THE UNIVERSITY OF CHICAGO

THE BODY IN PLAY: EMBODIMENT IN AND THROUGH VIDEOGAMES

A DISSERTATION SUBMITTED TO

THE FACULTY OF THE DIVISION OF THE HUMANITIES

IN CANDIDACY FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

DEPARTMENT OF ENGLISH LANGUAGE AND LITERATURE

AND

COMMITTEE ON THEATER AND PERFORMANCE STUDIES

BY

ARIANNA B. GASS

CHICAGO, ILLINOIS

DECEMBER 2022

© Arianna B. Gass 2022

All rights reserved.

For my parents, Ronald Gass and Johanna Pfund, who introduced me as a neonate to videogames via *Lemmings* (Psygnosis, 1991) on a hand-built MS-DOS computer. Thank you for prioritizing my education above all else and for cheering me along, every step of the way.

And for my "academic fairy godparents," Peter McDonald and Amanda Shubert, who have provided invaluable guidance and support through all the seasons of doctoral work and life. Thank you for the many pep talks, revisions, celebrations, gaming sessions, and check-ins that have helped this project reach this stage.

Table of Contents

List of Figures

Acknowledgements

This dissertation project would not have come to be without the early support and mentorship of Stephanie Boluk who inspired and mentored me during my undergraduate years at Vassar, and Frank Lee, who took a chance on me as a grant writer and administrator at Drexel University early in my working life. The alternate reality game I was required to play as an undergraduate in Stephanie's class was my entrée into game studies, and introduced me to two important graduate school mentors, Patrick Jagoda and Peter McDonald (even though it would take many years for me to figure that out!). Frank Lee offered me stability through my work at the Entrepreneurial Game Studio at Drexel University when my odd jobs could not. It was at EGS that I learned about the videogame development process and that I might like to be a teacher someday. Thank you for graciously allowing me to write while on the clock and giving me the confidence to finally press submit on those graduate school applications.

I am grateful for the guidance and feedback offered to me by the members of my dissertation committee; Patrick Jagoda, Ellen MacKay, Tina Post, and Riley Snorton. I am also indebted to the feedback of Katherine Buse and Peter McDonald, who offered such kind and detailed comments in the eleventh hour of many deadlines. Any parts of this work that shine are indebted to their generosity and brilliance. Likewise, I'm grateful for my fellow Ax-Getters; Eva Pensis, Marissa Fenley, Shirl Yang, Bellamy Mitchell, Michael Stablein, Clara Nizard, and more, whose sustained and generous attention over the last few years has kept me accountable to an interdisciplinary readership. I would also be remiss if I did not thank Ashlyn Sparrow and Kent Lambert for their words of encouragement and support in the forms of long-term console access and pre-pandemic desk space through the Media, Arts, Data and Design Center.

My work also benefitted from broader scholarly communities at the University of Chicago and beyond. Elements of Chapters One and Two were improved by conversations held at UChicago through the Theater and Performance Studies graduate workshop, the 20th and 21st Century graduate workshop, and the Digital Media graduate workshop. Many thanks to Kaelan Doyle-Myerscough who acted as a respondent to early drafts of my first chapter and Amanda Phillips who so generously provided extensive notes on my second chapter in these venues. Chapters Two and Three were shaped by presentations and conversations with fellow panelists at the Society for Cinema and Media Studies, the Queerness in Games Conference, and the Northwestern Media Aesthetics Conference.

My ability to pursue this work in the face of pandemic quarantine and isolation was aided by the scholarly company and comradeship of many. I'm forever grateful to my weekly writing supergroup, Shannon Draucker, Ally Field, Katerina Korola, Kate Nesbit, and Amanda Shubert, for providing structure, care, and excellent advice when things felt impossible and uncomfortable. A thousand thanks are owed to Ella Wilhelm, who stepped into my life at a difficult moment and held me in the proverbial light (and the strobe lights at Smartbar). I'm grateful for the companionship of Anna Gatdula and Caleb Sponheim, whose hospitality and giggles nourished me at many points in this difficult writing process (and personally ensured I finally got that vaccine!). Thanks are also owed to Lee Jasperse and Yao Ong for being intradepartmental friends and tethers, offering me a bean bag chair and a place to play games when I needed a safe place to rest. Thank you all for being my people.

Many thanks to my parents, Ronald Gass and Johanna Pfund, who have been so supportive of my academic work throughout my life. Thank you for helping me show up, even when I feel, as I often do, out my league. I am also grateful for the support of my grandmothers, Nancy Pfund and Trudy Gass, who have been steadfast in their support of my career.

I am eternally grateful for the patience, love, and soul-reviving generosity of my Philly family. Thank you to the fellow worker-owners of Obvious Agency; Daniel Park, Joe Ahmed, and Cat Ramirez for always making space to get silly and for working together despite the distance. Many thanks to Evelyn Langley and Joe for generously sharing their home when I've been in town (and for dancing with me to good news). A thousand thanks to Meryl Sands for the astrological weather reports, and for reminding me of the many past selves that dreamed me here.

Finally, I'd like to acknowledge Heather Nelson for the innumerable ways she supported me while I finished this dissertation. So many of the ideas in this dissertation benefitted from her gaming expertise and perspective. Thank you for the many, many delicious meals, long walks, and weekend videogaming binges that provided respite and solace away from work. Thanks for being my actual gamer girlfriend.

Abstract

This dissertation examines how the algorithmic processes and logics of 3D videogame engines shape our experiences of embodiment game play. Videogame engines are software tools used to author and develop videogames, enabling development across platforms. Commercially licensed game engines, like the Unity engine, are used by studios of varying sizes (from small independent to large AAA studios) to develop hundreds of thousands of individual game titles. Game engines define many of the core functionalities of videogames. These often-ignored processes are essential to how players experience embodiment through virtual, on-screen bodies and their own embodied performances of play off screen. This project examines 3D videogames developed after 1993, ranging from AAA titles to independent art games, tracking the gradual shift in videogame development away from modeling object appearance and towards modeling and simulating object behavior. This shift is marked by the rise of physical simulation, a process governed and parameterized by game engines. Each chapter considers how embodiment has been reshaped by the turn to physical simulation in video games by placing a particular simulation technique in a broader social and historical context. This work conceptualizes bodies as having both representational and computational elements, addressing physical simulations that make representations of human bodies visible through bouncing light, computational regimes for how objects like bodies collide and interact, and procedural animations that control how on-screen bodies, our avatars, move when we play with them.

In the first chapter I discuss the process of subsurface scattering, a form of rendering that dictates how skin (the visible surface of any object) interacts with light. Using *Detroit: Become Human* (Quantic Dream, 2018) as a case study, I demonstrate that this physically based approach

to rendering imposes a prototypical whiteness on representations of “realistic human skin” at a programmatic level. I contrast this approach with indie developer Tale of Tales’ refusal to render the body of their protagonist in *Sunset* (2015) in anything other than real-time reflections. This non-physically based rendering technique challenges the logics of “realistic” skin shaders and the imperatives of software efficiency and performance. The second chapter focuses on the processes of collision detection and response, which seek to model the interactions between solid objects in videogame worlds. This chapter outlines how interpenetration came to be a prohibited relationship between two video game bodies, culminating in a discussion of the relationship between video games and queer sexual orientations in the virtual reality game *Summer Lesson* (Bandai Namco, 2016). The third chapter explores video game embodiment through ragdoll physics. In videogames, a ragdoll is a procedurally animated body that is limp and floppy, much like its analog namesake, but also interacts with the 3D simulated environment in which it is situated. In this chapter I theorize an inverse relationship between physical performances of mastery and visual displays of mastery. Looking to games like *Half Life 2* (Valve, 2004), I trace the development of ragdoll physics from its origins in the first-person shooter genre, where its use emphasizes player control over the videogame world through spectacular performances of death, to later games, like *Octodad: The Dadliest Catch* (Young Horses, 2014), that use ragdoll physics as the quality of the player avatar, disorienting players with prior embodied literacy. I go on to claim that this haptic disorientation enacts a form of somatic entrainment, such that the successful player of fumblecore games become virtuosic human performers, forced to attend to the intricacies of simulated physics. On the whole, this dissertation considers how the software ontologies that inform the representation of bodies within video games become relational—between bodies within the video games and the world outside the game.

Introduction

Embodiment in and Through Videogames

When we play videogames we play with our bodies. When we run, jump, duck, aim, or dodge, we may intend to complete in-game objectives, or we might be acting for the sheer pleasure of experiencing that movement: what it looks like, feels like, and sounds like to navigate a simulated 3D space as a simulated 3D object. We also click buttons, push joysticks, flick mouses, pull triggers, bump bumpers, and drag fingers across screens. These off-screen actions interface on-screen movement, often requiring dexterity, coordination, and familiarity with the control scheme. When we play, we are caught in a constant loop between the on-screen action and the many physical movements, as well as computational processes and logics, that govern and determine those on-screen behaviors, sometimes at subperceptual scales. To play a videogame is to experiment and play with embodied difference. This dissertation triangulates the on-screen representations of bodies, the off-screen behavior of bodies, and the algorithmic processes and logics that shape the behavior of both.

Game engines, the software developers use to design and create games, are central to how we experience embodiment in game worlds. For example, Kitty Horrorshow's independent horror adventure game *Anatomy* (2016) plays with the default settings of the Unity game engine to produce effects that drastically change what it feels like to explore this gameworld. These effects are central to the horror and tension of the game. Gameplay consists of navigating a sparsely decorated and uninhabited house from the first-person perspective in search of cassette tapes that must then be played in order to progress in the game. As the three acts of the game progress, the house becomes filled with objects that appear to be unstable, either flickering in and out of existence, or embedded in walls or other objects (Figure 0.1). The dimly lit interiors suggest that the house is inhabited by a monster or evil presence that the player must escape or avoid, but it soon becomes clear that the only horror on display is the increasingly unstable and glitchy environment of the house—that is, the house's response to the unwelcome presence of the player.

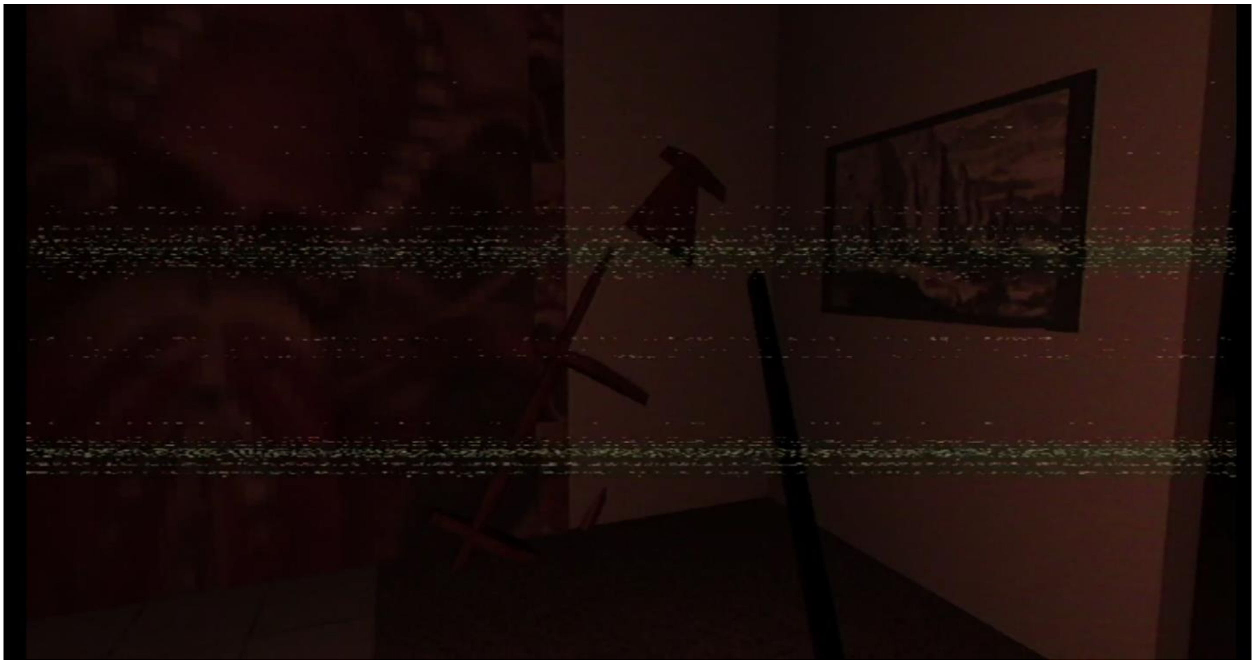

Figure 0.1 Objects embedded inside the walls of Anatomy *(Kitty Horrorshow, 2016). Screenshot by author.*

While *Anatomy* can be interpreted without knowledge of the tools used to develop it, the glitches affect the game's meaning when they are understood from a technical, as well as a narrative, perspective. When the player enters the master bedroom of the house in the third act, the room looks different. The walls surrounding the windows appear to shimmer and shift slightly. A closet door that could not be opened in prior acts opens, only to reveal another closed door: a dead end, rather than an escape. Two armoires intersect along one of the walls of the room, with one surreally floating in midair. They look unusual in the places where they overlap, where a flickering banded pattern shimmers across the surface of the drawers (Figure 0.2). This flickering is caused by something called “z-fighting.” Z-fighting, a phenomenon in computer graphics that is also commonly called “stitching,” is usually attributable to the imprecision of a given game engine’s z-buffer (also known as the depth buffer). All 3D game objects have a location along the x, y, and z-axes, where the z-axis describes the objects depth in 3D space. When two objects overlap along the z-axis, the engine attempts to render both at the same location, which leads to the two planes “fighting” each other to be seen (Figure 0.3).[1] The engine stitches the two objects together and the two objects “fight” for visibility as the engine attempts to render both at the same location.

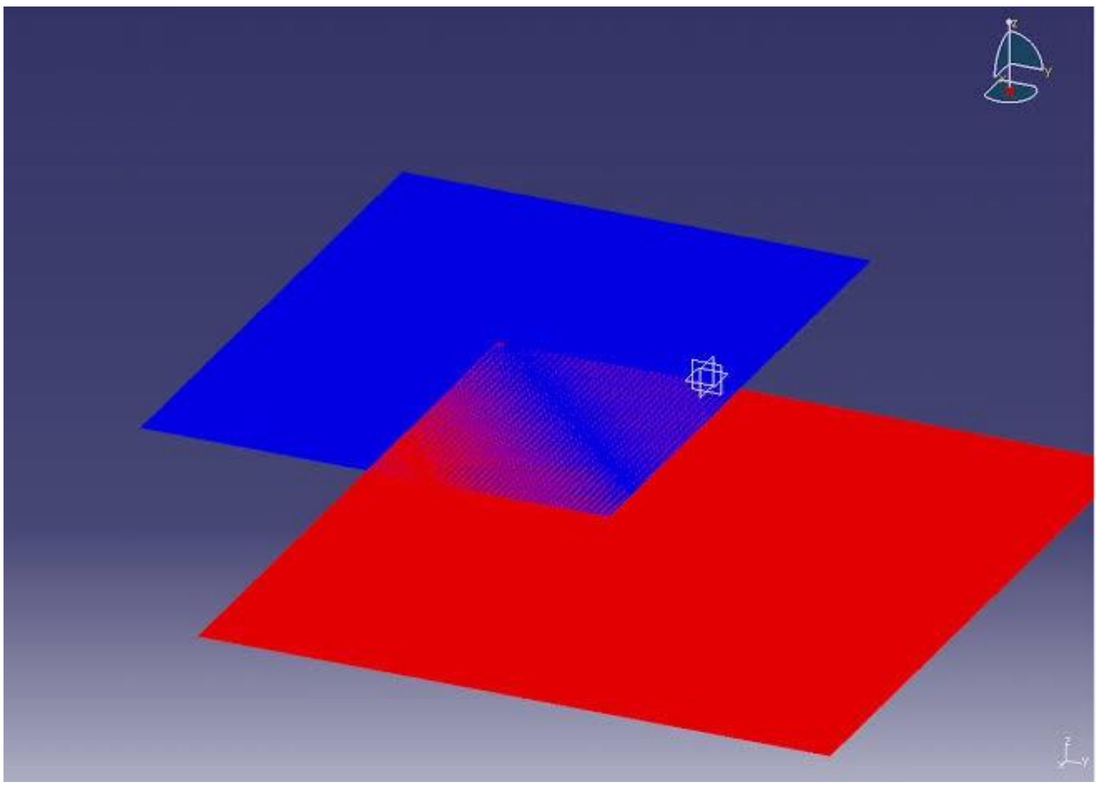

Figure 0.2 Demonstration of "Z-fighting" where the red and blue planes intersect along the z-axis. Mert Akça, "Depth Buffer and Z-Fighting," 6 January 2020, JPG, https://blog.devgenius.io/computer-graphics-depth-buffer-test-5c29807cf475.

[1] This can also happen in cases where the imprecision of the z-buffer causes objects that are numerically on separate planes to be “rounded up” to being on the same plane. “How To Fix Unity Z-Fighting With Multiple Solutions.”

Figure 0.3 "Z-fighting" in Anatomy *(Kitty Horrorshow, 2016). Screenshot by author.*

Objects that might register as merely broken, like those armoires, are a computational parable for a genre of dysphoria. Horrorshow describes the z-fighting effect as “psychologically abrasive” because “the world around you is tearing at its own skin, uncomfortable in its own existence, trying to be two things at once and failing both.”[2] Though the armoires and their shimmering intersections may seem mundanely glitchy, I understand them to be a programmatic expression of the gap between one’s self-knowledge and others’ perceptions or beliefs, which results in a discomfiting feeling that one is failing to fully inhabit either position. Z-fighting, and the many other techniques Horrorshow uses to produce visual glitches, are central to the way the game positions the player and many objects in the world as fractured, multiple, and thereby “horrific.” This analysis would not be possible without some knowledge of how Unity (and many other game engines) handle basic rendering tasks, as well as the ways that artists and developers work with and against the default settings of these development tools. In this dissertation I argue that it is essential for games studies to consider how utilitarian processes—

[2] Horrorshow, “Anatomy and Glitch Aesthetics,” March 12, 2022.

the often unremarkable, usually dismissed elements of videogames—can be expressive and ideologically meaningful.

Game engines and common developer practices—those aspects of games that pass as industry standards or expectations—are essential points of analysis for videogame studies because they express norms and thereby help us understand how individual games, developers, or communities work with or against these technologies and development practices for their own expressive purposes.[3] Throughout my writing, I focus on the many ways that videogames augment experiences of embodiment: representationally (through narrative and aesthetics); processually (through processes that abstract or make a given body computationally intelligible); and performatively (through the enactment of individual player strategies and the incitement to a repertoire of bodily performances).

The Mechanics of Representation

Accordingly, my research explores what I call the "mechanics of representation," the development practices and underlying logics of videogames that are often overlooked in humanistic writing on videogames. I use "mechanics" as an allusion to game mechanics, a term that describes the rule-based and predominantly algorithmic elements of videogame play in an influential paper on videogame design by developer-researchers Robin Hunicke, Marc LeBlanc, and Robert Zubek.[4] Just as mechanics will suggest to readers familiar with game studies, I hope to turn an eye towards the algorithmic elements that subtend real-time computer graphics, like

---

[3] Noah Wardrip-Fruin writes, "when today's game developers find well-developed operational logics for certain purposes built into their game engines, or certain playable models well understood in the craft wisdom of their field, this is neither natural nor accidental. And it should be no surprise that so many games are made in which combat is central. Had a similar level of investment been made in developing logics and models for other areas of human life, the game industry would likely have built upon those." Wardrip-Fruin, *How Pac-Man Eats*, 81.

[4] Hunicke, Leblanc, and Zubek, "MDA."

the rendering pipeline that results in artifacts like z-fighting. I turn an eye to the "supply side" of videogames, discussing specific development practices, industry standards, and the ways that developers work with or against their development tools. This requires specific attention to the tools and technologies used in videogame development, corporate histories of videogame development studies, and scientific research in the field of computer graphics, robotics, and computer science more generally. I work from an archive of primarily 3D videogames ranging from early failures like *Jurassic Park: Trespasser* (Dreamworks Interactive, 1998), to mid-2010s independent art games like *Sunset* (Tale of Tales, 2015), to AAA virtual reality oddities like *Summer Lesson* (Bandai Namco, 2016). Many of the games I study, particularly those published from the early 1990s to the 2000s, were first released for personal computers. I also work from archives of industry and consumer magazines, scientific whitepapers, tech demos, and game engine documentation, to illustrate how these non-diegetic processes meaningfully determine interaction within games, and how industry "best practices" shape embodiment on and off screen.

In *Gaming: Essays on Algorithmic Culture,* Alexander Galloway provides a framework for understanding games as "actions," breaking games into four analytic categories: diegetic and nondiegetic operator acts and diegetic and nondiegetic machine acts.[5] Diegetic operator acts "[privilege] the human realm over the technological realm," encompassing player movement and expression within the game world.[6] Nondiegetic operator acts are configurations of the informatic layers of the game, including pressing pause, configuring key-bindings, or any other adjustment to tailor the game to its human interlocutor. Diegetic machine acts are "pure process"

[5] Galloway, *Gaming*, 2.
[6] Galloway, 21.

and are the informatic layers that create the game world ambiance; player and non-player character resting animations, weather simulations, and the rendered environment.[7] Nondiegetic machine acts are "actions performed by the machine and integral to the entire experience of the game but not contained within a narrow conception of the world of gameplay."[8] The mechanics of representation include these non-diegetic machine acts; those many elements of gameplay that make the world something that can be moved through or interacted with, but are not at the conscious forefront of narrative or gameplay.

My orientation to non-diegetic machine acts aligns with a movement in feminist and queer videogames scholarship that takes an interdisciplinary approach to the study of games. Strikingly, over the past decade, these scholarly innovations have coagulated around the word "beyond," suggestive of both a new horizon for research in the field and a new relationship to perceived disciplinary boundaries. For example, when TreaAndrea Russworm and Jennifer Malkowski propose to study videogames "beyond the politics of the image," they are issuing a rejoinder to scholarship that sees videogames as continuous with visual culture, rather than as its own media form.[9] When Christopher Persaud and Adrienne Shaw propose to study videogames "beyond text," they are arguing for the importance of audience and reception studies in the field, noting that games are not only made by or made to depict queer genders and sexualities, but that communities of play are central to understanding how videogames intervene in culture, and should inform how and where we locate queerness in videogames.[10] When Bo Ruberg reads

[7] Galloway, 9.
[8] Galloway, 28.
[9] Russworm, *Gaming Representation*, 1.
[10] Shaw and Persaud, "Beyond Texts."

videogames as "queer beyond representation," they move the locus of "queerness" beyond the game itself, showing us what it might mean to read or play games queerly.[11]

My intervention unites technically-minded analysis of video game engines and the utilitarian processes that subtend videogame play with close, analytical readings of individual games. In my close readings I hope to address what "representation" means from two levels. At face value, "representation" might evoke the visual, sonic, haptic, and narrative elements of games that "beyond" hopes to expand upon. In this first sense, "representation" is a way of answering the question, "How and where do games generate meaning, and how do we interpret those meanings?" In this usage, I understand "beyond representation" to cite and recall a series of field-forming discussions, sometimes described as the narratology and ludology debates, that sought to articulate how videogames make meaning and what distinguishes them from other media.[12] In this second sense, "representation" asks, "Whose story is the videogame telling? By and for whom?" In its second formulation, representation refers not to how or where videogames generate meaning, but rather how videogames as interactive media interface larger cultural movements and concerns. In this usage "representation" is often invoked in the context of calls for "more diverse representation," where diversity might be positioned as a curative to stereotypical representations of marginalized people *and* overrepresentations of hegemonic cultures in videogames.

Thinking "beyond representation" in videogame studies might also mean turning towards materialism—the world behind the screen—as well as social and political analyses of games—the world outside the screen. Jacob Gaboury invokes this phrase when he describes his

[11] Ruberg, *Video Games Have Always Been Queer*.
[12] Aarseth, "Ludology"; Phillips, "Negg(at)Ing the Game Studies Subject: An Affective History of the Field"; Jagoda and McDonald, "Game Mechanics, Experience Design, and Affective Play"; Sicart, "Against Procedurality."

hermeneutic orientation to the study of computer graphics as opening "up the black box and look[ing] *beyond mere representation*."[13] This formulation looks not just at the visible products of computer graphics (what they render visible on a screen), but the techniques, logics, and materials used to craft them. For Gaboury, "beyond […] representation" indexes a materialist approach towards the historical development of computer graphics technologies and the logics they make possible. This strain of analysis is represented in each chapter through close examinations of the histories of the processes I study. Similarly, my analytical close readings of games are inspired by work like that of TreaAndrea Russworm in her study of the racial politics of two popular dystopian videogames, *The Last of Us* (Naughty Dog, 2013) and *The Walking Dead* (Telltale Games, 2012). She writes, "Thus, even if a dystopian game—finally!—signals an investment in the politics of representation by visually representing racial difference and employing people of color for voice acting and motion capture […] that attempt alone does not qualify it for doing rich, deconstructive work."[14] Russworm uses "representation" to describe what's visible on the screen, the narrative tropes of these games, and how these representations "work" culturally, as well as the material business and production practices that precede and enable those representations. I aim to center analysis that consider race, gender, and sexuality in videogames.

Looking at Game Engines

Game engines handle many of the processes that contribute to players' experiences of having or being a body in a gameworld. In this section, I will first define what a game engine is, drawing out the implications of this development framework for the study of contemporary

[13] Gaboury, *Image Objects*, 10.
[14] Russworm, *Gaming Representation*, 114.

videogames. Then I will make a case for why game engines are an important area of study for scholars interested in embodiment in videogames. Generally speaking (aside from embodiment-specific concerns), game engines are important because they are used across individual game titles, shared across multiple studios, and help those studios publish across platforms. While some large game development studios invest in developing and maintaining proprietary game engines, like Capcom's RE Engine, most videogames developed today are created using licensed, third-party engines. These engines minimize low-level programming work and offer a suite of pre-made tools for videogame design. Commercially licensed game engines, like the Unity engine, are used by studios of varying sizes (from small independent to large AAA studios) to develop hundreds of thousands of individual game titles.[15] Game engines are the increasingly shared framework that subtend a diverse range of videogames. As Eric Freedman writes, "the core technologies of the engine drive embodiment: they are the locus where static and dynamic elements are defined and world chunks are delimited."[16]

Inseparable from histories of computing and computer graphics, the videogame engine is part of a shift in computation towards modularity and standardization. Whereas arcade cabinets and the mask ROMs of game cartridges (like those of the Atari VCS) featured purpose-built integrated circuits, contemporary videogames are built upon software frameworks that are highly modular.[17] According to games historian Henry Lowood, the phrase "game engine" first appears in print in 1993 alongside *Doom* (id Software, 1993), but was used by the development team as early as 1991 to describe the shared code for all three episodes of *Commander Keen,* a

[15] Wallace and Chu, "Gaming Poised to Continue Accelerated Growth According to Unity Gaming Report 2022."
[16] Freedman, "Engineering Queerness in the Game Development Pipeline."
[17] For a closer look at the integrated circuits of arcade cabinets, see Gaboury. Montfort and Bogost discuss the particularities of the mask ROM in Atari VCS cartridges. Gaboury, *Image Objects*, 163–65; Montfort and Bogost, *Racing the Beam*, 20–22.

videogame series published by Apogee Software.[18] Based on archival research and interviews with John Romero, a designer and developer for *Doom* and *Commander Keen*, Lowood describes the game engine as:

> the fundamental software components of a computer game. These components typically include program code that defines a game's essential "core" functions, such as graphics rendering, audio, physics, and artificial intelligence […] At its heart, the game engine is also a particular way of organizing the structure of computer game software; this structure separates execution of core functionality by the game engine from the creative assets that define the play space or "content" of a specific game title.[19]

Where core functionality might handle things like the trajectory of a ball across an environment, assets would address what the ball looks and sounds like as it moves through space. This separation between core functionality and assets means that different game titles developed using the same engine are likely to use the same basic functionalities, even if they are distinct in other ways, including narrative (horror, scifi) and procedural genres (shooter, platformer). Games that appear to have little in common on the surface, may, in fact, be quite similar by dint of their game engine.[20] Eric Freedman expands upon this definition in *Game Engine Culture*, defining an engine as a "single piece of software that produces common functionality for *multiple games* […that] includes a tool suite or content editor […] and a runtime component that is active when a game is played."[21] This slight expansion acknowledges the interrelated practices of engine

[18] Lowood, "Game Engine," 203.
[19] Lowood, 203–4.
[20] Nick Montfort and Ian Bogost track the similarities between *Tank* (Kee Games, 1974) and *Combat* (Atari, 1977) in ways that verge on this kind of analysis, noting that *Combat* shares much of *Tank's* core functionality as well as shared personnel (Joe Keenan owned Kee Games and was later became president of Atari). However, in my work I'm making a historical and material distinction between games that were developed using game engines and those that share similar game mechanics or logics, but were fundamentally hardcoded – meaning that their operation/execution was determined by purpose-made integrated circuits (like *Tank*) or mask ROMs (as in *Combat).* Similarly, Noah Wardrip-Fruin offers a very close look at the similarities and differences between *Computer Space* (Nutting Associates, 1971) and *Spacewar!* (Steve Russel, 1962), but, again the object of my analysis is the authoring tools as much as the individual games themselves. Montfort and Bogost, *Racing the Beam*, 20; Wardrip-Fruin, "Gravity in Computer Space."
[21] Freedman, *The Persistence of Code in Game Engine Culture*, 1.

development and the creation of level editors and tools for use by modding communities, players dedicated to the creation and development of additional maps of existing games, as well as adaptations of popular films and TV shows in game engines.[22]

Lowood's historical definition articulates the move towards modularity that id Software's id Tech 1 engine signaled, but it fails to capture how engines influence developer and player practices beyond the modularity of the software framework. In a recent ethnographic survey of Australian game developers, Brendan Keogh and Benjamin Nicoll describe the game engine as a "software tool that enables real-time interactive digital content to be created, and a code framework that enables that content to run on different platforms."[23] This definition emphasizes cross-platform development, insofar as game engines enable studios to develop their videogames for consoles (like Sony's PlayStation, Microsoft's XBox, or Nintendo's Switch) as well as for home computers running Windows, Linux, or iOS operating systems, all using the same software framework.[24] Game engines allow developers to design games in ways that are hardware-agnostic rather than purpose-built, which influences the distribution and financial profitability of videogames. Game engines allow cross-platform releases, meaning that an individual title can be played by a larger market segment (not just XBox owners, but also PlayStation and home computer owners). This also means that cross-platform titles (as opposed to games that are released for a particular platform, like PlayStation exclusive titles) need to be considered

[22] For more on modding culture and the permeable relationship between modders and professional game developers in the mid-1990s, see Yang. For more information on avant-garde and artist's mods of popular videogames, see Lohmeyer. Yang, "A People's History Of The FPS, Part 2"; Lohmeyer, *Unstable Aesthetics : Game Engines and the Strangeness of Modding*.
[23] Keogh and Nicoll, *The Unity Game Engine and the Circuits of Cultural Software*, 9.
[24] At present, both Unity and Unreal support cross-platform development for current-generation iOS, PC, Nintendo Switch, Microsoft Xbox, Sony PlayStation 4, Sony PlayStation 5, and more. Unity Technologies `, "Unparalleled Platform Support"; Unreal Engine, "Multi-Platform Development."

according to the variety of play contexts different platforms imply. For example, playing a videogame on a personal computer invites a different set of embodied stances, behaviors, and interaction styles than the same title played on a communally located dedicated gaming console or a mobile gaming device. Game engines have fundamentally altered development practices, which have, in turn, altered how players play these games.

Licensable game engines and their vast developer support communities democratize the process of 3D videogame development by making it more accessible to people with limited knowledge of computer graphics. However, these technologies come with a characteristic signature that is imprinted on each game, which Keogh and Nicoll call "grain."[25] The grain of these technologies are default settings for things like how light interacts with the surfaces of objects, how objects behave when they come into contact with each other, and how objects react to the simulated forces of gravity. "Shaped not only by the decisions of Unity Technologies's key stakeholders and in-house software engineers, but also by the collective intelligence of its online communities and Asset Stored developers," grain results from the interplay of corporate, artistic, and technological demands.[26] This means that grain is always culturally freighted, a product of compromises between artistic, corporate, and consumer stakeholders that directly influence how a videogame feels to play. The grain of these technologies becomes even more important to attend to as game engines are increasingly being used to produce other media, including films, medical training and simulations, architectural models, and product designs. These engine technologies and their default assumptions have long tendrils that reach far beyond the scene of play. Put differently, videogames aren't (and really never were) just games: they are

[25] Keogh and Nicoll, *The Unity Game Engine and the Circuits of Cultural Software*, 64.
[26] Keogh and Nicoll, 65.

technologies that produce realities, communities, and ways of being that exist far beyond the screen.

Accordingly, in my dissertation I study game engines by exploring individual titles as examples of developer practices, in many cases working from game post-mortems or tech demos (presentations given by developers after games have been published or previews designed to showcase the technology behind games, often presented at trade conferences like the Game Developers Conference). Eric Freedman discusses the difficulty and importance of "reading" game engines in his book-length study of game engines, *The Persistence of Code in Game Engine Culture.* When discussing ways of "reading" or understanding the relationship between individual games and their engines, Freedman talks about looking to game mechanics and AI. He describes game mechanics as "the most readily accessible sign of an underlying engine mechanic" but also acknowledges that mechanics are "one step removed from the engine's underlying processes, providing more immediate insight into game design than game programming."[27] Freedman's play-centric approach runs counter to work by Robert Yang, in his insightful study of the code for *Dead Island* (Deep Silver, 2011), a game that was released in 2011 with a misogynistic variable name for a powerup for a dark-skinned indigenous Australian woman in the game. Yang's close reading of the game's code, the game engine's functionality, and the development practices around the game highlight the structural misogyny of this game's development process, the game itself, and the implications of this seemingly minor, if inappropriate, variable name for player strategies.[28] I seek to offer a middle ground to these two approaches, toggling between close readings of videogames as sonic, visual, textual, and haptic

[27] Freedman, "Engineering Queerness in the Game Development Pipeline."
[28] Yang, "On 'Feminist Whore Purna' and the Ludo-Material Politics of Gendered Damage Power-Ups in Open-World RPG Video Games."

media and explorations of developer practices to understand how game engines shape embodiment in and beyond the screen.

Further, by taking this developer-centric approach to videogame studies, I hope to contextualize videogames in the larger context of computer graphics, the histories of computer animation, and visual effects. Jacob Gaboury's work in *Image Objects* demonstrates the impact of early computer graphics applications, like Ivan Sutherland's *Sketchpad* (1963), in shifting the field of computing away from procedurally executed program structures towards object-oriented programming structures. Where procedurally executed structures dictate action as a flowchart might, object-oriented paradigms, articulated in the context of several early computer graphics applications, including Sutherland's, sought to map the relations between objects as a network. As Gaboury's history makes clear, this object orientation emerges in the 1960s and consolidates in the 1970s, marking "the beginning of a concern in computer science for the nature of objects."[29] My research contributes to a broader picture of the relationship between computer graphics and the paradigms of computing. Where Gaboury's work focuses on early computer graphics history in the mid-twentieth century, each chapter explores the historical shift from modeling appearance to simulating behavior around the turn of the twenty-first century. I seek to draw a connection between the practices of commercial videogame development and computer graphics research more broadly, often noting the ways that information and approaches transfer from government and military-funded applications to commercial and entertainment use. My

[29] Gaboury, *Image Objects*, 131.

research builds upon this work by focusing in on real-time computer graphics through the lens of videogame development practices and their communities of play.[30]

Embodiment in and Through Videogames

When I write that to play videogames is to play with bodies, I use "body" expansively. The activity of playing videogames involves many human bodies, even those beyond the body of the player—the bodies that assemble computer hardware, the bodies that designed and tested the game to have a certain "feel." We can also think of the "body" of the computer or console, the materiality of the control interface for a particular game and its affordances. Gameplay also involves "bodies" as an abstract category that describes "the thing we inhabit" and "the object we control" when we play videogames. In this sense, when a player plays a videogame, one of the bodies they are playing with is their avatar, which may or may not resemble a human body. For example, in classic arcade shooter *Galaga* (Namco, 1981), the player controls a spaceship and is tasked with mission of destroying other (enemy) spaceships (Figure 0.4). In *Galaga,* the spaceship is a metonym for a body. The player controls the spaceship object and might imaginatively project that the spaceship contains something that in other contexts could be called a body (be it a living human, humanoid, or nonhuman). The spaceship is a body in the sense that through play it is the thing that is inhabited or controlled.

[30] For more information on the history of computer graphics and computer animation from a cinema studies perspective, see Sito, *Moving Innovation*.

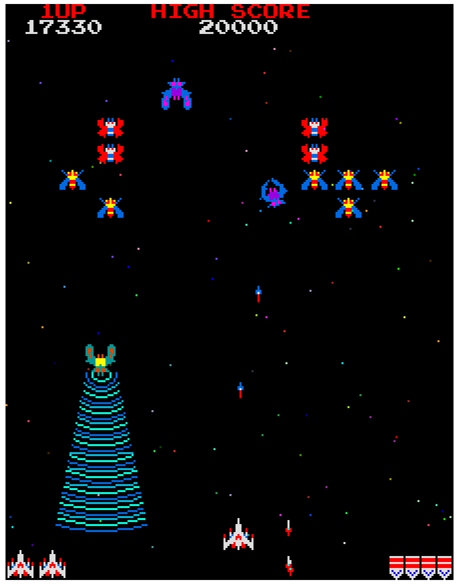

Figure 0.4 A screenshot of Galaga *(Namco, 1981).* The player controls the spaceship at the center bottom of the screen. The multicolor ships in the top two-thirds of the image are enemy spaceships. Namcokid47, "Galaga," 14 July 2019, PNG, https://en.wikipedia.org/wiki/File:Galaga.PNG.

In the last decade, media and performance scholars have increasingly considered the role of the body in the scene of videogame play. I see this revitalized interest in the role of the body as a challenge to a strain of research in the field often described as “proceduralist” or “ludological” that focuses more narrowly on the programmatic aspects of games.[31] Research on embodiment in games congeals around two models of embodiment. The first is the identificatory model in which embodiment in gameworlds happens because players un- or subconsciously identify with the objects they control through play. By contrast, in the cybernetic model of embodiment, embodiment is the technological extension of our bodies into the gameworld through habitual play.

The identificatory model, which claims that embodiment is something that happens through identification with a visible or implied player character or avatar, is often invoked in the

[31] Sicart describes proceduralism as an approach to videogames that is “interested in the ways arguments are embedded in the rules of a game, and how the rules are expressed, communicated to, and understood by a player. Via their simulation rules, games present embedded values, and it is the players’ appropriation and understanding of that model that make a game have meaning.” Sicart, “Against Procedurality.”

context of the social sciences. Researchers using ethnographic and experimental approaches seem to appeal to this model in their studies of embodiment. For example, Fox, Bailenson and Tricase ran an experiment that sought to determine if highly sexualized female avatars impacted player's self-perceptions and beliefs outside of videogame play. They describe what they term the "proteus effect" as

> when a user's self-representation is modified in a meaningful way that is often dissimilar to the physical self. The user then embodies the self-representation, observes him or herself behaving in this virtual form, and draws inferences regarding his or her internal beliefs or attitudes based on these observations.[32]

Predicated upon an identificatory model of embodiment, their study concludes that women that play games "wearing" sexualized avatars are more likely to have negative self-perceptions and to agree with "rape myths," that tend to blame victims of sexual violence because of their appearance or behavior (rather than holding the person who rapes accountable for their actions). I regard this research with some skepticism, noting that the study implies that mimesis is an aesthetic virtue or goal in videogame development and fails to explore the ways that embodiment in and through videogames might not be reducible to "wearing" an avatar (as one might clothing). I share this study as just one example of how the identificatory model circulates in videogame research—where "embodiment" on and off-screen are attributable to a subconscious identification with the objects players control in videogames.

The cybernetic model of embodiment is directly related to Marshall McLuhan's articulation of media as prosthetic. Early writing in the field of cybernetics in the mid-20th century metaphorizes the human body and its cognitive processes as digital machines,

---

[32] Fox, Bailenson, and Tricase, "The Embodiment of Sexualized Virtual Selves," 932.

formalizing a logic that becomes embedded in the study of media by thinkers like McLuhan.[33] For McLuhan, media extend human bodily capacities and reorganize our senses.[34] In this sense, embodiment is always mediated and technology is merely a prosthetic extension of the body's already-mediating sensoria. This line of thought has been particularly prevalent in recent studies of computer graphics and videogames. As Jacob Gaboury notes, "computer graphics saturate our lived environment in the most unremarkable ways, and this everydayness transforms our orientation to the world through those very categories with which we make sense of that world as phenomenally knowable."[35] Following this logic, every encounter with media (and therefore videogames) is not only necessarily embodied but also shifts how we perceive the world as we encounter it.

The issue of how mundane and habitual technologies impact or shift our sensoria is a key concern of the cybernetic model of embodiment. Shane Denson's focus on computer graphics and the post-cinematic argues that "new relations are being formed in the microtemporal intervals of algorithmic processing," calling these digitally produced images "discorrelated."[36] For Denson, discorrelated images are ones that interrupt the subjectivity of cinematic vision. No longer tied to a single subject position vis-à-vis the movement of a camera (suture), videogames, and other digitally produced images make "the viewing/playing subject into the bearer of a more versatile masterful gaze that can *both* fetishize the objectified body *and* inhabit that body as an instrument of subjective vision and action."[37] The distinction I make earlier in this section

---

[33] Von Neumann, Churchland, and Churchland, *The Computer and the Brain*; Weizenbaum, *Computer Power and Human Reason*.
[34] McLuhan and Gordon, *Understanding Media*, 202.
[35] Gaboury, *Image Objects*, 195.
[36] Denson, *Discorrelated Images*, 1.
[37] Author's emphasis. Denson, 13.

between "having" and "being" a body is central to my understanding of discorrelation, and in turn, the media-specific qualities of videogame play.

Likewise, in his game design manifesto *Game Feel*, designer Steve Swink uses the cybernetic model of embodiment as aspirational for videogames. As Swink explains, "game feel" is the "real-time control of virtual objects in simulated space, with interactions emphasized by polish."[38] Game feel is mostly characterized by the extension of the human body into the simulated three-dimensional space of the game – what Swink terms "virtual proprioception."[39] Accordingly, one of the most important elements of game feel for Swink comes from a cybernetic model of embodiment: the ability to interact with and manipulate simulated objects in simulated space in ways that replicate our interactions with objects in the real world. Swink addresses this primarily from a game design perspective, but several scholars, including Brendan Keogh and Timothy Crick take phenomenological approaches to understanding embodiment in videogames, holding together the materiality of gameplay alongside the aesthetic aspects of games (including, and particularly audio, visuals, and haptics).[40]

Chapter Summaries

Each chapter of this dissertation focuses on a core logic or process governed by a game's engine, exploring how that logic or process came to be an industry standard. The core logics I focus on are skin shaders, collision detection and response, and procedural animation. I pair this historical research with close attention to how developers and communities of play challenge,

[38] Swink, *Game Feel*, 6.
[39] Swink, 28.
[40] Keogh, *A Play of Bodies*; Crick, "The Game Body."

misuse, or take up these standards, drawing attention to the ways we feel embodied when we play videogames.

In my first chapter I show how the technical details of skin color and texture get encoded by game engines and end up shaping and being shaped by development pipelines and the kinds of stories that games tell. The chapter focuses on “shaders,” rarely remarked upon yet incredibly powerful bits of code that leverage the parallel processing power of graphics cards to dynamically alter the appearance of game objects without altering the underlying graphics data they take in. Shaders subtend racial representation in many contemporary 3D videogames, imposing a prototypical whiteness on representations of “realistic human skin” at a programmatic level. I discuss the overdetermination of “realistic skin” as behaving like white skin in videogames, illustrating how this overdetermination becomes narrativized within the storytelling of *Detroit: Become Human* (Quantic Dream, 2018). I contrast this “realistic” approach to modeling skin with indie/art game developer Tale of Tale’s refusal to render the body of their protagonist in anything other than real-time reflections. Through its refusal, this game—about a Black American expatriate named Angela—retheorizes the technologies of skin as both relational and porous, challenging the logics of “realistic” skin shaders. I explore the dynamics of visualizing skin using shaders relative to media histories of other technologies involved in the visualization of racial difference, including Kodak’s infamous Shirley cards.

In my second chapter, I propose that interpenetration, the phenomenon wherein two seemingly solid 3D rendered objects appear to overlap in space, is a useful paradigm for rethinking where and how we locate sex in videogames. Interpenetration is frequently thought of as a “glitch” or error, something that ruins how a game feels, yet it is the consequence of properly functioning collision detection and response—the very algorithm that is designed to enforce object solidity. Theorizing interpenetration through sex helps understand videogames as erotic technologies and the sexualities organized by and through technology. My case studies include analysis of "teabagging" in *Halo 3* (Bungie, 2007) and interpenetrating with the non-player character in the PlayStation 4 VR game *Summer Lesson* (Bandai Namco,2016). While neither of these games are "about" sex or sexuality, interpenetration offers players the opportunity to explore games erotically by perversely interpenetration with other players and non-player characters. This chapter outlines how games arrange embodiment and its relational possibilities through the rules imposed on object relations by algorithms like collision detection and response.

The third and final chapter focuses on "ragdoll physics," a method for procedurally animating objects via physical simulations. Implementations of ragdoll physics help demonstrate how the game engine's assumptions discipline the real-world bodies of its human interlocutors. Procedural animation and physical simulation technologies began to be used in video games in the early 2000s, affording new visual spectacles, ludic challenges, and narrative and representational possibilities. This chapter tracks the rise of the ragdoll animation in the service of hegemonic power narratives and virtuosic deaths in first-person shooter (FPS) games in the early 2000s, like *Hitman: Codename 47* (IO Interactive, 2003). The chapter also charts the equal but opposite development of the "fumblecore" game genre in the early 2010s, exemplified in Octodad's wiggly and unruly tentacles in *Octodad: Dadliest Catch* (Young Horses, 2015). While some scholars have seen fumblecore games as alternatives to the power fantasies of the FPS genre, I argue that they replicate them, conditioning the player's body to respond to machinic imaginings of “realistic” physical simulations with more disciplined and virtuosic physical performances. Where we might think that games with floppy and unruly avatars might lead to reflections the human body and its capacities, these games enact an opposite form of somatic entrainment in which virtuosic human performances tend towards machine-like execution.

The center of this project has been the question of how bodies are enmeshed in technical systems through acts of play, especially following the rise of simulation practices focused on the behavior rather than appearance of objects. It is essential to approach this question from both sides of the screen, considering how technologies are called upon to simulate aspects of (human) embodiment, and how human bodies adjust to, interact with, and compensate for those simulations in acts of play. The visual expression of bodies as identities, the way bodies are allowed to interact and behave, and the ways those representations affect how we use our bodies in play all have profound consequences. These consequences result not only from the experience of gameplay—alienating or inclusive, comfortable or uncomfortable, active or passive—but also from the ways that the norms, expectations, and values embodied within game engines bleed into a wider culture with impacts far beyond the games themselves. I strive to show how game engines came to encode and pre-shape the stories that games can tell about bodies and their potentialities. My hope is that this work will convince readers, gamers, and game developers of the contingency of these default settings that many have come to take for granted. I further hope that this dissertation can help to show what’s at stake when developing or creating bodies in gameworlds.

Chapter One

Translucent Skins and Reflective Surfaces in *Detroit: Become Human* and *Sunset*

In videogames, “skin” (also called the texture map) describes the visible surface of any three-dimensional digital object. At the most basic level, skin determines what an object looks like to a game player. Though the object is three dimensional, skin is actually comprised of 2D images that are then projected onto a 3D mesh in the rendering process. The “mesh” is the object’s computer-legible abstract mathematical representation, composed of points and edges that break the larger shape of the object into triangular polygons (Figure 1.1). Skin is the outermost visible surface of a digital object, while the mesh determines the shape the skin will take. In commercial game engines and 3D modeling software, skin and mesh are logically discrete and entirely modular and interchangeable. Skin is a word that can be broadly used for any visible surface, though, as its name implies, this colloquial term tends to be deployed to describe the visible appearance of a player avatar, which may depict something like human epidermis.

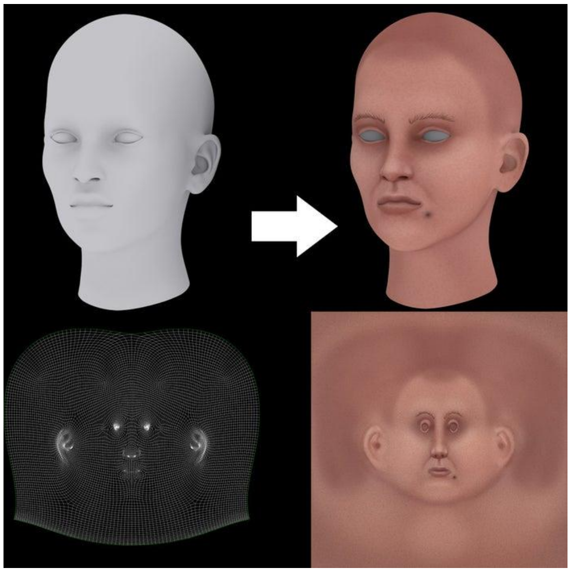

Figure 1.1: A UV-unwrapped 3D model and its skin. Clockwise from top left: a 3D model of a face; the same 3D model wrapped in skin; a UV map with skin textures and shading; a UV map of the 3D model. Tanya Weisner, "Hand Painted Game Texture Character Skin," Instructables, WEBP, https://www.instructables.com/Hand-Painted-Game-Texture-Character-Skin.

There are a host of player practices that are predicated on the modularity of skin and mesh. Character creation menus in games like *Mass Effect 2* (BioWare, 2010) allow players to "reskin" and customize their player character through the parameterized augmentation of skin and mesh. Reskinning can also refer to player-driven creation and distribution of skins that cosmetically alter game objects. For example, the *Quake* (id Software, 1996) and *Minecraft* (Mojang, 2011) online communities have longstanding and prolific traditions of developing and sharing skins for most game objects, allowing players to customize their avatars to look like versions of themselves, favorite TV characters, or even characters from other video games, as well as the appearance of other game objects. In this case, "reskinning" arises out of networked fan cultures and is a practice that extends the game world to include creative acts other than playing, like designing, distributing, commenting, voting, and more. Similarly, skins and reskinning practices abound in multiplayer online games (MMOs) like *Second Life* (Linden Lab, 2003), where avatar customization can be the basis for social interaction and play within the game world.

Developers also harness the modularity of skin and mesh to drive player engagement, in-game economies, and game sales. In MMOs like *Overwatch* (Blizzard Entertainment, 2016), *Fortnight* (Epic Games, 2017), and *Apex Legends* (Respawn Entertainment, 2019), developers release cosmetic skins in "loot boxes," randomized collections of consumable and cosmetic items that reward players for completing in-game missions and challenges. These cosmetic skins alter the appearance, but usually not the behavior, of the player avatar or other in-game objects.[41] Finally, modular skins also enable the corporate practice of using existing game source code and redeploying it with different graphics.[42] This development strategy maximizes a studio's capacity to re-engage players that have exhausted a game's levels or can help market the game to new market segments while also minimizing the amount of development work required to design or program a new game. Popular match-three mobile games like *Candy Crush Saga* (King, 2012) and its confectionery siblings—*Candy Crush Soda Saga* (King, 2014) and *Candy Crush Jelly Saga* (King, 2015)—exemplify this corporate min-maxing. At its core, reskinning describes the practice of changing the way a game or game object looks, not how it acts. Reskinning is a practice of substituting one surface for another that is only possible because skin is a logically modular, substitutable, and functionally equivalent attribute of a given game object.

[41] There is significant player experimentation and documentation regarding the impact of cosmetic skins in competitive MMOs like *Apex Legends*. For example, in 2019 reddit user superzaropp posted a side-by-side comparison of *Apex Legends* character Pathfinder to demonstrate the ways that the hitbox, which is mapped to the actual character mesh, is much smaller than the "Legendary" skin projected on its surface. This resulted in players shooting at the character, and it appearing to hit the character, without a hit registering by the game system because the skin exceeded the size of the hitbox/mesh. Though the character appears quite large in the game, the areas on it that actually result in damaging the character (the core mechanic of this game) is far smaller than the skin would suggest, potentially conferring players who chose to play this character strategic advantage over others. superzaropp, "Pathfinder's in-Game Model vs Hitbox (Picture Comparison)."

[42] I'm drawing a distinction here between reskinning and "cloning," which describes the practice of a developer copying or cloning an already popular game like *Flappy Bird* (dotGears, 2013), reverse engineering it, rebranding it, and releasing it under a different name. Particularly pervasive in the mobile game market, this strategy allows developers to capitalize on a viral gaming trend. In the case of *Flappy Bird*, the developer's decision to pull the highly downloaded application from mobile application stores in February 2014 spawned a host of free mobile clones of the game.

The modularity of skin has inspired some game scholars to lionize procedurality when analyzing games. For example, game scholar Espen Aarseth writes, "the game's "skin" or representational layer is interchangeable and therefore often inconsequential for the seasoned gamer, just as the scenery along an oft-traveled road becomes all but invisible for the frequent traveler."[43] For Aarseth, skin, the human-visible surface of game objects, recedes from view precisely because of its ubiquity and modularity. While it may be true that skilled players learn to ignore how a game looks as they develop a deep understanding of how a game plays, this position renders illegible the vast array of player and developer practices that focus primarily on skin. Aarseth's ludological approach fails to acknowledge that skins in video games exist at the nexus of human and machine interpretability: skins interface human players (and their cultures) with the abstract mathematical 3D representations that make play legible to the human's hardware and software interlocutors. Furthermore, Aarseth's perspective glosses over the many ways in which the surface of game objects are procedurally rich, subject to a wide away of shaders, small programs that take in graphics data and alter how game objects are rendered, generating effects like moving water, dynamic lighting, and more. Finally, Aarseth's analysis fails to acknowledge how skin as the surface of a (human) body, the thing to which this software metaphor refers, is exceptionally burdened by meaning in contemporary culture.

This failure to acknowledge the relationship between skin, digital visual representation, and how those representations are both products of and productive of contemporary culture is part of a larger tendency to cordon off videogames from cultural discourse.[44] Tara Fickle argues that the

---

[43] Aarseth, "Ludology," 188.
[44] It has become a trope of interviews with game developers and publishers to claim that their games, often with overtly political subjects like war, revolution, and enslavement, are "not political." This refrain is so common that online gaming magazine *Kotaku* has satirized this claim, producing a MadLibs version of the standard disavowal.

logic that makes racialized segregation, oppression, and exploitation possible is the same logic that makes it possible to believe that games have no political impact. She writes, "there is […] an important and overlooked symmetry between the racial logic that undergirds spatialized systems of oppression and exploitation and the ludic logic crucial to securing our perception of games as games—that is, as a fantastic virtual world that is Other than the real world—and vice versa."[45] The need to regard games as separate from politics and culture, to disavow them as cultural actors and refer to them as "just games," does little to unseat, and may in fact reproduce oppression. Soraya Murray likewise addresses the scholarly failure to understand games as embedded within and productive of contemporary culture, arguing that "to play video games is to engage with the myths of a constituency whose access, agency, and ability to wield the technology allows them to communicate their wishes, fears, dreams—and even identity politics—through a form of interactive entertainment."[46] Both Fickle and Murray argue that game studies needs to be grounded in the political and social repercussions of representation. This chapter builds on this strain of scholarship, demonstrating how we might expand the frame of this kind of analysis to include critical considerations of the tools and technologies that (quite literally) render skin, and how those technologies relate to cultural norm and hegemonic power structures. This chapter articulates how skins, the seemingly cosmetic outer surfaces of game objects, are crucial sites of cultural mythmaking from *both* programmatic and narrative perspectives.

"Ubisoft Doesn't 'Want To Make A Political Statement Specifically About Cuba' With Far Cry 6"; Alexandra, "The Division 2 Is Political, Despite What Its Developers Say"; Dayus, "Ghost Recon Breakpoint Not Making Political Statements, Ubisoft Insists Despite Obvious Themes"; Grayson, "Despite Political Overtones, David Cage Says Detroit Is Mostly About Androids"; Zwiezen, "Ubisoft Insists Latest Game, [INSERT NAME], Isn't Political [Update]."

[45] Fickle, *The Race Card*, 7.

[46] Murray, *On Video Games*, 27:3.

In this chapter, I focus on two videogames—*Detroit: Become Human* (Quantic Dream, 2018) and *Sunset* (Tale of Tales, 2015). *Detroit* is a top-selling AAA videogame designed as a PlayStation 4 exclusive title. *Sunset* is an independently published "art game" released for PCs that was deemed a commercial failure by its own developers.[47] Both are in the same narrative-heavy genre—adventure games—and both received middling reviews for their narrative writing by the games press.[48] Though neither of these games achieved great critical success, they both demonstrate a tendency for the technologies used to develop videogames to allegorize the narrative of the games themselves.

To be clear, I attend to the software metaphor of skin in video games not because I think that identities like race or gender *should* impact play in the same way that they impact people's experiences moving through the world, but rather because I believe that thinking critically about how representation happens in games, having a clearer understanding of how video games technologically and culturally take up "skin" as a software metaphor that describes the surface of

---

[47] O'Brien, "After Sunset."

[48] In general, critics panned Quantic Dreams' reductionist and defanged discussions of the continuing legacies of enslavement and anti-black racism in the United States. Games journalists Evan Narcisse critiques *Detroit's* "ham-fisted" allusions to the Underground Railroad in a plot arc in which Kara and the child she is charged with caring for, Alice, try to escape the segregation and abuse of androids in Canada. Yussef Cole critiques Quantic Dream's "paper-thin allusions to America's civil rights struggle," describing Quantic Dream's evasions of real discussions of the repercussions of racial capitalism as serving players "milquetoast Martin Luther King Jr. quotes and Instagram-ready parables about equality and freedom." Finally, Ian Graber-Stiehl critiques the studio's reductionist and binaristic portrayal of direct action, noting the possible repercussions for real-world movements for racial justice. Tyler Wilde describes *Sunset* as "overwritten," noting the disconnect between individual play strategies or choices and the overall plot arc of the game. Steven Hansen described Angela's monologues as too "on-the-nose," also noting the disconnect between Angela's monologues and character choices within the apartment. Narcisse, "Sunset"; Cole, "'Detroit' Siphons and Squanders a History of Marginalized Struggle"; Graber-Stiehl, "Quandry of Blackness"; Wilde, "Sunset Review"; Hansen, "Review."

all objects (not just humanoid avatars), may help us as players, developers, and critics, to envision ways of challenging the grain and default settings of videogame technologies.[49]

The intersection of feminist theory, critical race theory, performance studies, and the study of representational technologies allows me to think across the technological and the cultural. This chapter begins with a look at Frantz Fanon's consideration of how racial identity became intelligible at the level of the skin. Through the example of a tech demo, "Kara," created prior to the publication of *Detroit*, I argue that skin is often reductively made to be synonymous with racial identity in video games, demonstrating how the technologically mandated modularity and prototypical whiteness of digital skin ultimately impacts and determines the stories we can tell through it. I then offer a close reading of how the skin-based technologies demoed in "Kara" undercut the narrative arc of the full-length game, *Detroit: Become Human*. I close the chapter by considering how Tale of Tales utilizes photorealistic video game technologies to propose a different set of relations with skin in *Sunset,* relations that rely more on reflection and distortion than one-to-one realistic representation or mimesis. Overall, this chapter seeks to position skin as a crucial software metaphor in the study of new visual technologies, while also offering some speculative openings about how we might rethink what we mean when we talk about "diverse representation" in video games.

White Normativity and the Technologies of Skin

The "Kara" tech demo by Quantic Dream premiered at the Game Developers Conference in March 2012, six years prior to the release of the full-length videogame *Detroit: Become Human*.

---

[49] My position here is inspired by Adrienne Shaw, when she writes, "a better argument for representation can be made by focusing on the way diverse media gives us space to imagine the world differently." Shaw, *Gaming at the Edge: Sexuality and Gender at the Margins of Gamer Culture*, 11.

The seven-minute clip follows Kara, an android, as she is assembled and sent off for retail. Though it may look like any other computer animated film, this demo is a real-time 3D animation designed to showcase Quantic Dream's new game engine as well as the improved rendering capabilities of the PlayStation 3 hardware. The demo begins with a close-up shot of Kara's disembodied head as it rotates 180 degrees in the vice grip of a robotic factory arm. The shot highlights the translucency of Kara's skin, juxtaposing the glossy factory arms with the anthropomorphic and "realistic" skin on Kara's face. In a composition reminiscent of Botticelli's *Venus*, Kara is pieced together by the disembodied male voice that controls the robotic arms. The voice commands Kara to move her arms, and she complies, marveling at the white skin that seeps through the even whiter, glossy surface of her android body. Accompanied by a sound effect that sounds a like stirring a bowl of Jell-O, Kara strokes the excreted skin on her arms in wonder. Lowered from the grasp of the mechanical arms she takes her first steps. The camera pans out from a close-up of her joyful face to a three-quarter shot that captures her fully nude body as she turns for the camera. Fully covered in "realistic" skin, she becomes cognizant (and ashamed) of her own nudity: as she covers herself with her hands, the male voice declares, "you're ready for work, honey" (Figure 1.2).[50]

[50] *Quantic Dream's "Kara" PS3 Tech Demo @ HD ✓.*

Figure 1.2: Still from "Kara" (Quantic Dream, 2012). *"You're ready for work, honey." Still taken by author. Rajman Gaming HD, "Quantic Dream's "Kara" PS3 Tech Demo @ HD," 8 March 2012, Accessed 5 May 2021.*

In this demo, Quantic Dream's engineers show off the myriad ways in which they have endeavored to simulate the physical properties of light in a real-time graphics application. Robotic arms glint and gleam as if made of metal and plastic as they move fluidly to assemble Kara's body. Lens flares originate from overhead lighting and punctuate the sweeping wide-angle shots of Kara's assembly as if a camera with a lens made of glass were responsible for capturing this scene. Kara's skin seeps onto her body as she is fully assembled; the outer surface of her body transitions from a physical material that reflects light to one through which light is diffused, as if she had real human skin. In his 2018 Game Developers Conference (GDC) talk about *Detroit*, Lead Graphics Programmer Ronan Marchalot explains that physically based rendering and skin and eye shaders were a priority for Quantic Dream in their engine development process, something evidenced in the profusion of shader-based visualizations in this demo.[51]

Shaders leverage the parallel processing power afforded by graphics cards and make the surfaces of game objects (including representations of epidermis) responsive to the conditions of the scene in which they are placed. Shaders algorithmically calculate the appearance of each pixel, dynamically adjusting the appearance of game objects without altering the underlying graphics data they take in, which includes mesh, skin, and any other texture maps. Shaders are powerful tools for visual representation, responsible for everything from dynamic lighting effects, which allow light and shadow to play on the surface of an object as it moves through simulated space, to the appearance of curved surfaces. For example, in Unity, a popular commercial game engine, each game object has a material attribute which tells the engine which shaders to apply to that object in the rendering pipeline.[52] As both Marchalot's GDC talk and the profusion of shader-based effects in the "Kara" demo suggest, shaders are an essential part of how skin (both the surface of all game objects and mimetic human epidermis) are not merely visual but also programmatic, subject to manipulation by the algorithms that dynamically manipulate the game object's skin layers.

[51] In this talk delivered at the Game Developer's conference, Marchalot describes the "six pillars" of the new Quantic Dream engine as clustered-forward rendering (a way of optimizing rendering speeds by strategically updating clusters of pixels, rather than tiles of a screen), temporal anti-aliasing (a way of jittering pixels to smooth the edges of rendered objects and reduce the visual side effects of the downsampling required for real-time rendering), physically based rendering (including physical camera effects like bokeh and volumetric lighting), character skin and eye shaders, special particle effects like rain and snow, and minimizing loading screens and loading times. Marchalot, "Cluster Forward Rendering and Anti-Aliasing in 'Detroit."

[52]Unity 5 and beyond uses a standard shader for all of its physically-based rendering. This standard shader allows developers to customize materials through the adjustment of parameters like albedo (the ability to reflect or absorb sunlight – dark colors have low albedo), metallic, and smoothness. This replaced Unity's "more than 80" built-in shaders with pre-set values for how light would interact with the surface of objects. Unity Technologies, "Unity - Manual."

Kara's skin is the proving ground for Quantic Dream's new proprietary game engine. In the seven short minutes of the demo, Kara's skin transforms three times, a repetition that underscores the technological achievements represented by Kara's translucent white skin. As mentioned above, the demo's opening shots counterpose the android components that make up Kara's body with the non-anthropomorphic, robotic arms of the factory line that assembles her. In these first establishing shots, Kara's skin glows as though lit from within, while the robotic arms that assemble her appear glossy, reflecting the sterile laboratory light. This juxtaposition is central to understanding the rhetoric of this clip as a tech demo: Quantic Dream is showcasing their improved physical simulations of light *through* Kara's skin. As Marchalot explains, Quantic Dream's engineers employed screen space skin subsurface scattering to approximate the translucency of human skin, a physics simulation technique that models the particulate behavior of light in which it diffuses through surface materials rather than reflecting off them.[53] Kara's seeping humanoid skin differentiates her from the factory line that constructs her because her skin absorbs light in the manner of human epidermis rather than reflecting light like plastic or metal. The contrast between the simulated physical materials of Kara's body and the robotic arms highlights the genres of realism achievable using the improved shaders of Quantic Dream's game engine.

However, Quantic Dream's appeals to graphical "realism" belies a set of assumptions and commitments that are at odds with both the narrative arc and worldbuilding of the game. David Cage, President of Quantic Dream and director of both this demo and the studio's subsequent full-length title, claimed that the enhanced visual features of their game engine would yield

[53] Marchalot, "Cluster Forward Rendering and Anti-Aliasing in Detroit"; Pettineo, "Subsurface Scattering."

graphics so realistic they would "'[allow] you to, when you have a strong light behind your ear, see that your ear becomes red.'"[54] The studio's commitment to modeling the translucency of human skin in this demo trumps the fact that Kara and the other androids of *Detroit* are narratively non-human. In this demo, Kara's skin appears as though it were flushed with red blood, despite the science-fictional narrative that suggests her android body functions without these conventions of human biology.[55] The studio's technological aspiration to render "realistic" skin belies a commitment to a circumscribed notion of what "realistic" means that contradicts what players learn about what it means to be an android in this videogame.

Despite the creative possibilities afforded by the science fictional narrative of the "Kara" demo (and *Detroit* at large), the translucency of Kara's "realistic" skin is a product of white normativity embedded in both technological and narrative registers. Computer graphics researcher Theodore Kim approaches this issue from a technical perspective, discussing the limitations of contemporary computer graphics approaches to modeling epidermis. Kim puts it bluntly; "In graphics when we talk about skin [epidermis], we're talking about subsurface scattering," a quality that is most visible in lighter skin tones, and only addresses the ways light diffuses into skin.[56] Kim's talk describes how researchers and industry professionals perpetuate a false syllogism between "realistic skin" and the translucency of white skin, issuing an invitation to researchers in the field to develop better benchmarks and methods for the simulation of darker skin tones. Games journalists Yussef Cole and Tanya DePass write about the gap between well-lit cinematic representations of dark skin, like the work of James Laxton in *Moonlight* (Barry

---

[54] Arif, "Quantic Dream Wants to 'Push the Limits' With Advanced Visual Features for PS4-Exclusive Detroit."
[55] Several missions, including episode 5, titled "Partners," in *Detroit* actually emphasize that androids are discernable from humans because the blood that circulates in their bodies is blue.
[56] Kim, "Anti-Racist Graphics Research."

Jenkins, 2016) and the lackluster renderings of dark skin in *The Elder Scrolls: Skyrim* (Bethesda, 2011).[57] Cole and DePass specifically note the "flatness" of *Skyrim*'s dark-skinned avatars, critiquing the studio's one-size fits all attitude towards its skin shaders. While subsurface scattering is an accurate method for simulating the interaction of less melanated skin, as is the case with Kara's light skin, its narrative positioning aligns the technique of subsurface scattering with "realistic" skin, a gesture that centers whiteness and regards other skin tones as a departure from a norm.

That subsurface scattering in particular, and skin shaders more generally, were how Quantic Dream marketed their game as at the cutting-edge of computer graphics and simulation points to a larger complex in computer graphics where whiteness is presumed to be and do anything. In their work on 3D animation demos, Allison Reed and Amanda Phillips coin the term "additive race," to describe how 3D animation demos "rely on the logics of white supremacy to ground reality in either the transparent universality of whiteness or the embodied specificity of people of color."[58] Their work critiques the ways that whiteness functions as a default setting in some games with character creation menus, like *Mass Effect 2* (BioWare, 2010), to the effect that whiteness becomes "a blank surface on which race *as culture* can be mapped," and race is seen as an additive and primarily visual characteristic, reducing "racialized difference to a matter of style."[59] Part of Theodore Kim's work to develop "anti-racist graphics research" is to point out how the default whiteness that Reed and Phillips describe as a design feature of some games is also deeply embedded in the technologies that are used to develop videogames at large.

[57] Cole and DePass, "Black Skin Is Still A Radical Concept in Video Games."
[58] Reed and Phillips, "Additive Race," 140.
[59] Reed and Phillips, 137, 140.

Visual technologies and the representations they produce are co-constitutive with culture, both shaped by hegemonic cultural norms and contributing to their circulation. In *Second Skin*, Anne Anlin Cheng argues that "not only do new visual technologies affect how we see racial difference but […] racial difference itself influences how these technologies are conceived, practiced, and perceived."[60] In *Skin Acts*, Michelle Ann Stephens supports and extends Cheng's claim, writing that "the visual and recording technologies of the early twentieth century facilitated the scopic act of turning a word, an element of discourse [race], into a thing, a material object." [61] Both scholars focus their studies on 20th century visual technologies and performance—primarily through the media of photography and film—but this circuit between visual technology and racial identity continues to operate well into 21st century digital visual culture.

The "Kara" tech demo continues a long-standing tradition of using whiteness, and in particular, white femininity, as an industry standard *and* as the proof of concept for new visual technologies. In "Lighting for Whiteness," Richard Dyer takes photographic and cinematic lighting manuals as his source, demonstrating the ways photographic, and subsequently, cinematic, lighting conventions were designed to reproduce white skin, and particularly white women's skin, to the detriment of capturing darker skin tones.[62] Lorna Roth documents the enduring influence of the "Shirley Card," an image of a white woman used as a reference by Kodak technicians in the process photographic emulsion to aid with balancing exposure and matching colors. Roth narrates the transformation of the Shirley Card within and beyond

[60] Cheng, *Second Skin*, 6.
[61] Stephens, *Skin Acts*, ix.
[62] Dyer, "Lighting for Whiteness."

Kodak's labs in the mid-20th century, noting the prevalence of women's bodies and white skin in the processing and calibration of images both analog and digital.[63] Sarah Lewis writes on the continuing influence of these standards of photographic realism, and specifically the bias of present-day film technology against black skin.[64] Zoë Smith addresses the variations in representations of darker skin tones in comic books, providing evidence that white skin in comic books in the 1980s was frequently represented by transparency—literally an uninked page—while brown flesh tones during the same period required colorists to employ a range of techniques to represent dark skin using only the limited palette of cyan, magenta, and yellow pigments.[65] Each of these examples evidence a larger cultural complex in which visual technology is designed to reproduce whiteness, and in particular white women, as "transparent," a default setting or standard through which all subsequent representations are wrought.

In the Quantic Dream tech demo, Kara's translucent white skin serves a strong narrative function that a solely technological perspective on skin fails to capture. As Amanda Phillips deftly observes in their own reading of this demo, "Kara's whiteness is the invocation of white womanhood as the universal sympathetic victim, supplanting historical realism (performance on an auction block) for the emotional realism of the damsel in distress."[66] Phillips points out the loaded historical resonances of Quantic Dream's demo, in which Kara's performance as both human subject and machine object evoke historical practices of enslavement and the auctioning of humans as chattel, particularly in the American context. This historical resonance becomes increasingly troubling as the demo dramatizes Kara's skin as the bearer of her qualified

[63] Roth, "Looking at Shirley, the Ultimate Norm."
[64] Lewis, "The Racial Bias Built Into Photography."
[65] Smith, "4 Colorism, or, the Ashiness of It All."
[66] Phillips, *Gamer Trouble: Feminist Confrontations in Digital Culture*, 72.

humanity: her skin acts as a fulcrum through which her objecthood and subjecthood are wrought. It is only after Kara's realistic skin seeps onto her arms that the overseer addresses her as a subject, asking her to perform her initialization text. Yet as she is hailed as a subject, she is also made an object of the male gaze. The overseer addresses her as "honey," as she faces the camera in what would be a full frontal shot of her nude figure, were her arms not covering her breasts and genitals. From one perspective, these shots are "fanservice," designed to capture the attention of the presumably heterosexual male audience interested in new videogame technologies and attending the Game Developers Conference.[67] From another perspective, Kara's nudity in this moment of address establishes her as sexually vulnerable, a positionality that is shored up by both the whiteness of her skin, and her gendered android body. Kara defends herself as "alive," a confession that prompts the overseer to begin the process of her disassembly. This sense of Kara's imperiled white femininity is underscored by the violence of the robotic arms as they tear off the scant clothing they had, just moments prior, covered her with. Her realistic skin recedes from the surface of her body which is again revealed to be glossy and white as she is captured and manipulated by the robotic arms. Kara's realistic skin coincides with her capacity to defend herself as a subject, but it also marks her as nonhuman by virtue of its technicity and modularity. In this tech demo, Kara's skin bears the exhausting rhetorical burden of these transformations.

Epidermalization and the Visualization of Identity

Detroit: Become Human is an episodic adventure game set in the American city of Detroit in the year 2038. The plot follows three protagonists, all of whom are androids developed

---

[67] Fanservice is a term usually employed to describe a repertoire of sexual/sexualizing poses and perspectives in Anime and Manga. Russell, "The Glimpse and Fan Service."

by fictional tech conglomerate CyberLife. Kara (the same character from the tech demo) is a standard issue maid android tasked with caring for a child named Alice; Connor is a special-issue police android investigating “deviants” alongside a human investigator; and Markus begins the game as a valet for an aging and disabled human artist who, eventually, becomes the leader of an android liberation movement. Gameplay largely consists of navigating 3D space in the third person, controlling these three characters to accomplish simple objectives while choosing between time-sensitive dialog options or completing quick-time events in action-heavy sequences.

The very first scene of the game introduces the difference between deviant and “normal” androids as primarily visual. In this scene, which also serves as a tutorial, Connor (the player character), finds a deviant android, named Daniel (an NPC), standing on the precipice of a high-rise roof. In one arm, Daniel holds a young girl over the edge. He waves a gun at the police surrounding him with his free hand, yelling, “If I die, she dies.” As Connor, the player has just a moment to choose between addressing the android by his name, empathizing with his situation, attempting to calm him down, lying, or telling Daniel that Connor is armed. As the player selects how they would like to interact with Daniel, a heads-up display (HUD) informs them about Daniel’s software stability and the probability of the mission’s success. Additionally, a small status indicator light on Daniel’s temple, similar to those on a modem or router that indicate functioning, will blink and change color from yellow to red, registering his software stability externally (Figure 1.3). This visual cue helps players understand how their choices impact Daniel’s simulated state, connecting player choice to the episode’s plot progression.

Figure 1.3 Daniel's heads-up display in Detroit: Become Human *(Quantic Dream, 2018). Still by author. theRadBrad, "DETROIT BECOME HUMAN Walkthrough Gameplay Part 1 - INTRO (PS4 Pro)," 24 May 2018, Video, https://www.youtube.com/watch?v=t3cLDDwLeJA*

Quantic Dream doubles-down on heads-up displays; one status indicator is literally on the non-player character's head, the other is a more conventional extradiegetic overlay. This duel HUD can be understood as just another example of "juice:" a design choice that maximizes the illusion of player power and control in the gameworld by providing players with multiple haptic, sonic, or visual responses to player input.[68] This game design principle is most obvious in casual mobile games, where haptic, sonic, and visual effects make simple gestures or actions (like matching three similar candies in *Candy Crush*) feel impressive such that a single move can be understood to be impactful on the overall system of the game. In the case of the tutorial scene, if the player chooses to tell Daniel the truth about being armed, the game provides immediate visual feedback that reassures the player that their choices matter: they see that their choice reduces Daniel's software stability *and* changes the status light on Daniel's face back to yellow.

[68] Kucic, "How to Prototype a Game in Under 7 Days."

The choices players make will impact the options they are given much later in the game, but their impact is also made immediately tangible as a difference visible *on* the surface of Daniel's skin. It is my contention that this decision to make what the storyworld of *Detroit* frames as an ontological shift visible is not just "juice." This is a larger design tendency in games that seeks to simplify and condense identity into the realm of the visible.

Yet, within the storyworld of Detroit, deviance appears to be particularly threatening to the status quo because deviance is not primarily visual. For Kara, the behavioral line between obeisance and deviance is metaphorized as a physical barrier that she shatters and breaks through in a series of quick time events where she disobeys the commands of her owner.[69] Markus and the other deviant androids of Jericho (a safe house for androids in fictionalized Detroit) can transfer the function of deviance between androids as if it were a program or script. Towards the middle of the game, Kara easily removes the status indicator from her face in a motel bathroom to "pass" as human and bring Alice to the safety of non-segregated Canada. The narrative design frames deviance as "dangerous" because not primarily visible, a fact that remains in tension with the game design imperatives that demand such transformations be visualized.

As players progress through the game, the power of their decisions to effect change continues to be visualized as changing visible surfaces of non-player and player characters. When the player as Markus chooses to "awaken" other androids to their conditions of enslavement, this internal change of sentiment registers as an external change of their status indicator light from blue to red and back again, as well as a momentary exposure of their glossy

[69] A quick time event is an event that usually requires a player to press a gamepad button or a series of buttons within a short span of time to accomplish an action in-game. Some quick time events require the repeated pushing or "mashing" of a single button input for the duration of the event. These events often occur in the context of cinematic sequences or cut scenes.

android skin. The designers of this game focus on making visible something that is narratively not visual, following a convention within games to condense or simplify the non-visual components of identity (like the state of being deviant) as visual for the sake of gameplay.

My attention to this operation is inspired by the work of psychoanalyst and philosopher Frantz Fanon, who, writing in the technological context of the mid-20th century, describes how skin, the visible surface of the human body, becomes culturally meaningful. Fanon offers the term "epidermalization" in *Black Skin, White Masks* (1952) to refer to the efforts of the white colonial gaze to delimit ways of being in the world by writing race onto the outer surface of the body. Fanon proposes that white coloniality conditions an "epidermal racial schema," inscribing race on the skin of the body of the colonized.[70] For Fanon, race is written, it is semantic, but it is also a narrative construction that is put on and felt through the skin of the body. The epidermal racial schema is but one of several possible bodily schemas that both capacitate and delimit the body's way of being in the world. Bodily schemas are not generalized or generalizable, but are instead subjective, particular, and related to contingent historical distributions of power. Though Fanon writes to address the limitations of mid-20th century theories of the mind promulgated by Freudian psychologists, his description of epidermalization gives language to the ways that the technologies of skin allegorize the narratives written onto those skins. Epidermalization helps describe the unfortunate slippage between skin as the attribute responsible for making visible the abstract mathematical representations of 3D objects in videogames and skin as the locus of identities like race and gender.

[70] Fanon, *Black Skin, White Masks*, 92.

The relationship between identity and visible surface has been studied by other scholars in other videogame contexts. For example, Amanda Phillips discusses how choosing to play as the female version of the protagonist, Commander Shepard (colloquially called "FemShep"), in *Mass Effect 2* changes the appearance of the player avatar, but does very little to meaningfully alter how Commander Shepard inhabits and interacts in with the gameworld. Phillips identifies the many ways in which "BroShep" (the male version of Commander Shepard) serves as the "index for all other characters in the game," where gender and racial difference appear in the game as merely cosmetic alterations, "surface characteristics on an avatar."[71] Phillip's larger analysis of FemShep brings to the fore exactly how gender, something that richly structures human experience, becomes operative primarily *as* skin, the surface of game objects in *Mass Effect 2*. "Deviance" in *Detroit* is ultimately not quite as simple as a skin swap (like gender is in *Mass Effect 2*), but the studio's insistence that deviance be visible/visibilized is part of the larger workings of neoliberal multiculturalism.

Skin-based transformations in *Detroit* work in the service of the player experiences of power over the narrative and environment, and they also promulgate a neoliberal multicultural politics that recenters whiteness as the default and norm. Jodi Melamed describes neoliberal multiculturalism as "overlay[ing] conventional phenotypical racial categories with new systems for ascribing privilege and stigma, interjecting flexibility into race procedures" while also disavowing overt racisms invested in biocentric or essential definitions of race.[72] Quantic Dream's storyworld takes pains to offer "equal opportunity" representation: androids and humans come in a range of skin tones, shapes, ages, and sizes with masculine and feminine

---

[71] Phillips, *Gamer Trouble: Feminist Confrontations in Digital Culture*, 147, 138.
[72] Melamed, "The Spirit of Neoliberalism."

signifiers. However, androids, like Kara in the tech demo, are all prototypically white: their realistic skin masks their glossy white android skin.

This transformation is foregrounded in the climax of deviant android Markus's plotline. Markus (the player character) and his deviant comrades Josh, Simon, and North (non-player characters) storm Channel 16 news in a series of events involving a stolen window-washing scaffolding, laser cutters, and a dramatic scene where Markus and North scale the glass façade of the skyscraper to the top floor. After a scuffle with the guards outside of the broadcast control room, Markus stands in front of a green screen, preparing to deliver his address to the humans of Detroit. Before he can start, Simon intervenes, saying, "Markus, your face." In an almost fourth-wall breaking moment of self-referentiality, the HUD indicates that the player should press the right joystick up and hold it there to "remove skin" (Figure 1.4).

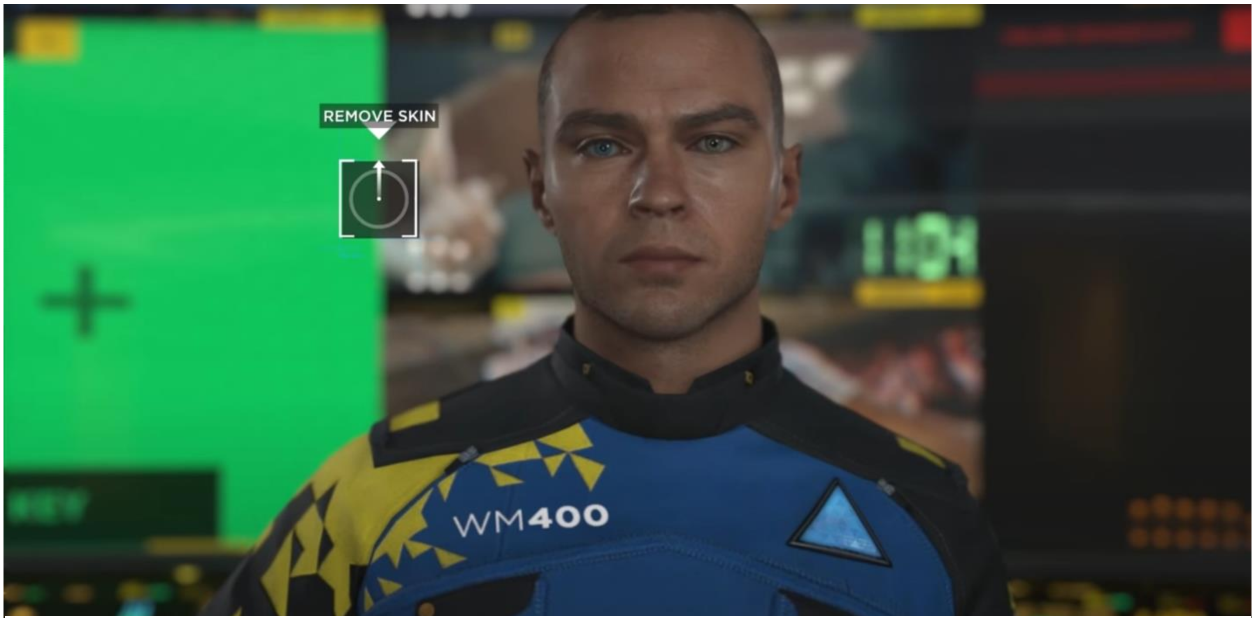

Figure 1.4 Prompt for Markus to remove his skin in Detroit: Become Human *(Quantic Dream, 2018). Stills by author. VGS - Video Game Sophistry, "Detroit: Become Human - The Stratford Tower Perfect Run // A Plan Comes Together Trophy,"28 May 2018, https://www.youtube.com/watch?v=_SuPnzu9Jno*

Completing this action (required to progress in the story), causes Markus to touch his temple and close his eyes, draining his realistic skin from his face to reveal the white and gray "true" surface of his android body. In a strange reversal of Fanon's book title, Markus relays his demands for android liberation, a pastiche of American 20th century civil rights and 19th century abolitionist demands reskinned, glossy and white (Figure 1.5). [73]

Figure 1.5 Markus removes his skin in Detroit: Become Human *(Quantic Dream, 2018). Stills by author. VGS - Video Game Sophistry, "Detroit: Become Human - The Stratford Tower Perfect Run // A Plan Comes Together Trophy,"28 May 2018, https://www.youtube.com/watch?v=_SuPnzu9Jno*

In light of this understanding of the ways that videogames condense identities like race and gender into the regime of the visible via skin, I want to return to Aarseth's ludological argument in which he describes skin as interchangeable and therefore "inconsequential," receding from view for the seasoned gamer. As this example has demonstrated, the surfaces of game objects, and particularly when they represent epidermis, are often the concentrated site of identity in

[73] The demands in the game include recognition, an end to slavery, equal rights, free speech, justice, an end to segregation, a right to work, universal suffrage, a right to own property, the control of the means of production, and sovereign territory - all of which can be relayed in "peaceful" or "determined" moods. The "determined" mood appears to be a euphemism for militant direct action; working in this mood gives players the option to destroy and deface public and private property, as well as the option to kill a (human) cop.

games. In the case of Markus's de- and re-skinning, their interchangeability is both foregrounded and deeply meaningful, in terms of the hegemonic cultural norms it belies and the story the studio attempts to tell.

Reflective Skins in *Sunset*

Detroit, for all of its investments in engine efficiency, photorealism, and new rendering technologies, offers an example of how videogame technologies are being used to collapse identity into skin, showing how skin, as a software metaphor, is a powerful tool of foreclosure. I offer *Sunset* as a counter example of how developers use commercial game engines in ways that defy common development practices that relegate identity to a visible surface rather than foregrounding identity as relational, thereby limiting what representation is and can do in games. In *Sunset*, Tale of Tales stages refusals—of win/fail states, generic convention, gamified labor, and computational efficiency—and they also provide alternatives for how we might reconceptualize how we characterize representation in games. By foregrounding reflection computationally and narratively, *Sunset* uses skin, the visible surface of game objects, to render boundaries and relations. Skin is not simply where representation happens; an unplayable and visual phenomena. Tale of Tales uses real-time rendering technologies to rethink the surfaces of objects as layered, relational, and porous.

Sunset is set between May 1972 and March 1973 in a fictional South American country and focalizes around Angela Burnes, a highly educated Black American expatriate who now works as a house cleaner for art collector Gabriel Ortega. Every day, Ortega assigns Angela a set of domestic tasks. Gameplay consists of navigating the lush 3D interiors of Ortega's mod bachelor pad from the first-person perspective, completing these tasks before the sun sets and the game advances to the next day. Players can choose to do as much or as little domestic work as they please without the risk of ending the game prematurely: the game lacks win or lose conditions recognizable as such, and a failure to complete assigned tasks has little influence on the course of the game's narrative. Eventually, time will pass, and the player will be forwarded to the next day.

Figure 1.6 Angela's reflection on the surface of the elevator in Sunset (Tale of Tales, 2015). *Screenshot by author.*

The videogame begins with an image of the protagonist, Angela, reflected on the surface of the elevator door. As she enters Ortega's opulent penthouse, the player catches glimpses of Angela's body on the glass façade of the penthouse and the mirrors in the guest bathrooms, where Angela pauses to adjust her afro. As players explore Ortega's apartment to complete their tasks, their movement is constrained by reflective glass doors that impede access to certain areas of the house, depending on the day. Text adventure developer Emily Short describes this quirk of Tale of Tale's environmental design as a "middling" device to direct player interaction and limit player movement.[74] While certainly the closed doors do help players locate the chores they are assigned to complete, Short's design-centric critique misses precisely what the unopenable glass doors reveal: Angela's reflection. Unlike locked doors in other adventure games, these doors are not part of a larger puzzle – there's no solution, no code, no key to be found, and no way around them. *Sunset* is designed so players eventually meet dead ends, only to see Angela's reflection looking back at them (Figure 1.6).

Rather than revealing a passageway or hidden secret, the reflective doors in *Sunset* reveal that Tale of Tales chose to include a fully-animated character model for Angela, balking a convention of the first-person adventure game genre. The metonymic relationship between the player and the first-person camera perspective in adventure games can be traced back to Cyan's influential *Myst* (1993).[75] In a game postmortem given at the Game Developers Conference in 2013, developer Robyn Miller described immersion as the design principle behind their choice to

[74] Short, "Sunset (Tale of Tales)."
[75] Another popular first-person game, *Doom,* was released three months after *Myst.* Robert Yang details the popular reception and cultural influence of *Doom*, a combat-heavy shooter game. Yang argues that *Doom's* popularity made it nearly synonymous with the first-person perspective, such that subsequent first-person titles would be called "Doom-clones." Throughout this series, Yang also speculates about the games that might have been made had *Myst's* puzzle-driven adventures not been eclipsed by *Doom's* gun-centric gameplay. id Software, "Doom"; Yang, "A People's History Of The FPS, Part 1."

tell *Myst* from the first-person perspective. The goal of this camera perspective was to allow the player to become "the main character. You didn't have an avatar or anything like that. You were just sort of in the world, and you were the person in that world, wandering around."[76] Indeed, *Myst* doesn't attempt to cast the player in any particular role; its use of direct address narrates the player as embedded within the game world, something that is reinforced by the lack of an avatar within the game. More recent entries in the first-person 3D adventure game genre like *Dear Esther* (The Chinese Room, 2012) and *Gone Home* (Fullbright, 2013), narratively cast the player into a particular role but don't include rendered avatars. For example, *Gone Home* is told from the perspective of Katie Greenbriar, a teen returning home after studying abroad. As players investigate the Greenbriar's abandoned home, they hear Katie's narration, but never see her. *What Remains of Edith Finch* (Giant Sparrow, 2017) and *Firewatch* (Campo Santo, 2016) are notable exceptions, at times featuring the arms and legs of the player character in view of the game's virtual camera. Tale of Tales includes both a fully-rendered and animated character model for Angela and provides players with many opportunities to encounter Angela's reflection on the many shiny surfaces of Ortega's apartment. This artistic choice questions *Mysts's* design logic: Does no body stand in equally as well for every body? Does every body serves every story all the same? Despite the first-person perspectival camera, players in *Sunset* are not "the person in that world;" they frequently encounter the fact that they may be controlling the first-person camera, but this is Angela's story.

From a technological standpoint, *Sunset* works against its own computational best interest to make the player-character game object not just visible, but specifically only visible as a reflection on the surface of other game objects. Were a player to direct their in-game camera

[76] Miller, "Classic Game Postmortem: Myst."

down in hopes of looking at Angela's feet, they would find that Angela's body is not visible from the first-person perspective. Her body is only visible as a reflection, as skin, the visible surface of another game object. Tale of Tales accomplishes this by employing real-time reflections on select surfaces, like glass doors and mirrors, in the game environment.[77] Realtime reflections are computationally expensive: each realtime reflective surface greatly impacts game performance, where performance indexes the amount of useful work the computer is able to accomplish in a given amount of time. Poor game performance often registers as a drop in number of frames rendered per second. In Unity, the game engine used to develop *Sunset*, reflections rely on information from what is best described as another camera that is positioned in 3D space that then projects what it captures as a skin onto the surface of another game object. Each of the reflective doors, mirrors, and windows in the game that reflect Angela's image are effectively additional in-game cameras just like the game object the player controls. The Unity manual specifies that "the rendering overhead is generally more significant at for [sic] realtime probes than for those baked in the editor. Updates are potentially quite frequent and this can have an impact on framerate if not managed correctly."[78] Notably, achieving probe updates that are "synchronized exactly with the appearance of surrounding objects" is described as having a "prohibitive" processing cost.[79] Tale of Tale's insistence on representing Angela as a reflection wrought on the surfaces of the environment she is contracted to clean and care for actually may cause the game to slow down as the user's graphics hardware meets the demand to render these real-time reflections.

[77] Notably, Ortega's apartment contains many shiny and reflective objects, but not all of these employ real-time reflections. Many use reflection probes and have pre-rendered textures that make them reflective of the static elements of the environment, but not Angela's moving body.
[78] "Unity - Manual: Reflection Probe Performance and Optimisation."
[79] "Unity - Manual: Reflection Probe Performance and Optimisation."

It is a bit counterintuitive to discuss framerates and computational performance in a game whose win conditions (if, we are to consider this game to have any) are unlikely to be impacted by hardware performance. Framerate is tied to a player's unique hardware configuration, and changes in framerate are often sub-perceptual (unless a player has enabled a framerate overlay or has trained to be highly attuned to such shifts). In 2020, playing *Sunset* using a GeForce GTX 570 graphics card, my framerate ranged from a benchmark of 60 frames per second (FPS) plummeting down to 20 FPS.[80] Looking at any real-time reflective surface (mirrors, windows, glass doors) generally halved my framerate to around 30 FPS. This drastic framerate drop was palpable during my play sessions and was likely due to the increased computational load of rendering real-time reflections in the surfaces of Ortega's mansion. As more reflective surfaces entered into view, time seemed to proceed with a jagged texture, resulting in momentary losses of control, a disjunctive lag that opened up and prolonged my experiences of gazing at Angela's reflection.

The proliferation of Angela's reflections enacts a computational slow-down that can then be perceived (depending on the hardware configuration of the player) as a different temporality marked by judders or sharpness, not smooth, not "realistic," and not approximating the fidelity of visual information we perceive in the real world. Tale of Tales works against the "grain" of the Unity engine, which discourages developers from using real-time reflections on multiple surfaces in the same scene (seemingly confining the effect to isolated mirrors or windows). Tale of Tales instead adopts a design strategy that sacrifices computational efficiency and smooth performance

[80] The GTX 570 debuted in 2010, making it already outdated technology in the context of the game's initial release (and quite ancient relative to the graphical demands of games being released in 2020). It's likely that top-of-the-line hardware configurations in 2015 would not have registered this framerate drop in quite the same way, though because Tale of Tales tends to develop art games, it is plausible that many players may have been playing on computers without specialized graphics accelerators and may have encountered this during their play sessions.

to proliferate Angela's reflection in the environment. I interpret this proliferation as a way of staging "poor performance," meaning that the game sacrifices fast rendering speed and a normative relationship to the work of visualizing the avatar's body to instead foreground reflection.

Tale of Tale's maximalist commitment to costly real-time reflections lines up with the in-game actions available to players that include refraining from work, resting, and self-reflection. The tasks players are asked to complete by Ortega are uneventful—cleaning windows, tidying papers—and as non-events, the player never gets to see the cleaning process, just the progression of the sun towards the horizon. Completing tasks in the game condenses the amount of real-world time it takes for the hour of in-game time to pass. Time moves faster when Angela labors, thus, completing all the assigned tasks limits the amount of time the player has to explore the apartment before the sun sets. Accordingly, refusing to complete the assigned labor leaves players more real-world time to explore the apartment. While exploring, players can collect books from Ortega's library, encounter records they can play (featuring commissioned performances recorded for the game), and respond to notes from Ortega. Perhaps one of the most narratively important tasks players can undertake, however, is to locate a slipcovered chair that moves between days around Ortega's apartment and opt to sit and rest. As the player continues to refrain from interacting with the game, Angela's diary entries appear in an overlay on the screen, simultaneously voiced by Tina Marie Murray. In these entries, Angela reflects upon the world outside of Ortega's apartment, describing a recent military coup, the difficulties of living abroad, the frustrations of underemployment, and the loss of her brother. The computational slow-down incited by the proliferation of Angela's reflection across the surfaces of Ortega's home transposes the in-game refusal of labor into something that happens both narratively and computationally.

This refusal is a critique of the ways that games both replicate and contribute to extractive economies of play. In some games, players take on the labor of “gold farming” acquiring rare loot items, time-consuming achievements, or well-managed accounts, and selling them in exchange for out-of-game currency.[81] Angela’s work also recalls the rhythmic interludes of “casual games” that emotionally mediate the precarity and discontinuity of the neoliberal workplace through feminized, repetitive labor, which is experienced as play in games like *Diner Dash*.[82] Tale of Tale’s body of work demonstrates a long-standing interest in not playing as a form of interaction with games. In *The Path* (2009), when a player stops controlling the game, eventually a young spirit will approach them and guide them to a different area on the map with a playful dance, sometimes holding hands with the player character. A player patient enough to allow this simulation to unfold will be brought to locations in the environment that trigger larger story events for each of the six player characters. In both *Sunset* and *The Path*, not playing the game is a viable play strategy; the lack of input is as important to the game as the actions players choose to take.

But *Sunset* is more than a hall of mirrors. The reflective skin of the penthouse windows that separates and insulates Angela from the rest of the city is also porous, it connects the goings-on of the apartment with the outside world, just as the game itself is a reflective of American politics in 2015. Players are remined of the permeability of boundaries between inside and outside, the porosity of the window-skin we perceive as a boundary, when, in week nine, the

---

[81] Tai and Hu, “Smart Play.”

[82] See Anable, "Rhythms of Work and Play," Playing with Feelings and “Casual Games, Time Management, and the Work of Play.”

windows are shattered by bomb shrapnel. As the weeks continue, the world on the other side of the windows erupts in flames: the people, including Angela and her employer, revolt against a dictator backed by western superpowers in a fight for their freedom. Angela's brother, David, becomes incarcerated by the government for his involvement in the revolution. Developer Auriea Harvey describes this choice to set *Sunset* inside an apartment:

> The focus of *Sunset* is on what happens in regular people's daily lives. Today, we are all living our lives while in the background a war is going on. [...] *Sunset* is about all of our lives, the lives we all lead: in our peaceful apartments while the world is burning outside.[83]

The revolution I encountered on my computer screen reflected the world on the other side of my computer screen: The game was released May 21st, 2015, just weeks after public unrest in Baltimore after Freddie Gray was tortured and killed by Baltimore Police. I first played the game in August 2015, shortly after a white supremacist murdered nine people at prayer on June 17th, and nearly on the day of the year anniversary of Michael Brown's murder in Ferguson, Missouri. Philadelphia, the place where I played, was erupting in solidarity protests against these extrajudicial murders and in defense of Black life. Returning most recently to the game in the summer of 2020, the game resonated with the experience of an isolated and extended quarantine period during the ongoing and sustained uprisings after the murders of Tony McDade, Breonna Taylor, and George Floyd at the hands of police. In this case, the puncturing of the reflective skin on the windows also prompted a puncture in the line between the game and the world outside of the game.

The profusion of real-time reflections in *Sunset* offers an alternative model of representation where skin is relational and porous. Critic Tyler Wilde writes, "*Sunset's* protagonist comes in two forms: one is a character in the story, and the other is a reflection of the

[83] Harvey, On Politics.

player and game designer, a distortion. The real Angela, I think, is the one who exists without me."[84] Instead of adopting the tactic of not visually representing the player character as genre convention might dictate, and instead of proposing a one-to-one relationship with a real human performer that underwrites and makes the performance of the avatar narratively coherent, Sunset's approach to representing their first-person character that is so reliant on reflection actually opens up representation to something that isn't mimesis – to creative distortion that opens up playful possibilities.

Conclusion

This chapter focuses in on skin as just one component of the mechanics of representations, those video game technologies and industry standards that work to define and naturalize how and where games can make meaning. I offer up this close look at skin, the visible surface of game objects, because skin—often specifically the covering of player characters, but also the visible surface of all 3D game objects—is frequently dismissed within the field of game studies as non-essential to meaning-making in games. On the contrary, in this chapter I have argued that skin is a crucial site of analysis that requires significant understanding of both the processual elements of video games, the culture in which games are played, and the player strategies adopted in relationship to these skins. I argue against what I call the "epidermal schema" of games that collapses identity into skin, and offer an alternative to this by demonstrating how developers, like Tale of Tales, are using game technologies to rethink representation in games, offering skin up as relational and porous.

[84] Wilde, "Sunset Review."

Chapter Two

Polygonal Perversity: The Erotic Logics of Interpenetration

Figure 2.1 A non-player character interpenetrates with a highway barrier in Cyberpunk 2077 (CD Projekt RED, 2020). *Still by author. Kudos, "10 Minutes of Cyberpunk 2077 Bugs...", 12 December 2020, https://www.youtube.com/watch?v=RXLohSvTKpg*

Interpenetration describes the phenomena in videogames when seemingly separate, supposedly solid objects briefly trouble each other's boundaries. In Figure 1, reddit user Savagely_Rekt captures the interpenetration of a (presumably recently killed) non-player character (NPC) and a highway barrier in the world of CD Projekt Red's 2020 release of *Cyberpunk 2077*.[85] Amidst the cyber-rubble of the overdeveloped world, the NPC—visible in this screenshot as a lower torso clad in fanny pack and gym shorts—twirls, obliquely, on the ankle of its right foot, arms thrown back in ecstasy despite its unfortunate bisection. As the clip continues, the player maneuvers their camera closer to the dervish as it recedes back into the

[85] *10 Minutes Of Cyberpunk 2077 Bugs...*

scene, documenting the assemblage as it lifts off the ground entirely. The failure of the NPC and barrier to behave "realistically," like solid objects subject to the same physical forces game players are subjected to in everyday life, indexes the separation between the appearance of solidity in computer graphics and the data structures and algorithms that subtend the behavior of these objects within the videogame engine. In this example, the NPC and highway barrier interpenetrate because the abstract volumes that mathematically represent their solid boundaries and the algorithms that determine and enforce how those boundaries behave when they touch or intersect have resolved what should have been a momentary touch—a collision—into some other relation—interpenetration. Interpenetration is generally regarded by players (including our intrepid *Cyberpunk* documentarian) as a "bug" or "glitch," notable for its immersion-breaking power, disconcerting visual effect, and inadvertent comedy. In this chapter I look to instances of interpenetration as evidence for how a videogame engine conceptualizes or describes the relationships between objects.

As Noah Wardrip-Fruin defines them, operational logics in videogames are the "foundational combinations of *abstract processes* with their *communicative roles* in the game, connected through an *ongoing game state presentation* and supporting a *gameplay experience*."[86] In his usage, operational logics hold together abstract mathematical processes, their impact on the overall game state, and how those logics and processes are communicated to a player through the act of playing. Operational logics are "foundational elements that do cultural work, that structure our understanding, and that do so in part through how they function computationally."[87] Most games share the same basic operational logics, even if the software underpinning them

[86] Wardrip-Fruin, *How Pac-Man Eats*, 46.
[87] Wardrip-Fruin, 41.

implement those logics via different methods. Collision detection is Wardrip-Fruin's paradigmatic example of an operational logic—it is a central component of many videogames, particularly in the platformer and first-person genres, and broadly enables interactions ranging from jumping to shooting to eating (as the title of his monograph suggests). His scholarship discusses the many metaphorical reimaginings of collision detection, far beyond the military applications that spurred this operational logic's development. Collision detection broadly defines the boundaries between the play space and the object you control (the player character), yet this same operational logic metaphorizes a melee hit in a combat game like *Mortal Kombat* (Midway, 1992), the consumption of a yellow dot in *Pac-Man* (Namco, 1980), and the wielding of a sword *The Legend of Zelda* (Nintendo, 1986).[88]

The observation that one operational logic, collision detection, has mutated into various grammars and meanings within video games is foundational to my inquiry. However, my approach takes a closer look at how the changing algorithmic methods for collision detection and response produce different relationships between objects. These differences become available to the player through their experience of inhabiting a game world, and what it feels like to collide, clip, or touch other objects. How then, does collision detection and response impact our experience of play and of being embodied, an object among objects, in games? While Wardrip-Fruin both gives language to and draws attention to the indispensable role of operational logics like collision detection and the stories it helps to tell, I present a more granular approach to the computational processes of collision detection and response, and what it means for the bodies that play and are played by games.

[88] Wardrip-Fruin, "Beyond Shooting and Eating: Passage, Dys4ia, and the Meanings of Collision."

Interpenetration is often colloquially referred to as “clipping.” In videogames, players are familiar with “clipping” as it relates to physical simulation via collision detection and response processes.[89] While there isn’t an official history of this association, its origins likely lie in a console command written for *Commander Keen Episode I: Marooned on Mars* (1990, Apogee Software) that allowed designers to walk through an uncompleted level to the next one in the game’s level selection menu and world map for testing purposes, though the command also circulated among players as a “cheat code.”[90] Later id Software games, like *Doom* (1993), *Doom II* (1994), and *Quake* (1996) implemented versions of this debugging tool (or cheat code, depending on your perspective) that would “turn off” collision detection, thereby allowing the first-person player character to move through previously solid walls. Today “noclip mode” is available in many 3D games and generally refers to a gameplay mode in which collision detection is disabled, which enables players to “clip” through level geometry and explore the game map.[91] Noclip.website is a site devoted to the recreation of popular games, like *Katamari Damacy* (2004, Bandai Namco) and *Dark Souls* (2011, FromSoftware), in noclip mode.[92] There is a strong cultural association between collision detection and response algorithms and “clipping,” and the prevalence and popularity of noclip modes suggests that there is some kind of pleasure to be had from exploring games without the encumbrances of object solidity.

---

[89] “Physical” here refers to the scientific discipline of physics, or the study of the structure of matter.

[90] I should note that my sources here are popular and not scholarly, and that the two found don’t seem to be in agreement about whether it was John Romero or John Carmack who originated the command in *Commander Keen* or the term “no clipping.” An alleged email exchange between @me_irl and John Carmack is frequently cited online and attributes the term, short for “clipping a movement vector” and its implementation in id Software’s later games (like *Doom, Doom II, and Quake*) to Carmack. Collision prevention would be what “clips” a movement vector in these games, so “noclip” mode is characterized by unfettered movement through otherwise solid behaving objects. *The History of No-Clipping − Codex*; @me_irl, “John Carmack on ‘No Clipping’ - Pastebin.Com.”

[91] Kelly, “Why I Love Noclip Mode.”

[92] This website describes itself as a “digital museum of video game levels.” Each of the game recreations allows players to fly through walls and explore game levels without the encumbrances of collision detection/physics and the challenges of gameplay. “Noclip.”

"Clipping" is also a term commonly used by players who speedrun games—that is, players who take preexisting games and play them not to "win" in the terms of the game, but rather to complete an area, level, or entire game, in as little time as possible. In these communities, "clipping" describes a genre of tricks or exploits that allow players to quickly move through a game world by passing through seemingly solid objects or barriers. For example, in the *007: Nightfire* (2002, Gearbox Software) speedrunning community, there are several clipping tricks that exploit the GoldSrc engine's approach to resolving collisions between the player character and the environment.[93] As the speedrunning community describes it, in wall and floor clipping, players approach a solid surface in the environment and cycle through their weapons or character position.[94] Cycling through character positions and weapons changes the bounding volume of the player character such that the player character and the wall's respective bounding volumes interpenetrate. The engine's collision response algorithm is designed to prevent the interpenetration of two solid objects and attempts to resolve this interpenetration. If done correctly by the speedrunner, the algorithm places the player on the other side of the solid surface, effectively warping them into a different part of the level/game area. In this usage, "clipping" exploits collision detection and response for strategic ends. Instead of regarding "clipping" as an erroneous behavior in a 3D game world, knowing how and where to "clip" becomes an important part of the level and essential to mastering the speedrunning metagame.[95]

However, "clipping" is a slightly less precise term with wider and more diverse usage in the field of computer graphics. In computer graphics, "clipping" is a rendering process that

[93] GoldSrc is a modified version of id Software's Quake engine. Originally developed by Valve for *Half-Life* (1998), GoldSrc is the precursor to the Source engine.
[94] "Clipping."
[95] For an example of one community of speedrunners, see the section on speedrunning *The Legend of Zelda* in Boluk and LeMieux, *Metagaming*, 41–50.

facilitates the appearance of solidity, removing from view the planes of an opaque object that should not be seen from a particular perspective.[96] In this usage, "clipping," sometimes called "culling" or "windowing," determines which surfaces are removed from the "view frustrum," "window," or perspectival camera in a given 3D scene.[97] In this usage, "clipping" is not directly related to object interpenetration or the processes of collision detection and response. Accordingly, I use "interpenetration" throughout this chapter in lieu of "clipping" to avoid this terminological confusion.

Interpenetration constellates the software ontological separation between the object's appearance and the data structures that make it calculable, the algorithmic processes of collision detection and response, and the player strategies that exploit both. In this chapter, I analyze the "glitchiness" of object relations in videogames, exploring the phenomena of interpenetration from a technical perspective, as well as in conversation with queer theory. The former illustrates how interpenetration comes to be a problem to be solved in both computer graphics research and in the context of commercial videogame development. By engaging in conversation with queer theory, I intervene in ongoing conversations about representations of sex in videogames, using queer theory's focus on sex as relational rather than actional, an intensified space of encounter with the incoherence of the self. This chapter explores how the simulation of object solidity and the default production of objects as hard, impenetrable, and inviolable also paradoxically leads to perverse play experiences of interpenetration.

---

[96] Jacob Gaboury has discussed this rendering process, as known as the "hidden surface problem," at length. He argues that "visibility becomes an algorithmic process of withholding whose specificity articulates a distinct theory of computer graphics as simultaneously screen image and simulated object." Gaboury, *Image Objects*, 23.
[97] "Clipping (Computer Graphics)"; McConnell, "Computer Graphics Principles," 16.

Collision detection and prevention, the algorithmic processes that produce relations of solidity between objects, is typically executed by the game engine. The media archaeology of collision detection and prevention that follows reveals how touch and the relationships between 3D objects in 3D worlds are governed by idiosyncratic algorithmic processes that attempt to simulate aspects of real-world physics but are always limited and compromised by computer hardware and tweaked for subjective notions of realism. Even the most realistic-feeling physical interactions in games do not approach how objects interact in real life because real-world interactions are too complex to compute in real-time graphics applications (like videogames). Hence, these algorithms work to produce hard, impermeable, inviolate objects. However, as this chapter shows, these algorithms establish interpenetration as prohibited, yet inevitable. This contradiction leads to enforcing norms of penetrability and hardness that produces some object interactions as normative and others as perverse.

This chapter's media archaeological approach to object solidity reveals that interpenetration emerges as a problem to be solved, both within the context of academic computer graphics research in the late 1980s and within the context of commercial videogame development in the early 1990s and beyond, visible in trade magazines and through failed games like *Jurassic Park: Trespasser* (Dreamworks Interactive, 1998). These articulations of interpenetration as a problem of behavior marks a progression from the "hidden surface problem," which largely concerned itself with the calculations needed for perspectivally accurate visual representations of 3D objects. Interpenetration interfaced hardware limitations with genres of kinematic realism,[98] a new investment in replicating real-world object relations (not just appearances) in digital spaces.

Though it may seem like an unlikely bedfellow to this history of object relations in videogames, I seek to understand interpenetration alongside queer theory's interest in sex, antisociality, and negativity. In this chapter, I do not use the word sex exclusively as a synonym for intercourse or any particular repertoire of sexual acts. Following the work of Lauren Berlant and Lee Edelman, I use this word expansively to include sexual acts, as well as to gesture towards what these theorists describe as "an encounter with what exceeds and undoes the subject's fantasmatic sovereignty."[99] In their reframing, sex is less about doing anything in particular with anyone in particular; it is a relation that reveals the incongruities between our desires and our self-knowledge. Their focus on negativity, those things and relations that attract us yet are politically and aesthetically "unbearable," brings them to think about scenes of "relief, play, interruption, glitchiness" as "space[s] of interest within which other rhythms and therefore forms of encounter with and within sexuality can be forged."[100] I see interpenetration as evoking all of these forms of encounter – interpenetration provides "relief" to speedrunners who strategically clip through environments to skip through levels and avoid enemies. Noclip modes invite players to interpenetrate with objects in game worlds for freeform environmental "play." Interpenetration can "interrupt" gameplay, occasionally trapping players or causing objects to act unexpectedly. Interpenetration is also frequently thought of as a "glitch" or error, something that ruins player immersion in the gameworld. Theorizing interpenetration through sex helps

[98] Many thanks to Clara Nizard for this turn of phrase.
[99] Berlant and Edelman, *Sex, or the Unbearable*, 2.
[100] Berlant and Edelman, 6.

understand videogames as erotic technologies and the sexualities organized by and through technology. It also helps us understand how games arrange embodiment and its relational possibilities through the rules imposed on object relations by algorithms like collision detection and response.

Making Objects Behave with Computer Graphics in the 70s and 80s

Non-player characters, walls, crates, and cars behave like solid objects in 3D video games because of collision detection. As opposed to visible surface detection, which seeks to perspectivally render opaque 3D objects by culling occluded areas from vision, collision detection and response seeks to model the *behavior* rather than the *appearance* of solid objects.[101] Collision detection enforces and polices the boundaries of game objects and notifies the game engine when objects collide, touch, or intersect. Collision response tells the system how to respond to the detected collision. Collision detection and response are both generally handled by a game's engine and are essential components of physical simulations that involve solid or "rigid body" objects. The methods for collision detection and response have changed in step with technological advancements in computer graphics, advances in 3D graphics acceleration hardware, and demands from animators, game developers, and players for more "realistic" game environments. The story of collision detection spans military and scientific applications, computer graphics research, and eventually videogames. A wholistic historical account of the hardware and software innovations around collision detection is beyond the scope

[101]Jacob Gaboury has meticulously documented the many idiosyncratic solutions to the "hidden surface problem" in the late 1960s through 1970s, demonstrating how computer graphics "produces vision by constructing absence" ("Hidden Surface Problems" 57) and how computer graphics as a field adopts a radically different set of assumptions about vision and perspective from cinema and film. Gaboury's materialist intervention into digital media studies highlights the discontinuity of computer graphics from other contemporary optical technologies, like cinema and photography. Gaboury, "Hidden Surface Problems"; Gaboury, *Image Objects*.

of this chapter: instead, I offer a genealogy of real-time computer graphics that demonstrates how computer objects came to be solid and how interpenetration came to be an undesirable state in videogames.

The first paper in the Association for Computing Machinery catalogue to use the phrase "collision detection" is an essay by Richard Weinberg published in 1978 about the NASA Visual System, an Evans and Sutherland crafted behemoth that networked many analog and digital computers, displays, projectors, and hand-built scenery to simulate cockpit tasks for would-be astronauts. This massively expensive system, funded by the US Government's space race, is a decent example of how computationally and financially expensive it was to process realtime collision data in the late 1970s: the NASA Visual System's "Collision Detection System" required its own PDP-11/45 modified with two additional hardware units special-made by Evans and Sutherland for NASA.[102] As the Evans and Sutherland final report on this project in 1978 specifies, this system was designed to "detect when the simulated objects are in collision with each other, thereby providing a feedback mechanism which may be used to give the impression of solid, impenetrable surfaces."[103] It is unclear from this documentation whether or not collisions were visually modeled for astronauts during the simulation.[104] Yet, even if the NASA Visual System merely represented collisions via a report, the achievement of the system was its simulation of both the opacity of objects and, even if separately, their behavior as solids.

[102] The PDP-11/45 was a 16-bit minicomputer sold by the Digital Equipment Corporation. Each PDP-11/45 cost around $20,000 in 1971, the year of its release (approximately $135,000 in 2021 currency). Note that Evans and Sutherland call this the "Collision Detection System" whereas Richard Weinberg calls it the "Collision Avoidance System." I use "Detection" in line with Evans and Sutherlands official report. Weinberg, "Computer Graphics in Support of Space Shuttle Simulation"; Evans and Sutherland Computer Corporation, "Improved Scene Generator Capability."

[103] Evans and Sutherland Computer Corporation, "Improved Scene Generator Capability," 2–1.

[104] The Evans and Sutherland final report indicates that the collision data was relayed to the "HOST" computer, which, would "alter the simulation, modify the motion of the objects, or simply log the collision for later reference" in response. Evans and Sutherland Computer Corporation, "Improved Scene Generator Capability," 2-8-9.

By the late 1980s, researchers were proliferating approaches to the physical simulation of solid objects for animation (notably not for real-time graphics applications). The August 1988 SIGGRAPH proceedings feature two consecutive articles that offer insight into how computer graphics researchers framed the problem of simulating object solidity. Jane Wilhelms and Matthew Moore, researchers at University of California Santa Cruz, write "when no special attention is paid to object interactions [in computer graphics], the objects will sail majestically through each other, which is usually not physically reasonable and produces a disconcerting visual effect."[105] The "disconcerting visual effect" results from the sudden revelation that solid looking objects don't act the part. They appear to touch, but the objects are unable to respond to each other. Similarly, James Hahn emphasizes this shift in his research priority from appearance to behavior: "analogous to the development of physically based illumination models in computer graphics display algorithms, we need to think of objects in a scene as real objects having mass, moment of inertia., elasticity, friction, etc."[106] Both papers appeal to the discipline of physics in service of a kind of realism. As Katherine Buse so compellingly demonstrates in her case study of the "Genesis Effect" for *Star Trek II: The Wrath of Khan* (1982), "realistic" computer graphics in the 1980s were both narratively and conceptually related to science fiction and constructed to be "realistic" to a lay observer.[107] Wilhelms described interpenetration as an "undesired state" for animations that seek to model "a realistic world."[108] Similarly, Hahn emphasizes the "realism" of the animations produced using his method, even though the

[105] Moore and Wilhelms, "Collision Detection and Response for Computer Animation," 289.
[106] Hahn, "Realistic Animation of Rigid Bodies," 299.
[107] Buse's argument focuses specifically on the creation of science-fictional simulations and the artistic and aesthetic values embedded in this particular claim to graphical realism. Tom Sito discusses *The Wrath of Kahn* and the Genesis Effect as turning point for computer graphics. His industry-centered account notes the impact this example of computer-generated visual effects had on Industrial Light and Magic's in-house practical effects team. Buse, "Genesis Effects," 221; Sito, *Moving Innovation,* 158–59.
[108] Moore and Wilhelms, "Collision Detection and Response for Computer Animation," 289.

scenarios used to demonstrate his algorithmic approaches are highly contrived. Even if the choice of simulating a rocket smashing into a plate was intended to demonstrate the robustness of Hahn's method by modeling an interaction between an object with a very large mass and one with a nearly negligible mass, this scenario is unrealistic in the sense that it neither models something we would expect to happen in the real world and that it probably not a likely simulation for animators. Furthermore, Hahn admits to tweaking his examples by hand "to get a desired effect."[109] Both Hahn and Buse's papers seek to simulate materiality of objects by modeling physical laws, yet, in doing so, end up developing tools that construct a new kind of kinematic science fiction when approximating the relationships between solids.

Both papers agree that solidity is a matter of behavior, rather than appearance for computer graphics, though their solutions to simulating object solidity exemplify two different approaches to the problem. Wilhelms and Moore detail two methods in their paper. Ideal for gentle collisions and objects that touch and then remain in contact, the spring force method prevents interpenetration by pushing two objects that come into contact just far enough apart to prevent interpenetration.[110] Their second proposed method is better suited to handling brief, high-impact collisions and focuses on the conservation of momentum. Upon collision, the two objects will both have new angular and linear velocities that take the force of gravity and the mass of the two objects into account.[111] Both of these approaches approximate physical interactions in order to determine how the objects should behave so as to remain separate. Hahn, on the other hand, refutes the spring method. Instead of constructing a system according to what the object should do in response to another object, his attention shifts to always ensuring that the

[109] Hahn, "Realistic Animation of Rigid Bodies," 305.
[110] Moore and Wilhelms, "Collision Detection and Response for Computer Animation," 293.
[111] Moore and Wilhelms, 293.

objects do not misbehave. He writes, “the most general constraint should therefore not be expressed in terms of what the objects *must* do (remain on a point, a line, etc.) but in terms of what the objects *must not do* (penetrate each other).”[112] In service of this, Hahn greatly reduces the degrees of freedom in the system being modeled (e.g. reducing a chain link interaction into a system with fewer degrees of freedom) and to simplify the shapes being “tested” for penetration into bounding boxes. Overall, these tactics work to prioritize object solidity over other aspects of the dynamic simulation. Preventing interpenetration is the first-order task in Hahn’s algorithmic approach. Despite the different approaches detailed in these two papers, both characterize the ways early computer graphics researchers were redefining “realism” through their computer simulations. Within these redefinitions, one thing violated that new kinematic realism and arose as particularly undesirable, if still prevalent – interpenetration.

Interpenetration Problems in Videogames in the 1990s

While licensed and shared engines eventually came to characterize (and democratize) game development in the 2010s, the early 1990s represents a period before there are highly consolidated and industry-standard solutions for computer graphics problems. Studios are not yet licensing their engines; teams develop custom engines for the game in question. Accordingly, approaches to collision detection and response are ad hoc and are being implemented by individual engine developers. Additionally, though hardware graphics acceleration becomes common and affordable for home PC enthusiasts in the late 1990s with the release of 3Dfx’s Voodoo cards, graphics acceleration was not yet standardized: solutions for 3D graphics acceleration ranged from software-centric renderers to hardware add-ons that would require

[112] Hahn, “Realistic Animation of Rigid Bodies,” 302.

consumers to have a particular card configuration in order for the videogame software to run reliably. Even within this moment of technological transition, one thing was certain: demand was high for interactive 3D worlds, and that meant real-time physical simulations.[113] In 1999, an article in *Game Developer* magazine laments, "gone are the times when you could check every polygon of an object against every other polygon in the scene."[114] Videogame developers in the late 1990s would need to adopt techniques articulated nearly a decade prior by computer graphics researchers in order to implement real-time physical simulations in videogames.

Dreamworks Interactive's 1998 title *Jurassic Park: Trespasser* is a cult-classic videogame that received a lot of marketing hype during its development it could not live up to, even if it had been released on schedule.[115] Part of what made *Trespasser* such an ambitious and anticipated title was its early attempt to physically model solids in physics-based puzzles, adding physics-inspired gameplay to the "floating gun" first-person shooter genre (of which *Doom* is another example). Notable for both its implementation of inverse kinematics (a method for procedural animation I will address in the following chapter) and for its attempts to physically simulate many objects in the game's environment, the game's ambitious technological innovations impeded gameplay. The *Trespasser* physics engine gave all game objects that could interact physically invisible bounding boxes (sometimes called "bounding volumes"). These bounding boxes were rectangular prisms that roughly corresponded to the shape of the object's

---

[113] Chris Carloy dissertation offers a history of 3D videogames for 4th and 5th generation consoles and on the personal computer in the mid-1990s. Carloy, "'True 3D': The Form, Concept and Experience of Three-Dimensionality in 1990s Videogames."
[114] Bobic, "Advanced Collision Detection Techniques," 34.
[115] Cobbett, "Crapshoot."

mesh.[116] This was particularly convenient because many of the objects in the game are rectangular prisms like crates and shipping containers (Figure 2.2). In order to make these game objects with physical properties feel solid to a player, *Trespasser's* engineers implemented a "penalty force method" to prevent object interpenetration similar to the spring and damper method described ten years earlier by Matthew Moore and Jane Wilhelms.[117] The penalty force approach allows objects' bounding boxes to intersect mathematically before applying force against both objects until their bounding boxes are pushed apart so they no longer intersect. In this approach – the more objects touched, the more they would repel each other.

Figure 2.2: A T-Rex interpenetrates with a rectangular bunker in Jurassic Park: Trespasser (Dreamworks Interactive, 1998). *My Abandonware, "Trespasser," https://www.myabandonware.com/game/trespasser-the-lost-world-jurassic-park-cnw*

[116] This continues to be a common method for simplifying the process of collision detection in many 3D game engines.
[117] Wyckoff, "Postmortem."

Moore and Wilhelms' preferred method for objects that touched or rested on top of each other in 1988, had unfortunate consequences for *Trespasser*'s interactive, real-time simulations. In a review for *GameSpot* in 1998, Elliott Chin writes,

> There are numerous collision detection bugs. Dinosaurs crashed into each other, boxes got pushed through walls, a brachiosaur impaled itself on a few trees. Many times I walked into an area to see the resident dinosaur fall 50 feet from the sky or jump up that same distance, turn around, and then crash back to the ground.[118]

The penalty-force method for collision response caused stacked crates to dance or jitter while at rest, and occasionally caused the player to die when attempting to jump on top of a crate due to the force exerted by the crate pushing back on the player character.[119] According to developer Richard Wyckoff, the physical simulations in *Trespasser* only worked with boxes on a particular scale, and it often made objects appear to flicker in and out of existence.[120] Chin's frustrated description of the game demonstrates how the studio's attempt to make objects behave "realistically" was precisely the cause of the game's surreal landscape of misbehaving objects that clip, crash, jump, jitter, flicker, and interpenetrate.

Reminiscent of Hahn's proposition that the most stringent requirement of a physics simulation is the prevention of interpenetration, Wyckoff's *Trespasser* postmortem in 1999 articulates an industry standard in the making: real-time physical simulations cannot tolerate interpenetration in videogames. Wyckoff admits:

> […] at best, these interpenetration bugs completely blow the consistency of simulation we were trying to set up, and at worst they make the game unplayable. If it was not clear

[118] Chin, "Trespasser Review."

[119] Youtube user Trevimus Prime demonstrates that an attempt to jump onto crates to reach a gun ends up killing the player character immediately, ostensibly due to the penalty force method. I suspect that penalty force between the PC and crates' bounding boxes exceeds the physical forces the PC is programmed to endure. *Jurassic Park - Trespasser*.

[120] Wyckoff, "Postmortem."

before shipping *Trespasser*, it is clear now: no amount of interpenetration is shippable, and preventing it absolutely should be the number one concern of any physics coder.[121]

Wyckoff explains that Dreamworks Interactive moved forward with the penalty force method of collision response, even though this method was already considered outdated in 1997 and had been discarded by other studios working on real-time physical simulations of solids. In the context of a game design that featured physics-based puzzles, most of which rely upon the player's ability to topple objects, the instability of objects included in physical simulations frequently interfered with gameplay.

In a 1999 article for *Game Developer* magazine on collision detection, author Nick Bobic addresses the emotional repercussions of inaccurate or poorly optimized collision detection and response.

> Many gameplayers have been disappointed by the sight of their favorite heroes or heroines with parts of their bodies inside rigid walls. Even worse, many players have had the experience of being hit by a rocket or bullet that was "not even close" to them. Because today's players demand increasing levels of realism, we developers will have to do some hard thinking in order to approximate the real world in our game worlds as closely as possible.[122]

Within Bobic's description, objects that appear solid but fail to behave as solids do in the real world evoke a range of feelings, from disappointment to complete incredulity. Echoing Moore and Wilhelms's observations about interpenetration as "disconcerting," Bobic argues that, in addition to being visually displeasing, it is emotionally or affectively undesirable to see objects interpenetrate. Solid objects that behave as we would expect them to under the rules of our world are unremarkable, but when objects misbehave, they become the source and target of negative player emotions. Bobic's tutorial, which includes pseudocode (i.e. natural language that retains

[121] "Shippable" refers to the state of being ready for commercial sale and public consumption. Wyckoff.
[122] Bobic, "Advanced Collision Detection Techniques," 34.

the structure of computer programs, but is intended for human rather than machine reading) examples of collision detection algorithms, as well as information on axis-aligned bounding boxes, offers up these solutions with the goal of helping developers avoid interpenetration *because* it arouses frustration and disappointment in players. Computer-graphics researchers and industry professionals seem to agree: when solid looking objects don't behave solidly—which is to say impermeably or inviolately—they provoke negative emotions. But what is it about seeing a hero's arm inside a wall that causes a player to experience "disappointment?" What is "disconcerting" about objects which "sail majestically through each other?"

Echoing Bobic from a decade prior, Steve Swink, author of the design manifesto *Game Feel: A Game Designer's Guide to Virtual Sensation* (2009), states that "interpenetrating objects or bizarre, unpredictable motion are disturbing to the player."[123] His larger argument homes in on physical simulation, and, specifically, collision detection and response as a cornerstone of true "game feel." Swink defines game feel as "real-time control of virtual objects in simulated space, with interactions emphasized by polish."[124] Game feel is mostly characterized by the extension of the human body into the simulated three-dimensional space of the game – what Swink terms "virtual proprioception."[125] Accordingly, one of the most important elements of game feel for Swink is the ability to interact with and manipulate simulated objects in simulated space in ways that replicate our interactions with objects in the real world. Game feel is held together by the idea that simulated physics should emulate real world physics, such that when objects come into contact, they should remain separate but receptive to each other. Objects should be impermeable and bounded, but responsive to the forces exerted on them. Swink argues that interpenetration

[123] Swink, *Game Feel*, 32.
[124] Swink, 6.
[125] Swink, 28.

might evoke negative emotions because it causes "inconsistencies in the player's mental model of the virtual space," particularly when other aspects of representation, like sound and visual design, offer conflicting feedback to a player.[126] It seems that even in games with exemplary physical simulations, "there are usually inconsistencies to be found (the characters' feet clip through stairs, for example)."[127] Interpenetration evokes negative emotions because it interrupts or impedes our sense of touch and immersion in videogames. It is a wrong response (as in the case of jittering crates) or non-response (as in objects that sail through each other) to touch that contradicts other information provided to us by the gameworld.

Developers' best attempts to simulate the physical world in game worlds are, paradoxically, the source of these immersion-breaking inconsistencies. Interpenetration is often referred to as a glitch or bug, but it is actually the byproduct of properly functioning collision detection and response algorithms, just not directed appropriately towards a designer's goal. Even though interpenetration is a relation between objects that collision detection and response algorithms seek to limit or prevent when simulating interactions between two solid objects, interpenetration is nearly ubiquitous in 3D games. Instead of writing off such moments to the status of "error," this next section will look to moments of interpenetration in 3D videogames as moments where videogames are telling us something important about how the game world conceptualizes the boundaries between objects (aka object solidity), asking what kinds of cultural fantasies these object relations prop up.

---

[126] Swink, 3.
[127] Swink, 30.

Sex in Videogames

In *Sex in Video Games*, Brenda Romero's research makes visible the heterogeneity of what we might mean when we say "sex in videogames." Her examples attest to the proximity of videogame technology and erotic consumer content over the last half-century, detailing the attempts of the videogame industry to sell sexual content to consumers—from the nippled rubber mounds of Atari's *Gotcha* (1973) arcade cabinet to the 2004 *Playboy* centerfold featuring *Leisure Suit Larry: Magna Cum Laude's* (High Voltage Software, 2004) Luba Licious and beyond.[128] Romero's research yields a typology of sex in videogames that encompasses everything from sexualized graphical representations of characters, to hardcore pornographic simulators, to emergent play practices, to studies of the paratextual marketing tactics (like booth babes) that sell games to consumers. Romero's study makes it clear that while there are certainly pornographic games that foreground visual representations of sexual acts, what counts as "sex," and where we locate it "in" videogames, is quite varied.

Part of what emerges from Romero's sweeping study of "sex in videogames" is the incoherence and variation in representational approaches to sex in videogames. Her study includes games that use sexualized content as rewards for succeeding at unrelated game tasks, games where sex is implied or represented but "passive," and even games where sexual content is primarily paratextual. This last point, that games that are not marketed as pornographic or even as containing sexual content can be repurposed by players for sex, particularly challenges how we understand or interpret sex in games. Romero terms this phenomenon "emergent sex," demonstrating that games need not have overt or explicit sexual content in order for the game to

[128] Braithwaite, *Sex in Video Games*, 43, 24.

serve as a medium for sexual expression and gratification. Most of the games that fall into this category are networked multiplayer games, many of which heavily feature player-to-player text chat. Linden Lab's *Second Life* (2003) is perhaps the most emblematic example of emergent sex for Romero.[129] *Second Life* supports a wide range of user-generated content, including skins, custom objects, and "pose balls" (animations). Using this content players can repurpose the core functionality and mechanics of *Second Life* for sexual expression and gratification.[130] In these examples we might say that sex isn't "in" the videogame at all, and that sex happens through communities of play.

As if to respond to the questions about representation in videogames that this raises, recent scholarship in game studies has focused on expanding how we think about sex in videogames. In "The Strange Case of the Misappearance of Sex in Video Games," scholar Tanya Krzywinska ultimately argues in favor of a "ludo-poetic" approach to videogames that focuses not on representations of sex in either content or mechanics, but on the erotic relationship forged through gameplay between players and their games. Despite the title of the article, Krzywinska shifts her focus from sex (ostensibly synonymous with sex acts) to "erotics." This shift away from overt representations of sex acts to erotic content enables her analysis of the "ludo-poetic devices [developers use] to please, tease and excite the player."[131] Krzywinska describes the tactility of gameplay in *Assassin's Creed* as central to its appeal, such that the tactility of

[129] More recent ethnographic studies of online erotic roleplaying in videogames have discussed the potential for the medium to insulate players' real lives from their sexual fantasies, as in Ashley ML Brown's study of MMOs. Bo Ruberg's ethnographic study of players in *Second Life* highlights "cybersex" as queer sexuality while also detailing the proximity of "real world" sex to videogames. Both of these studies seem to support Romero's observations about the propensity for networked multiplayer games to be repurposed by players as sexual technologies. Brown, *Sexuality in Role-Playing Games*; Ruberg, "Sex as Game: Playing with the Erotic Body in Virtual Worlds."
[130] Braithwaite, *Sex in Video Games*, 105–6.
[131] Krzywinska, *The Strange Case of the Misappearance of Sex in Video Games*, 154.

Assassin Altair's sword and his physical interactions with the simulated gameworld are what makes the game erotic.[132] In the shift from analyses of overt representations of sexual acts to an attention to ludo-poetics and erotics, Krzywinska redirects our attention to the role of physical simulations in this experience of "the erotic," zeroing in on collision detection and response as contributing to this experience. She specifies that Assassin Altair's "silky-assured movements and the physical contact with those he shoulders past or fights" are what makes swordplay erotic.[133] This gesture returns us to the design principles articulated by Steve Swink as "game feel," a sense of immediacy and ability to effect change in a simulated 3D world via "virtual proprioception." Ubisoft Montreal's Technical Director Claude Langlais makes it clear that the tactility and interactive physical simulations of objects in the gameworld were of key concern to the studio's development team, who built the Scimitar (later renamed Anvil) game engine specifically for this title.[134] Essentially, Ubisoft Montreal focused a great deal of their development effort on making more of *Assassin's Creed* world physically responsive to player input, making more objects behave like solids.

Where Krzywinska seems to equate "erotics" with good "game feel" or good game design (i.e. pleasurable play experiences interacting with well-tuned game systems), Robert Gallagher focuses on the disabling or frustrating elements of game play and design as erotic. Gallagher advocates for an approach to games that understands how "gamic thrills and frustrations can become symbols or similes for aspects of our sexual experience."[135] He uses Bernard Suits' writing on games to draw out what it is about games that might be erotic, positing

[132] Krzywinska, 156.
[133] Krzywinska, 156.
[134] "Exclusive."
[135] Gallagher, "No Sex Please, We Are Finite State Machines," 408.

"if there is […] a quantum of erotic excitement to be had from playing video games, it is less a consequence of what they permit us to do than of their attempts to baulk, baffle, or obstruct us."[136] Not only do Gallagher and Krzywinska have opposite perspectives on what makes a gameplay experience "erotic," Gallagher ultimately argues that sex is a limit for game design. If Kryzwinska's approach locates sex everywhere (or at least in all games that have "game feel"), Gallagher argues that sex (defined as "frustrations") is missing from games entirely. He writes, "[…] sex represents a technical challenge for games designers. Not only do the limitations of graphics processors and interface hardware constrain them but so does the problem of devising systems and mechanics through which sex could be modeled."[137] He continues, "coitus however is harder to model satisfactorily [than gun play], and the difficulty of translating sex into a set of rewarding game mechanics […] may play a bigger part than is sometimes supposed in preventing games from addressing sex."[138] Though Gallagher does not elaborate on how exactly "graphics processors and interface hardware" and the "systems and mechanics" of videogames limit representations of sex, this line of thought inspires my attention to both queer theorizations of sex and moments of interpenetration as queer sex within videogames.

Interpenetration is a phenomenon regarded by graphics researchers and game developers as disturbing and disorienting experiences that should be minimized or avoided in videogames. I am interested in how interpenetration, the moment where momentary collision gets resolved into a relation that seems to negate or challenge the previously inviolable boundaries of two seemingly solid objects, lends itself to interpretation through queer theorizations of the relationality of sex. In *Sex, Or the Unbearable,* Lee Edelman and Lauren Berlant utilize

[136] Gallagher, 405.
[137] Gallagher, 412.
[138] Note the slippage between erotics, sex, and, surprisingly, "coitus" here. Gallagher, 409.

psychoanalytic (specifically, Lacanian) theory to reframe sex as relational, rather than actional. In their dialogue, sex is not something you do with another person so much as it is an encounter with our often-contradictory attachments and investments. Sex is "a site for experiencing the intensified encounter with what disorganizes accustomed ways of being."[139] Their work expands upon earlier writing by Leo Bersani, in which he argues that sexual desire can be recognized by "an agitated fantasmatic activity in which original (but, from the start, unlocatable) objects of desire get lost in the images they generate. Desire, by its very nature, turns us away from its objects."[140] Berlant, Edelman, and Bersani share a common interest in rethinking sex within the framework of negativity, without the burden of framing sex as necessarily liberatory, redemptive, or politically radical. All these authors describe sex as a disorganizing scene in which object relations are jostled by external forces, rub up against our own self-knowledge (or lack thereof), and are constrained and moved around by virtue of our attachments and investments in those objects.

The language these theorists mobilize to think about sex via negativity is strikingly physical. In Lee Edelman's response to Lydia Davis's short story "Breaking it Down," he highlights how the "it" in the story's title fails to achieve "solidity" through the protagonist's narration of a sexual encounter.[141] Bersani characterizes sexuality as a relation that "shatters" the self, drawing on Lacan's writing on *jouissance*.[142] Both the idea that the sexual encounter is what precipitates the failed solidity of Lydia Davis's protagonist, and the idea that sex is a relation that "shatters" us, compel me to think about how objects in games regularly fail to achieve solidity as

[139] Berlant and Edelman, *Sex, or the Unbearable,* 11.
[140] Bersani, "Is the Rectum a Grave?," 28.
[141] Berlant and Edelman, *Sex, or the Unbearable,* 74.
[142] Bersani, "Is the Rectum a Grave?," 25.

a matter of behavior. Games' boundaries are temporarily shattered by the very processes employed to simulate the inviolability of their boundaries. Queer theorizations of sex as non-reparative also recall the bad feelings that get tied to interpenetration in the writing of both computer graphics researchers and trade reporters. This queer retheorization of sex offers a way of re-examining the ontological premises imposed on objects through algorithmic processes like collision detection and response, showing us how phenomena like object interpenetration might be more than just illusion-breaking errors. Instead of following erotics as good game feel, I am interested in following Gallagher's line of thought, looking to how experiences of discomfort (or bad game feel) might be a part of how we experience games as sexual.

Without taking these ideas about sex as axiomatic, I make a case for reading this form of object relations in videogames through interpenetration. The following examples track the phenomenon of interpenetration as both a game design choice and a player strategy within some communities of play. In *Summer Lesson* (Bandai Namco, 2014), a short virtual reality (VR) game, designers harness the nondiegetic phenomenon of interpenetration to express a form of intimacy between the player and an NPC. I also argue that interpenetration is a key component of "teabagging," a social practice in which players repeatedly crouch over the bodies of downed opponents or teammates as if to mimic or imply the sexual act of placing one's genitals (usually referencing a scrotum) near or in another person's mouth. Teabagging is a form of harassment, but it also can be a sign of intimacy between some players. In both cases, what might be disregarded as a minor inconvenience or unremarkable aspect of the gaming experience opens up how videogames might begin to address the negativity of sex and approach sex more queerly.

Sex, Incoherence, and Interpenetration

Summer Lesson: Hikari Miyamoto was developed by Bandai Namco and was intended for release as a tech demo for the Tokyo Game Show in 2014.[143] One of the first games designed to showcase the PlayStation VR headset, then under the name of PlayStation Project Morpheus, *Summer Lesson* is part tech-demo, part dating simulator, and part virtual "booth babe." In the game, players take on the role of tutoring Hikari Miyamoto, a high school student struggling to prepare for her fall exams. The game consists of managing Hikari's statistics, using lessons, conversation topics, and "lucky items" to improve her character statistics before the week of tutoring ends. As many of the reviewers of *Summer Lesson* acknowledge, the "game" aspects of this experience are its least captivating feature: *Summer Lesson* is less about the specifics of tutoring Hikari than it is about experiencing the impressive simulated physical proximity of your NPC protégé.[144]

The game is perhaps best described as "in your face:" in order to progress in the game, players must complete short mini-games, interacting with Hikari at an arm's distance or less. These mini-games require the player to "pick up" an object from the environment using the right trigger button (R2) on the PlayStation controller, while gesturing with the controller to use these objects in proximity to Hikari. For example, players will find themselves waving the controller in midair to daub an insect bite on Hikari's neck with anti-itch cream, fan her face to cool her down after a run, or share earbuds with her. All of these activities bring Hikari's dynamic character

[143] *Summer Lesson: Hikari Miyamoto*, the version of the game I played, was localized in 2017 for English speakers. The game was re-released in 2018, four years after the game's initial debut, with two additional NPCs, American schoolgirl Allison Snow, and a horror inflected experience with NPC Chisato Shinjo. Grant, "VR School Girls?"; Frank, "Summer Lesson Is the Scariest VR Experience I've Ever Had"; Stenbuck, "More Summer Lesson English Releases Confirmed."

[144] Kohler, "Let's Play Summer Lesson, PlayStation VR's Most Unexpectedly Creepy Game"; Lang, "'Summer Lesson' Made Me a Creep, and That's a Good Thing"; Hollister, "I Ogled a Schoolgirl in Sony's Virtual Reality."

model very close to the first-person camera, which metonymizes the player's face in this 3D world. Hikari is nearly always in motion – she dances around her bedroom (the setting of your lessons), practices softball, or runs laps around you at the local shrine. By contrast, the player character remains in a staid seated position, and therefore cannot navigate away from Hikari when she approaches. Players spend much of this game enduring Hikari's extreme proximity.

Because the player model is confined to a chair during gameplay, they are unable to retreat from Hikari's advances. This also means that it is possible for the player's head/camera to fully interpenetrate with her body. Chris Kohler, a correspondent for *Wired* magazine describes this experience: "I was sitting in such a way that my field of view intersected with Hikari's face slightly—and the entire screen quickly faded to black. The game was still running, but my vision was cut off. Turns out, this is exactly what happens when your face intersects with Hikari's body in any way."[145] Kohler's narrative, as well as my own experiences as a player, seem to suggest that interpenetration is a common player experience and a logical outcome of a game design that features a highly mobile NPC near a player character with limited mobility. However, Kohler's experience at the Tokyo Game Show differs from my own in one important respect. While playing the 2017 United States release of *Summer Lesson: Hikari Miyamoto*, collision with Hikari's character model caused the scene to fade to a dark screen with a faint glowing particle effect, while a restful "heartbeat" sound played through the PlayStation VR headset's audio system. Upon interpenetration, it was as though I, as the player character, were holding my head to her chest to listen to her heartbeat in an extreme gesture of intimacy. Startlingly, these additional game assets (glowing particle effect and heartbeat) transformed the extra-diegetic

[145] Kohler, "Let's Play Summer Lesson, PlayStation VR's Most Unexpectedly Creepy Game."

“fade to black” designed to mitigate the “immersion breaking” effects of object interpenetration into an important diegetic act that expresses a (taboo) intimacy between student and teacher.

I want to stay with this uncomfortable example of object interpenetration because it takes a non-diegetic and usually unremarkable algorithmic process in videogames—collision detection—and makes it both visible and intelligible as an aspect of games that changes how games generate meaning through the most banal of algorithmic operations. There are several ways for developers to handle solid object collisions in VR games. One solution would entail scaling or limiting the possible player head translation to the boundaries of solid objects in the scene. For example, if a player faces a wall at a half-meter distance, but moves their head one meter forward, the game will limit their translation forward in space to the boundary of the wall to prevent them from going through it. Another approach constantly checks to see if the player has crossed into a solid object and simply stops rendering the scene upon that collision, causing the VR headset to go black in hopes of prompting the player to return to the playable area of the simulated space. *Summer Lesson* takes this second approach when it comes to Hikari’s moving body. I can guess at the scenarios that necessitated such a design choice. The scaling approach is likely only feasible for immobile objects in a scene because checking the distance between two moving objects would require too many calculations per time step. Hence, permitting interpenetration with moving objects but checking for collisions with them is more computationally efficient. It is common to refer to such moments of interpenetration as glitches or errors, but *Summer Lesson* exposes that the compromises made between realism and speedy calculations in the generally nondiegetic processes of collision detection and response can be both diegetic and meaningful (even if we find that meaning to be unsavory). Unlike a pornographic game that would directly encourage players to penetrate a "virtual doll," this development team permits players to interpenetrate with Hikari, experiencing a momentary dissolution of the supposedly solid boundaries of two game objects.

One rebuttal to my observations here could run along the lines that *Summer Lesson*, while erotic or titillating, is not about sex. However, the connection between the core game design decision to permit interpenetration and erotics are rendered explicit in the examples that follow. First, *Summer Lesson* has inspired a "viral" metagame where players attempt to look up the NPC's skirt at her "underwear" (called upskirting). According to gaming outlet *Kotaku*, "all" players have to do [to "upskirt" Hikari] is "stand two or three meters away from the PlayStation Camera and […] move around during this early scene […] If that doesn't work, clipping also seems to do the trick."[146] In the second case, players play with the boundaries of the simulated space, effectively tricking the PSVR into rendering the scene from one height while players negotiate their body so that they can glimpse Hikari from a less constrained perspective than their seated mesh affords, effectively clipping through the floor of the simulated bedroom. Second, the game has inspired several pornographic adaptations, also in VR. Similarly titled *Private Lesson* is an interactive full motion video (FMV) VR adaptation of the game released in Japan in 2017 that recreates Hikari's bedroom and several gameplay vignettes.[147] In 2018, Illusion, a popular Japanese *eroge* studio best known for their controversial title *RapeLay* (2006), created a pornographic VR clone titled *VR Kanojo* (VRカノジョ).[148] This adaptation recreates *Summer Lesson's* user interface and general narrative premise, but also includes explicit sexual

[146] Ashcraft, "Trying Hard To See Underpants In Summer Lesson."
[147] Ashcraft, "Summer Lesson Gets Inevitable Porn Adaptation [NSFW]."
[148] "VR Kanojo / VRカノジョ on Steam."

acts between tutor and tutee. Both adaptations recreate elements of *Summer Lesson*, realizing the barely latent sexual content of Bandai Namco's game.

Summer Lesson is not an isolated case of interpenetration mediating sex and intimacy. Brian Myers's ethnographic study of teabagging in *Halo 3* (Bungie, 2007) highlights how this emergent player behavior, often used to harass opponents in multiplayer online matches, actually mediates intimacy for a small community of players. As Myers describes it, within *Halo 3*, "teabagging is a controversial practice where the player's avatar repeatedly crouches over a defeated player's "body" in order to simulate rubbing his or her genitals over the avatar's body."[149] Myers's major finding is that teabagging is "poor strategy during competitive matches, though, [it] can become a signifier of closeness between friends, as it demonstrates that the player trusts the other players enough to not take advantage of them while in a vulnerable state."[150] In other words, because teabagging makes you vulnerable to enemy attack and generally takes time away from meeting in-game objects, teabagging players on your team or opponents can be a sign of trust between players that others will observe the ritual without interrupting it. Myers puts forth a "weak theory" that optimistically casts teabagging as a queer player practice embedded within a hardcore gaming culture generally considered to be predominantly white, male, cis-gendered, and heterosexual.

Myers's insightful study focuses primarily on communities of play. Accordingly, his analysis is limited to the social implications of this emergent player practice and does not consider how this sexual act is translated into the representational regime of this particular videogame. He briefly addresses how *Halo 3* enables such emergent behaviors: "by taking

[149] Myers, "Friends With Benefits," 765.
[150] Myers, 775.

advantage of the “crouch” button as well as the camera system of the game, which lingers on the avatar’s corpse after death, players were able to simulate the act of teabagging.”[151] This description overlooks the fact that that “crouching” over other players is only possible because *Halo 3*’s Blam! engine allows player characters to interpenetrate with other objects, including dead player characters, in the game space. The third-person camera perspective of the dead player makes it possible to cinematically frame the act. Finally, as players “crouch” on the corpse, the corpse responds to the forces exerted upon it, moving up and down in time to the other player’s crouches. As YouTube user Just Eat It Videos demonstrates in their “Halo 3 TeaBag Montage,” teabagging involves interpenetrating the opponent’s character model (Figure 2.3). In this image, a player (on top) is teabagging a recently killed member of their team (on the ground), and as they do so, their left lower leg bisects their fellow player’s torso.

Figure 2.3 The player in red "teabags" the player in blue in Halo 3 (Bungie, 2007). Still by author. Just Eat It Videos, “*Halo 3 TeaBag Montage,” 21 October 2008,* https://www.youtube.com/watch?v=ZYs92_QQoJo.

[151] Myers, 766.

Each of the examples compiled by Just Eat It Videos include the player character briefly interpenetrating with the other player character's model. Repeated crouching is just one part of teabagging, and that interpenetration, a moment in which the player reveals the boundaries of two game objects to be opaque but not solid, is a crucial part of how this sex act and in-game behavior overlap.[152] Teabagging is another example of how glitchy object relations enforced through the algorithmic processes of collision detection and prevention open up space for encounters with queer sex.

Interpenetration as Graphical Perversion

In his 2018 talk at the Queerness and Games Conference, developer and games scholar Robert Yang posited soft-body physics as one of the possible queer futures for videogames. In a later blog post summarizing the talk he writes, "softness and deformation are still very difficult to do in every game engine. Why is that? I argue that it's difficult because we let it be difficult, and in video games we haven't invested ourselves in softness."[153] Yang diagnoses an over-investment in solidity in videogame development tools, framing the dynamic simulation of softness as a queer horizon for videogame development. His observations were prescient – prior to 2018, games with soft objects that players can dynamically deform, squish, or slop around were novel because popular commercial game engines did not support soft-body physics and

[152] It is worth noting that more recent reporting in the popular games press has emphasized repeated crouching as part of what makes an in-game behavior intelligible as teabagging in *Halo Infinite* (343 Industries, 2021). In one case, IGN correspondent documents a weapons swap between opponents mediated through a "teabag dance." Similarly, players during summer 2021 complained about AI opponent NPCs that appeared to be teabagging players. 343 Industries clarified that was actually a loop of the landing animations caused by a bug in the bot traversal program. In both cases, teabagging was reduced to repeated crouching without the context of player death and interpenetration. It's clear that many behaviors could be called teabagging. Moore, "Halo Infinite Players Are Learning How To Communicate Through Teabag Dancing"; Taylor, "Halo Infinite's Bots Aren't Teabagging You, at Least Not on Purpose."
[153] Yang, "Queer Futures in Game Feel."

dynamic deformations of solid objects. In 2014, researchers from NVIDIA introduced FLeX, a middleware physics simulation software that sought to allow developers to simulate a variety of different physics objects, including gases, liquids, and deformable (aka soft) solids without using multiple middleware tools.[154] It wasn't until the Game Developers Conference in 2017 that NVIDIA announced that FLeX would be included in NVIDIA's GameWorks DX12 software development kit (SDK), making it available as a plug-in for both the Unity and Unreal game engines. Notably, FLeX 1.0 did not support "gameplay affecting physics," meaning that NVIDIA left developers interested in using FLeX physics objects in core gameplay loops to their own devices to implement this kind of functionality.[155] Instead, NVIDIA encouraged the use of rigid-body (solid) objects for objects involved in gameplay. Solidity remains the default paradigm for physical simulation in real-time graphics.

Shortly after delivering this talk, Yang published a short, tongue-in-cheek physics game called *Shapeshitter* (2018) in which players extruded "realistically modeled" feces from the top of the frame onto targets placed in 3D space below. Developed in Unity, the interactive feces simulation shows exactly how difficult it is for things to squish, deform, and amass. As more feces are extruded and fall to hit targets below, the strands remain visually discrete, each strand jittering as the Unity engine attempts to reconcile how they should amass on the ground without interpenetrating. In short, the shit shapes up too well, failing to exhibit the squishy and deformable properties Yang seems to be demonstrating.

The problem of interpenetration arises out of the desire to model object solidity. Collision detection and response attempt to model a fantasy of inviolate objects subject to the forces of

[154] Macklin et al., "Unified Particle Physics for Real-Time Applications."
[155] "Introduction — Flex Artist Tools 1.0 Documentation."

other inviolate objects. Collision detection and response articulate a fantasy of touch as something that reifies the boundaries between two objects. Touch usually involves two objects pushing up against each other – the closer the objects get, the more they repel each other. Touching is ultimately about separateness. Paradoxically, simulating touch inevitably results in a touch too deep – interpenetration, which violates the principles of mimetic realism (which is its own kind of fantasy) in these simulations. But within these systems, interpenetration makes touching more high-stakes – every moment of touch leaves open the possibility of an arrangement that reveals that the simulated boundaries aren't so impermeable after all.

To borrow a concept from sexuality scholar Gayle Rubin, there is a way in which solidity emerges in the 2010s as part of the "charmed circle" of object relations within videogames. We expect interactive objects in 3D videogames to look and act like solid objects, and therefore we excuse moments of interpenetration as glitches, or errors. Where Yang moves directly to softness and dynamic deformations as ways for "queer people to do queer things" with and in videogames, I have argued that interpenetration, the nearly inescapable byproduct of the algorithmic processes that model and enforce object solidity within 3D gameworlds, may already model this for us, if we bother to attend to it as a meaningful part of embodiment in 3D worlds.[156]

[156] Yang, "Queer Futures in Game Feel."

Chapter Three

Ragdoll Physics and Performing the Orderly Body in "Fumblecore" Videogames

In this chapter, I look at spectacles of flailing bodies – first in the context of death animations, then in the context of the active player avatar. I look specifically at "ragdoll physics," a physics-based animation technique commonly found in 3D videogames that departs from animation pipelines that rely exclusively or primarily on hand-authored animations or the performances of motion-capture artists. Ragdoll animations rely on approximations of Newtonian physics in collaboration with constraints as determined by animators to produce infinitely malleable (and, often, hilarious) embodied performances. Often seen in the context of player and non-player character death animations in shooter games, ragdoll animations emphasize the responsiveness of the gameworld and aim to make death fun.

The second section of this chapter then turns to 3D videogames that use procedural animation, and particularly ragdolls, to animate the body of the player character. These games, often called "fumblecore" games, use ragdoll physics to pursue player alienation.[157] Fumblecore games generally feature ragdoll animations in the humanoid avatar whose unruly body must be guided through a series of banal tasks, like picking up a pencil or running. These games are very difficult to play and are characterized by granular, non-ergonomic control schemes. Most video games present avatar bodies as super abled, capable of Olympic displays of agility while enemy bodies remain eminently penetrable; the transition from enemy body to incapacitated ragdoll follows a narrative of domination, penetration, and destruction through the successful

[157] This review of *Octodad* by Kirk Hamilton is the earliest use of the term on *Kotaku*, a popular videogame media outlet. In this review, Hamilton places *Octodad: The Dadliest Catch* in the same category as *QWOP* and *Surgeon Simulator*. Hamilton, "Octodad."

collaboration of the player and the avatar. Fumblecore games disrupt this narrative by placing the floppy ragdoll body at the center of the gamic action; ragdoll physics become the unruly and uncontrollable baseline quality of embodiment, rather than a means of incapacity and domination. The ragdoll-as-avatar brings to the fore what the super-abled avatar bodies merely displace onto the ragdoll-as-dead-body. This inexpert, flailing body is willfully achieved in fumblecore games through disorientation at two levels: the first is at the level of control scheme and interface, and the second in the materiality/physical simulation of the player-as-ragdoll.

These sections are united by two intertwined concepts, the cybernetic extension of the human sensoria through the technological apparatus of videogaming, and the ways that videogames are designed for real-time control and manipulation. In *A Play of Bodies,* Brendan Keogh explains embodiment in videogame play as cybernetic, offering a forensic look at how different gamepads configure player's hands and assume a set of physical abilities (including fine motor control) and skills (like managing an avatar's movement through 3D space while also manipulating an in-game camera to frame the action). Keogh's close attention to the materiality of the controller leads him to argue that "videogames reconfigure the body, and they are experienced through this reconfigured body."[158] This line of thought makes it clear that videogame play is both instructional and disciplining. Keogh elaborates,

> To understand the pleasures and meanings that emerge from a particular videogame is to understand that videogame as it is played by a competent body wrapped around an input device: hands tapping at a keyboard, waving at a motion sensor, clutching a joystick, smearing a touchscreen, or, more often than not, wrapped around a gamepad.[159]

---

[158] Keogh, *A Play of Bodies*, 89.
[159] Keogh, 108.

His orientation to the specifically “competent” body that plays videogames is one that seeks out the norms of videogame input and haptic design from the position of the player who has already been interpolated by the videogame system.

Videogames are vectors of somatic entrainment and performance. Thus, it is crucial to understand how videogames play produces some bodies as “competent’ and how those “competent bodies,” in turn, influence software and hardware interfaces for videogames. As Brendan Keogh writes,

> If the dressage of everyday life produces social bodies that are bent to particular socially constructed experiences of the body, then we must consider what bodies are most likely to be bent toward the input devices of videogames and what bodily configurations the input devices of videogames are most likely to bend toward.[160]

His catalogue of game controllers and their scriptive possibilities is a record of the presumptions videogame interfaces make about their players. This consideration of how videogames are influenced by communities of play, and how communities of play are influenced by controller and game design point specifically to the player’s body as a crucial intermediary. David Parisi’s research on videogame haptics and controller design also highlights how player bodies influence controller design. Parisi draws attention to the relationship between controller design and brand identity in console videogames, where the stability of the controller design between generations of the same console (e.g. Xbox 360 and Xbox One) is the “tactile equivalent to the brand’s logo” and this feeling is maintained through the corporate cultivation of gaming experts, referred to as “golden hands.”[161] That a “golden hand” exists points back to the idea that videogames are always in the business of maintaining and producing competent player bodies, a process that happens through gameplay.

---

[160] Keogh, 92.
[161] Parisi, “A Counterrevolution in the Hands: The Console Controller as an Ergonomic Branding Mechanism,” 3.

The second thread of this chapter focuses on the central role of real-time physics simulations in creating both the sensations of control and influence over the environment central to FPS games, and the comedic flailing of fumblecore games. Physics simulations are foundational to an understanding of not just the representation of bodies in videogames, but the means of their embodiment from a procedural, rather than aesthetic, perspective. Recalling Alexander Galloway's categories of operator acts (which describe the ways that players interact with videogame systems) and machine acts, physics simulations are non-diegetic machine acts that determine materiality and embodiment within video games. My exploration of the rise of procedural animation in videogames through the figure of the falling, flailing ragdoll looks to the ways non-diegetic machine acts regulate and determine the nature of the diegetic operator act, and the human body engaged on the other side of the screen.

One of the turns scholarship about fumblecore games and ragdolls in particular make is to propose that the relationship between player and machine is characterized by performance. Douglas Stark makes this characterization in his essay on *QWOP*, a browser-based flash game in which players control the eponymous avatar using the Q, W, O and P keys in an attempt to make it to the end of an Olympic 100-meter dash. He writes, "*QWOP* forwards a less hierarchical relation between human and machine: like two participants in a performance."[162] It's my assumption that "performance" is used here to characterize a relationship between human player and machine execution that operates somehow in excess of the normative relationship—one that is perhaps here conceived of as more collaborative and open-ended than in games with less ambiguous control schemes and intrusive physical simulations. Ian Bryce Jones discusses

[162] Stark, "Unsettling Embodied Literacy in QWOP the Walking Simulator," 62.

fumblecore games with respect to the cinematic genre of slapstick comedy, arguing that games like *QWOP* "foreground the collaborative dimensions of human-computer interaction, bursting apart the unthought unity of player and machine actants into a form of comedic repartee I refer to here as dehiscent performance."[163] Dehiscent performance is characterized by the "emergence of a single on-screen character from an uneasy collaboration between human and machine."[164] Both scholars suggest that fumblecore brings to the fore a somehow different relationship between human bodies as they play videogames and the videogames that simulate the movement of human bodies through imagined gameworlds. Throughout this dissertation, I've argued that videogames are always sites of everyday embodied performance. I disagree with both Stark and Jones that fumblecore games are in any way uniquely collaborative performances between players and machines. Rather, I think these games are useful edge cases that demonstrate a broader truth about how the processes (like physical simulation) that are carried out by videogame engines shape the collaborative performances between human players, videogame software, and hardware.

Fun with Falling Bodies

In a talk given at the Game Developer's Conference in 2018, Jalpesh Sachania, a physics engineer for Electronic Arts, describes the advantages of ragdoll animations: they are "So much FUN!!!," they lend a game a "variety that can't be authored through procedural animation."[165] From applications in EA's popular *FIFA* soccer games to *Star Wars Battlefront 2,* Shachania advocates for the integration of ragdolls into games because they allow players to spectacularly

[163] Jones, "Do the Locomotion," 88.
[164] Jones, 89.
[165] Sachania, "Physics Driven Ragdolls and Animation at EA."

dismember droids with lightsabers and up the entertainment value of sports simulators as tackled footballers sail across the pitch, all with endless variation.[166] In his estimation, the problem with WWI FPS *Battlefield 1*'s (Electronic Arts, 2016) initial approach to death animation lay in the fact that "if you chuck a grenade to the side of [the character], [the character] will still play this big roly poly animation, so there's no […] connection between the weapon you're firing and his reaction."[167] The "roly-poly" animation Sachania refers to is one derived from a motion-capture animation process, where a human motion capture artist provides the basis for the keyframe animations that play whenever body is hit by a grenade. Sachania explains that his intervention was to blend the motion-capture animations, while applying the force and trajectory of the weapons to the body to make the game feel more responsive to the actions of the player. For Sachania, the joy of the procedural animation comes from an improved circuit between player action and NPC death, making even the uncontrollable (death) controllable by proxy. By eschewing one genre of realism, motion-capture animation, for another, real-time physical simulation, Sachania argues that games become more "fun" when the player's control over the gameworld is reflected in how the world responds to their in-game actions.

This section aims to look backwards from Sachania's ragdoll hype to explore the ways that ragdolls became the icons of player control over gameworlds. Starting with a brief look at other methods for animating objects in games, from hand-drawn animations to hand-authored constraints, I track the movement towards procedural and physics-based animations. This section also looks specifically to the spectacle of the falling or incapacitated ragdoll that remains available for manipulation by the player character as a kind of second-order representation of

[166] Sachania.
[167] Sachania.

playing videogames—an avatar of the avatar that emphasizes the control the player wields within the gameworld.

Doom (id Software, 1993), was one of the first 3D first-person shooter (FPS) games available for home computers. *Doom,* like 2D shooters before it, uses hand-authored animations to dramatize non-player character death. One of the oft-advertised features of *Doom*, as part of its over-the-top satanic imagery, was its gory character death animations, designed by Adrian Carmack and Kevin Cloud (Figure 3.1). Many of these NPC animations were drawn and/or sculpted by Carmack and Cloud first, photographed in the eight necessary key positions, and then imported into a utility designed by John Carmack for the NeXTSTEP computer called "Fuzzy Pumper Palette Shop."[168] This utility would convert the photograph into the proper graphic format and allow artists to edit individual pixels to create the individual frames of the animations, called "sprites." Given this extensive process, each individual sprite—each frame of each death animation—required a great deal of authorial oversight and labor. When players shoot monsters in *Doom*, the game triggers the same hand-drawn death animation regardless of the angle and unique ballistic behavior of the fictional projectiles. In other words, every kill in *Doom* yields a pre-determined death animation sequence. Once an NPC has been on the receiving end of enough damage, the pre-authored animation sequence will be triggered. This animation approach allows for a high degree of authorial control in terms of what character death looks like, but is time-intensive, which ultimately limits the number of animation variations a team is able to produce.

[168] Kushner, *Masters of Doom*, 110; "Fuzzy Pumper Palette Shop."

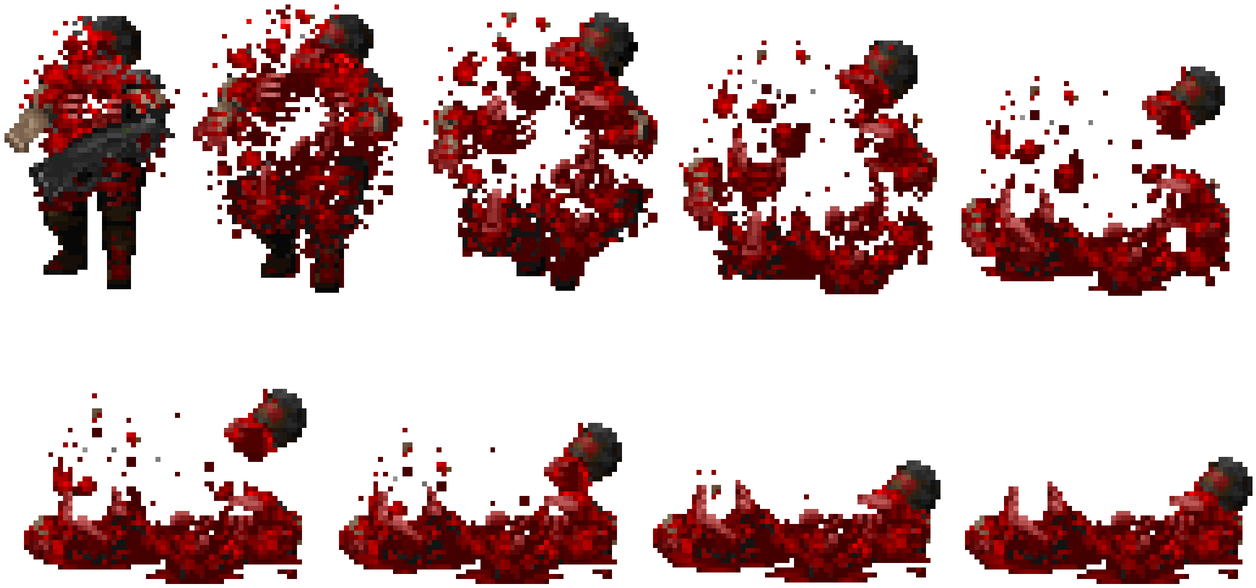

Figure 3.1: Zombieman "gib" death animation from Doom (id Software, 1993). The explosive "gib" death animation happens on select characters when the player deals almost twice as much damage as the character's initial health. GIF split into individual frames and arranged by author. Doom Wiki. "Gibs." GIF. https://doom.fandom.com/wiki/Gibs.

By incorporating polygonal 3D characters, game studios automated several parts of the animation process. A single model could be deformed by adding "bones" that controlled multiple vertices simultaneously by rotating "joints," and 3D modelling software allowed animators to add keyframes to the skeletal representation which would automatically interpolate intermediate frames of movement. Directly manipulating the animation in this way is called "forward kinematics," and it requires careful attention to body parts that move in synchronized ways, such as shoulder and elbow rotations. A further technique called "inverse kinematics" was developed to automate such linked movements, allowing the animator to directly move an arm and have the computer interpolate the proper orientation of the elbow, finger joints, or knee. The popular 3D animation software *Softimage*, a program used by animators at both Industrial Light and Magic and Pixar was the first to incorporate inverse kinematics in 1992; inverse kinematics became widely available in 3D animation software by 1998.[169] Traditionally, these animation tools would reduce, or “bake,” the forward and inverse kinematics to a series of individual frames called animation clips that lacked the animating skeleton. During gameplay, these animation clips can be looped or played in series but cannot incorporate any contextual changes to their motion. This pre-rendered form of procedural animation took a step towards simulating the behavior of bodies as they moved through space but was unable to incorporate player input because they were still pre-rendered and not calculated on the fly.

One of the first videogames to incorporate inverse kinematics in a real-time application was *Terra Nova: Strike Force Centauri* (1996), published by Looking Glass Studios. Under the direction of Seamus Blackley, the programmers at Looking Glass Studio used inverse kinematics to animate artificially intelligent squad mates as they traversed the game world, as well as player gun recoil and the arc of fired projectiles.[170] Unlike hand-drawn sprite animations, or pre-baked 3D animations, real-time inverse kinematics determines the logical path between two predetermined poses. The computer captures initial and final poses for the character based on animator or machine-determined constraints, then calculates a possible path between these two poses by manipulating the initial and final joint angle values.[171] This technique allowed NPCs in *Terra Nova* to appear to move across the varied terrain of the Centauri System without necessitating an array of time and labor-intensive, and thus costly, sprite animations. With inverse kinematics, the computer takes on much of the work of the animator, both determining tactically where AI non-player characters (NPCs) should move, while also determining how to embody them on screen.

[169] Sturman, “The State of Computer Animation.”
[170] Hiles, “Looking Glass and Terra Nova: Strike Force Centauri.”
[171] Parent, “Physically Based Animation,” 172–73.

This implementation of procedural animation is part of a larger paradigm shift in videogames at the edge of the millennium. Part of this transition is enabled by the move from fundamentally 2D sprite images to 3D polygonal modeling, a distinction that game historian Chris Carloy discusses in his chapter focusing on 3D FPS videogames in the 1990s.[172] This trend towards polygonal modeling is evident in a shift within the FPS genre from maze-like interior spaces to less constrained map designs, typified in the differences between navigating the repetitive maze-like design of *Doom* to the vast exterior spaces of *Unreal* (Epic Games, 1998) where players can manipulate and climb barrels and scale rock faces. But, it can also be understood through the shift away from hand-authored animations that borrowed techniques from cartoon animation towards a fundamentally object-oriented approach to animation.[173] As Casey Alt explains, object-oriented programming "reverse engineers complexity by accurately defining the specific algorithmic behaviors and properties of each of the discrete elements in the system such that an accurate simulation of complex behavior emerges, bottom-up, from the sum of the individual interactions."[174] Thus, the move towards procedural animation is one characterized by an interest in the algorithmic simulation of how body parts should behave when gravitational or kinetic forces act upon them, rather than how they should look. This shift from appearance to modeling behavior is one that matches the earlier transition towards object-oriented paradigms in the 1960s and 1970s inaugurated by computer graphics that Jacob Gaboury tracks in his work on the origins of object-oriented programming paradigms.[175] In

[172] Carloy, "'True 3D': The Form, Concept and Experience of Three-Dimensionality in 1990s Videogames," 270.
[173] Sito, *Moving Innovation*, 225. Tom Sito discusses the use of filmed toy models, much like id Tech's models, in the animation vehicles in *101 Dalmatians* (Disney, 1996).
[174] Alt, "Objects of Our Affection," 280.
[175] Gaboury, *Image Objects*, 131.

general, *Terra Nova's* use of procedural animation is part of this shift in the late 1990s towards physically-based procedural animation visible within the shooter genre.

Another important step in procedural animation was the development of ragdoll simulations, where physical forces such as gravity are applied to the skeletal joints while simultaneously simulating the collisions between individual body parts and the surrounding world. Though not designed for real-time applications, John Nagle's *Falling Bodies* program is credited as the first stable ragdoll physics simulation software and offers an early glimpse at the promises of physically-based procedural animation.[176] Debuting in 1997, *Falling Bodies* was released as a plugin for Softimage and uses the principles of inverse kinematics to model spectacular falls in which the falling body interacts with the environment it falls on. Over the course of six seconds, one of the demo videos for the software shows a body clothed in grey army fatigues and a gun holster as it is pushed over the banister at the top of a spiral staircase by an invisible force. As its waist clears the railing, it enters a nosedive towards the stairs below. Its leg catches on the railing of the staircase below, forcing the body into a gruesome face-forward slide. The camera pans around the central pole of the staircase to give us a closeup of the body; legs splayed, head wedged between two newel posts (Figure 3.2).[177]

[176] Nagle, Method and system for generating realistic collisions in graphical simulations.
[177] *Spiral Stair Fall*.

Figure 3.2. A still from "Spiral Stair Fall" (John Nagle, 2001). Still by author. John Nagle, "Spiral Stair Fall," 1 June 2001, https://www.animats.com/topics/videos.html.

Nagle's program demonstrates the potential of physical simulation to create spectacular death animations, shifting the labor of animators from hand-animating keyframes to authoring constraints. *Falling Bodies* was intended to work alongside keyframe animation, taking over to animate falls "because the collisions with obstacles are hard to get right. Motion capture is hard on the actors."[178] The manual explains that animators need only to author the constraints on the falling body, allowing the computer to do the challenging work of modeling how the body collides with the world around it. The computer can surrogate the risks inherent in motion

[178] Nagle, "Animating Fall Stunts with Falling Bodies and Softimage 3D."

capture stunts, voiding the relationship between spectacular death animations and the physical pain or damage incurred by motion capture artists.

As Amanda Phillips writes, “ragdolls balance a desire for realism with a desire for entertainment.”[179] We can see this sentiment in the repetitive affirmations of the enthusiastic EA engineer in 2018, but it also sneaks into the user manual for *Falling Bodies,* years before the ragdoll becomes real-time. In addition to discussing how *Falling Bodies* uses inverse kinematics and collision detection to constrain and animate the ways that objects behave when they interact, its user manual includes a list of “More fun things to do,” including:

- Try making the little guy hit the stairs at different speeds. The difference between the frame at which you start Falling Bodies and the previous frame determine the velocities, so you can keyframe different speeds. If the little guy is going fast, he'll go over the railing. If he's going slow, he'll slide down the stairs. Somewhere in between, he'll end up doubled over, sliding down the railing.
- Give the little guy different initial rotation rates. You can get a backflip that way.
- Try removing a step from the staircase or a section from the railing.
- Try the little guy in some scene of your own. Falls and slides will work.[180]

If inverse kinematics in the context of *Terra Nova* is used to animate the movement and behavior of artificially-intelligent NPCs, Nagle’s *Falling Bodies* emphasizes the novelty of experimentation in excess of what would be possible with a motion-capture artist or time-intensive keyframing technique. Moreover, the repeated diminutive “little guy” brings forward the associations players might make between the flop of the ragdoll body and the cute or adorable play practices of children with actual dolls made of cloth. Even before its use for real-time animations in videogames, *Falling Bodies* hints at the novelty and entertainment value of manipulating soft bodies as they fall in endless variation.

[179] Phillips, “Shooting to Kill,” 139.
[180] Nagle, “Animating Fall Stunts with Falling Bodies and Softimage 3D.”

In *Hitman: Codename 47* (2000), IO Interactive introduced the Glacier physics engine, designed to simulate "the movement of cloth, plants, rigid bodies, and for making dead human bodies fall in unique ways depending on where they were hit, fully interacting with the environment (resulting in the press oxymoron "lifelike death animations")."[181] Glacier was designed to be more stable and faster than prior physics models. To achieve this, Glacier employs a simplified physics model called Verlet Integration. First developed to model molecular dynamics, Verlet Integration has higher tolerances for numerical inaccuracy and flexible error margins that can be reconfigured on the fly.[182] Glacier treats 3D objects as made of "points," which are treated like particles and are connected via "sticks," which restrain the distance between points. Instead of calculating angles between joints, Glacier calculates the new position of each particle at every timestep relative to all of its stick constraints and any physical forces imparted on the particles. Treating a digital body as a simulation of forces, however, makes well-defined movements, like walking or running, incredibly difficult to recreate. Instead, *Hitman* alternates between clip-based animations for living characters, and switches to ragdoll physics only when a character dies. The Glacier engine ensured that dead NPCs in *Hitman* interacted fully with the environment as they fell to their deaths.

Hitman and the Glacier engine were part of an early wave of shooter games that wanted to integrate physical simulation and procedural animation into their 3D simulated worlds. *Hitman* provides for a vision of player control over the game world that arise from interactions that could never be planned or foreseen by designers. So, for example, in *Hitman*, bodies can be spectacularly shot at while inside a helicopter, only to catch on the lip of the helicopter's landing

[181] Jakobsen, "Advanced Character Physics."
[182] Jakobsen.

skids just before they plummet to the ground below. In this instance, the falling ragdoll body instructs players about a key gameplay and game engine feature and offers up a spectacle that tells a story of player control and power over the world of the videogame, where that world is conceived of as a simulation.

While the real-time ragdoll simulations of *Hitman* are a technical feat, the game only allows the ragdoll to collide with itself and with static objects that do not themselves move. As a result, the physics simulation only needs to be calculated once and can be stored to play out over later frames. This is far from the ideal of a "fully interactive," physically simulated environment that responds in real-time to player manipulation and action, something that *Half Life 2* (Valve, 2004) sought to bring to people's home computers. Gabe Newell, former Microsoft Developer and co-founder of Valve, presented the first demo of *Half Life 2,* a physics-based FPS game, at the 2003 Electronic Entertainment Expo. In this 20-minute live presentation for a small audience of industry professionals and journalists, Newell shows off the physical simulation improvements made with the Source Engine. Newell demonstrates the intuitive behavior of objects in the world of *Half Life 2;* empty barrels float on water, wood splinters, and flexible objects, like discarded mattresses and lifeless bodies, contort and respond to the other objects they interact with.[183] Newell "picks up" the ragdoll body by one leg, dragging it through space using *Half Life 2*'s signature weapon, the "Zero Point Energy Field Manipulator," more frequently called the "gravity gun."[184] The advance Newell seeks to demonstrate is the player's influence over the world, all of which is physically simulated. Because the game cannot predict the player's interactions with the ragdoll, the full simulation is recalculated each frame.

[183] *Half Life 2 Tech Demo - E3 2003*.
[184] "Zero Point Energy Field Manipulator." Fans have also documented that within the game's source code, the gravity gun has the entity name weapon_physcannon.

Newell demonstrates the ways the ragdoll, an exemplary "flexible object," can interact in real-time with other solid objects, even as they move throughout the scene. Newell swipes a table set with half of a destroyed watermelon and a box with a set of cans on top of it, into a pool, proclaiming "there's no limitations on the complexity of those interactions [between flexible objects and complex surfaces]. So, it's this level of believable and consistent interactivity that opens the door to a wide variety of new gameplay mechanics."[185] The flexibility of the ragdoll body is the symbol of the endless possibilities of gameplay that arise from physically-based procedural animation. This demo also highlights the ragdoll not as a dead-other but as a controllable and manipulable object, almost an avatar of the player's avatar. The gravity gun allows players to manipulate the ragdoll in the simulated 3D space of the game environment in a way that duplicates the player's control of their avatar. The main difference is the contrast between the predictable feeling negotiation of space of the player character, versus the floppy and unpredictable negotiations of the ragdoll as secondary avatar.

Finally, the *Half Life 2* demo features a sequence designed to show off the AI behavior of the player's squad mates that culminates in the spectacular death of an NPC enemy. During this encounter, the player character (performed by Newell) shoots an NPC off a balcony; the velocity of the projectile hurls the NPC body off the edge of the balcony, causing it to plummet in a dramatic swan dive down to the ground below. Upon contact with the street, the NPC body bounces, contorting into a crumpled shape, eventually resolving into a prone position to the audible amazement of the audience. This short, six-second sequence illustrates part of the dream of the Source Engine, where improved physical simulation tells a story about the player's control over inputs in the gameworld, that result in exciting, varying, and spectacularly unpredictable

[185] *Half Life 2 Tech Demo - E3 2003*.

outputs. While other technical feats, such as a Pachinko machine made of falling oil barrels, are met with similar amazement during this demo, the audible "woah" indicates that the spectacle of the ragdoll body as a stand-in for NPC death was at least as compelling and exciting to this niche audience as the other physics-based animations on display.

The ragdoll is a technology of incapacity. Where inverse kinematics sought to enliven non-player character animations by making them more responsive to the environment and its effects, the ragdoll objectifies the NPC, "bypassing its agency to subject it to the physical forces of the game world."[186] Once an NPC converts into a ragdoll, it is often imagined to be in an irreversible and incapacitated state. The NPC is "dead," but, importantly, not yet culled from the scene. The "corpse" remains behind, a toy available for manipulation and play. Physics-based procedural animations make the gameworld feel more responsive to player input, often in ways that spectacularize death and destruction.

Let us briefly return to Jalpesh Sachania's description of ragdolls in the World War I-themed FPS *Battlefield I*, where the physics engineering team at Electronic Arts sought to enhance motion-capture death animations. Sachania explains that these animations blend keyframe animations derived from motion capture performances with procedural physics simulations, capturing information about the direction and force of the weapon fired at them and applying that trajectory to the motion capture-based animation as it plays. The over-the-top parkour-style flips of the motion-capture artists draw the players' attention to instances of character death in an otherwise saturated scene where gunfire, flamethrowers, and screams vie for the player's attention. While the intention of the studio may have been to emphasize the human cost of war with these death animations, as Sachania suggests in his GDC presentation,

[186] Phillips, "Shooting to Kill," 139.

they are entertaining to watch because their stylization recalls action movie stunts. It's worth mentioning that the first mission (called a "War Story" within the game) is called "Storm of Steel"; the campaign features the 369th Infantry Regiment (an African-American regiment often referred to as the Harlem Hellfighters) during World War I. In order to progress in this mission, the player must die repeatedly, and as they die, they experience the disabling transformation into a ragdoll in the first-person perspective, flopping to the ground. Kishonna Gray and David Leonard critique this element of gameplay in their introduction to *Woke Gaming,* writing:

> This trend [in which players must die in order to progress] continues throughout the game, causing many Black gamers on social media to reflect on their uncomfortableness witnessing and experiencing hypervisible Black Death. We liken this pattern within *Battlefield I* to the present era of consuming and sharing Black Death via associated hashtags, where we witness the final moments of Black and Brown life without context or a historic backdrop.[187]

Death is made visible in the context of this game via the use of procedural animation as a disabling mode. Gray and Leonard's critiques of *Battlefield I* draw attention to the real-world stakes and cultural meanings of this process of physical simulation.

In line with Gray and Leonard's critique, Amanda Phillip's work on "headshots" speaks to the "mechropolitical" elements of gameplay, a wordplay that blends game mechanics with the concept of "necropolitics" from post-colonial political theorist Achille Mbembe. A headshot is when a player, often in a first or third-person shooter game, is able to kill an enemy NPC by hitting them in the head. Achieving a headshot requires skill and dexterity on the part of the player and many games explicitly reward this strategy in gameplay. For Phillips, "mechropolitics" refers specifically to the ways that headshots make "death fun, not merely as visual spectacle but as cooperative activity performed with a machine and encouraged by the

[187] Gray and Leonard, "Post-Racial," 6.

mechanics of game and system design."[188] When games reward players in ways that produce death primarily as a spectacle, the resulting power fantasy produces shooter videogames as a "playground of mortality in which new orientations toward death and dying might be invented, rehearsed, and even normalized."[189] While Phillip's article (smartly) focuses on the headshot as central, I look to the moment just after the headshot—the NPC's transition from upright enemy to passive ragdoll—as another key part of the spectacle of death and its corollary, the power fantasy of the player, in videogames.

Playing As Unruly Bodies

Part of the challenge, and perhaps the appeal of fumblecore games, comes from being confronted by a disorienting use of an input device—the shock of the usually "competent" or well-trained player at suddenly inhabiting an incompetent body specifically because of their prior training and habituation. Fumblecore games are designed in ways that delay the control scheme from blending into the background, and full-length titles prevent this initial shock from fading away by way of stochastic physical simulations and additional in-game challenges. For example, in the previously mentioned progenitor of the fumblecore genre, *QWOP* (Bennett Foddy, 2008), instead of controlling player movement with the W, A, S, and D keys common to many videogames with keyboard input, players use Q and W operate the avatar's thighs while O and P operate the calves. Qwop (the avatar) takes a race-ready position, but appears unstable on his feet—without any input from the player at all he rocks back and forth on his feet as though buffeted by powerful winds. Advancing towards the 100m line is comically difficult, and randomly pressing the Q, W, O, and P keys almost always leads to a spectacular backwards fall

[188] Phillips, "Shooting to Kill," 139.
[189] Phillips, 138.

and a negative distance travelled (Figure 3.3).

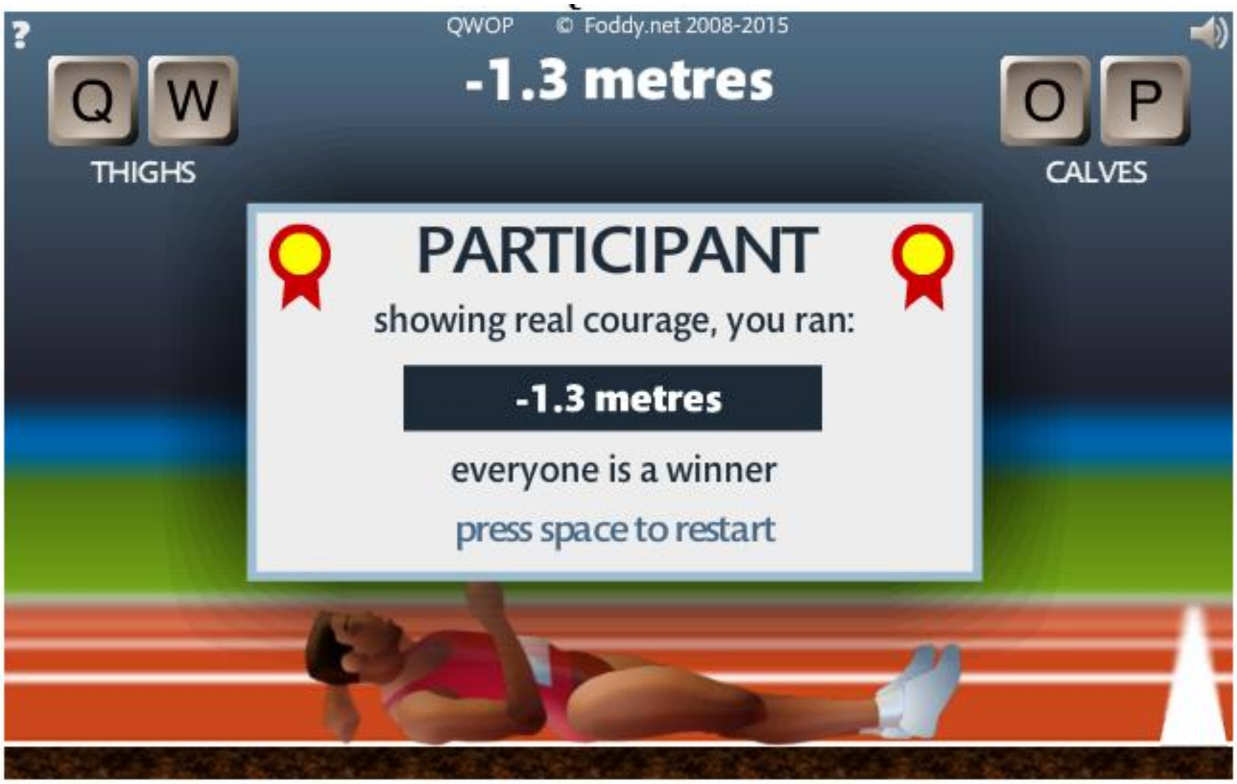

Figure 3.3. A backwards fall in QWOP *(Bennett Foddy, 2008). Screenshot by author.*

QWOP, and fumblecore games more generally, can be characterized by an inverse relationship between control granularity and control exerted by the player over the game world. As Doug Stark points out, in *QWOP*, "players experience a seemingly aleatory relation between their intentions and [the avatar's] movements—one that highlights what they habitually take for granted to feel in control."[190] This is attributable to the ambiguity and granularity of the game's control scheme, as well as the game's simulation of physical forces. The WASD interface for player movement simplifies the more complex neuromuscular task of negotiating ones' body through space into buttons that condense movement into a single directional button press.

[190] Stark, "Unsettling Embodied Literacy in QWOP the Walking Simulator," 59–60.

QWOP's interface playfully subverts this control scheme, breaking the act of walking down into more granular parts. Importantly, the heads-up display for the game does not indicate which keys are mapped to the right or left legs. This ambiguity is central to the difficulty of the game; only careful experimentation will reveal that Q and P operate the right leg and W and O operate the left leg. The challenges of gameplay are not usually associated with the ambiguity of control schemes. In fact, videogames normatively go to great lengths to be explicit about their control schemes, commonly providing players the opportunity to customize so-called "keybindings" in extradiegetic configurations menus. Keybinding is not just an accessibility feature that allows some players to remap game controls to purpose-built inputs; it also represents a central tenant of normative game design in which input should yield predictable outputs and control schemes should be explicit. The explicit control scheme allows the player to memorize and customize the control scheme in pursuit of mastery over the avatar body, and resultingly, the game.

Even for players able to experimentally overcome the ambiguous, yet granular, control scheme of *QWOP*, they still must contend with the unpredictable and wobbly-feeling physical forces exerted upon Qwop. Stark largely neglects the role of physical simulation in this game, focusing predominantly on the game's non-normative control scheme. He writes, "by asking players to imagine what it would be like to control granular movements, *QWOP* invites a consideration of the complex relationship between intentions and control."[191] However, I contend that the physical simulations that cause Qwop's body to wobble back and forth are an essential component of the difficulty the game poses to players, and part of a larger picture of how physical simulation via the ragdoll shapes how we play with our bodies on and off screen. While

[191] Stark, 59.

the control scheme of this game, and other fumblecore games I'll discuss in this section, is certainly a crucial component of how these games confront the player with the gap between their intentions and the control they exert over the gameworld, I argue that physics-based procedural animation, and in particular the placement of the ragdoll in the position of the player avatar, ultimately has a disciplining effect on the bodies of players.

Part of my argument is that physics-based animation extends beyond the narrow purview of ragdoll physics, and that the phenomenon that some scholars localize to "fumblecore games" is actually apparent in games that appear long before the advent of ragdoll physics and the fumblecore genre. One such example of this is the use of inverse kinematics on the arm of the player character in *Jurassic Park: Trespasser* (DreamWorks Interactive, 1998). Borrowing Blackley and others from Looking Glass's team, DreamWorks Interactive (a collaboration between Steven Spielberg and Microsoft) sought to launch a new physics-based first-person exploration and shooter game alongside the 1997 release of *The Lost World: Jurassic Park* (Universal Pictures). As I've already discussed in the prior chapter, in addition to being an early instance of real-time rigid body physical simulation in videogames, the resulting title, *Jurassic Park: Trespasser* also used inverse kinematics on the player-character's arm. This meant that animators did not hand-author the player character's arm animations, but rather set "realistic" constraints that would govern the behavior of the arm as it interacted with other objects. However, this design specification intended to immerse players in a 3D simulated environment actually alienated players and made the game difficult to play. Reviewer Elliott Chin spoke to the procedural animation on the arm in online videogaming website *Gamespot*:

> Well, the arm looks ridiculous, and you can get it to bend in sickening ways that no human would be able to bear. It's also absolutely ludicrous the lengths the designers force you to go through to pick up an object. Yes, it's realistic, but it sure as hell isn't fun having to jut out your hand at every object and then hit two keys while maneuvering your arm to the precise point to pick it up. Half the time, I ended up pushing the object around like some drooling idiot instead of picking it up.[192]

The difficulties this reviewer and others faced when playing *Trespasser* demonstrates the propensity for procedural animation to undo the hegemonic narratives and perceptions of embodiment in video games. This reviewer goes as far as to suggest that his own failure to control the avatar's body effectively in-game had a chiasmatic effect on his own affect, crossing from the screen to his body, leaving him "like some drooling idiot." Procedural animation not only makes avatar body feel incompetent, it also seems to make the player body incompetent at playing. *Trespasser* is regarded as a failure in normative (aka "market-driven") video game discourse, however its (albeit unintentional) subversion of the fantasy of the ultra-hard and masculine avatar body sheds light on the possibilities of how procedural animation challenges the separations we traditionally uphold between on and off-screen embodiment.

One game that is widely considered in existing literature on fumblecore games is *Octodad: The Dadliest Catch* (Young Horses, 2014), a videogame in which players must perform the role of human father while occupying the body of an octopus. Players navigate suburban life, completing dadly objectives, like picking up groceries or bringing the family to the aquarium. However, Octodad's floppy and tentacular movement make even the simplest of tasks, like taking the escalator, a battle against sticky, floppy limbs and environments littered with precariously perched objects. Unlike games that use ragdoll bodies to make non-player deaths "satisfying," the development team used ragdoll physics to imagine how a bipedal cephalopod

[192] Chin, "Trespasser Review."

might navigate space. Rather than using a premade game engine (like Unity), the student team opted for Irrlicht, an open-source graphics engine and PhysX, an open-source middleware from NVIDIA for physical simulation that included softbody physics simulations.[193] For the consumer release of the game, the team dispensed with softbody physical simulations because deformable, softbody simulations were removed from PhysX 3 in favor of more efficient cloth simulations.[194] Accordingly, the team swapped out Octodad's softbody physics for ragdoll physics, blending ragdoll animations with inverse kinematics, which were used to animate Octodad's head and signature floppy moustache.

Developers Kevin Geisler and Devon Scott-Tunkin describe the kinds of physical forces that the game had to simulate on Octodad's body just to keep the ragdoll upright and stable enough to be manipulated in their 2015 game postmortem:

> The main stabilizing force was an upward force on his head which pulled him up like a balloon. To keep him from floating away his feet needed to be very heavy at most times, about as heavy as the whole rest of his body combined. The player only controlled one leg at a time otherwise Octodad would constantly fall on his ass or fly away. Once a leg was controlled the mass was greatly lightened on the foot so it didn't create huge forces when kicking things and to make it easier to control. When input was stopped or when switching to the alternate leg the mass increased again.[195]

The shift from ragdoll as a satisfying death animation to ragdoll as player character necessitates the use of a vast array of compensatory forces in excess of gravity to keep the floppy body upright. Many of the challenges of playing *Octodad* arise from dealing with the surprisingly light-feeling limbs and unevenly weighted head. These forces draw attention to how Octodad's body reacts to different objects in the environment; a player interested in completing the game

[193] Geisler and Scott-Tunkin, "Octodad."
[194] NVIDIA, "Migrating From PhysX SDK 2.x to 3.x."
[195] Geisler and Scott-Tunkin, "Octodad."

must learn how to account for these novel forces as they attempt to move Octodad's body through the gameworld.

In their chapter on *Octodad* as a queer parable about passing, Bo Ruberg argues that the control schema of the game "does not just represent difference. It allows players to inhabit that difference."[196] This argument sees a mimetic impulse in game design: where the unruly and unusually floppy avatar body is understood to be duplicated as the mode of the player's embodiment via a granular, unusual, or disorienting control interface. Ruberg sees Octodad's floppy body as queer "counterhegemonic resistance," its chaotic movements frustrating player's attempts at mastery and control in such a way that it invites "players to replicate the awkwardness of Octodad's body with the uncomfortable motions of their own."[197] While I agree that this game, and perhaps the fumblecore genre at large, highlights the importance of the "player's own body in the act of playing," I am not certain that fumblecore games (or *Octodad* more specifically) lend themselves to this mimesis, particularly because these games seem to invite either hyper-skilled play (adapting to the disorienting interface and simulations) or a non-goal-oriented exploration of the physical simulations of the world, made interesting by haptic disorientation.

Rather than opening up the genre to counterhegemonic play, I argue when ragdoll animations become the primary quality of embodiment this form of procedural animation actually disciplines human bodies as they attempt to attend to machine approximations of physical forces. Fumblecore players are forced to attend to physical simulation in ways that often emphasize their own physical dexterity and capacity to anticipate how physical simulation will

[196] Ruberg, "Octodad," 85.
[197] Ruberg, 86.

alter how objects move in simulated spaces. For example, gameplay guides and walkthroughs for fumblecore games demonstrate the level of precision required to master the ragdoll avatar body. YouTube user stabguy describes how to successfully "march" in *QWOP*, telling players to direct their attention to "the leading leg. To decide when it's time to switch strides, you can either watch for the leading thigh to be parallel with the ground or you can switch just before the leading foot hits the ground."[198] This is just one of the many tips, tricks, and corrective strategies stabguy offers fellow gamers that aim at keeping the avatar body vertical and moving forward. As stabguy's guide illustrates, in *QWOP*, players are forced not only to deal with an unusual and uncertain control scheme, but also to pay attention to how the game models the forces on their unruly human avatar. Looking at the angles of body parts and ensuring that they remain inside of certain boundaries required for human movement becomes the work of the human player, rather than the machine. This play strategy forces the human interlocutor to contend with the realities of machinic embodiment, ultimately taking on part of the labor the machine performs in normative physics animations for the sake of realism. Performing reality and the orderly body becomes the purview of the player, rather than the machine.

In the case of unskilled play, play is not focused on mastery of the control scheme, but rather non-goal-oriented experimentation with physical simulation that is made engaging and comical through haptic disorientation. Players are not as concerned with the maintenance of orderliness for the sake of reaching a goal (like *QWOP's* 100m finish line), but instead concern themselves with the unexpected physical interactions that are the byproduct of a difficult-to-control avatar. The comedy of *Surgeon Simulator* (2013, Bossa Studios) comes mostly from over-the-top

[198] *QWOP Running Tutorial*.

physics-based interactions where the inert ragdoll body of the patient on the table plays the straight man to the player's foibles. In *Surgeon Simulator,* players assume control over a single difficult to control hand and arm rather than an entire body. The A, W, E, R, and space keys control each of the fingers of the hand independently, moving the fingers out of the "home row" position for QWERTY keyboards and into an arrangement that accommodates the relative length of the pinky finger to the rest; ergonomic but still disorienting and unfamiliar. The player's right hand grasps the mouse, where the left mouse button controls the y-axis height (much in the manner of an arcade claw machine) and the right mouse button controls the rotation of the hand (revealing the palm or flexing the wrist). The game is designed to be challenging and frustrating: the pleasures of play arise from the success of picking up a thin scalpel in one's undexterous simulated hands as much as they do from the unexpected and toy-like physics sandbox.

There is a great deal of effort put in by Bossa Studios to make the player's flailing entertaining. Upon entering surgery, it is a delight to find that the watch on the wrist of the unhygienic surgeon is not a cosmetic feature of the arm. It is physically simulated and as it collides with other objects (including the body of the patient) it is liable to pop off the player's wrist and get lost amidst the viscera. Even the level select screen for the game, which also functions as the game's tutorial, emphasizes the physics-sandbox elements of play. The desk is scattered with pads of paper that can be mixed up, open pill bottles that can be spilled, cups filled with pens that can be flung out of frame, a phone that periodically rings and can be picked up, and a desktop computer into which a player can insert a tantalizing stack of difficult-to-pick-up floppy disks (Figure3.?). Though this part of the game does not technically have a "goal," its design encourages players to experiment with and attend to how the difficult-to-control hand interacts with a wide range of physically-simulated objects.

The default keybindings of *Surgeon Simulator* dictate that players will control each finger of the simulated hand with the corresponding finger of their actual hands resting on the keyboard. According to Luke Williams, Lead Designer of *Surgeon Simulator*, the game's granular control scheme was directly influenced by *QWOP*, but, unlike *QWOP*, the indexicality of the controls draws even more attention to the gap between the player's perceived control over their own hands playing and their lack of control over the hand they control on the screen in front of them.[199] The narrative conceit of the game also does work, evoking the fine and controlled tasks of surgery and undercutting that expectation with overblown physically-based interactions between objects and a difficult to control hand. Douglas Stark argues that *QWOP* "defamiliarizes our own embodied experience of movement and draws attention to how our conscious mind relies on distributed, biological and technical intelligence to act."[200] I would extend Stark's argument to say that the control scheme of *Surgeon Simulator* draws even more attention to the gap between embodied performance on screen and off-screen.

Conclusion

Though it is currently beyond the scope of this chapter, a larger consideration of physics-based procedural animation and the ragdoll might look to the physics sandbox genre of 3D videogames, like *Gary's Mod* (Facepunch Studios, 2006) and *Goat Simulator* (Coffee Stain Studios, 2014) as an intervening figure between procedural animation methods and physics-based simulation. Within these titles, players are free to experiment and play with objects to see

[199] *The Origins of Surgeon Simulator & Bossa Studios*.
[200] Stark, "Unsettling Embodied Literacy in QWOP the Walking Simulator," 51.

how they will interact within the physical system. In a game like *Garry's Mod*, this can mean spawning characters from *Half Life 2,* which come packaged with the game, and experimenting with manipulating them much in the way Gabe Newell does in his *Half Life 2* demo: using them as tools through which to understand how objects in the 3D simulated world interact with each other. I see a relationship between these physics sandbox games and games like *Surgeon Simulator*, *Hand Simulator*, and *I am Bread*, which combine granular control schemes and elements of the physics sandbox genre. This chapter elides the history of 2D flash games that use the ragdoll to allow players to manipulate bodies (often representing politicians and celebrities) into compromising positions or repeated falls. These games continue the trend of using the ragdoll as a sign of power or player control, but are also intermediary steps to the fumblecore game genre. I also do not consider Bennett Foddy's larger oeuvre of 2D fumblecore games, like *GIRP* (2011), and *Getting Over It with Bennett Foddy* (2017), instead focusing on games with 3D physical simulation.

This chapter charts the rise of real-time physics-based animation in 3D videogames. I look to the ragdoll animation specifically as a symbol of player control over 3D simulated environments, particularly in the 3D shooter genre. I then consider how things change when the unruly floppiness of ragdoll physics becomes the quality of the embodiment of the player character, and how that forces players to attend to physics simulations in ways that other games do not. I see fumblecore games as a useful limit case that demonstrates a broader truth about the ways that videogames teach players to attend to and anticipate processes of physical simulation. Ragdoll animations arise from and are marked by their generic deployments, where these animations are used to illustrate death, simulate mastery, and emphasize player control. When these animations are used to animate the body of the player character, they create a kind of ludoperformative dissonance, where the body of the player (who has an investment in “winning”) is forced into ever more masterful and virtuosic performances in order to content with the unruly and chaotic locomotion of the player character.

When we play 3D games, our experiences of embodiment, as well as our embodied performances on the other side of the screen, are enmeshed with the particular and contingent physical simulations implemented in the game engine. My attention to mostly 3D videogames, from *Hitman,* to *Half Life 2,* to *Surgeon Simulator* demonstrates the ways that the kinds of physical simulation, enabled by polygonal modeling, affect how bodies play on the other side of the screen. This welcomes further explorations of how other implementations and uses of physical simulations change what it means to have or be a body across gameworlds, noting the cultural valences of these aspects of videogames that often bear the mark of objectivity through their appeals to computational efficiency and scientific accuracy.

Coda: Critical Literacies of Videogame Embodiment

Figure 4.1 A screenshot of Hard Lads *(Robert Yang, 2020) depicts the fallen lad on his skyward journey. Screenshot by author.*

You are the implied fourth mate of the three on-screen hard lads, filming them as they drink, smoke, and hit a lad with a folding chair. They also sometimes kiss. The phone through which you view this scene dips below the 10% battery threshold: the game is coming to an end. The hurt lad collapses for a seventh time and something different happens. Rather than standing back up for another round, the lad begins to float skywards. The pile of 69 chairs that had fallen from the sky on top of him likewise become airborne. As the lad ascends, his limbs are loose and jelly-like, contorting under the influence of invisible forces on his journey sunwards (Figure 4.1). A chorus of lads accompany this spectacle with a raucous a cappella rendition of Savage Garden's 1997 single "Truly Madly Deeply." Repeated playthroughs unlock angel wings for the ascendant lad, Icarus-based public domain art, and, finally, a recording of the viral YouTube video that inspired Robert Yang to develop *Hard Lads* in 2020.

The surreal ending to this experimental art game is the byproduct of an accident. Recounting his development process, Yang writes, “the ending sequence for Hard Lads began as a failure in my code. I was trying to apply physics forces to keep the ragdoll upright, but instead it levitated the hurt lad off the ground.”[201] In this particular case, the compensatory forces Yang needed to apply to the fallen lad *because he was soft* provided the infrastructure and accidental inspiration for this ending. The unexpected outcome of applying simulated physics forces on a ragdoll in the Unity game engine gave Yang the campy, uncanny, and strangely emotional resolution the original source material never could. He kept it in the game.

To be clear, Yang could have fixed this error. He could have made the fallen lad’s body comport itself appropriately, obeying Earthly standards of physics and human standards of anatomy. But what would be the point? After all, the game is not merely an interactive recreation of its YouTube source material. The accident-cum-ending constitutes part of the game’s commentary on masculinity, failure, violence, and what it means to be a “hard lad” who is actually soft and floppy. The flying floppiness of Yang’s ragdoll at the conclusion of the game is a disabling act—players have nothing else to do but watch the ascent and observe how the hard lad’s body is quite soft. This softness critiques the hard façade of masculinity that the lads in the YouTube video display (drinking, getting hit). It also draws attention to the underlying logics of embodiment in videogames; Yang’s game explores the paradigms in which embodiment is typified by softness, modeled in such a way as to be vulnerable to physical forces in ways that

[201] Yang, “Hard Lads.”

rigidbodies are typically not. This game showcases what forms of expression are available when we have the critical game engine literacies to understand embodiment in gameworlds.

Though the majority of the games I discuss in this dissertation are in some way commercial—either they are the product of large corporate game studies, or, at the very least, released to paying audiences in for-profit contexts—I share this art game at the close of this project to bring to the fore the ways that moments when something does not look quite right, when something behaves in a way that defies expectation, animate my chapters. Rather than write off these momentary discomforts as accidents, user errors, or system glitches, they are essential tools for indexing the core logics, and the attendant cultural assumptions, of videogames. What differentiates the mass market appeal of games like *Detroit: Become Human, Halo 3,* or *Half-Life 2* from the surreal art of *Hard Lads* is that *Hard Lads* is dedicated to the task of asking players to dwell in the accidental. Art games, like *Hard Lads*, foreground the constructedness of game engine logics in ways that help us develop the literacies we need to appreciate when things in games appear unremarkable, feel good, or look "right." Game engines, and their embedded logics, including shaders, collision detection and response, and physically-based procedural animations, are one vector through which we can explore the experience of being embodied in and through gameworlds.

It is essential to develop this literacy in this moment, particularly as realtime 3D computer graphics become increasingly focused on mimesis and are making their way into other media formats. On this first count, the popularity and availability of graphics processing units (GPUs) permits developers to implement more complex physical simulations, just as game engines are starting to include more physically-based or dynamic realtime effects in their game engines.[202] The availability of these technologies paired with the consolidation of pre-built (and blackboxed) solutions to these simulation problems points to the ways in which these core logics at the heart of videogames might continue to recede into the murky waters of "industry standards."

Furthermore, game engines are only becoming more relevant to the study of digital media as more media production processes adopt game engine technologies for the creation of their visual effects. For example, Unreal was used as a way to integrate realtime graphics effects in principal photography for *The Mandalorian* (Jon Favreau, 2019), where large, high-definition LED screens displayed 3D environments running in-engine.[203] This trend seems likely to continue in cinematic media: Unity, another leading commercial game engine, acquired New Zealand-based visual effects company Weta in 2021 to increase their capacities for realtime cinematic visual effects.[204] Not only is this an interesting moment of corporate consolidation, in which popular engines continue to absorb other third-party products into their platform, but it also forecasts the continuing relevance of computer graphics and realtime simulation to artistic expression in both cinematic and ludic media.

A better understanding of the cultural logics embedded in game engine logics, can also help us better understand the construction of embodied difference in our world, shaped by the cultural forces of race, gender, sexuality, and ability. As *Hard Lads* demonstrates, game engines are tools to help us see things we couldn't otherwise, and to tell new stories (or, at the very least,

---

[202] For example, Unity 5.0 (2015), was the first version of the Unity engine to include a standardized physically based shader (PBS) geared towards making the surfaces of (primarily solid) objects interact with light in real time. The PBS tool standardized what were a set of ad-hoc procedures to simulate the dynamic play of light on the surface of objects in gameworlds. Lopez, "Physically Based Shading in Unity 5."
[203] Turnock, "Unreal Engine: ILM in a Disney World," 221.
[204] Whitten, "Welcome Weta Digital!"

imagine different endings). A critical understanding of the cultural dynamics embedded in video game engines can also shine light on the contingency of these dynamics in the world beyond the screen.

Bibliography

10 Minutes Of Cyberpunk 2077 Bugs..., 2020. https://www.youtube.com/watch?v=RXLohSvTKpg.

Aarseth, Espen. “Ludology.” In *The Routledge Companion to Video Game Studies*, edited by Mark J. P. Wolf and Bernard Perron, 185–89. New York, N.Y: Routledge, 2014.

Alexandra, Heather. “The Division 2 Is Political, Despite What Its Developers Say.” Kotaku, June 12, 2018. https://kotaku.com/the-division-2-is-political-despite-what-its-developer-1826776710.

Alt, Casey. “Objects of Our Affection: How Object Orientation Made Computers a Medium.” In *Media Archaeology*, edited by Erkki Huhtamo and Jussi Parikka, 278–301. Berkeley, CA: University of California Press, 2011. https://doi.org/10.1525/9780520948518-015.

Arif, Fahad. “Quantic Dream Wants to ‘Push the Limits’ With Advanced Visual Features for PS4-Exclusive Detroit: Become Human.” *Wccftech* (blog), June 30, 2016. https://wccftech.com/ps4-exclusive-detroit-advanced-visuals/.

Ashcraft, Brian. “Summer Lesson Gets Inevitable Porn Adaptation [NSFW].” Kotaku Australia, June 24, 2017. https://www.kotaku.com.au/2017/06/summer-lesson-gets-inevitable-porn-adaptation/.

———. “Trying Hard To See Underpants In Summer Lesson.” Kotaku, October 21, 2016. https://kotaku.com/trying-hard-to-see-underpants-in-summer-lesson-1788059280.

Berlant, Lauren Gail, and Lee Edelman. *Sex, or the Unbearable*. Theory Q. Durham [North Carolina]: Duke University Press, 2014.

Bersani, Leo. “Is the Rectum a Grave?” In *Is the Rectum a Grave? And Other Essays*, 3–30. Chciago, IL: University Of Chicago Press, 2010.

Bobic, Nick. “Advanced Collision Detection Techniques.” *Game Developer Magazine*, May 1999.

Boluk, Stephanie, and Patrick LeMieux. *Metagaming: Playing, Competing, Spectating, Cheating, Trading, Making, and Breaking Videogames*. Minneapolis: Univ Of Minnesota Press, 2017.

Braithwaite, Brenda. *Sex in Video Games*. Createspace Independent Publishing Platform, 2013. https://bookshop.org/books/sex-in-video-games/9781491079263.

Brown, Ashley ML. *Sexuality in Role-Playing Games*. Routledge, 2015.

Buse, Katherine. “Genesis Effects: Growing Planets in 1980s Computer Graphics.” *Configurations: A Journal of Literature, Science, and Technology* 29, no. 2 (2021 Spring 2021): 201–30. https://doi.org/10.1353/con.2021.0012.

Carloy, Chris. “‘True 3D’: The Form, Concept and Experience of Three-Dimensionality in 1990s Videogames.” Dissertation. Chicago, IL, 2018.

Cheng, Anne Anlin. *Second Skin: Josephine Baker & the Modern Surface*. Oxford: Oxford University Press, 2010. http://pi.lib.uchicago.edu/1001/cat/bib/11234321.

Chin, Elliott. “Trespasser Review.” *GameSpot* (blog), November 19, 1998. https://www.gamespot.com/reviews/trespasser-review/1900-2535286/.

Nightfire Speedrunning Wikia. “Clipping.” Accessed December 19, 2021. https://nightfire-speedrunning.fandom.com/wiki/Clipping.

“Clipping (Computer Graphics).” In *Wikipedia*, June 10, 2021. https://en.wikipedia.org/w/index.php?title=Clipping_(computer_graphics)&oldid=1027879115.

Cobbett, Richard. “Crapshoot: Trespasser, the Jurassic Park Game That Was Ambitious, at Least.” *PC Gamer*, September 5, 2020. https://www.pcgamer.com/saturday-crapshoot-jurassic-park-trespasser/.

Cole, Yussef. “‘Detroit’ Siphons and Squanders a History of Marginalized Struggle.” *Vice*. Accessed June 14, 2021. https://www.vice.com/en/article/qvne4d/detroit-become-human-review-marginalized-struggle.

Cole, Yussef, and Tanya DePass. “Black Skin Is Still A Radical Concept in Video Games.” Vice, March 1, 2017. https://www.vice.com/en/article/78qpxd/black-skin-is-still-a-radical-concept-in-video-games.

Crick, Timothy. “The Game Body: Toward a Phenomenology of Contemporary Video Gaming.” *Games and Culture* 6, no. 3 (May 1, 2011): 259–69. https://doi.org/10.1177/1555412010364980.

Dayus, Oscar. “Ghost Recon Breakpoint Not Making Political Statements, Ubisoft Insists Despite Obvious Themes.” *GameSpot* (blog), May 10, 2019. https://www.gamespot.com/articles/ghost-recon-breakpoint-not-making-political-statem/1100-6466778/?ftag=GSS-05-10aaa0b.

Denson, Shane. *Discorrelated Images*. Durham, NC; London: Duke University Press, 2020.

Dyer, Richard. “Lighting for Whiteness.” In *The Film Cultures Reader*, edited by Graeme Turner, 95–106. London ; New York: Routledge, 2002.

Evans and Sutherland Computer Corporation. “Improved Scene Generator Capability.” Final Report. Houston, TX: NASA, October 28, 1977.

GamingExcellence. “Exclusive: Assassin’s Creed Q&A - The Scimitar Engine,” October 25, 2007. http://www.gamingexcellence.com/features/exclusive-assassins-creed-q-and-a-the-scimitar-engine.

Fanon, Frantz. *Black Skin, White Masks*. 1st ed., New ed. New York: Grove Press, 2008.

Fickle, Tara. *The Race Card: From Gaming Technologies to Model Minorities*. Postmillennial Pop. New York: New York University Press, 2019.

Fox, Jesse, Jeremy N. Bailenson, and Liz Tricase. “The Embodiment of Sexualized Virtual Selves: The Proteus Effect and Experiences of Self-Objectification via Avatars.” *Computers in Human Behavior* 29, no. 3 (May 1, 2013): 930–38. https://doi.org/10.1016/j.chb.2012.12.027.

Frank, Allegra. “Summer Lesson Is the Scariest VR Experience I’ve Ever Had.” *Polygon* (blog), September 21, 2017. https://www.polygon.com/2017/9/21/16343274/summer-lesson-tgs-2017-scary-vr-games.

Freedman, Eric. “Engineering Queerness in the Game Development Pipeline.” *Game Studies* 18, no. 3 (December 2018). http://gamestudies.org/1803/articles/ericfreedman.

———. *The Persistence of Code in Game Engine Culture*. New York ; London: Routledge, 2020.

DoomWiki.org. “Fuzzy Pumper Palette Shop.” Accessed June 1, 2022. https://doomwiki.org/wiki/Fuzzy_Pumper_Palette_Shop.

Gaboury, Jacob. “Hidden Surface Problems: On the Digital Image as Material Object.” *JOURNAL OF VISUAL CULTURE* 14, no. 1 (20150401): 40–60. https://doi.org/10.1177/1470412914562270.

———. *Image Objects: An Archaeology of Computer Graphics*. Cambridge, MA, USA: MIT Press, 2021. https://mitpress.mit.edu/books/image-objects.

Gallagher, R. “No Sex Please, We Are Finite State Machines: On the Melancholy Sexlessness of the Video Game.” *Games and Culture* 7, no. 6 (01 2012): 399–418. https://doi.org/10.1177/1555412012466287.

Galloway, Alexander R. *Gaming: Essays on Algorithmic Culture*. Electronic Mediations 18. Minneapolis: University of Minnesota Press, 2006.

Geisler, Kevin, and Scott-Tunkin. “Octodad: Dadliest Catch Post-Mortem Pt. 4: Tech.” *Game Developer* (blog), March 30, 2015. https://www.gamedeveloper.com/programming/octodad-dadliest-catch-post-mortem-pt-4-tech.

Graber-Stiehl, Ian. “The Profound Quandary of Blackness in the Video Game ‘Detroit: Become Human.’” The Root, June 17, 2017. https://www.theroot.com/the-profound-quandary-of-blackness-in-the-video-game-d-1796172314?utm_source=theroot_twitter&utm_medium=socialflow.

Grant, Christopher. “VR School Girls? When a Pokemon Fighting Game Isn’t the Weirdest Project from Bandai Namco.” *Polygon* (blog), September 1, 2014. https://www.polygon.com/2014/9/1/6093223/tekken-team-summer-lesson.

Gray, Kishonna L., and David J. Leonard. “Not a Post-Racism and Post-Misogyny Promised Land: Video Games as Instruments of (in)Justice.” In *Woke Gaming: Digital Challenges to Oppression and Social Injustice*, 3–26. Seattle: University of Washington Press, 2018.

Grayson, Nathan. “Despite Political Overtones, David Cage Says Detroit Is Mostly About Androids.” Kotaku, June 15, 2017. https://kotaku.com/despite-political-overtones-david-cage-says-detroit-is-1795939952.

Hahn, James K. “Realistic Animation of Rigid Bodies.” In *Proceedings of the 15th Annual Conference on Computer Graphics and Interactive Techniques*, 299–308. SIGGRAPH ’88. New York, NY, USA: Association for Computing Machinery, 1988. https://doi.org/10.1145/54852.378530.

Half Life 2 Tech Demo - E3 2003, 2011. https://www.youtube.com/watch?v=4ddJ1OKV63Q.

Hamilton. “Octodad: Dadliest Catch: The Kotaku Review.” Kotaku, April 22, 2014. https://kotaku.com/octodad-dadliest-catch-the-kotaku-review-1512040710.

Hansen, Steven. “Review: Sunset.” Destructoid, 2015. https://www.destructoid.com/reviews/review-sunset/.

Harvey, Aureia. A Tale of Tales on the politics and interior design of Sunset. Interview by Konstantinos Dimopoulos, April 17, 2015. https://www.gamedeveloper.com/design/a-tale-of-tales-on-the-politics-and-interior-design-of-i-sunset-i-.

Hiles, Bill. “Looking Glass and Terra Nova: Strike Force Centauri.” *GameSpy*, May 1, 2001.

Hollister, Sean. “I Ogled a Schoolgirl in Sony’s Virtual Reality.” Gizmodo, June 19, 2015. https://gizmodo.com/i-ogled-a-schoolgirl-in-sonys-virtual-reality-1712391186.

Horrorshow, Kitty. “Anatomy and Glitch Aesthetics,” March 12, 2022.

Unity3d Tips. “How To Fix Unity Z-Fighting With Multiple Solutions,” October 4, 2017. https://www.unity3dtips.com/unity-z-fighting-solutions/.

Hunicke, R., M. Leblanc, and R. Zubek. “MDA: A Formal Approach to Game Design and Game Research,” WS-04-04:1–5, 2004.

id Software. “Doom.” MS-DOS, 1993.

“Introduction — Flex Artist Tools 1.0 Documentation.” Accessed January 5, 2022. https://docs.nvidia.com/gameworks/content/artisttools/Flex/FLEXUe4_Intro.html.

Jagoda, Patrick, and Peter McDonald. “Game Mechanics, Experience Design, and Affective Play.” In *The Routledge Companion to Media Studies and Digital Humanities*, edited by Jentery Sayers, 174–82. Routledge, 2018. https://doi.org/10.25846/xzr3-2k81.

Jakobsen, Thomas. “Advanced Character Physics.” Copenhagen, Denmark: IO Interactive, January 21, 2003. https://www.gamedeveloper.com/programming/advanced-character-physics.

Jones, Ian Bryce. “Do the Locomotion: Obstinate Avatars, Dehiscent Performances, and the Rise of the Comedic Video Game.” *Velvet Light Trap*, no. 77 (March 22, 2016): 86.

Jurassic Park - Trespasser : Physics and Glitches, 2013. https://www.youtube.com/watch?v=AJdZf1txiz0%27.

Kelly, Andy. “Why I Love Noclip Mode.” *PC Gamer*, April 3, 2019. https://www.pcgamer.com/why-i-love-noclip-mode/.

Keogh, Brendan. *A Play of Bodies: How We Perceive Videogames*. MIT Press, 2018.

Keogh, Brendan, and Benjamin Nicoll. *The Unity Game Engine and the Circuits of Cultural Software*. Switzerland: Palgrave Macmillan, 2019.

Kim, Theodore. “Anti-Racist Graphics Research,” 2021.

Kohler, Chris. “Let’s Play Summer Lesson, PlayStation VR’s Most Unexpectedly Creepy Game.” *Wired*, October 18, 2016. https://www.wired.com/2016/10/summer-lesson-playstation-vr/.

Krzywinska, T. *The Strange Case of the Misappearance of Sex in Video Games*. *Computer Games and New Media Cultures: A Handbook of Digital Games Studies*. Computer Games and New Media Cultures: A Handbook of Digital Games Studies. Springer Netherlands, 2012. https://doi.org/10.1007/978-94-007-2777-9_9.

Kucic, Matt. “How to Prototype a Game in Under 7 Days.” Gamasutra, October 26, 2005. https://www.gamasutra.com/view/feature/130848/how_to_prototype_a_game_in_under_7_.php.

Kushner, David. *Masters of Doom: How Two Guys Created an Empire and Transformed Pop Culture*. Reprint edition. New York: Random House Trade Paperbacks, 2004.

Lang, Ben. “‘Summer Lesson’ Made Me a Creep, and That’s a Good Thing.” *Road to VR* (blog), September 16, 2015. https://www.roadtovr.com/summer-lesson-for-playstation-vr-made-me-feel-like-a-creep-and-thats-a-good-thing/.

Lewis, Sarah. “The Racial Bias Built Into Photography: Lens.” New York Times (Online). New York, United States: New York Times Company, April 25, 2019. http://www.proquest.com/globalnews/docview/2213743935/abstract/5224F090775C46BEPQ/1.

Lohmeyer, Eddie. *Unstable Aesthetics : Game Engines and the Strangeness of Modding*. Bloomsbury Academic, 2021. https://eds-a-ebscohost-com.proxy.uchicago.edu/eds/ebookviewer/ebook/bmxlYmtfXzI3MTk5MDRfX0FO0?sid=fa9b9aa3-07f2-4418-8855-955ba28ef2ea%40sdc-v-sessmgr01&vid=0&format=EB&rid=2.

Lopez, Rod. “Physically Based Shading in Unity 5: A Primer.” Unity Blog, October 29, 2014. https://blog.unity.com/technology/physically-based-shading-in-unity-5-a-primer.

Lowood, Henry. “Game Engine.” In *Debugging Game History: A Critical Lexicon*, edited by Raiford Guins and Henry Lowood, 203–9. Cambridge, MA: MIT Press, 2016.

Macklin, Miles, Matthias Müller, Nuttapong Chentanez, and Tae-Yong Kim. “Unified Particle Physics for Real-Time Applications.” *ACM Transactions on Graphics* 33, no. 4 (July 27, 2014): 153:1-153:12. https://doi.org/10.1145/2601097.2601152.

Marchalot, Ronan. “Cluster Forward Rendering and Anti-Aliasing in ‘Detroit: Become Human.’” San Francisco, CA, 2018. https://www.gdcvault.com/play/1025084/Cluster-Forward-Rendering-and-Anti.

McConnell, Jeffery J. “Computer Graphics Principles.” In *Computer Graphics Companion*, edited by Jeffery J. McConnell, 4th ed., 4–22. New York, N.Y.: Palgrave Macmillan, 2002.

McLuhan, Marshall, and W. Terrence Gordon. *Understanding Media: The Extensions of Man*. New York: Gingko Press, 2013. http://pi.lib.uchicago.edu/1001/cat/bib/11200119.

@me_irl. “John Carmack on ‘No Clipping’ - Pastebin.Com,” November 16, 2012. https://web.archive.org/web/20200510033549/http://pastebin.com/8sj4RAxq.

Melamed, Jodi. “The Spirit of Neoliberalism : From Racial Liberalism to Neoliberal Multiculturalism.” *L’esprit Du Néolibéralisme : Du Libéralisme Racial Au Multiculturalisme Néolibéral*, no. 89 (January 1, 2006): 1–24.

Miller, Robyn. “Classic Game Postmortem: Myst.” Presented at the Game Developers Conference 2013, April 5, 2013. https://gdcvault.com/play/1018048/Classic-Game-Postmortem.

Montfort, Nick., and Ian. Bogost. *Racing the Beam: The Atari Video Computer System*. Cambridge, Mass.: MIT Press, 2009.

Moore, Jared. “Halo Infinite Players Are Learning How To Communicate Through Teabag Dancing.” *IGN*, December 2, 2021. https://www.ign.com/articles/halo-infinite-players-communicate-tea-bag-morse-code.

Moore, Matthew, and Jane Wilhelms. “Collision Detection and Response for Computer Animation.” In *Proceedings of the 15th Annual Conference on Computer Graphics and Interactive Techniques*, 289–98. SIGGRAPH ’88. New York, NY, USA: Association for Computing Machinery, 1988. https://doi.org/10.1145/54852.378528.

Murray, Soraya. *On Video Games: The Visual Politics of Race, Gender and Space*. Vol. 27. International Library of Visual Culture ; London: I.B. Tauris & Co. Ltd., 2018.

Myers, Brian. “Friends With Benefits: Plausible Optimism and the Practice of Teabagging in Video Games.” *Games and Culture* 14, no. 7/8 (2017): 763–80.

Nagle, John. “Animating Fall Stunts with Falling Bodies and Softimage 3D.” Animats, 1997. https://www.animats.com/dynamics/tutorials/runandfalltutorial.html.

———. Method and system for generating realistic collisions in graphical simulations. United States US6067096A, filed March 4, 1998, and issued May 23, 2000. https://patents.google.com/patent/US6067096/en.

Narcisse, Evan. “Sunset: The Kotaku Review.” Kotaku, May 26, 2015. https://kotaku.com/sunset-the-kotaku-review-1706965316.

“Noclip.” Accessed December 15, 2021. https://noclip.website/.

NVIDIA. “Migrating From PhysX SDK 2.x to 3.x.” NVIDIA PhysX SDK 3.4.0 Documentation. Accessed June 7, 2022. https://docs.nvidia.com/gameworks/content/gameworkslibrary/physx/guide/Manual/MigrationFrom28.html.

O’Brien, Nicholas. “After Sunset.” Rhizome, June 25, 2015. http://rhizome.org/editorial/2015/jun/25/dusk/.

Parent, Rick. “Physically Based Animation.” In *Computer Animation: Algorithms and Techniques*, 3rd ed., 541. Morgan Kaufman, 2018.

Parisi, David. “A Counterrevolution in the Hands: The Console Controller as an Ergonomic Branding Mechanism.” *Journal of Games Criticism* 2, no. 1 (2015).

Pettineo, Matt “MJP.” “An Introduction To Real-Time Subsurface Scattering.” *The Danger Zone* (blog), October 6, 2019. https://therealmjp.github.io/posts/sss-intro/.

Phillips, Amanda. *Gamer Trouble: Feminist Confrontations in Digital Culture*. New York: NYU Press, 2020.

———. “Negg(at)Ing the Game Studies SubjectAn Affective History of the Field.” *Feminist Media Histories* 6, no. 1 (January 1, 2020): 12–36. https://doi.org/10.1525/fmh.2020.6.1.12.

———. “Shooting to Kill: Headshots, Twitch Reflexes, and the Mechropolitics of Video Games.” *Games and Culture* 13, no. 2 (March 1, 2018): 136–52. https://doi.org/10.1177/1555412015612611.

Quantic Dream’s “Kara” PS3 Tech Demo @ HD ✓, 2012. https://www.youtube.com/watch?v=PPCw09-DNFg.

QWOP Running Tutorial, 2012. https://www.youtube.com/watch?v=HBFYJvq_o_4.

Reed, Alison, and Amanda Phillips. “Additive Race: Colorblind Discourses of Realism in Performance Capture Technologies.” *Digital Creativity* 24, no. 2 (2013): 130–44. https://doi.org/10.1080/14626268.2013.808965.

Roth, Lorna. “Looking at Shirley, the Ultimate Norm: Colour Balance, Image Technologies, and Cognitive Equity.” *Canadian Journal of Communication* 34, no. 1 (March 2009): 111–36. https://doi.org/10.22230/cjc.2009v34n1a2196.

Ruberg, Bonnie. “‘Loving Father , Caring Husband, Secret Octopus’: Queer Embodiment and Passing in Octodad.” In *Video Games Have Always Been Queer*, 84–109. New York: New York University Press, 2019.

———. “Sex as Game: Playing with the Erotic Body in Virtual Worlds.” *Rhizomes*, no. 21 (Winter 2010). http://rhizomes.net/issue21/ruberg.html.

———. *Video Games Have Always Been Queer*. New York: New York University Press, 2019. https://nyupress.org/9781479831036/video-games-have-always-been-queer.

Russell, Keith. “The Glimpse and Fan Service: New Media, New Aesthetics.” *International Journal of the Humanities* 6, no. 5 (August 2008): 105–10. https://doi.org/10.18848/1447-9508/CGP/v06i05/42444.

Russworm, Edited by Jennifer Malkowski and TreaAndrea M. *Gaming Representation: Race, Gender, and Sexuality in Video Games*. Indiana University Press, 2017.

Sachania, Jalpesh. “Physics Driven Ragdolls and Animation at EA: From Sports to Star Wars.” Presented at the Game Developers Conference 2018, 2018. https://www.gdcvault.com/play/1025210/Physics-Driven-Ragdolls-and-Animation.

Shaw, Adrienne. *Gaming at the Edge: Sexuality and Gender at the Margins of Gamer Culture*. Minneapolis; London: University of Minnesota Press, 2014.

Shaw, Adrienne, and Christopher J. Persaud. “Beyond Texts: Using Queer Readings to Document LGBTQ Game Content.” *First Monday,* July 24, 2020. https://doi.org/10.5210/fm.v25i8.10439.

Sicart, Miguel. “Against Procedurality.” *Game Studies* 11, no. 3 (December 2011).

Sito, Tom. *Moving Innovation: A History of Computer Animation*. Cambridge, Massachusetts: The MIT Press, 2013.

Smith, Zoe. “4 Colorism, or, the Ashiness of It All.” *Women Write About Comics* (blog), May 24, 2019. https://womenwriteaboutcomics.com/2019/05/4-colorism-or-the-ashiness-of-it-all/.

Spiral Stair Fall. ..Mp4, 2001. https://www.animats.com/images/soldier.mp4.

Stark, Doug. “Unsettling Embodied Literacy in QWOP the Walking Simulator.” *Journal of Gaming & Virtual Worlds* 12, no. 1 (March 1, 2020): 49–67. https://doi.org/10.1386/jgvw_00004_1.

Stenbuck, Kite. “More Summer Lesson English Releases Confirmed.” PlayStation LifeStyle, January 29, 2018. https://www.playstationlifestyle.net/2018/01/29/more-summer-lesson-english-releases-confirmed/.

Stephens, Michelle Ann. *Skin Acts: Race, Psychoanalysis, and the Black Male Performer*. Durham: Duke University Press, 2014.

Sturman, David. “The State of Computer Animation.” *SIGGRAPH Computer Graphics Newsletter* 32, no. 1 (1998). https://ohiostate.pressbooks.pub/app/uploads/sites/45/2017/09/sturman-animation.pdf.

superzaropp. "Pathfinder's in-Game Model vs Hitbox (Picture Comparison)." Reddit Comment. *R/Apexlegends*, April 18, 2019. www.reddit.com/r/apexlegends/comments/beii91/pathfinders_in_game_model_vs_hitbox_picture/el64qm7/.

Swink, Steve. *Game Feel: A Game Designer's Guide to Virtual Sensation*. Amsterdam ; Boston: Morgan Kaufmann Publishers/Elsevier, 2009.

Taylor, Mollie. "Halo Infinite's Bots Aren't Teabagging You, at Least Not on Purpose." *PC Gamer*, August 13, 2021. https://www.pcgamer.com/halo-infinites-bots-arent-teabagging-you-at-least-not-on-purpose/.

The History of No-Clipping − Codex, 2018. https://www.youtube.com/watch?v=KkGmg1irVWA.

The Origins of Surgeon Simulator & Bossa Studios, 2021. https://www.youtube.com/watch?v=OYrpQdX-yzQ.

Turnock, Julie A. "Unreal Engine: ILM in a Disney World." In *The Empire of Effects: Industrial Light and Magic and the Rendering of Realism*, 216–22. Austin, UNITED STATES: University of Texas Press, 2022. http://ebookcentral.proquest.com/lib/gsu/detail.action?docID=6961300.

TheGamer. "Ubisoft Doesn't 'Want To Make A Political Statement Specifically About Cuba' With Far Cry 6," May 28, 2021. https://www.thegamer.com/ubisoft-spoke-to-actual-guerilla-fighters-but-doesnt-want-to-make-a-political-statement-with-far-cry-6/.

"Unity - Manual: Reflection Probe Performance and Optimisation." Accessed August 11, 2021. http://stalhandske.dk/UnityDocs/Manual/RefProbePerformance.html.

Unity Technologies. "Legacy Shaders." Unity Manual 2021.3, July 5, 2022. https://docs.unity3d.com/Manual/Built-inShaderGuide.html.

Unity Technologies `. "Unparalleled Platform Support." Accessed June 28, 2022. https://unity.com/solutions/multiplatform.

Unreal Engine. "Multi-Platform Development." Unreal Engine. Accessed June 28, 2022. https://www.unrealengine.com/en-US/features/multi-platform-development.

Von Neumann, John, Paul M. Churchland, and Patricia Smith. Churchland. *The Computer and the Brain*. 2nd ed. New Haven, CT: Yale Nota Bene, 2000.

"VR Kanojo / VRカノジョ on Steam." Accessed December 2, 2021. https://store.steampowered.com/app/751440/VR_Kanojo__VR/.

Wallace, Ryan, and Shirley Chu. “Gaming Poised to Continue Accelerated Growth According to Unity Gaming Report 2022.” Unity.com, April 16, 2022. https://investors.unity.com/news/news-details/2022/Gaming-Poised-to-Continue-Accelerated-Growth-According-to-Unity-Gaming-Report-2022/default.aspx.

Wardrip-Fruin, Noah. “Beyond Shooting and Eating: Passage, Dys4ia, and the Meanings of Collision.” *Critical Inquiry* 45, no. 1 (Autumn 2018).

Wardrip-Fruin, Noah. “Gravity in Computer Space.” *ROMchip* 1, no. 2 (December 5, 2019). https://romchip.org/index.php/romchip-journal/article/view/91.

———. *How Pac-Man Eats*. Software Studies. Cambridge, Mass: MIT Press, 2020.

Weinberg, Richard. “Computer Graphics in Support of Space Shuttle Simulation.” In *Proceedings of the 5th Annual Conference on Computer Graphics and Interactive Techniques*, 82–86. SIGGRAPH ’78. New York, NY, USA: Association for Computing Machinery, 1978. https://doi.org/10.1145/800248.807375.

Weizenbaum, Joseph. *Computer Power and Human Reason: From Judgement to Calculation*. San Francisco: W. H. Freeman, 1976.

Whitten, Marc. “Welcome Weta Digital!” Unity Blog, September 21, 2021. https://blog.unity.com/news/welcome-weta-digital.

Wilde, Tyler. “Sunset Review.” *PC Gamer* (blog), May 29, 2015. https://www.pcgamer.com/sunset-review/.

Wyckoff, Richard. “Postmortem: DreamWorks Interactive’s Trespasser.” *Gamasutra*, May 14, 1999. https://www.gamasutra.com/view/feature/131746/postmortem_dreamworks_.php.

Yang, Robert. “A People’s History Of The FPS, Part 1: The WAD.” *Rock, Paper, Shotgun*, September 19, 2012. https://www.rockpapershotgun.com/a-peoples-history-of-the-fps-part-1-the-wad.

———. “A People’s History Of The FPS, Part 2: The Mod.” *Rock, Paper, Shotgun*, September 20, 2012. https://www.rockpapershotgun.com/a-peoples-history-part-2-the-mod.

———. “Hard Lads as an Important Failure.” *Radiator Desigm Blog* (blog), June 21, 2020. https://www.blog.radiator.debacle.us/2020/06/hard-lads-as-important-failure.html.

———. “On ‘Feminist Whore Purna’ and the Ludo-Material Politics of Gendered Damage Power-Ups in Open-World RPG Video Games.” In *Queer Game Studies*, edited by Adrienne Shaw and Bo Ruberg, 97–108. Minneapolis; London: University of Minnesota Press, 2017.

———. “Queer Futures in Game Feel,” October 4, 2018. https://www.blog.radiator.debacle.us/2018/10/queer-futures-in-game-feel.html.

Half-Life Wiki. “Zero Point Energy Field Manipulator.” Accessed June 9, 2022. https://half-life.fandom.com/wiki/Zero_Point_Energy_Field_Manipulator.

Zwiezen, Zack. “Ubisoft Insists Latest Game, [INSERT NAME], Isn’t Political [Update].” Kotaku, May 28, 2021. https://kotaku.com/ubisoft-insists-latest-game-insert-name-isn-t-polit-1846995146.