SHOTGUM SHELLS & SHATTERED CLAYS

A Skeet Shooting Physicality System

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Intent Statement

By using click and drag mouse inputs to manually pump shells in and out of a shotgun, an immersive first person aiming perspective, and fast moving targets, I intend to create a "skeet shooting" gameplay system that is kinetic in its feel and precision & timing based in its challenges.

Research & Thesis

My goal is to create a physicality based system which revolves around the player having to manually pump a shotgun with the mouse before taking carefully timed shots at fast moving clay pigeon targets rather than simply having the pumping be a non-interactive animation. The overarching objectives with this system are to create a gameplay loop where the player faces an additional physicality challenge besides simply aiming and moving and to make the player feel physically connected with the weapon by means of kinetic interaction and game feel.

Most shooters with shotguns or other manually operated firearms like hunting rifles simply play an animation when a new round needs to be chambered, leaving the player with no possible interactions with the weapon during this time. In real life, however, loading a new round is just as physical as target acquisition and sharpshooting. I strongly feel that the majority of shooter games tend to ignore the potential for a high amount of player interaction with their weapons, and since players spend the majority of their time using these weapons, why not allow them to interact with them as much as possible?

I first got the idea for creating a physical feeling weapon interaction system after deconstructing the VR game *Hot Dogs, Horseshoes, & Hand Grenades* (or H3VR for short). H3VR is a game solely focused around physical weapon interactions with highly detailed and realistic gun models that offer a huge range of interactions. Additionally, the game features many enjoyable shooting range activities that test not only the timing and precision reflexes of players, but also their physical abilities, since weapons must be loaded, chambered, and fired with 100% physical interactions. The combination of physicality in weapon interaction, kinetic game feel, and timing challenges interested me greatly because of how different it made the experience feel from a traditional shooter. One of the challenge in particular is a mini skeet shooting range in one of the maps where players can shoot clay birds in intervals with any weapon they want, but it feels best with a pump action shotgun. After interacting with this challenge, I was inspired to create an experience that replicates the same kinetic feeling of pumping the shotgun shells physically while still having to have spot on timing to hit the targets. This is where the idea for mouse drag based shotgun pumping in a skeet shooting scenario was born.

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Although I have much experience in skeet shooting in real life, I still had some questions about the physicality factors of the sport and how I could reflect them in gameplay. To learn more about this, I did research into the physical aspects of skeet shooting and eventually found an article from the Journal of Human Sport and Exercise that was exactly what I was looking for. In the article, which is titled "The relative importance of selected physical fitness parameters in Olympic clay target shooting", the researches discuss four different physicality elements that occur in the sport of skeet shooting: postural stability, strength, Quiet Eye duration, and maximal oxygen consumption (VO²max). While postural stability and strength somewhat apply to my system (posture translates to player local and strength to recoil control), the most important thing I learned from researching this article was the idea of the "Quiet Eye", which is described as the "final fixation gaze to a target" (Peljha) before the shooter fires the weapon. I managed to reflect this in my system, as the best way to shoot and hit the targets is by waiting to fire until the "Quiet Eye" period has occurred, or when the sight/crosshair has lined up perfectly with the arc of the target.

One of the main pillars of the system I intended to create was a sense of "kinetic game feel", or a satisfying feeling resulting from the motion of the weapon's parts. In order to maximize my ability to achieve this, I decided to focus my second research effort on learning more about game feel in general and how to make it as satisfying as possible. I managed to find a long Gamasutra article published by a designer that goes into detail about what game feel actually is and a 6 step process to making it work well. These steps include input, response, context, polish, the metaphor, and rules. The ideas discussed about input, response, and polish were particularly useful to me because they highlighted the areas that my manual pumping system would utilize to get the shotgun interactions feeling kinetic. The manual pumping controls stemmed from the input section while the audio, animations, screen shake, particle effects, model recoil, etc stemmed from the response and polish sections.

Now armed with a broader understanding of the physicality of skeet shooting and how to achieve kinetic game feel, I now had a solid vision for how to create the manual pumping system. However, before jumping into Unity and starting to build it, I did one last piece of research into the purpose of reloading systems in games to determine if this manual pumping system I had devised was essential to my experience or just a cool idea. I managed to find an article that discusses the role of reloading as a mechanic in shooting games and ponders if these mechanics are essential to shooters in the first place. After breaking down several common reloading mechanics found in games (from simple "press R to play animation" to "active reloading based on timing"), the article concludes by explaining that reload systems are fundamentally important to a shooter if they provide tension in the experience. With this in mind, I concluded that my manual pumping mechanic would indeed be essential to my intended experience because it adds an extra layer of tension, as players must be able to physically pump their gun between shots.

System & Mechanics

Explanation

The system gives the player control of a first person character equipped with a pump action shotgun in a small skeet shooting range. Clay pigeons infinitely spawn at two separate stations, once of which spawns them in random patterns while the other spawns five pigeons in a line every 5 seconds. The experience is meant to be experimental and does not have an overall goal, however a points system allows players to keep track of how many clay pigeons they have successfully hit.

Players can move around the range using the WASD keys on their keyboard. The shotgun is aimed using movement from the mouse. Players can also jump with the space bar to perform trick shots. Clicking the left mouse button fires the shotgun, but only if a shell has been loaded into the barrel. To load a shot, players first click and hold the right mouse button to enter Pumping Mode. Once in Pumping Mode, aiming the shotgun is disabled, allowing the mouse to be used to move the pump. While remaining in Pumping Mode, players first pull the mouse downwards to pump out the currently loaded shell, whether it has been fired or not. To load a new shell, players then push the mouse forward, pumping a new shell into the barrel. Once this process has taken place, the shotgun may be fired again. Faster movements of the mouse while in Pumping Mode allow the shotgun to be pumped faster, allowing for faster follow up shots and rewarding players who engage more physically with the system.

Clicking in the scroll wheel toggles the aiming mode between a shouldered perspective (with the shotgun at the side of the screen and a crosshair in the middle of the screen) and a sight perspective (which uses the actual physical sights of the shotgun model). There is no difference in the accuracy of the weapon between the two modes, but they each give a distinctive feel to how precise the weapon feels. Firing the shotgun causes the player's aim to recoil upwards, requiring them to pull their mouse back down to compensate when taking follow up shots. This combination of firing, recoil compensation, and manually pumping as well as the way this process feels is what provides the experience with its physicality aspects. In other words, this system exhibits physicality in a gameplay challenge sense and a game feel sense.

Visual Design Document



Video Overview Storyboard



QA Testing

Test Plan

Test Intent: The goal of this test is to determine if the desired intent of my physicality prototype has been successfully achieved in a playable form. Survey questions relate to tester behavior when aiming, loading, and firing the shotgun at a target as well as how testers think this process feels. The prototype will be considered successful if players feel physically challenged by the manual shotgun pumping and precise timing required to hit the targets, as well as if the feel of operating the shotgun is interpreted as kinetic. I plan to get feedback from at least 4 different people. The test will be held informally outside of the QA lab.

Testing Setup & Procedure:

- 1. Explain concept of the system and controls to tester
- 2. Launch game and observe if tester notices instructions in game world. Record observation.
- 3. Let tester play with the system as long as they like, since it is an endless shooting gallery.
- 4. Have tester fill out form
- 5. Thank tester for their time and feedback

Test Questions:

- 1. Did you think about the timing of your shots when aiming at the targets?
- 2. Did manually pumping the shotgun add another layer of physical challenge to the process of aiming and firing at targets?
- 3. Did you feel that your aim needed to be extremely precise to successfully hit a target?
- 4. When pumping the shotgun, did you find yourself flicking the mouse as fast as possible?
- 5. How would you describe the feeling of the process of aiming, pumping, and firing the shotgun? Did it feel physical and kinetic?
- 6. Did the kickback of the shotgun require you to quickly readjust your aim when taking follow up shots on missed targets?
- 7. Which aiming mode felt more accurate to you: shoulder aiming with the crosshair or sight aiming with the shotgun's sight?

8. Did you prefer one aiming mode over the other? Why or why not?

Survey: https://goo.gl/forms/kJcDxmHKL4YoGts53

Test Results

Summary: Overall, the testing was a resounding success. I got five people to test the game, which was one above my goal of four. Three of the testers do not normally play video games which resulted in a less biased test. These same three testers have all fired shotguns and gone skeet shooting before, meaning they are familiar with the real life version of the experience I intended to replicate. The other two testers are game production majors at Champlain College. While neither of them typically play shooting games, this didn't seem to affect their enjoyment of the game.

Survey Responses:

- 1. Did you think about the timing of your shots when aiming at the targets?
 - A) Yes: 5
 - B) No: 0
- 2. Did manually pumping the shotgun add another layer of physical challenge to the process of aiming and firing at targets?
 - A) Yes: 5
 - B) No: 0
- 3. Did you feel that your aim needed to be extremely precise to successfully hit a target?
 - A) Yes: 4
 - B) No: 0
 - C) Other: 1: "Not extremely, but within the boundaries of the crosshairs"
- 4. When pumping the shotgun, did you find yourself flicking the mouse as fast as possible?
 - A) Yes: 2
 - B) No: 0
 - C) Sometimes: 3

- 5. How would you describe the feeling of the process of aiming, pumping, and firing the shotgun? Did it feel physical and kinetic?
 - A) I felt involved
 - B) It felt really physical and kinetic, I love the use of the mouse to reload. Much better than pressing some key
 - C) Yes and it was very satisfying when you hit a bird.
 - D) pumping and firing were some of the most enjoyable aspects of the game. I also liked the sound effect of the shells hitting the ground, very realistic.
 - E) Since I've shot a real shotgun I felt that this game was very physical and kinetic.
- 6. Did the kickback of the shotgun require you to quickly readjust your aim when taking follow up shots on missed targets?
 - A) Yes: 5
 - B) No: 0
- 7. Which aiming mode felt more precise/accurate to you: shoulder aiming with the crosshair or sight aiming with the shotgun's sight?
 - A) Sight aiming with shotgun's sight: 4
 - B) Shoulder aiming with crosshair: 1
- 8. Did you prefer one aiming mode over the other? Why or why not?
 - A) I liked the sight aiming because I felt more in control of where my shots went
 - B) I think both were fun, the shoulder aiming was harder due to the big size of the crosshairs, but overall both were really fun.
 - C) Down the sights
 - D) I used the crosshair aiming more, just because I have done that in other games (I am not an experienced gamer, just casual player)
 - E) I preferred the sight aiming and I seemed to hit more targets that way. I think because it allowed me to stop thinking about lining up the crosshairs and just relax and hit the targets.
- 9. Any additional comments/suggestions/feedback?
 - A) this is great b
 - B) This is epic, make a full game

- C) very fun gg m8
- D) It was particularly satisfying to hit the clays, though I enjoyed the whole process, it reminded me of real clay bird shooting.
- E) The audio effects on all the gun noises are very accurate. Also liked that you added the noise of the shell hitting the ground. Visually I liked the smoke in between shots and I pretty much could smell it too! I was a little confused with the movement tools, maybe because I'm not a big gamer, but I did figure it out. Also, wasn't sure how to quit the game.

Resulting Observations:

- 1. Testers took the timing of their shots into account before firing
- 2. The manual shotgun pumping was found to be a physicality challenge
- 3. Tester's generally preferred the sight aiming over the crosshair because it felt more precise to them
- 4. Shooting the shotgun was interpreted as being kinetic and even realistic by two of the testers who have used real shotguns
- 5. Shotgun recoil managed to add another layer of physicality to the experience
- 6. The speed at which the shotgun was pumped using the mouse didn't seem to matter too much

Analysis: Based on the responses to the survey, the prototype seems to have succeeded in both delivering a physicality based experience as well as delivering on the intended experience outlined in the Intent Statement. It was also successful based on the success criteria outlined in the QA plan. Testers understood the timing required to hit the targets by lining the sight up in the targets arc instead of following it through the air. Having to manually pump the shotgun managed to physically challenge the testers with an additional action to perform before shooting again. However, the speed at which the shotgun is pumped in correlation with the speed at which the mouse is moved didn't seem to really affect the experience of many testers, indicating that some tweaking of the pumping speed in response to slower mouse input vs faster mouse input needs to occur to increase the effort required in this challenge. Interestingly, all but one of the testers reported that the sight aiming mode was more precise than using the crosshair, despite the fact that there was no programmed difference in shot accuracy between the two modes. This indicates that a perceived difference in precision and accuracy occurred when using the sight mode, perhaps due to the fact that using sights is more accurate in real life and the testers may have felt this in an immersive sense. The feel of operating the shotgun was described as kinetic and satisfying by the testers, meaning the experience managed to convey physicality through its game feel successfully. Additionally, the

addition of recoil on the shotgun and the player's aim added even more physicality to both the gameplay and the game feel.

Survey Results:

https://docs.google.com/forms/d/1AXLZy_iuVJzZkVPpRi6I63y72hYEcGs3VTrNpgAcftw/edit#res ponses

Post Mortem

As I alluded to in the QA results, this system was a resounding success in delivering on its intended gameplay experience. Not only did all the testers find the game physically challenging, but also found the game to *feel* physical, which were the two core pillars of my intent for the system. Proper timing to hit the targets was a huge part of the experience for the testers, and the manual pumping mechanic as well as the recoil and aiming modes of the shotgun managed to deliver the intended physicality based gameplay.

What Worked:

- 1. The controls for pumping the shotgun as well as all the other shotgun operations worked exactly as I had originally intended. They were streamlined, simple to understand, and satisfying to use.
- 2. Operating the shotgun actually *felt* like operating a shotgun. Testers described the use of the shotgun as physical and kinetic, with those that have used shotguns in real life describing it as realistic. This is mostly a result of the next point...
- 3. Gameplay feedback to the player was abundant and successful on both visual and audio levels. The use of particle effects for the pellet impacts, muzzle flash and gun smoke managed to go a long way in making the game feel be perceived as physical. Including shattering on clay pigeons when they were hit was a good choice for feedback, as hitting the clays was described as satisfying by the testers. Creating a punchy and powerful sound effect for firing the shotgun paid off, as some testers said the audio was realistic and added to the physicality of the game feel. Lastly, even though I struggled with programming the vertical mouse recoil, it was a huge part of getting the game to feel physical, as it provided actually kinetic feedback to players to indicate that the gun was moving without their input.
- 4. Using clay pigeons as targets made the experience much more physical than it would've been with large stationary targets. Since the clays moved in predictable arcs, it also allowed players to become skilled with lining up their sights in these arcs

and firing at the precise moment the clay entered their sights. Additionally, having multiple clays spawn at different times and in different spots at one of the stations provided a nice physicality challenge, as players had to move their mouse quickly to get combos on clays in different locations

What Didn't Work:

- 1. The pumping speed of the shotgun didn't seem to matter to most of the testers. Originally, the pump was supposed to respond exactly to the speed at which the mouse was being moved by the player, meaning the faster the mouse was moved, the faster the pump would engage. In its current iteration, moving the mouse below or above a certain threshold cause the pump to move towards its target. While this still feels good, it doesn't offer a certain physical resistance that the pumps have in real life that I would've liked to convey.
- 2. While this is not an issue with the system itself, I spent far too much time trying to get the recoil on the mouse to work. While in the end it was worth it, programming this type of feedback was far beyond my mathematical knowledge of rotations in Unity. The time spent on this feature would have allowed me to focus my efforts on other areas that needed improvement, such as extra sounds for the shotgun and movement as well as a scoring system based on accuracy on the clay birds.

What I Learned:

Perhaps my biggest takeaway from the experience of designing this system was that game feel plays a significant part in making a player feel physically connected to their actions. The amount of time spent tweaking the feel of the shotgun, from the screen shake and recoil when shooting it to the sound of the shells falling in the correct direction after pumping, was well worth the effort and without a doubt one of the most substantial factors in making this system a success in terms of physicality. I also learned that a game can have very streamlined controls and still remain a physical experience. Many of the physicality based games that I play, from action games to shooters, often feature rather complicated control schemes to achieve physicality in their game play (e.g Dark Souls, Squad). When designing this experience, I wanted to make sure that my pumping controls would feel natural to use and would eventually become second nature to the players. I believe I succeeded in that regard, as the testing results indicate the players not only found the pumping to be an additional physical challenge in the gameplay but also enjoyed using it. Overall, this experiment taught me that perfecting the feeling of a game's core mechanics is key to the entirety of the experience. If the shotgun didn't make any sound, visibly recoil after firing, have no movement on the pump, etc, I think that players would've felt very differently about the experience.

Peljha, Z., Michaelides, M., & Collins, D. (2018). The relative importance of selected physical fitness parameters in Olympic clay target shooting. Journal of Human Sport and Exercise, 13(3), 541-552. doi:https://doi.org/10.14198/jhse.2018.133.06

This article discusses the different physical parameters that are required to be successful in the sport of skeet shooting. Most of the article focuses on the sport itself and how factors like postural stability, gun kinematics, and "Quiet Eye" influence an athlete's performance in the sport.

The paper beings by introducing the sport of skeet shooting and providing a clear and detailed explanation as to what it entails. It then goes on to detail 4 separate physical parameters that have been studied in relation to the sport: postural stability, strength, Quiet Eye duration, and maximal oxygen consumption (VO²max).

Key takeaways:

- Postural stability focuses on the correlation between physical steadiness and marksmanship
- Strength examines the correlation between shoulder and forearm muscular control and the ability to stabilize a firearm
- Quiet Eye is the idea of the "final fixation gaze to a target" before firing the weapon, or the period when the target has lined up perfectly with the gun sights during its flight arc

This article provided me with a lot of valuable information for designing the skeet shooting aspects of my system. For example, the idea of the "Quiet Eye" is reflected in the gameplay, as the best way to shoot and hit the targets is by waiting to fire until the "Quiet Eye" period has occurred. I learned more about the physical aspects of skeet shooting and how to reflect that experience in a game system.

Rust LTD. Hot Dogs, Horseshoes, & Hand Grenades. Rust LTD. 5 April 2016. Video Game

Hot Dogs, Horseshoes & Hand Grenades (H3VR) is VR sandbox gun simulation game currently available in Steam Early Accessfor the HTC Vive, Oculus Rift, and Windows Mixed Reality. The gameplay revolves around experimenting in shooting ranges with hundreds of different realistically modeled and operated firearms through purely physical & kinetic interactions.

Key takeaways:

- Streamlined control scheme allows for natural feeling loading and handling of weapons
- > Kinetic gameplay feedback, or "game feel", makes the experience feel extremely physical

- > Target shooting challenges involve both precision and timing to successfully hit targets
- > Limitless experimentation and immersive game feel induce flow

The highly kinetic game feel as well as the timing and precision based target shooting challenges are what influenced the design of my system the most from *H3VR*. The physicality involved in both loading/operating weapons (especially the shotguns) and the proper timing to hit moving targets in the shooting ranges is especially unique to this game, and I really aimed to translate that physicality to a non-VR game. I learned the importance of game feel in regards to physicality while deconstructing this game, as a huge part of the game's physical attributes come from the kinetic feeling of every interaction.

Swink, Steve. "Game Feel: The Secret Ingredient." *Gamasutra*, 23 Nov. 2007, www.gamasutra.com/view/feature/130734/game feel the secret ingredient.php.

This article describes the phenomenon of game feel and design techniques and processes to improve the game feel of any game. It is both an informative and instructional article, as the information defines the concept of game feel and breaks down in detail some good game feel design practices.

The article begins by describing what game feel is and how powerful it can be to a player experience. After this, most of the rest of the article breaks down a 6 step process for achieving optimal game feel for any system. The article concludes by asking the user to consider the aesthetic qualities of game feel and how it can truly make or break an experience.

Key takeaways:

- Input is how players express their intent to the game system
- Response is the way in which the system processes and modifies this input
- Context determines the meaning behind the systems. Without it, even the best feeling systems have nothing
- Polish is what creates the physicality of the system's feel; animations, sounds, and input driven effects
- The "Metaphor" of the experience ties emotion to the motion of the system and helps prevent frustration
- Rules provide additional challenges with the tweaking of variables

I found this article extremely useful when creating my system and designing my intended experience. The kinetic feeling I aimed to achieve was influenced largely by the information provided in this article about input (manual pumping), response and polish (audio and animations), while the timing and precision challenges (shooting the clay birds) came from information related to the context and rules sections. I learned the basic steps to achieving optimal game feel, and I will be using the information in this article quite a lot in the future.

"What Is the Role of Reloading as a Game Mechanic? ." *Medium.com*, Medium, 22 Aug. 2018, medium.com/rock-milk/what-is-the-role-of-reloading-as-a-game-mechanic-10f9e67ccc42.

This article discusses the idea of a reloading mechanic in shooting games, researches the various types of reloading in these games, and considers whether the mechanic is essential or not to the shooter experience. The article also establishes the idea of "needs vs wants" in relation to game mechanics; needs are mechanics that are essential for the game to be fun while wants are simply desired because they're interesting.

The article begins by introducing the concept of reloading in games and with an anecdote about a game jam shooting game that added reloading simply because it was a shooter. This prompted the author to want to research if reloading is a "need or want" in shooter games. In the research section, the article examines various types of common reload systems found in games, such as simple button press reload, no reload, active reload, and more. The article concludes by declaring reloading as a needed mechanic in shooters, as it complements shooting by creating extra tension and also fits thematically.

Key takeaways:

- Plain, button based reloads exchange a period of vulnerability for increased battle readiness to limit the duration of encounters
- > No reloading makes a shooter feel more fast paced and encourages constant encounters
- Heat gun reloads strike a balance between plain and no reloading
- Active reloading makes reloading into a player skill that can be learned and mastered, increasing interaction and reward potential

This article was important in helping me identify ways in which reload mechanics contribute to the overall experience in a shooting game. This article taught me that the shotgun pumping mechanic in my system is a part of the active reloading category, as it allows reloading to become a skill that can be mastered in tandem with shooting and aiming.

- Clay pigeon parabola arc script by "DitzelGames": <u>https://gist.github.com/ditzel/68be36987d8e7c83d48f497294c66e08</u>
- Wood materials on shotgun by "Mezanix": <u>https://assetstore.unity.com/packages/2d/textures-materials/wood/high-quality-realistic-wood-textures-mega-pack-75831</u>
- Metal materials on shotgun by "Yughues": <u>https://assetstore.unity.com/packages/2d/textures-materials/metals/yughues-free-metal-materials-12949</u>
- Shotgun shell samples from Audiokinetic Wwise 101 Tutorial
- All other audio source samples used when creating sound effects found in the Public Domain