processes within the world: weather patterns, water cycles, atmospheric circulation, or homeostasis in the body of a frog.<sup>22</sup> And like Tinguely's contraptions, Haacke's physical systems exist in their various permutations independent of artistic intention or the viewer's interpretation. To Haacke, systems continue to operate outside "knowledge, past experience, the mechanics of perceptual psychology . . . emotions, or any other involvement short of . . . running berserk and smashing it." Yet, the viewer's encounter with the system produces "a gulf of subjective projections," mental processes imbricated in the generative development of the work.<sup>23</sup> Haacke speaks to the viewer's embodied interfacing in his early experimentations with mirrored and stainless-steel objects:

There is neither a correct nor an incorrect point of view from which to look at them. Their environments—including the spectator—form an integral part of them. The environment is constantly participating in their creation. They are not fixed, their appearances are infinite. They are exceeding their material boundaries and are limited, respectively, by the boundaries of sight in the space in which they happen to be, the workshop, the exhibition room, and the stars.<sup>24</sup>

Here, Haacke considers the body's incorporation into material processes of light and reflection, yet throughout 1963–5 he further experimented with the spectator's involvement (or lack thereof) in his hydrodynamic sculptures, namely *Condensation Cube* in its various iterations. Haacke constructed the sculpture as an enclosed cube of transparent plastic containing a small trace of water. Adhering to its own natural cycle, the sealed water evaporates and produces condensation droplets which eventually drip back down to the bottom of the cube. The cube serves as an ongoing, self-regulating system composed of interdependent processes within the gallery including temperature changes, air currents from an AC system, or varying directions and intensities of natural and artificial light. Even the traffic of spectators potentially alters the rate at which

<sup>21</sup> Hans Haacke, "Untitled Statement, 'For some years . . .,' 1967," in Hans Haacke and Alexander Alberro, *Working Conditions: The Writings of Hans Haacke* (Cambridge, MA: MIT Press, 2016), 10.

<sup>22</sup> Alberro, "Introduction: Hans Haacke and the Rules of the Game," in *Working Conditions*, xi.

<sup>23</sup> Haacke, "Untitled Talk at Annual Meeting of Intersocietal Color Council, New York, April 1968," in *Working Conditions*, 24.

<sup>24</sup> Haacke, "'Observing My Mirror Objects,' 1962," in *Working Conditions*, 2.



the cube's water performs its cycle as the warmth of bodies slightly affects the surrounding room temperature, producing changes on a molecular scale.

In 1966, Haacke began experimenting with water systems in other physical states, witnessed in his installation *Ice Stick*: a refrigerated metal coil on which layers of moisture freeze and melt from changes in external temperature. An unexpected change in temperature or humidity generates novel patterns of ice crystals, introducing a degree of unpredictability into the system. A year later, Haacke featured his humidifying sculpture *Steam* that when exhibited with *Ice Stick* would provide a counterpart to the freezing water. He illustrates that water vapor from the humidifier would increase moisture in the gallery space, in turn, dehumidifying the refrigerated stick through a physical reciprocation within an intricate organized structure.<sup>25</sup> By the end of the decade, Haacke interrogated the role of biological systems in works such as *Grass Grows* (1967–9), a mound of grass centered within the gallery that carries out photosynthesis and growth dependent upon changes in temperature and light (Figure 4.3).



**Figure 4.3** Hans Haacke, *Grass Grows*. Installation view, *Hans Haacke: All Connected*, 2019, New Museum, New York. © Hans Haacke / Artists Rights Society (ARS), New York / VG Bild-Kunst, Bonn. Photo: Dario Lasagni.

<sup>25</sup> Haacke, "Untitled Talk at Annual Meeting of Intersocietal Color Council, New York, April 1968," in *Working Conditions*, 23.

With these natural systems in mind, Haacke proposes several rules in a brief “untitled statement” from 1965, which parallel Tinguely’s Meta-matics and generative art techniques more broadly:

... make something which experiences, reacts to its environment, changes, is nonstable ...

... make something indeterminate, which always looks different, the shape of which cannot be predicted precisely ...

... make something which cannot “perform” without the assistance of its environment ...

... make something which the “spectator” handles, with which he plays and thus animates ...

... make something which lives in time and makes the “spectator” experience time ...<sup>26</sup>

Thus, experimentation with generative artworks throughout the 1960s not only involved a spectator’s entwinements with constituent parts of an organized system but also reciprocally, incorporated the artwork’s reaction to the spectator from which unexpected outcomes were produced. The situated and embodied contingencies among spectator and system reveal aesthetic experience as an evolving process, one that is continually renegotiated among an exchange of human and nonhuman temporalities, affects, and perceptions. As I now turn to, Oliver and Betts’ modifications work within traditions of generative art to engage the body’s sensory response to fractured video game spaces, namely, *ioq3aPaint* and *QQQ*, which utilize an existing computational framework: the *Q3A* engine’s bot AI, multiplayer network, and shaders, to produce a nuanced system of interrelated bodies and machines. In the presence of these generative mods, aesthetics unfold through the autonomy of the engine’s logic: disruptive glitches that produce abstract forms through a flattening of the arena’s depth. Once running, Oliver and Betts’ mods operate through an ongoing instability to their surrounding ecology, which as I suggest, rearticulates the game’s representations of bloodshed as an intensive violence within the body.

<sup>26</sup> Haacke, “Untitled Statement,” “... make something which experiences ...,” 1965,” in *Working Conditions*, 5.

## The Meat of Glitch

The ways in which *ioq3aPaint* and *QQQ* continually transform conventional 3D space into glitch projects what contemporary Japanese artist Takashi Murakami has termed Superflat aesthetics. Drawing from avant-garde traditions of the Japanese eccentric artists, Murakami expresses his own painterly approach through Superflat, a style in which forms work to distribute perception across a visual field as opposed to perspectival rendering in which the eye penetrates the image's depth. Within the Japanese Superflat lineage, ranging from Edo period ink paintings of nature to contemporary anime films, the viewer's eye is prompted to trace and retrace sensuous forms across the image's surface. For Murakami, this aesthetic "violently accelerates and decelerates the gaze as it swings it from side to side." In Superflat, images possess a balance of visual forms dispersed across the picture plane (Figure 4.4).<sup>27</sup>



**Figure 4.4** Takashi Murakami, 727, 1996. Museum of Modern Art, New York. © The Museum of Modern Art/Licensed by SCALA / Art Resource, NY and Takashi Murakami.

<sup>27</sup> Takashi Murakami, "A Theory of Super Flat Japanese Art," in *Super Flat*, ed. Takashi Murakami (Tokyo: MADRA Publishing, 2000), 193–4.

In Oliver and Betts' mods, the Q3A engine works to defamiliarize our experience of the arena deathmatch by flattening 3D space into a continually shifting terrain of abstract forms, a result of the hall of mirrors effect that smears multiple frames across the interface. These instantiations of Superflat elicit an apperceptive spectatorship of the engine's ongoing computational processes as they are carried out interdependently within a broader generative system. Yet as I have mentioned, the body's mimetic encounter with Superflat forms of glitch excites a proprioceptive strangeness by transposing the representational fragging in the arena into violent intensities. In his writings on the painter Francis Bacon, Gilles Deleuze illustrates how the figural is expressed through bodily sensation. Deleuze explores what he calls the *violence of sensation* inherent to Bacon's grotesque paintings of popes, screaming mouths, and crucifixions as well as self-portraits and those of close friends, including painter Lucian Freud (Figure 4.5).



**Figure 4.5** Francis Bacon, *Study for Portrait VII*, 1953. Museum of Modern Art, New York. © The Estate of Francis Bacon. All rights reserved. / DACS, London / ARS, NY 2020.

Bacon often depicts his subjects in a diptych or triptych, isolating figures within parallelepiped spaces. Here, Deleuze is interested in the affective forces among materials, forms, and the body, especially how the image propels outside of figuration in the viewer's aesthetic engagement with Bacon's abstract subjects. Bacon's concept of the figure—through a deformation of its own body: violent spasms, vomiting, and excrement—is in constant escape of its “figuration,” hollowing itself of organizing bodily traits and returning to the materiality, the forms, and the surface of the painting. These asignifying traits of Bacon's figure produce a zone of indiscernibility between face and head, animal and human, that Deleuze describes as the *meat*. In his portraiture, Bacon does not portray the face and its signifying features, but rather he paints the head without a face. Thus, through the head, Bacon's figures catechize the strange imperceptibility among the flesh of the human and the meat of the animal: forces of animality that operate outside discursive frameworks of the human form. In Bacon's work, Deleuze introduces the concept of meat to interrupt standard demarcations of a human *body* outside organizing principles of the figure within histories of art.<sup>28</sup>

In her aesthetic theory, Elizabeth Grosz argues that chaotic forces in the world, rather, unpredictable, material happenings and processes, generate sensation and artistic production through sexual attraction. By this, Grosz broadly refers to the way sexual energies in the natural world carve out novel territories of aesthetic experience by affirming the body's sensuality and affectivity. For Grosz, “sexuality is the rendering artistic, the exploration of the excessiveness, of nature.”<sup>29</sup> As she explains, “Where art comes to use sensations, the condensation, purification, and exploration of percepts and affects; sex comes to use embodied gestures, traces, connections from which the percept or affect may be born.”<sup>30</sup> Grosz illustrates the universality of aesthetic experience as the interweaving of sexual forces and living bodies that produce novel modes of becoming: the beautiful plumage of a peacock, fetid smells of a corpse flower, or the sonorous notes of a whale's song. In Bacon's paintings, the meat operates as a dynamic of sexuality, evoking sensory engagement through what Grosz sees as “the force of an invisible, unheard gravitational pull.”<sup>31</sup>

<sup>28</sup> Gilles Deleuze, *Francis Bacon: The Logic of Sensation*, trans. Daniel W. Smith (Minneapolis, MN: University of Minnesota Press, 2004), 16, 19–22.

<sup>29</sup> Elizabeth Grosz, *Chaos, Territory, Art: Deleuze and the Framing of the Earth* (New York, NY: Columbia University Press, 2008), 3, 7, 11.

<sup>30</sup> *Ibid.*, 102–3.

<sup>31</sup> *Ibid.*, 86.

Through the gravitational forces of meat, the bodily reciprocation of Bacon's forms in the viscera sustain sensation through a vital rhythm: the figure's violent spasms as it attempts to return to the visual field of the painting. It is the figure that constitutes this violence of sensation. As Deleuze states:

The violence of sensation is opposed to the violence of the represented (the sensational, the cliché). The former is inseparable from its direct action on the nervous system, the levels through which it passes, the domains it traverses: being itself a Figure, it must have nothing of the nature of a represented object.<sup>32</sup>

In the meat of the figure, the viewer experiences different orders of violent sensation which fold into each other. Within these sensory domains, the figure frees the viewer's eye from its fixed status as an organ, engaging a haptic function that *sees-feels* the painting's rhythms. Echoed by Grosz, Deleuze locates sensory experience in the material exchanges among the viewer's embodied excessiveness and the chaotic forces stimulated by Bacon's figures.<sup>33</sup>

In *ioq3aPaint* and *QQQ*, the generative instability of glitch, which continually flattens and deconstructs the gameworld, evokes the body's apperceptive and proprioceptive senses through the forces of a sensual violence: gravities, pressures, elasticities, frictions, and inertias. Betts describes this conflation of the game's deathmatches and the vibrancy of glitch in *QQQ*:

I wanted to question the traditional assumptions of video games (*Quake III* in particular) as blood-filled violence simulators by creating an abstract, painterly re-rendering with an interface you couldn't use for killing. I was also interested in the endless recycling of data, the constant death/rebirth of players and the futile performance aspect of the game and the idea of data as a mutable form, with meaning constructed in the process of its rendering, either as a specific expression or as generative possibilities.<sup>34</sup>

This uncanny rendering of death and respawn is evident in Betts' exhibit of *QQQ* at the 2002 Evolution Festival in Leeds, UK, where the mod was displayed from a scrim attached to metal scaffolding within the darkness of a theater. Before the screen, the artist placed a small, illuminated podium with keyboard buttons protruding from its surface, inviting the viewer to interfere with the continuous mutation of forms outputted from the multiplayer server (Figure 4.6). As participants attempt to modulate the in-game camera, they are confronted by trailing effects in which

<sup>32</sup> Deleuze, *Francis Bacon: The Logic of Sensation*, 39.

<sup>33</sup> *Ibid.*, 37, 42–5.

<sup>34</sup> Tom Betts, interview by *Neural*, "Nonlinear Software: Tom Betts/Nullpointer Interview," *Neural*, issue 23, 45.





**Figure 4.6** Tom Betts (Nullpointer), *QQQ*, 2002. Installation view, Evolution Festival, 2002, Leeds, UK. Courtesy of Tom Betts.

frames rapidly duplicate across the screen, while aggressively zooming in and out on colorful fragments of Q3A's shader textures. With each death and respawn of live players, the spectator witnesses recycled frames project wildly in the interface, prompting the eye to trace their circuitous paths laterally throughout the flatness of the screen (Figure 4.7). In perhaps a more pronounced Superflat effect, Oliver's stills of *ioq3aPaint* force the eye to follow calligraphic lines of trailing frames along the surface of the image. In these instantiations of disrupted 3D space, remnants of Q3A's saturated textures and bot movements pervade the screen space with an equal hierarchy of distribution. The rhythms of the bots' autonomous activity—killstreaks, headshots, and frags—are reconfigured as violent intensities of abstract forms (Figure 4.8). Oliver states that *ioq3aPaint*:

is closer to a graphic echo of an arena, an unforgettable [*sic*] transcript of the events therein. Here the drive to hunt and kill is abstracted and used as control data to drive the painting process; I have simply manipulated the representation in such a way as to turn this fight into something unrecognizable and perhaps even beautiful; a transduction of the hunt into a cumulative stream of graphic memory. The bots have no sense of this experimentation, they simply hunt each other in an endless cycle of simulated life and death.<sup>35</sup>

<sup>35</sup> Oliver, interview by Quaranta, "Delire (Julian Oliver)," 132.





**Figure 4.7** Tom Betts (Nullpointer), *QQQ*, 2002. Screenshots.

I would argue that although static, Oliver's stills portray a timeslice of a complex system in its dynamic unfolding. At the 2013 transmediale, *ioq3aPaint* was projected in real time so that participants could play with its interface, yet was exhibited with multiple prints captured from the system, allowing for a closer

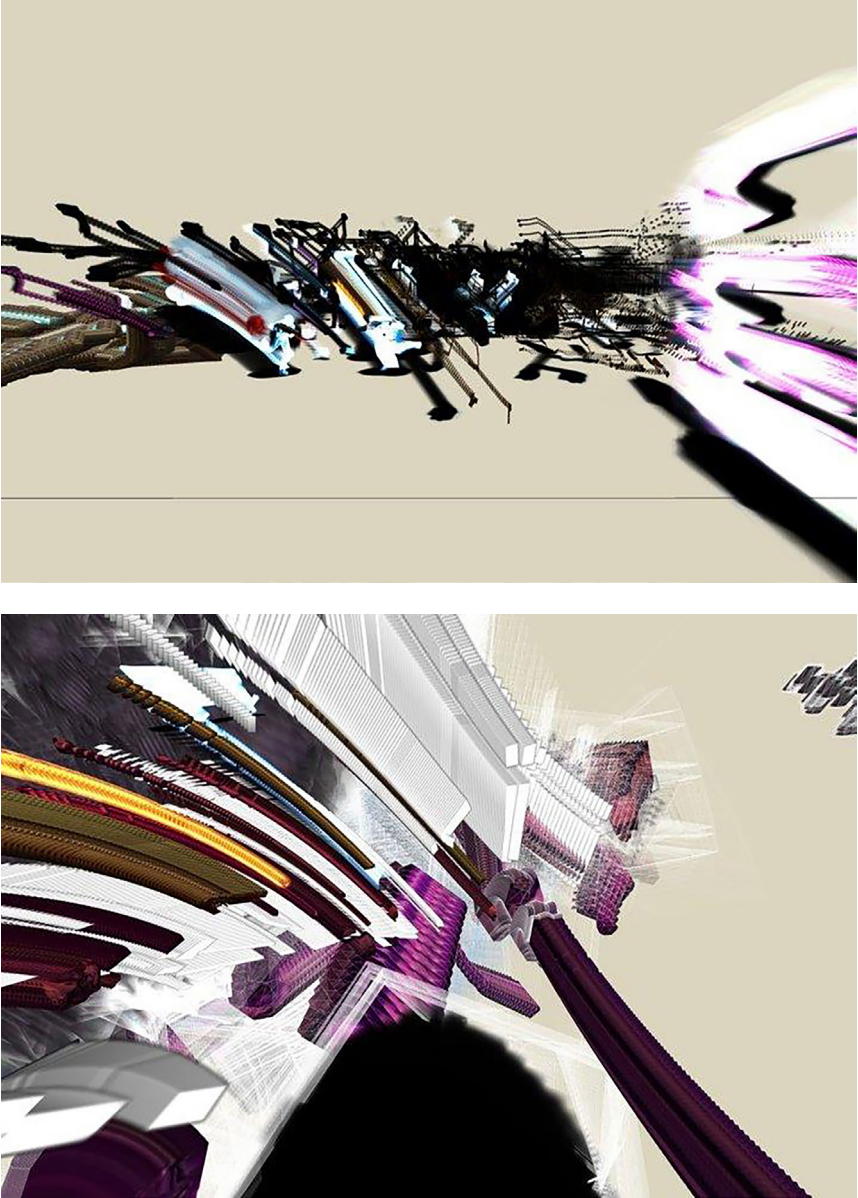


Figure 4.8 Julian Oliver, *ioq3aPaint*, 2002–3, 2010. Screenshots.

examination of the mod's operations. Similarly, at the Hannah Maclure Centre solo show, *ioq3aPaint* self-generated 36 million images in a real-time installation during the two and a half months of the exhibit, yet Oliver also displayed several still images from the mod while freely distributing hundreds of prints and

the system's source code to the public. Within the generative ecologies of *ioq3aPaint* and *QQQ*, the viewer's spatial experience of the arena deathmatch is fundamentally upended through the violence of sensation, or what I refer to as the *meat* of glitch. I employ Deleuze's concept of meat to consider the strange indetermination among the representational properties of the gameworld, its polygonal architectures, figures, weapons, animated objects, and their reterritorialization in a continual field of abstraction. The meat emerges from the liminal space between the figurative remains of the arena and their ongoing deconstruction into arrangements of glitch. The meat describes the bleed between the game's familiar assets and their dissolve into nonrepresentational forces: an intensive presence that pulls upon the body's sensory capacities.

In his discussion of glitch art, Tim Barker explains that generative characteristics of error are realized within programming constraints set forth by the artist. Within histories of interactive art, glitch emerges from within a field of aesthetic potential, shaped by software logic, artist interactions, and participatory experience. Generative errors result from bodily engagement within a complex system that mobilizes aesthetic possibilities, generating embodied difference by "shak[ing] the system free of its precise or pre-programmed functioning."<sup>36</sup> Remarkably, *ioq3aPaint* and *QQQ* do not require direct human intervention to generate aesthetic potential. The code executed by the altered mods are singular processes within an extensive constellation of independent mechanisms. Like Haacke's physical systems, *ioq3aPaint* and *QQQ* resemble self-sufficient organisms that respond to stimuli within their surrounding environment. Once booted up, *ioq3aPaint* produces abstract sequences through the procedural activity of the engine's AI. When the user enters this technical milieu and moves the camera angle or captures a frame from the bot deathmatch, the system further generates aesthetic meaning from a virtual territory of interactions.

Similarly, Tilman Baumgärtel observed that at the *games. Computer games by artists* exhibition, *QQQ* operated through an inherent logic that at times reacted to unsuspecting human agents on the game's server. During the night or on weekends, when traffic on the game's server was slow, the installation would remain quiet, intermittently producing small deformations of the gamespace. Yet, if multiple players logged on, the mod would violently lurch into action, churning out kaleidoscopic forms. And just as suddenly, if players logged off,

<sup>36</sup> Tim Barker, "Aesthetics of the Error: Media Art, the Machine, the Unforeseen, and the Errant," in *Error: Glitch, Noise, and Jam in New Media Cultures*, ed. Mark Nunes (New York: Continuum, 2011), 52, 54, 57.

the mod would return to its graphically retrained state.<sup>37</sup> As the altered Q3A engine exercises its freedom to produce errant forms within a complex ecology of machines and human users, it implicates the body within a phenomenal instance of *meat*. The eye no longer operates as an organ through which to perceive and act within conventional 3D space, but instead adopts a primal sensuality in its commingling with the mod's affective forces: a haptic quality that traverses the game's dismantled interface. In this instance, the spectator is shown a gameworld removed from its signification as an arena of competition, challenge, and rewarded kills.

I conclude by proposing that within the generative frameworks of *ioq3aPaint* and *QQQ*, the violence of sensation enables a sensory exchange between the body and the strange agency of nonhuman matter, what Jane Bennett calls thing-power. In her speculative ontology, Bennett expresses the productive forces of things: a plastic cup, rubber tree, or game engine. Specifically, Bennett recognizes the capacities for material things to *act*, freed from human utility and the conditions that organize human knowledge of their existence. Things possess an ability to affect other things, limiting or empowering trajectories of nonhuman forces. She refers to such forces as *vibrant matter*, nonhuman flows of agency that seek to dissociate material things from their long-held dependency on automatistic and mechanistic theories. As Bennett asserts, by engaging a politics that recognizes the intricate connections among human and nonhuman materials such as stem cells, landfills, and fish oil, we are better equipped to manage ethical imperatives related to those natural ecologies.<sup>38</sup>

Bennett's politics of things does well to explain an aesthetics of generative modding, one that undergirds human users interacting with a nonhuman engine that in its autonomy, possesses the readiness to affect other material bodies. The potential for sensory experience in Oliver and Betts' mods points to a braiding of actants: user, processor, server, screen, bot, shader, keyboard buttons, and protocol, which mobilize aesthetic participation within an assemblage of human and nonhuman entities. The violence of sensation which transpires from this ecology of things, demonstrates the vibrancy of our embodied involvement with game engines.

<sup>37</sup> Baumgärtel, "On a Number of Aspects of Artistic Computer Games."

<sup>38</sup> Bennett, *Vibrant Matter*, 1–2, 4–5.



## Random Planets and Alien (Dis)orientations in *WE BUILD WORLDS*

*Capital is at every level an eerie entity: conjured out of nothing, capital nevertheless exerts more influence than any allegedly substantial entity.*

—Mark Fisher, *The Weird and the Eerie*

*Our bodies are prime sites of disidentification; they are objects, subjects, and spaces where we can break up our binary patterns, chart our points of disidentification—the things with which we no longer identify, the things in which we no longer believe. In doing this, all of our psychological, cultural, and physical differences can become queer, strategic empathies in preparation for the Great Game of our own making.*

—Derek A. Burrill, “Queer Theory, the Body, and Video Games,”  
*Queer Game Studies*

In their installation *WE BUILD WORLDS* (2019) at the Treefort Art Gallery in Boise, Idaho, the artist collective STRT/SLCT (Krista Hoefle and Eli Kahn) presented audiences with an abstract machinima of *No Man's Sky* (2016) in which Hoefle augmented footage of the game's procedurally generated planets. Integrating machinima techniques into her work, Hoefle produces an aesthetic of disembodiment, positioning the spectator within the anonymous perspective of a disorienting trek through glitching alien landscapes. Within the gallery, spectators encountered projected sequences of strange flora and fauna on distant planets, bleeding in and out of vibrant color fields and grid patterns, along with on-screen warnings of increasing toxicity levels. Among the dizzying terrains, the artists encouraged playful interaction via a small round window portal, allowing spectators to peer into the installation from outside the gallery. Reflecting this uncanny exploration of extraterrestrial worlds, the installation walls and floors incorporate blacklight illuminated neon motifs, continuing



the machinima's erratic grid into physical space. Tentacle-like fluorescent life-forms made of woven plastic and foam hang from the ceiling and sprout along the walls. Additional grids with flickering geometries were projected onto the installation's floor along with a soft sculpture of a spaceship, functioning as a kind of beanbag for participants to rest upon. Kahn composed an energetic soundtrack synchronized to the machinima's psychedelic environments. As Hoefle and Kahn illustrate, these forms of participatory engagement imbricated with the procedurally generated spaces of *No Man's Sky* and gallery's sculptural forms, reconfigure dominant expressions of play "by deliberately obfuscating the goal of the game . . . renouncing its functional logic while simultaneously emphasizing the lethal nature of the lush environment." More so, *WE BUILD WORLDS*, through the presence of the grid that reveals itself beneath the deteriorating gameworld, foregrounds the artificiality of game engines, or rather, their technical capacities to generate palpable illusions of space.<sup>1</sup>

In the book's final chapter, I draw upon STRT/SLCT's *WE BUILD WORLDS* exhibited at both the EndCap in the Vested Interest building, South Bend, Indiana, as part of the Birdsell Project Residency (2018) and the Treefort Art Gallery, examining the ways artists refashion contemporary open world engines to queer hegemonic video game play through the lively fabric of nonhuman entities. Here, I engage recent feminist materialisms, and specifically object-oriented feminism (OOF) which works to expand the lens of marginalized subjects to include feminist-oriented *objects*, or as Katherine Behar points out, extending traditional feminisms' ethics of care "to promote sympathies and camaraderie with nonhuman neighbors." That is to say, OOF doesn't forgo empathy for subjects (women, people of color, LGBTQ+ communities) but instead observes the always already co-constituted and phenomenally situated presence of bodies with objects of *exploitation*: things, tools, instruments whose human utility organizes subjectivity within capitalist, patriarchal, and colonialist regimes of power. Object-oriented feminism intervenes in those oppressive frameworks by examining objects from the *inside-out*, rather an object's agency extending outward within the broader arrangements of active material bodies.<sup>2</sup>

I first examine open world video game spaces through an archaeology of the *No Man's Sky* engine. The game's software framework provides the spatial

<sup>1</sup> STRT/SLCT, "WE BUILD WORLDS #1." Vimeo video, 1:43. August 9, 2018, <https://vimeo.com/284244049>.

<sup>2</sup> Katherine Behar, "An Introduction to OOF" in *Object-Oriented Feminism*, ed. Katherine Behar (Minneapolis, MN: University of Minnesota Press, 2016), 7–8.



illusion of expansivity and scale through forms of nonlinear gameplay that encourage the player to explore emergent narratives within vast digital spaces. I argue that Hoefle's reconfiguring of *No Man's Sky* enables phenomenal instances of interobjectivity that disrupt codified video game experiences within exclusionary, masculinized histories of computers. In *WE BUILD WORLDS*, vibrant constellations among spectators and open world engine operate through mimetic instances of what I call "mirrorless affect," a term modified from Cristina Albu's concept of mirror affects within genealogies of contemporary art and, specifically, modes of embodiment that reflect or respond to the presence of self and others. Albu examines site-specific uses of mirrors, video cameras, sensors, as well as reflective interfaces and surfaces, prompting novel forms of empathetic and interpersonal connection with other bodies who simultaneously experience affective instances of mirroring.<sup>3</sup>

Instead, mirrorless affects disassociate the spectator from familiar interfaces, avatars, and playability, working to interrupt standard player identification. Such mirrorless encounters present audiences with games that on the surface, appear to reflect interactivity and the audiovisual feedback of a human controlled game, yet do not echo a player's tactile response and corresponding actions on screen. Mirrorless affects concretize a mode of spectatorship that ultimately reconfigures the standard proprioceptive logic of video games. In *WE BUILD WORLDS*, it is not a human navigating open world spaces but rather *a game engine navigating itself*, feeling out its native technical procedures in often chaotic ways. As I demonstrate, our embodied attentiveness to an alien perspective slowly dying on a toxic exoplanet elicits a proprioceptive disorientation through which the activities of nonhuman objects lay bare dominant video game play, in Behar's terms, from the "inside-out." This critical spectatorship evokes vital and situated modes of embodiment, highlighting the nuanced ways in which bodies are made meaningful in their material and social arrangements with technical objects.

## *No Man's Sky* and Open World Engines

Although the engines I have analyzed in the previous chapters generate technical illusions of gamespaces, they still confine player interaction to spatially

<sup>3</sup> Cristina Albu, *Mirror Affect: Seeing Self, Observing Others in Contemporary Art* (Minneapolis, MN: University of Minnesota Press, 2016), 5, 6.

limited gameworlds: scrolling 2D planes and 3D arenas, and map architectures that encourage goal-oriented tasks from a starting point to the level's end. Contemporary engines that render games like *No Man's Sky*, produce algorithmic spaces that are often encyclopedic and perceivably interminable in scale, allowing the player to freely explore emergent narrative forms. Developed by independent studio Hello Games using an in-house engine and initially released in 2016, *No Man's Sky* is a convincing simulation of deep space survival and exploration: a virtual microcosm of the universe. Players are afforded the near infinite possibilities of traversing a procedurally generated open world galaxy containing 18,446,744,073,709,551,616 planets, each with unique weather, ecosystems, flora, and fauna (Figure 5.1).<sup>4</sup> The game was highly anticipated, featuring gameplay demos of its engine at E3 (Electronic Entertainment Expo) in 2014 and 2015, yet was met with mixed reviews. Players found the game's objectives, with resource harvesting, technology upgrades, and traveling to new waypoints to be repetitive and tedious. Instead of a standard AAA title, players were met with a kind of art game that foregrounds the sensual and often meditative experiences of navigating cosmic scale and abstract worlds that, as



**Figure 5.1** Procedurally generated planets in *No Man's Sky* (Hello Games, 2016). Screenshot.

<sup>4</sup> Raffi Khatchadourian, "World Without End: Creating a Full-Scale Digital Cosmos," *The New Yorker*, May 11, 2015, <https://www.newyorker.com/magazine/2015/05/18/world-without-end-raffi-khatchadourian>.

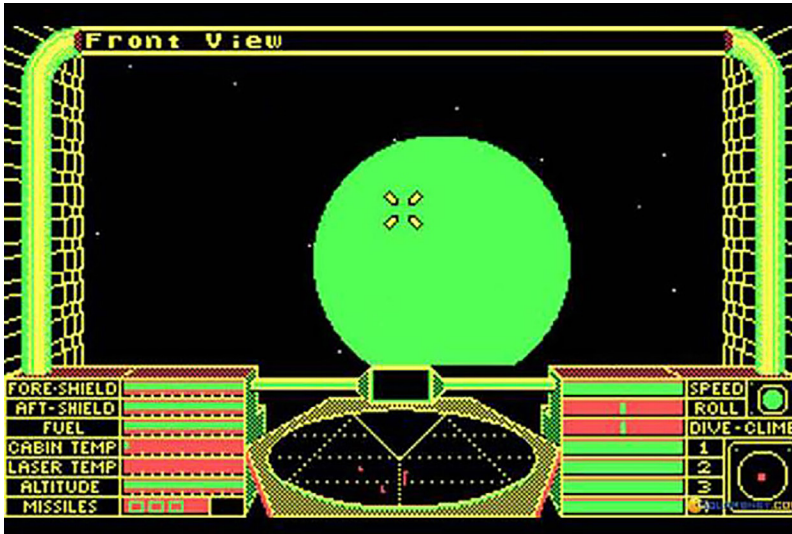
the game's art director Grant Duncan notes, were inspired by the science-fiction illustrations of Chris Foss.<sup>5</sup>

The *No Man's Sky* engine employs pseudorandom generators that continually feed noise into one another, calculating everything from solar systems, star constellations, and asteroid belts, down to the quantity of a planet's moons, orbital path, gravity, and atmospheric makeup. Planets mirror the scale of actual planetary bodies, in some instances, taking approximately thirty hours for a player to travel from the north to south pole. Only a small percentage support life-forms. More so, planets are distanced from each other by light-years of algorithmic space and in the game's initial multiplayer launch, players never actually encountered one another within the emptiness of space until the game's subsequent NEXT and Beyond updates, which allow for cooperative exploration of the universe. The generative properties of the *No Man's Sky* engine were influenced by Sean Murray's (director at Hello Games) experiences with the space combat and trading computer game *Elite* (1984) developed by David Braben and Ian Bell. The game's significant open world software lets players travel interstellar distances among procedurally generated galaxies rendered in 3D wireframe graphics using hidden line removal techniques (Figure 5.2). The engine produces eight galaxies each containing 256 planets that serve as outposts for trade, piracy, mining, as well as military excursions and bounty hunting. Planets are created using a pseudorandom generator in which an initial seed number is processed repeatedly by an algorithm that computes strings of numbers. These number strings determine the parameters of each planet: its name, location, resources, and so on.

Similarly, the *No Man's Sky* engine uses a seed number that structures the creation and entropy of the simulated galaxy. As Murray explains, the seed value, a phone number from one of the game's programmers, is run through an algorithm that outputs lengthy numerical strings. These numbers are randomly truncated when the game attempts to store them in 64 bits. The remaining pseudorandom strings generate stars within the galaxy. This process is iterated so that newly outputted seed numbers calculate the planets that orbit stars, their landscapes, atmosphere, flora, fauna, and human-made structures.<sup>6</sup> In a talk at the 2017 Game Developers Conference, the game's lead programmer Innes

<sup>5</sup> Grant Duncan, "No Man's Sky: How I Learned to Love Procedural Art," YouTube (Game Developers Conference, 2015), <https://www.youtube.com/watch?v=vcEA41eBOGs>.

<sup>6</sup> See Murray's explanation of *No Man's Sky* engine in Khatchadourian, "World Without End: Creating a Full-Scale Digital Cosmos."



**Figure 5.2** Procedurally generated worlds in *Elite* (David Braben and Ian Bell, 1984). Screenshot.

McKendrick refers to these algorithmic procedures as hierarchical, top-down generation. In this technique, a positional seed number is fed into a solar system generator, which arbitrarily determines the proximity of planets to stars. Its data output is fed into a planet generator that formulates orbital movement, day/night cycles, and ecosystems. Resulting data is run through a terrain generator that shapes mountains, cliffs, oceans, swamps, and deserts.<sup>7</sup> The entirety of the gameworld is rendered in the instant of the player's encounter with the artificial universe.

Instead of polygon meshes, *No Man's Sky* employs voxels (volumetric pixels) to spontaneously construct its universe. When a polygon is comprised of multiple vertices that form a geometry in 3D space, a voxel functions like a cubic pixel: a singular 3D coordinate that is assigned values for size, opacity, and color. A voxel serves as a discrete unit of volume within uniformly divided areas of 3D space. In his technical analysis of *No Man's Sky's* engine, Thomas Morgan observes that as distinct units, voxels can be easily manipulated to procedurally build hundreds of miles of unique terrains for each massive planet.<sup>8</sup> Murray

<sup>7</sup> Innes McKendrick, "Continuous World Generation in *No Man's Sky*," *YouTube* (Game Developers Conference, 2017), <https://www.youtube.com/watch?v=sCRzxEEcO2Y>.

<sup>8</sup> Thomas Morgan, "Tech Analysis: *No Man's Sky*," *Eurogamer.net*, August 11, 2016, <https://www.eurogamer.net/articles/digitalfoundry-2016-no-mans-sky-tech-analysis>.

further illustrates the interconnectedness of the game's top-down generation through the continual decay and recomposition of voxels:

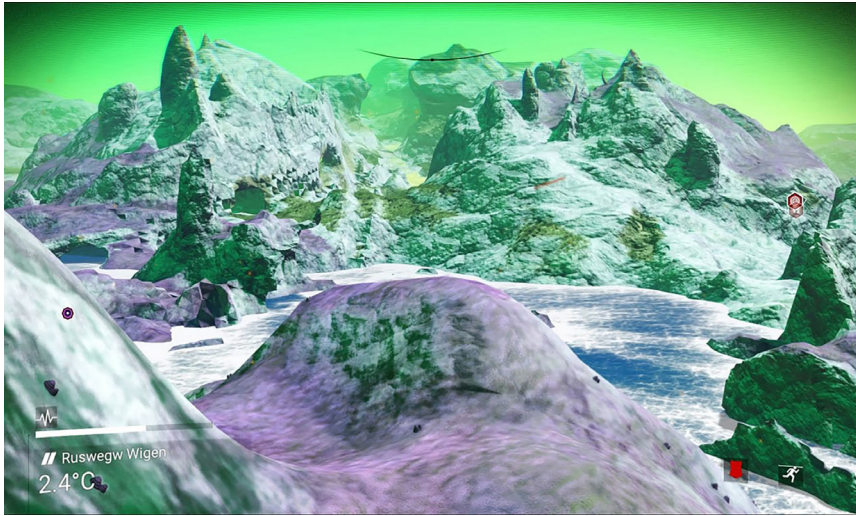
Because it's a simulation, there's so much you can do. You can break the speed of light—no problem. Speed is just a number. Gravity and its effects are just numbers. It's our universe, so we get to be Gods in a sense. . . . Something as simple as altering the color of a creature can cause the water level to rise.<sup>9</sup>

The game's deterministic pipeline operates through, as Murray says, “a unifying method of noise generation” or uber noise. The engine implements design choices based on relationships among varying octaves of digital noise. As one specific technique, the game's programmers use Perlin noise, a function developed by computer scientist Ken Perlin while working on special effects for the film *TRON* (1982). Perlin noise generates natural textures that simulate fire, billowing clouds, mountains, and plants through a coherent structure, meaning that values transition smoothly among two distinct points in space. The engine works with an array of billions of voxels and randomly creates a position for each voxel within the game's hypothetical universe. As Murray explains, the problem with the uber noise model is that a programmer cannot query adjacent voxels because this requires knowing the generated content of a given voxel and its arbitrary positioning in 3D space, resulting in a cascading, “intractable problem.”<sup>10</sup> The inability to determine a voxel's parameters before they are generated makes it difficult to alter terrains such as cave systems and rivers as well as creating erosion. This is because outputted noise layers must flow into each subsequent generator within the top-down hierarchy. To solve this problem, Murray and a small team of programmers at Hello Games calculated the analytical derivative of specific voxels, or rather, the measurement of change for their noise levels. Determining the rate by which noise fluctuates for an array of voxels helps predict the overall form of a planet's terrain and whether, for instance, altitude is trending upward or down toward sea level. In this way, noise can be manipulated to account for various ecosystems. A planet with rocky, mountainous terrain will have more noise for its crags and peaks, while a swamp planet will require less noise to produce flat wetlands and forests (Figure 5.3).

<sup>9</sup> Roc Morin, “Inside the Artificial Universe That Creates Itself,” *The Atlantic* (Atlantic Media Company, February 18, 2016), <https://www.theatlantic.com/technology/archive/2016/02/artificial-universe-no-mans-sky/463308/>.

<sup>10</sup> Sean Murray, “Building Worlds in No Man's Sky Using Math(s),” *YouTube* (Game Developers Conference, 2017), <https://www.youtube.com/watch?v=C9RyEiEzMiU&t=2s>.





**Figure 5.3** Mountainous terrain generated from noise fluctuations in *No Man's Sky* (Hello Games, 2016). Screenshot.

Cave systems are developed by determining the required amount of Perlin noise and subtracting it from the terrain surface. Furthermore, analytical derivatives are fed into layers upon layers of noise in other aspects of the simulated universe. As an example of this recursive generation, Murray illustrates a technique known as domain warping, or when noise layers are further distorted through other functions. This typically describes when noise is fed back into the same layer via different octaves to produce, for example, coastlines, tributaries, and basins using fractal arrangements that are often mirrored in natural ecologies.<sup>11</sup> Once noise parameters are calculated, McKendrick explains that the engine employs dual contouring to construct a polygon mesh for the density data of voxel regions. Here, a polygon grid is applied to voxels by calculating their surface vertices and joining those points to produce a mesh. For hilly and mountainous regions, a cube polygonizer renders landscapes, while a flat plane polygonizer is used to smooth out large bodies of water. A process known as triplanar texturing is then applied to the planet's terrain. Voxels include a blend value that determines the composition of their artist-produced textures (grass, rock, sand, water, snow, etc.). Textures are evenly distributed across the planetary sphere on three axes of distinct blend areas using a height map which alters a texture's visible sections

<sup>11</sup> Ibid.

to produce naturalistic forms of surface lighting. To capture a realistic sense of motion when entering or exiting a planet's atmosphere, lower and higher detailed textures are continually exchanged at two separate scales. As the player flies toward the planet's terrain, textures are scaled down and when leaving the atmosphere, textures are scaled up to assist with blending the sphere's multiple surfaces.<sup>12</sup>

After the engine configures the terrain, additional noise layers are used to place objects within the gameworld and generate its biodiversity, ranging from foliage to animal markings and territories. Duncan explains that the game's artists used a blueprint system with base templates for alien creatures, plants, spaceships, and buildings. Libraries of game assets are funneled into an algorithmic "container," which produces an arbitrary seed value. Working from base templates, the container generates variation for in-game objects. In alien life-forms, characteristics such as skin, territorial markings, fins, horns, and bone structure are randomly combined within the container to produce transgenic creatures.<sup>13</sup> The same process applies to plants and spaceships. Trees are created through variations in leaf structure and bark textures, while spaceships are formed through permutations of engines, wings, cockpits, fuel tanks, and noses. Because the game's noise layers are closely intertwined, procedurally generated flora and fauna are specific to a planet's ecosystems. Moreover, various postures, stances, and movements are generated for organisms depending on a planet's environments. Some of the game's larger interspecific animals possess a lumbering gait like that of a hippopotamus or rhino, while others that resemble a gazelle or deer have a distinct spring and liveliness to their step (Figure 5.4).

For instance, a desert planet will include flora with variations drawn from cacti and succulents as well as animals that have lizard, scorpion, and even horse-like features. In terms of the engine's AI, unique territorial paths are generated for creatures to navigate. Fauna are rendered and instructed to interact with the player only when their individual paths converge.<sup>14</sup> In perhaps the most staggering example of *No Man's Sky's* astronomical scale, Duncan explains that color palettes are produced for each of the game's 18 quintillion planets and require virtual drones to fly over their terrain. These drones record a short

<sup>12</sup> McKendrick, "Continuous World Generation in *No Man's Sky*."

<sup>13</sup> Duncan, "No Man's Sky: How I Learned to Love Procedural Art."

<sup>14</sup> See explanation of game object noise layers in McKendrick, "Continuous World Generation in *No Man's Sky*."





**Figure 5.4** Alien biodiversity in *No Man's Sky* (Hello Games, 2016). Screenshot.

GIF of the planet's color scheme which is then evaluated for quality control.<sup>15</sup> In the following section, I examine Hoefle's formal manipulations to *No Man's Sky*'s procedurally generated ecosystems and the counterhegemonic modes of play revealed in the spectator's embodied disorientations with an open world engine.

## Mirrorless Affect in *WE BUILD WORLDS*

Hoefle's art integrates video game mechanics, tropes, and cultural emblems into sculpture, installation, and needle crafts, often through subversive interventions into game culture and gendered spaces of play. Recently, her video game quilts, which embody Rauschenberg-esque collages of pixels, sprites, and fabric squares, were featured in the traveling exhibit *Open World: Video Games and Contemporary Art*, which opened at the Akron Art Museum in 2019, accompanied by works from Angela Washko, Cory Arcangel, Invader, Feng Mengbo, and Suzanne Treister, among others. Her recent work *American Dream: The Visa Lottery Game* (2020), ironically simulates the US Diversity Visa Lottery via a modified version of the NES game *American Dream* (1989) and a repurposed Japanese gashapon toy vending machine. The mod encourages participants to try their

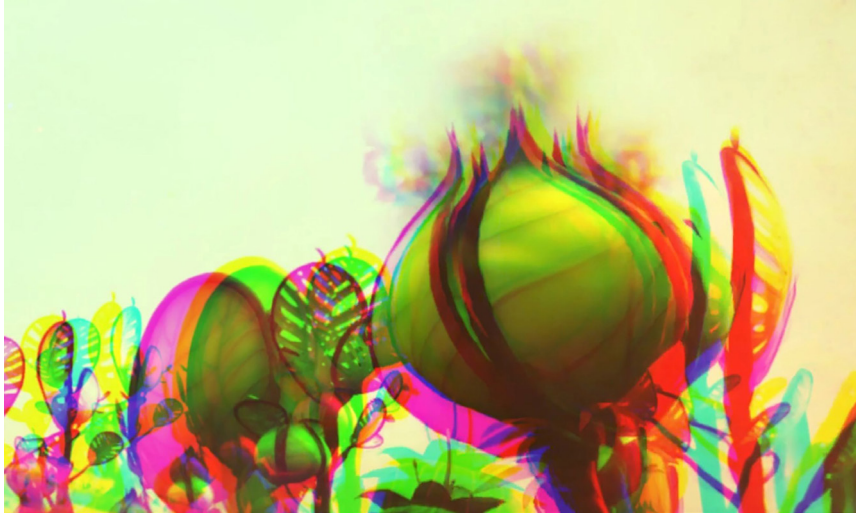
<sup>15</sup> Duncan, "No Man's Sky: How I Learned to Love Procedural Art."

hand at winning a virtual green card through chance. Plastic toy capsules are deployed from the machine containing small pins made from either mylar emergency blankets or, in the winning capsule, a swatch of a welcome mat. Players have a 1 in 285 chance of winning: a citation to 2017 Visa Lottery statistics in which 50,000 winners were chosen from 22 million applicants.<sup>16</sup> In an interview, Hoefle articulates the repetitive labor of video games in her aesthetic process; the iterative techniques of play that condition a body toward expertise. Before her work in *WE BUILD WORLDS*, Hoefle experimented with running performative “tests” in *World of Warcraft* (2004) using an in-game glitch to question the role of death as a mechanic. Navigating to a certain region of the map would kill her avatar repeatedly, eventually forming a pile of virtual bodies. As part of the collaborative *STRT/SLCT* with musician Eli Kahn, Hoefle designed the machinima sequences in *WE BUILD WORLDS* through a critical feminist lens, revealing the “unseeable architecture . . . the actual guts of the game” and the ritualistic modes of play that are continually reinscribed in gendered and exclusionary gaming cultures.<sup>17</sup> As I argue in this chapter, *STRT/SLCT*’s critique of standard game design in *WE BUILD WORLDS* operates through an embodied reflection of a game engine as a feminist-oriented media object: a thing that in an unfamiliar, glitched, and broken state elicits empathy for its *objectification* within broader human-thing relationships, and particularly, the historically marginalizing frameworks of gaming culture. The critical focus of *WE BUILD WORLDS* is not so much *No Man’s Sky* itself as it is the perceptual mechanisms the game mobilizes. Hoefle appropriates the game’s surreal ecosystems from a first-person perspective, while intentionally configuring an anonymous vision of *something* (human, animal, alien, engine) aimlessly moving (and slowly dying) within a toxic color field stripped of rewards, goals, and competition (Figure 5.5). These anonymous visions of procedurally generated worlds reflect the conventional play experiences and perceptual effects of first-person shooters.

As discussed in the book’s introduction, masculinist discourses of video games were reterritorialized from previous ideologies of hacker culture predicated on technical skill and literacy within a politics of exclusion. Gendered histories of computers have worked predominantly to naturalize identities such as “gamer,” “player,” and “developer” as heteronormative, white, and male. As a popular commercial genre, first-person shooters and the engine technologies that generate

<sup>16</sup> Krista Hoefle, “American Dream: The Visa Lottery Game,” February 17, 2020, <http://www.kristahoele.com/blog/2020/2/17/american-dream-the-visa-lottery-game>.

<sup>17</sup> Krista Hoefle (artist) in discussion with the author, May 2020.



**Figure 5.5** STRT/SLCT, *WE BUILD WORLDS*, 2018–19. Screenshot. An anonymous perspective trekking through alien landscapes.

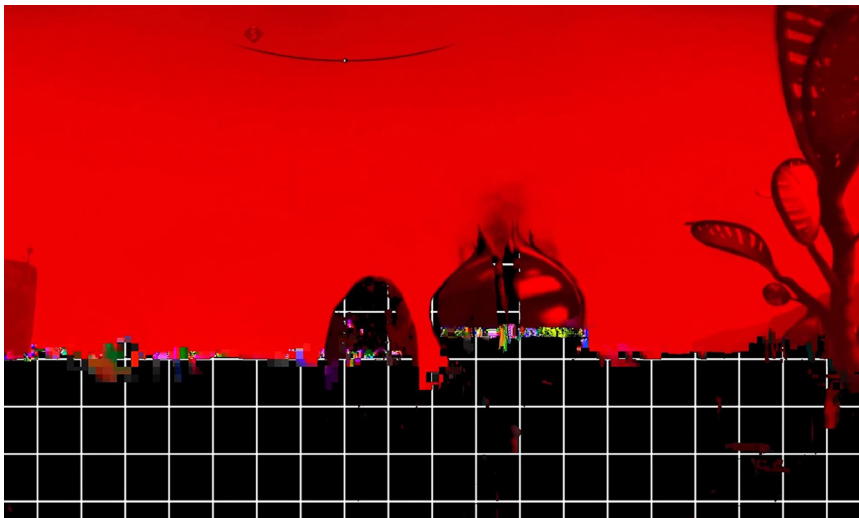
actionable 3D spaces are embedded within male-dominated video game culture. In their commodified applications, the popular engines discussed throughout this book are not without critique. Forms of racism, homophobia, and sexism have persisted on deathmatch servers and in “hardcore” modding communities. As Brendan Keogh argues, oppressive systems at the center of video game culture work to conceal “a plethora of other audiences and values that persist in marginal videogame cultures but that are delegitimized by a dominant and commodified discourse.” Keogh rethinks situated and embodied play experiences not through a hacker ethos undergirded by mastery and expertise but in terms of the cyborg within theories of feminist technoscience. Specifically, he draws from Donna Haraway’s understanding of the cyborg as a feminist construct that interrogates dominant technical epistemologies. As Haraway explains, “we can learn from our fusions with animals and machines how not to be Man, the embodiment of Western logos.”<sup>18</sup> For Keogh, the player as cyborg marks a turn toward hybridity and the nuanced assemblages of flesh and machine, foregrounding embodied

<sup>18</sup> Haraway qtd. in Keogh, *A Play of Bodies: How We Perceive Videogames*, 181. See Donna Haraway, “A Cyborg Manifesto: Science, Technology, and Socialist Feminism in the 1980s,” in *Simians, Cyborgs, and Women: The Reinvention of Nature* (New York, NY: Routledge, 1991), 173.

play that disrupts authoritative gaming identities who seek to develop technical superiority over a system.<sup>19</sup>

As I hope to demonstrate through STRT/SLCT's *WE BUILD WORLDS* and specifically Hoefle's machinima, art modding interventions embrace a similar kind of heterogeneity through the body's strange entanglements with disrupted game systems. By defamiliarizing *No Man's Sky* into psychedelic abstractions, Hoefle reveals the game engine as a nonhuman entity, a technical instrument employed by its human developers to render artificially constructed gameworlds and concretize dominant expressions of play. Through the machinima's grids that bleed in and out of the game's ruined terrains, we bear witness to an *engine-thing* carrying out its native operations through a critical, embodied spectatorship (Figure 5.6).

Like Arcangel's *Super Mario Bros.* mods, Hoefle's machinima projects a machinic agency that eerily discloses itself to the world. The artist uses *No Man's Sky* to generate variation among machinima sequences. That is, each time Hoefle has played the game and captured her avatar's perspective trekking through alien landscapes, it portrays a unique time slice of the engine's procedural top-down generation: a forensic view of different gamestates produced from random noise seeds. Hoefle explains that she recorded in-game footage via Elgato capture



**Figure 5.6** STRT/SLCT, *WE BUILD WORLDS*, 2018–19. Screenshot. A grid bleeding into psychedelic abstractions of *No Man's Sky*'s gameworld.

<sup>19</sup> Keogh, *A Play of Bodies: How We Perceive Videogames*, 181, 182.

hardware and then corrupted video files using the glitch tool *byebyte* created by artist Way Spurr-Chen. *Byebyte* destroys or exchanges a file's bytes with arbitrary values to create datamoshing effects, or when compressed I and P frames are cut or replaced to distort video playback and transitions, resulting in sequences of frames that appear to trail and smear across the screen. Additionally, Hoefle generated the artificial grid that dissolves in and out of the game's corrupted ecosystems using *After Effects* and keying out areas of video to reveal the grid layer below.<sup>20</sup> Although, Hoefle's technical approaches in *WE BUILD WORLDS* differ from other game art interventions in that she does not directly alter the engine's code, I do argue that her work engages art modding histories in the way she appropriates the algorithmic procedures of a commercial engine to deconstruct representational video game forms and modes of play. Modding and machinima have always been historically intertwined and mutually informing: early engines were modified to capture player achievements and narratives outside the game's diegesis. Machinima often operate as a modification of a game's formal materiality and take advantage of an engine's rendering and physics to produce aesthetic experience beyond the contours of expected gameplay. Like other art mods, Hoefle's machinima techniques elicit a critical disembodiment or distancing that reflects upon the inherent biases of game culture.

STRT/SLCT's *WE BUILD WORLDS* deploys a feminist materialist critique through the installation's spatial assemblage of both screens and sculptural objects. The machinima's disorienting motion and the installation's portal window, alien plants, paper craft gems, and soft spaceship work to disrupt the player's typical identification with a video game text. Adrienne Shaw argues that in game studies, a presumed relationship exists among interactivity and the player's identification with characters and avatars. This often underemphasizes the nuanced social and embodied play contexts that construct player-game identification. Forms of social and ludic interactivity assist the player in identifying as themselves, when narrative elements, much like in film or television, promote identification with game characters.<sup>21</sup> Shaw illustrates that processes of identifying *as* and *with* an avatar become indistinct through interactivity. Gameplay is often too self-reflexive for a player to empathize with a character and critical distancing is needed from the game's evident artificiality for identification to occur.<sup>22</sup> To Shaw,

<sup>20</sup> Krista Hoefle (artist) in discussion with the author, May 2020.

<sup>21</sup> Adrienne Shaw, *Gaming at the Edge: Sexuality and Gender at the Margins of Gamer Culture* (Minneapolis, MN: University of Minnesota Press, 2014), 98.

<sup>22</sup> *Ibid.*, 126, 141.

if players are indifferent to the gendered forms of Lara Croft in *Tomb Raider* or *God of War*'s Kratos that reflect their on-screen actions, then games should diversify identities, focusing critical attention toward "modes of being in the world."<sup>23</sup> If identification with on-screen representation occurs with interactivity yet through a distancing from the self-reflexivity of gameplay as Shaw describes, then Hoefle's machinima elicits an embodied *disembodiment*, unsettling the player's normative identification with an avatar's first-person view.

A player usually empathizes with the representational aspects of an avatar's line of sight and perceptual operations of *No Man Sky*'s intergalactic explorer moving through procedurally generated space. Instead, the slow plod through Hoefle's decaying alien worlds arouses a kind of nonrepresentational empathy with a technical thing. The distance among presumed player and the machinima's disembodied view is extended to a breaking point through which standard embodied protocols of a first-person shooter dissolve into aimless kaleidoscopic sensations. By appropriating the illusory motion of controlling an avatar in 3D space as well as removing the life support system and planetary data from the interface, Hoefle strips *No Man's Sky* of its ludic interactivity, in turn, projecting the human-programmed activities of a nonhuman object of exploitation. Through glitch, *WE BUILD WORLDS* denaturalizes the engine's utility, engendering a mimetic relation among spectators, machinima, and installation, or what I refer to as mirrorless affect (Figure 5.7).

Within histories of contemporary art, Cristina Albu employs the concept of mirror affect to describe the range of affective reciprocations among spectators and video projections, sensor-based interactive works, and other reflective installations. Mirrored affects take shape in the way participants vicariously experience these kinesthetic reflections with the colocation of others, allowing bodies to "see themselves seeing and acting as part of diffuse collectivities."<sup>24</sup> Albu illustrates that embodied forms of mirroring produce an encounter with one's self-image through dynamic, interconnected happenings, "which momentarily seems to collapse the distance between individuals without necessarily abolishing interpersonal tension."<sup>25</sup> Playing with Albu's concept, I argue that *mirrorless* affect describes mimetic contingencies between spectator and contemporary works of machinima and video art that superficially imply a mirrored experience yet results in bodily dissociation by failing to echo certain

<sup>23</sup> Ibid., 143, 144.

<sup>24</sup> Albu, *Mirror Affect: Seeing Self, Observing Others in Contemporary Art*, 7, 17.

<sup>25</sup> Ibid., 16, 23.





**Figure 5.7** STRT/SLCT, *WE BUILD WORLDS*, 2018–19. Screenshot. Hoefle’s datamoshing techniques and the production of mirrorless affects.

physical, tactile, and perceptual responses. We might consider mirrorless affect as an embodied dynamic of the nonplay experiences discussed earlier in Arcangel’s work. Mirrorless installations like *WE BUILD WORLDS* suggest a normal space of play, yet fall short of reflecting the player’s interactivity with a system. Instead, Hoefle’s machinima and Kahn’s accompanying soundscapes take up the viewer in a mutually constitutive experience with a nonhuman entity through pure audiovisual sensation. Hoefle produces this disembodied aesthetic through an unspecified viewpoint, eliminating any in-game statuses as well as flora and fauna classifications, projecting a screen space that entangles viewer perception with the engine’s perspective of the gameworld. In the next section, I suggest this uncanny interfacing with *No Man’s Sky*’s deteriorating planets produces a critical and participatory spectatorship that evokes contemplation of a game engine as a feminist-oriented object, working to queer standard gameplay toward heterogeneous and embodied modes of difference with our neighbors.

## Feminist Traditions in Performance and Media Art

In considering a disrupted game engine as a feminist-oriented object, it is important to trace feminist critiques within genealogies of performance and



video art to contemporary works of game-based art. Roberto Simanowski proposes that interactive media installations generate a “physical dialogue” between self, system, and other participants, offering a unique grammar of interaction to explore one’s own affective bodily feedback. Simanowski points out that interactive art progresses from traditions of performance and body art in the 1960s and 1970s, particularly interventions from women artists expressed through acts of masochism, ritual, self-transgression, and violations of social taboos.<sup>26</sup> Here, the body is implicated as a form of signification that, in feminist critiques, reveals the woman’s body as both a commodity and an object of male desire and control within patriarchal systems. For instance, in her ritual performance *Rhythm 0* (1974), Marina Abramović invited audience members to interact with her still-standing body, allowing the public to do as they please, choosing from an array of seventy-two items intended to encroach upon her physical presence: a feather, grapes, a rose, scissors, nails, chains, a pen, and a loaded gun. Over a six-hour period, individuals removed Abramović’s clothes, cut her body, and wrote upon her flesh. The performance was stopped when several participants became too violent. If in Abramović’s *Rhythm 0*, the female body serves as the object of feminist critique through ritual, consensual harm, and public transgression, then interactive works rearticulate questions of subjectivity toward the body’s imbrication with a system. The latter aligns more with Haraway’s feminist technoscience and the posthuman conception of a cybernetic being: the commingling of flesh and computer that serve to rethink inherent dualisms governing Western society.<sup>27</sup>

However, in their time-based configuration, Hoeffle’s machinima do not project the standard interactivity of video games through which such feminist critiques may be enabled. Rather, through its mirrorless projections, *WE BUILD WORLDS* aligns more closely with feminist aesthetics of media installation art from the 1960s and 1970s that prefigure Haraway’s concept of the cyborg. As an example, Austrian artist VALIE EXPORT experimented with the materiality of mass media to challenge cinema’s ideological grammar and organization of a passive viewing subject as well as the objectification of women on screen through the dominant male gaze. In her infamous expanded cinema performance *Tapp und Tastkino* (*Tap and Touch Cinema*) (1968), EXPORT wore a Styrofoam box over her torso with a hole in its front covered by a small curtain. She then

<sup>26</sup> Roberto Simanowski, *Digital Art and Meaning: Reading Kinetic Poetry, Text Machines, Mapping Art, and Interactive Installations* (Minneapolis, MN: University of Minnesota Press, 2011) 120, 121, 134.

<sup>27</sup> Haraway, “A Cyborg Manifesto: Science, Technology, and Socialist Feminism in the 1980s,” 177.

walked the streets of Vienna and invited individuals to touch her nude breasts by reaching through the curtained opening. Through irony and wit, EXPORT'S explicit sexual freedom works to counter cinema's inherent voyeurism of the female body through direct and confrontational tactile sensation.

If performance art sought to conceptualize the body as both concept and material object of the work, then media art of the period worked to catechize the body's relationship with film and screen apparatuses that have historically disciplined perceptual engagement. In her analysis of media art installations, Kate Mondloch examines the phenomenal relation between viewing subjects and the presence of screen-based video and interactive works, which she argues, unfolds through an "architecture of spectatorship." This illustrates the varied experiences of spectatorial bodies and the way artists have employed screen-based apparatuses to influence aesthetic encounters with media forms.<sup>28</sup> Mondloch examines EXPORT's work *Ping Pong* (1968), a film installation inviting the viewer to play ping pong against a series of projected images. The work is comprised of a ping pong ball, paddle, and half of a ping pong table placed against a white wall in a darkened room. An 8-mm film is projected onto the back wall, displaying rhythms of black dots that continually materialize and disappear. More so, the projector is placed at the back of the gallery, casting the viewer's shadow upon the screen space. The experience of EXPORT's *Ping Pong* is realized when participants target the moving dots and volley against the projector. As with other screen-based works of the era, Mondloch suggests that unlike traditional cinema's construction of a passive spectator, *Ping Pong* calls attention to the participant's embodied relation to the screen space. EXPORT's projected dots situate the materiality of the screen—the flatness of the wall—as a playing *subject* that mobilizes the participant's embodied involvement. That said, each time the participant volleys a rebounding ball, it elicits an apperceptive attentiveness to the screen as a technical object.<sup>29</sup> By laying bare the illusory nature of the screen's surface, EXPORT's *Ping Pong* discloses narrative cinema's ideological insistence on controlling the spectator's attention and the ways they are voyeuristically drawn to subjects on screen.

Like *Ping Pong*, I argue that through its mirrorless affects, *WE BUILD WORLDS* attunes the participant to a feminist-oriented game engine through a destabilizing of *No Man's Sky*'s flow. EXPORT situates the screen as an

<sup>28</sup> Kate Mondloch, *Screens: Viewing Media Installation Art* (Minneapolis, MN: University of Minnesota Press, 2010), 23.

<sup>29</sup> *Ibid.*, 64–5, 67.

opposing *subject*, a technical entity that plays against the participant, unveiling patriarchal and capitalist frameworks that territorialize conventional modes of spectatorship. Similarly, *WE BUILD WORLDS* works to destabilize the flow of a commercial game, serving as a feminist metaphor for the ways an engine disciplines the player toward competition, reward, and technical virtuosity. Just as *EXPORT* calls our attention to the screen's materiality, *WE BUILD WORLDS* elicits an apperceptive spectatorship that defamiliarizes the game engine as a technical object whose functions are a coextension of player input. As Hoefle describes:

I wanted the environment in the machinima . . . [to] always win and the anonymous player would die, but that player would never do the things they were supposed to do in the game to ensure your survival. They were literally just waking up, walking around in this hallucinogenic space and then dying . . . I didn't even really want you to necessarily think that that player was a human.<sup>30</sup>

The artist deconstructs optimal flow by aligning the spectator's vision with a nonhuman gaze, portraying an engine that sporadically disintegrates, at once revealing its algorithmic fabrication while rendering the disembodied view of *something* that fails to play *No Man's Sky* based on developer intentions. The engine's perspective challenges ingrained play experiences of fun, pleasure, and reward systems. It does not mine and collect natural resources, look for rare items, or care to complete in-game objectives. Instead, it slowly walks through a psychedelic landscape taking in its environment and ignoring its increasing toxicity and radiation levels (Figure 5.8).

The anonymous view eventually terminates itself by falling off a cliff, only to spawn again when the machinima re-loops. These cycles of nonconformitive play upend standard reiterations of video game death and revival through which a player gains expertise and continues to invest their affective labor into capitalist regimes. As I demonstrate in the following section, mirrorless affect in *WE BUILD WORLDS* engenders an apperceptive contemplation of a game engine as a feminist-oriented object: one whose objectification by its human neighbors is materially agential within broader arrangements of knowledge production. Through a critical feminist perspective, *WE BUILD WORLDS* demonstrates a proprioceptive *disorientation* away from conventional gameplay toward radical and meaningfully embodied ways of being present with others.

<sup>30</sup> Krista Hoefle (artist) in discussion with the author, May 2020.



**Figure 5.8** STRT/SLCT, *WE BUILD WORLDS*, 2018–19. Screenshot. The slow death of an anonymous viewpoint.

## The Strange Life of a Feminist-oriented Engine

Returning to Behar’s object-oriented feminism, I consider how *WE BUILD WORLDS* evokes a strange empathy for a game engine whose agency and perception is dispersed within a constellation of human and material entities. Behar observes that an ethics of care for an inanimate object such as a game engine “imparts political urgency to the ideas that humans and nonhuman objects are of a kind, and that the nonsubjective quality of being an object is grittily, physically realist.”<sup>31</sup> Within contemporary technoculture, to experience a feminist “nonsubjective” empathy for a game engine means to recognize a technical object’s agency in the material configurations of very *real* systems of oppression. This understanding of a thing’s agency is taken up by Karen Barad in her own theory of feminist technoscience, particularly through what she calls agential realism. For Barad, material processes that shape how we come to know the world manifest through “*the ontological inseparability of agentially intra-acting ‘components’*” (emphasis in original). Discursive frameworks that govern human actors, technical objects, and their unique perceptions become known

<sup>31</sup> Behar, “An Introduction to OOF,” 8.

through a dynamic and phenomenally present relationality, that is, their agential “intra-acting” with each other.<sup>32</sup>

In her discussion of Behar’s own exhibition *E-Waste* (2014–15), Irina Aristarkhova postulates what it would mean to empathize with and care for a technical artifact from the “inside-out” through its relations with humans. Premiering at the Tuska Center for Contemporary Art in Lexington, Kentucky, *E-Waste* features an assemblage of USB devices encapsulated in stone resembling strange prehistoric fossils. Stretched across the gallery floor, Behar places these alien USB drives in a tangled community of wires, small whirring fans, and blinking LEDs. Working within ecofeminist traditions, Behar invites reflection on a speculative future of USB devices left to transfer and store data in a world extinct of humans.<sup>33</sup> Aristarkhova meditates on the agential realities, environmental effects, and machinic labor of *E-Waste*’s USB colony in which such devices are left to “fend for themselves” yet are communal and “act individually.” The USB creatures require a human-made power supply and continue their execution of computational tasks as an effect of their creators, even though such operations are rendered useless in a world without humans. Aristarkhova illustrates that as feminist-oriented objects, Behar’s USB organisms elicit sympathy for their digital existence, as well as a sense of familiarity and strangeness in which “We are left contemplating (with) them.”<sup>34</sup>

Like Behar’s *E-Waste*, *WE BUILD WORLDS* draws forth an apperceptive spectatorship of a game engine as a feminist-oriented object whose agency is always embedded within the material fabric of human actors. That is, to speculate on an engine’s ontological distinctions is to empathize with the nuanced ways its nonhuman functions—visible surface determination, lightmapping, procedural generation—are mobilized within the broader flows of late capitalism. Observing and “contemplating (with)” Hoefle’s machinima and its nonsubjective vision of hallucinatory alien worlds is to understand a game engine as software that executes the design goals and inherent biases of its developers. As an engine interprets thousands of lines of human-written code, it procedurally organizes hegemonic forms of play and channels player desire toward commodifiable experiences. Under the guise of capitalism, the engine obeys. Whether it is

<sup>32</sup> Karen Barad, “Posthumanist Performativity: Toward an Understanding of How Matter Comes to Matter,” *Signs* 28, no. 3 (2003): 815.

<sup>33</sup> For exhibition description, see Katherine Behar, “Katherine Behar: E-Waste (Exhibition),” accessed June 22, 2020, <http://www.katherinebehar.com/art/e-waste-installation/index.html>.

<sup>34</sup> Irina Aristarkhova, “A Feminist Object,” in *Object-Oriented Feminism*, ed. Katherine Behar (Minneapolis, MN: University of Minnesota Press, 2016), 53–4.

aware of guilt (can an engine show remorse?) in its entanglements with players, an engine is often *objectified* by human agents to proliferate racist, sexist, and heteronormative discourses within the gaming industry. If an engine is conceptualized as a feminist object through its relationality with human actants, then processes of game design are always contextual within its broader material involvements. In her landmark study of novice student game designers and their experiences with engines like *RPG Maker* and *Stencyl*, Sarah Evans articulates that design biases ingrained within software code serve as material agents in and of themselves. They not only influence what games are produced but also concretize the political ideologies that underlie design processes.<sup>35</sup> But expressing a sense of care for a game engine is to also understand its inherent potential to deconstruct oppressive institutions and dominant video game play through radical design. Like Behar's USB devices that continue their data transfer in a posthuman existence, an engine can run when no player is around. It possesses the capacity to randomly generate a player-less gameworld or instruct bots on efficient pathfinding throughout a map. More so, engines are unpredictable, possessing a hidden agency below familiar interfaces that crash, freeze, and glitch faithfully rendered gamespaces, interrupting the developer's intended flow. Most important to this book, in its interfacing with human users, an engine *willingly enacts modifications made to its architecture*.

One example of a feminist orientation toward a game engine is Brent Watanabe's art mod *San Andreas Streaming Deer Cam* (2015–16). Here, the artist programs a deer to autonomously explore the bustling 49 square miles of San Andreas in *Grand Theft Auto V*. The mod was configured as a series of faux wildlife cams in a multichannel installation at the 2016 Neon Digital Arts Festival in Dundee, Scotland, and streamed live at [sanandreasanimalcams.com](http://sanandreasanimalcams.com) and on Twitch, with over 200,000 viewers joining in to watch the deer endlessly survey the game's boundaries. Using the RAGE (Rockstar Advanced Game Engine), Watanabe programmed the deer's actions based upon the game's pedestrian AI to generate its unpredictable behaviors. The deer not only is invincible but is periodically transported to different locations in San Andreas. Through its interactions with other artificial intelligence, the majestic creature often finds itself in a chaotic unfolding of events, a butterfly effect cascade of destruction. In one moment, the deer is the victim of a police manhunt, while in others, it

<sup>35</sup> Sarah Evans, "Disruption by Design: Feminist Interventions in Digital Game Production on a University Campus" (dissertation, 2018), 76–7.





**Figure 5.9** Brent Watanabe, *San Andreas Streaming Deer Cam*, 2015–16. Screenshot. Gang members shooting at an autonomous deer.

clumsily breaks into a high-security military base or causes a violent multicar pileup on the freeway. In one of its most compelling enactments, the animal mistakenly crashes into a group of racially stereotyped gang members, causing them to shoot at the defenseless creature (Figure 5.9).

Through a rouge deer, Watanabe portrays a commercial game engine exposing the racial biases embedded in its code. Speaking to these concerns, Kishonna Gray argues that black identity in commercial games often “reinforces and reinscribes the primacy and supremacy of whiteness,” unveiling racially oppressive frameworks.<sup>36</sup> Similar to *WE BUILD WORLDS*, Watanabe’s mod brilliantly illustrates hegemonic flows of power through an engine *existing on its own terms*, outside of human utility yet a consequence of human labor, productivity, and consumption.

## Queer Disorientations

The participant’s mutual contemplation *with* a game engine in *WE BUILD WORLDS* unfolds among the spatial dynamics of the installation itself.

<sup>36</sup> Kishonna Gray, “Power in the Visual: Examining Narratives of Controlling Black Bodies in Contemporary Gaming,” *The Velvet Light Trap* 81 (2018): 63.



Through the mimetic reception of a gamespace gone awry, the machinima engages a proprioceptive disorientation away from standard video game logics of action and movement. In her book *Queer Phenomenology*, Sarah Ahmed brings Maurice Merleau-Ponty's work into conversation with queer studies, examining "orientation" as the processes through which bodies are constructed in their proximities to objects, spaces, and temporalities. As an approach to understanding the nuanced spatiality of gender, sexuality, and race, a queer phenomenology articulates how identity is shaped through objects that are within our bodily distance yet are *deviant* and run counter to hegemonic norms.<sup>37</sup> Ahmed further emphasizes the idea of disorientation as spaces and objects that fail to align with bodies and their phenomenal extensions within the world. Ahmed says, "At this moment of failure, such objects 'point' somewhere else or they make what is 'here' become strange."<sup>38</sup> As an example, queer bodies that do not orient toward social structures of heteronormativity, people of color who find themselves uncalibrated with white spaces, or immigrants starting anew in another country experience an embodied sense of falling out of place in the world. Yet, Ahmed argues that being present in those failed spaces can sometimes result in novel reorientations toward what is normative, providing a wellspring of radical potential, "of vitality as well as giddiness."<sup>39</sup>

I consider the spatial experiences of *WE BUILD WORLDS* through Ahmed's queer disorientations, especially in how it upends standard video game proprioception and modes of play. Through the mirrorless affects of the projected machinima and playful staging of physical space, *WE BUILD WORLDS* mobilizes radical difference and new orientations to the world through the way bodies are made meaningful in their material entwinements with technologies. Collaborating on the installation's arrangement, Hoefle and Kahn configured its spaces, in part, to resemble the architecture of an MMOG (massively multiplayer online game). In summer of 2018, the installation was exhibited in the EndCap space at the Vested Interest building in South Bend, Indiana, and featured wayfinding, as Hoefle mentions, to guide participants through the work. Spectators enter through a corridor, much like a queue before entering a MMOG, with outlines of pink neon bricks that glow from overhead blacklights. Illuminated paper craft gems with screen printed patterns designed by Hoefle

<sup>37</sup> Sara Ahmed, *Queer Phenomenology: Orientations, Objects, Others* (Durham, NC: Duke University Press, 2006), 2–3.

<sup>38</sup> *Ibid.*, 160.

<sup>39</sup> *Ibid.*, 4.

hang from the ceiling, providing an analog to the tedious resource mining in *No Man's Sky* and serving as an inaccessible and useless reward system.<sup>40</sup> In March of 2019 at the Treefort Art Gallery in Boise, Idaho, *WE BUILD WORLDS* featured a similar neon illuminated queue area with a small convex porthole window that, like the view from a spaceship, allowed viewers to peer into the installation space and preview the machinima's alien planets. Along its walls, participants were greeted by messages announcing that "You've crashed on an alien planet" and "You are on a spaceship traveling between galaxies." In both instantiations, queue areas guided participants into a central viewing room. In the EndCap, machinima sequences were displayed along the length of the far wall in a large industrial space with sections of the structural grid projected onto the floors and walls. Pixelated color fragments dance across the expanse of moving grids. Located across the room from the dizzying projections, the artists placed a series of *physical* voxels: large boxes with iridescent neon edges. The same paper craft gems featured in the queue continue into the viewing room, lit by blacklight and the projected grid's shifting forms (Figure 5.10).



**Figure 5.10** STRT/SLCT, *WE BUILD WORLDS*, 2018–19. Installation view, The EndCap, Vested Interest building, 2018, South Bend, IN. Courtesy of STRT/SLCT.

<sup>40</sup> Krista Hoefle (artist) in discussion with the author, May 2020.

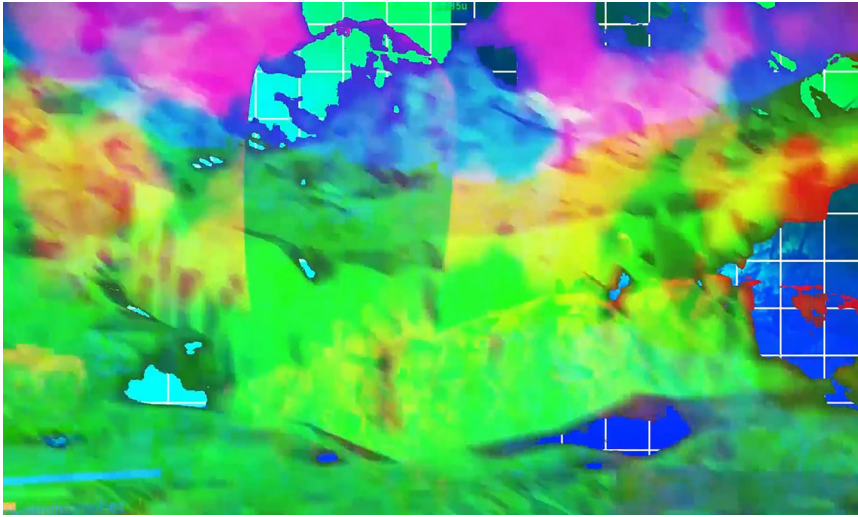
In the Treefort Art Gallery, the queue opens to a different viewing space that reflects a continuation of the machinima's fabricated grid onto the walls through a matrix of neon lines. The physical voxel cubes are replaced with alien plants and tentacles attached to the walls and dangling from the ceiling, as well as a vinyl soft sculpture of a "crashed" spacecraft. Similarly, the machinima and accompanying grids are projected on the wall and floors (Figure 5.11).

The installation's central viewing room(s) work to queer standard video game experiences by operating as a physical site of play coextensive with the disorienting effects of the machinima. Hoefle states that the machinima and grids moved through a slow crawl that was synced with Kahn's soundtrack (Figure 5.12). In this "literally dizzying" experience, participants often felt "like they were falling forward or had to steady themselves."<sup>41</sup> Among on-screen reminders of diminishing thermal projection, toxic damage, and failing life support, the machinima's alien perspective violently shakes and pans, revealing an occasional tentacle or alien quadruped that runs through the frame. With each erratic pan or shake, a residual trail of frames is dispersed across fields of color, composing the anonymous view's slow death and eventual suicide.



**Figure 5.11** STRT/SLCT, *WE BUILD WORLDS*, 2018–19. Installation view, Treefort Art Gallery, Treefort Music Festival, 2019, Boise, ID. Courtesy of STRT/SLCT.

<sup>41</sup> Ibid.



**Figure 5.12** STRT/SLCT, *WE BUILD WORLDS*, 2018–19. Screenshot. The slow crawl through Hoefle's disorienting machinima.

This imbrication of physical and illusory screen space reorients the spectator toward affective, material, and social exchanges of bodies through forms of proprioceptive disidentification and within the playful context of exploring an alien world. The critical spectatorship enacted by the machinima informs heterogeneous possibilities for interpersonal engagement and play; that is, the potential unfolding of active and embodied difference among neighbors. In this sense, the procedurally generated worlds in the *No Man's Sky* engine correspond to the possible interactions within the installation: *WE BUILD WORLDS* functions as a generative engine in itself. In her analysis of feminist materialisms in contemporary new media art, Mondloch discusses how multisensorial installations highlight a critical proximity: modes of viewing that at once disengage the spectator and draw perception to the inconspicuous details of technoculture, “but always from an insistently located position of intimate and embedded nearness.”<sup>42</sup> As an example, Mondloch looks to Swiss artist Pipilotti Rist's immersive video installation *Pour Your Body Out (7354 Cubic Meters)* exhibited at MoMA throughout 2008–9. Working to reveal bodily entanglements among participants, Rist's installation features three 25-foot-high video channels shown on the walls of the museum's second floor atrium.

<sup>42</sup> Kate Mondloch, *A Capsule Aesthetic: Feminist Materialisms in New Media Art* (Minneapolis, MN: University of Minnesota Press, 2018), 62.



Projectors in the form of breasts display a strange flux of animals, nature, and feminine elements, providing sensual attraction and the grotesque: a writhing nude Eve, pigs devouring fruit, wriggling worms, fields of flowers, dripping blood, the bottom of feet, and wrinkled skin. Among the videos, carpeted floors and a large circular couch invite participants to comfortably meditate among the surreal flow of images (Figure 5.13). As Mondloch observes, through its critical proximity, Rist's installation foregrounds the vibrant material activity between people and technical objects, positioning "subjectivity as enmeshed within the very stuff of the world."<sup>43</sup> In these emergent interactions, participants expressed a kind of calm productive *aimlessness*, shoes removed, lounging on the installation's cushioned furniture, laying on the floor, or in some instances, doing yoga together.

Although not exhibited within the sensationalized spaces of the contemporary art museum, *WE BUILD WORLDS* operates through a participatory aesthetic like Rist's work, one that encourages bodily *reorientations* toward normative gameplay via a self-reflexive engagement with game engines. Hoefle describes



**Figure 5.13** Pipilotti Rist, *Pour Your Body Out (7354 Cubic Meters)*, 2008. Installation view, Museum of Modern Art, New York. © Pipilotti Rist; Courtesy of the artist, Luhring Augustine, New York, and Hauser & Wirth and The Museum of Modern Art/Licensed by SCALA / Art Resource, NY.

<sup>43</sup> Ibid., 63.

that children and teens would often make “sandbox” games out of the installation spaces. At the Treefort Gallery, the artists handed out small holographic stickers of rocket ships: an alternate reward system of gift giving and a tangible expression of the installation’s multisensory engagement. While in the EndCap, pins with textured patterns were offered as a small reward. Children placed the pins on the installation’s floor to create hopscotch-like games and then ran and jumped to different points of the grid.<sup>44</sup> These same whimsical mimetic behaviors were reflected in the Treefort Art Gallery when children curiously walked upon flickering grid patterns or reached out to *feel* the slow crawl of the machinima (Figure 5.14). At times, both children and adults would climb and play upon the soft rocket ship or use it as a comfortable seat to examine the bizarre unfolding of landscapes (Figure 5.15).

More so, other generative happenings occurred during the exhibition of *WE BUILD WORLDS* at the Treefort Music Festival in March 2019. Amid the installation’s otherworldly images, the Los Angeles-based contemporary dance artists WHYTEBERG (consisting of Gracie Whyte and Laura Berg) choreographed a hypnotic interpretation of the work’s physical and screen-based



**Figure 5.14** STRT/SLCT, *WE BUILD WORLDS*, 2018–19. Installation view, Treefort Art Gallery, Treefort Music Festival, 2019, Boise, ID. Courtesy of STRT/SLCT.

<sup>44</sup> Krista Hoeffle (artist) in discussion with the author, May 2020.



**Figure 5.15** STRT/SLCT, *WE BUILD WORLDS*, 2018–19. Installation view, Treefort Art Gallery, Treefort Music Festival, 2019, Boise, ID. Courtesy of STRT/SLCT.

spaces, at times moving like robotic windup toys or gyrating in the darkness through mesmerizing bodily rhythms. In another instance, Kahn performed live electronic music in accompaniment with the machinima projections.

The possibilities for interaction in *WE BUILD WORLDS* underlie how the nonhuman technics of a game engine are always intertwined in the active work of matter. In the processes of subverting our cognition of video games, STRT/SLCT draws awareness to the game engine as an object that, when taken up in novel aesthetic contexts, can reorient the typical disciplining of bodies in conventional gameplay toward dynamic and meaningfully embodied encounters: a kind of *productive unproductivity* with those nearby. In the spectatorship that *WE BUILD WORLDS* elicits, our strange empathy with an engine's ontological worldview demonstrates that players are socially and culturally organized in their material interfacing with software, controllers, screens, and avatars. In its psychedelic disorientation, *WE BUILD WORLDS* shows bodies in productive variation and reconstitution through deconstructive uses of a game engine that counter technical command and mastery over video games. As STRT/SLCT pronounce through the emergent spaces of their work, *we* define the contours of our active embodiment, carving out our own territories of play.



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## Intractable Spaces

As I have hoped to illustrate in this book, the role of modding practices within histories of video games and digital media is mutually intertwined with an understanding of game engine materialities. The artists examined in these chapters engaged with popular gaming technologies and strategies of the avant-garde within heterogeneous sites of experimentation. By altering the spaces of commercial engines into fields of abstraction, they questioned common regimes of gameplay and organized lively and situated forms of embodiment with gaming technologies. By focusing on this singular period in video game history, my aim has been to highlight the broader significance of modding as a cultural and technical practice. Histories of modding reveal a technical history of rendering space in computer graphics. By breaking open the computational black box of game engines and reconfiguring new types of gamespaces, artists disclosed the technical illusions through which those spaces are developed by the gaming industry as immersive and palpable as well as competitively oriented. Furthermore, experimentations with game engines introduced new forms of digital media production. That is to say, artists, gamers, and casual programmers held a particular desire to playfully engage with engines and explore their potential beyond programmed industry operations.

Modding and its contingencies within current media landscapes, by nature, produce *intractable* spaces. I use “intractable” to describe the technical disordering of space as difficult for the player to control or comprehend, a space that is uncooperative, awkward, and unruly. At the same time, I also evoke the term to indicate the lively materiality of the mod, its ontological complexity and uniqueness as a nonhuman thing. Glitch sequences, surreal bricolages of game assets, and deconstructed AI systems engender phenomenal instances

of interobjectivity that surpass our codified understanding of video games.<sup>1</sup> The mod's intractability serves as a kind of anthropomorphic descriptor. Jane Bennett observes that providing metaphors for the way nonhuman things possess human characteristics "can catalyze a sensibility that finds a world filled not with ontologically distinct categories of beings (subjects and objects) but with variously composed materialities that form confederations." She articulates that "revealing similarities across categorical divides and lighting up structural parallels between material forms in 'nature' and those in 'culture,' . . . can reveal isomorphisms," or the unusual correspondences among things in the world.<sup>2</sup> And, as Bennett asserts, nonhuman bodies find a place within a Rancierian conception of politics in their co-constitution with human actors. Through their interactions, the body, game engine, mod, and other nonhuman actants hold the potential to reconfigure dominant regimes of sensation and experience. Like humans, nonhuman beings "have the power to startle and provoke a gestalt shift in perception: what was trash becomes things, what was an instrument becomes a participant, what was foodstuff becomes agent, what was adamantine becomes intensity."<sup>3</sup>

In the mod's capacity to act, intractability refers to its stubbornness, its refusal to render standard gamespaces or operations of play. It is the intractable personality of art modding that serves as an affective dynamic through which aimless encounters emerge. By making space difficult or troublesome through abstract noise, the art mod disarms the aim of a weapon (leaving the player "aimless") within perspectival space and severs the player's optimal flow within the game. From this moment of aimlessness arises difference, unfamiliarity, and aesthetic possibilities. Embodied meaning is a product of our encounter with the mod as a technical object *and* a form in itself. Eugenie Brinkema makes a similar argument about cinema when she says that images carry affects—*anxiety, disgust, and grief*—within their form. As a textual artifact, film holds the capacity to express an "affective exteriority, an ectoaffect," through formal compositions that do not presuppose a spectator.<sup>4</sup> Just as cinematic forms can be read for their affective forces, I propose that modding possess an ectoaffectivity in

<sup>1</sup> In part, I borrow the term "intractable" as it is used by Bennett to describe the vibrant materialism witnessed in a pile of debris along a Baltimore street. Here, she quotes Stephen Jay Gould who articulates what he refers to as the "excruciating complexity and intractability" of nonhuman entities. See Stephen Jay Gould, *The Structure of Evolutionary Theory* (Cambridge: Belknap, 2002), 1338 qtd. in Bennett, *Vibrant Matter*, 4–5.

<sup>2</sup> Bennett, *Vibrant Matter*, 99.

<sup>3</sup> Bennett, *Vibrant Matter*, 107.

<sup>4</sup> Eugenie Brinkema, *The Forms of the Affects* (Durham, NC: Duke University Press, 2014), 4, 23.

its formal disruption of space. When an art mod interrupts normal gamespaces, it adheres to its own affective disposition of intractability. And just as it has the capacity to affect the body, its ontological status is not dependent upon a human participant. Rather it exists through its own autonomy, or the vital processes that occur among a braiding of technological components, images, and interfaces.

Modding has always been historically defined by a type of intractability, especially in the way that it deliberately works within capitalist structures to subvert, deconstruct, and challenge our preconceptions of gameplay. With games such as *Doom* and *Quake*, players explored ways to alter environments and mechanics of play, working both with and outside these engines' precalculated operations. Currently, communities of modders introduce new modes of play through Steam Workshop: a repository developed by Valve Corporation as part of their game distribution platform Steam, allowing players to publish, share, and purchase modifications for popular titles such as *Skyrim* and *Team Fortress 2*. As Watanabe's *San Andreas Streaming Deer Cam* suggests, *GTA V* has likewise encouraged a vibrant modding community to create, for instance, a neon-saturated Los Santos reminiscent of *Blade Runner* or a vehicle cannon that uses cars as projectiles in lieu of bullets.

To conclude, I frame the intractability of modding and the reterritorializing of play within dominant gaming culture through what artist, hacktivist, curator, and game scholar Anne-Marie Schleiner calls *ludic mutation*: the player's capacity to upend the game's standard procedures through mods, hacks, glitches, and reconfigurations, taking authoritative reins back from commercial enterprises. Schleiner illustrates modding as an ongoing exchange among two separate cultural economies: professional industries and the gifted, affective labor of modders, artists, gamers, and amateur programmers.<sup>5</sup> Drawing from Michel Serres' concept of the parasite, Schleiner sees modding practices through a biological analogy of "parasitism," especially in the ways artists appropriate game engines from a "wealthier industrial host" and channel noise into its operations, deconstructing a game's orthodox rules and mechanics.

Schleiner's work with Joan Leandre and Brody Condon on their art mod *Velvet-Strike* (2002) highlights aesthetic forms of ludic mutation. Reconfiguring the graffiti mechanic in the popular counterterrorist first-person shooter *Counter-Strike* (2000), Schleiner and her collaborators made "protest sprays" that were used to proliferate anti-military messages among the game's hypermasculine,

<sup>5</sup> Schleiner, *The Player's Power to Change the Game: Ludic Mutation*, 11, 13, 36.



**Figure 6.1** Anne-Marie Schleiner, Joan Leandre, and Brody Condon, *Velvet-Strike*, 2002. Screenshot.

right-supporting players (Figure 6.1). Mariam Naziripour observes that *Velvet-Strike* was created as a timely intervention into conservative and militaristic ideologies that gained traction in mainstream video game spaces after 9/11 and increasing US conflict in the Middle East.<sup>6</sup> For example, *Counter-Strike* featured counterterrorist excursions against stereotyped Middle Eastern enemies and in 2002 the US Army developed and published their first-person shooter *America's Army* as a combat simulator and recruitment platform.

Protest graffiti tags created by the artists ranged from the “BORN TO KILL” slogan and peace sign from Kubrick’s *Full Metal Jacket* (1987) to a graphic of two soldiers kissing each other as well as pink teddy bears: a reminder of the innocent women and children impacted by the War on Terror.<sup>7</sup> The artists shared their custom sprays on the *Velvet-Strike* website for other players to use in their own anti-military interventions. More so, Schleiner, Leandre, and Condon held live performances in which the artists entered multiplayer deathmatches and tagged sections of the game’s maps as they were repeatedly targeted and killed by other

<sup>6</sup> Mariam Naziripour, “Full Metal Spray,” July 13, 2017, <https://rhizome.org/editorial/2017/jul/13/velvet-strike-text/>.

<sup>7</sup> Net Art Anthology, “Velvet-Strike,” *Rhizome*, 2016, <https://anthology.rhizome.org/velvet-strike>.

players. Video documentation of the *Velvet-Strike* performance was featured in the 2004 Whitney Biennial. Their modding interventions were met with hostile and misogynist reactions within gaming communities. Hardcore gamers saw *Velvet-Strike* as an artistic encroachment that failed to participate in the game's conventional fragging: a transgressive act upon the escapist entertainment of the game. *Counter-strike* players were especially threatened by Schleiner's contribution to the mod as a woman artist, pointing fingers at Schliener, Leandre, and Condon's apparent ignorance about *Counter-Strike* being just a video game. The *Velvet-Strike* website was bombarded by hateful emails with misogynistic language aimed toward Schleiner. One email in particular stated:

Hello,

What a stupid initiative!!! If you don't like the game just don't buy it, and don't piss off other people with your shit.

Just a woman could have think of making something like Velvet Strike . . .

if you don't realize that videogame is just a VIDEOGAME, an that its a fake world, well then, GO PLAY WITH YOUR BARBIE!<sup>8</sup>

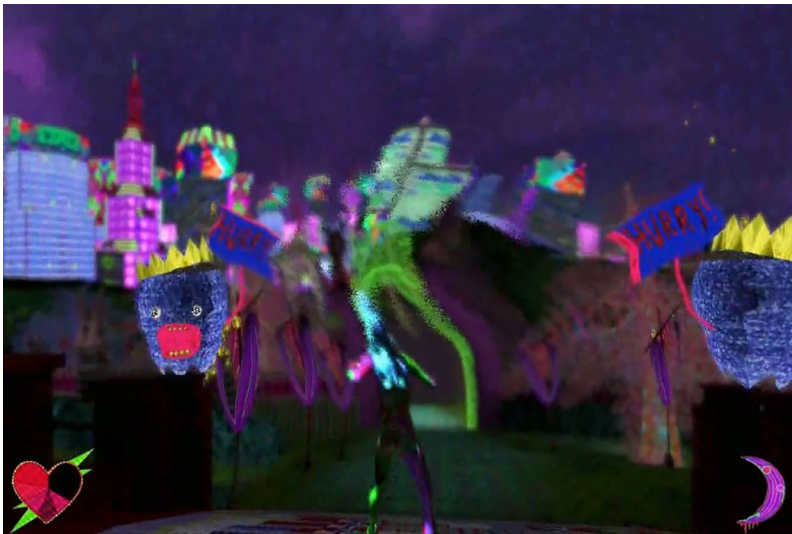
Schleiner's work in *Velvet-Strike* highlights the nuanced ways modifications operate as potential sites of ludic mutation, redirecting flows of power and authority away from mainstream gaming culture through the agency of creative practitioners. In this sense *Velvet-Strike* is a parasitic thief, attaching itself to the underbelly of a popular game engine and using its productive forces to disrupt a larger (and toxic) host system. Yet, Schleiner argues that modding's dynamics are more aligned with a reciprocal symbiosis instead of a unilateral parasitism: player-created mods, skins, and other content leached from popular engines are subsequently reabsorbed into industry design choices.<sup>9</sup>

As I have aimed to express in the chapters of this book, engines possess unique forms of agency that in their complex material involvement with human modders aid in the construction of aesthetic, ludic, and social meaning. As marginalized histories of video games show, modders are not always the valiant punkers and software pirates that one might imagine. In certain contexts, player customizations work to reinforce the often-violent sexist, racist, and homophobic biases that lurk within gaming culture more broadly. This is witnessed in *GTA V* mods that allow for sexual assault of a player's avatar so as to humiliate them publicly or *Doom* and *Counter-Strike* mods created by neo-Nazi and

<sup>8</sup> Email qtd. in Naziripour, "Full Metal Spray."

<sup>9</sup> Schleiner, *The Player's Power to Change the Game: Ludic Mutation*, 13–14.

Alt-Right groups that carry out on-screen violence against Semitic communities and people of color. Yet, as Schleiner demonstrates, when engines are taken up in novel aesthetic configurations with human creators, they can enact radical change by introducing abstract noise into game systems. This parasitic invasion of noise channels undergirds modding's contingencies into the present. Whether such parasitic interventions made by artists are planned or accidental, they catalyze forms of ludic mutation, "clearing the way for a new order of play culture to come (whatever that order may be)."<sup>10</sup> In contemporary art modding, this infiltration of abstract noise is exemplified, for instance, in Anita Fontaine and Mike Pelletier's *CuteXDoom II* (2008), a mod that transforms the violent, competitive landscapes of *Unreal Tournament 3* into an unsettling, dreamlike realm of Japanese Kawaii culture imagery. The player must navigate the mod's protagonist Sally Sanrio through a hallucinatory realm after her consciousness is altered by a poison drink. As the player leads Sally through this nightmare world, they encounter unexpected glitches, rapidly changing TV screens, oversaturated pulses of color, sinister anime forms, and an interface that appears to breathe as if alive (Figure 6.2).



**Figure 6.2** Anita Fontaine and Mike Pelletier, *CuteXDoom II*, 2008. Screenshot.

<sup>10</sup> Schleiner, *The Player's Power to Change the Game: Ludic Mutation*, 49.

More recently, the performative works of Beijing/Shanghai-based artist Tianzhuo Chen express abstract noise by capturing bodily gestures and integrating them into illusory game engine fragments. In his *Exo-performance* series (with artist/filmmaker Andrew Thomas Huang), Chen samples the dancing movements of coperformers Beio and Baby Chinayu who work with the artist in the Shanghai-based art group Asian Dope Boys. Both performers are naked except for various motion capture sensors attached to their torso and limbs. In distinct multichannel performances, Baby Chinayu wears an ornate ball gag with red face paint. While holding a staff, Beio dons a traditional bamboo hat along with fake pink lips and metallic teeth. As the performers slowly dance, their captured movements are rendered on separate channels as fractured mythological entities. The contours of these traditionally rendered beings are projected back onto the performers, resulting in overlapping layers of virtual and fleshy bodies. As they continue dancing, their hybrid forms glitch in and out of the frame among disquieting 3D spaces filled with raging fires, exploding cars, falling snow, and statues of fearsome entities. Chen's work often explores the relationship among Buddhist philosophies and nightclub culture, drawing parallels between the temple and dance floor as spaces of both transcendence and deviance.<sup>11</sup> In histories of art modding, the proliferation of abstract noise into existing systems of power and control points to how artists worked from within capitalist systems to generate radical instantiations of embodied difference. Early twentieth-century artist László Moholy-Nagy says that art emerges from the way technologies produce "unknown relations" instead of mere reproduction or repeating existing modes of experience.<sup>12</sup> We would do well to regard modding in a similar light: a technique that enables aesthetic potential through its intractability, its instability.

<sup>11</sup> See Chen's work in Miriam Kelly, "Feedback Loops," accessed July 5, 2020, <https://acca.melbourne/exhibition/feedback-loops/>.

<sup>12</sup> László Moholy-Nagy, "Production—Reproduction," in *Moholy-Nagy*, ed. Krisztina Passuth (London: Thames and Hudson, 1987), 289.





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