**COVENTRY UNIVERSITY**

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SCHOOL OF COMPUTING, ENGINEERING AND MATHEMATICS

**DO GAME PHYSICS AFFECT REALISM AND PLAYER ENGAGEMENT IN VIDEO GAMES**

**303COM – INDIVIDUAL PROJECT**

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# **Preamble**

## The focus/problem

Video games have been around for so long and they are a part of a big majority of people’s lives nowadays, having this into consideration, people keep adding themselves to more and more games, what this report aims to discover is the why people prefer certain physics in games and how they are connected to the increased likeability of gaming.

## The solution/methodology

To base the research of this report, a questionnaire and other sources about game physics and their influence in game are the main key points to achieve the final conclusion, there are so many mechanics and physics that contribute to this factor, it is quite interesting to know why and how this happens and the main preference in game genres.

My solution is to gather the people’s opinion about realistic and less realistic physics and mechanics and use this against proper research to confirm my point and explain why it is so.

## Conclusion taken

From the questionnaire and research that were done, we can take a more realistic answer which aims towards more real-world like games, although some of the users did prefer less realistic mechanics, but this does not mean they do not enjoy the same type of games as the others who went for realistic physics. In few words, realism is taken as the preference for the people, and they would more often like to see it in games as well as the mechanics that use it.

**Acknowledgements**

I would like to thank, firstly my parents, who gave me the support, being emotional or monetary as best as they could throughout the whole duration of the course and helped me keep my head held high even during the tough times.

I would also like to thank my grandmother who has always been there for me as well and she always gave me a guiding light towards good decisions.

Finally, I would like to thank my friends who have kept on motivating me to be able to achieve graduation and also keep me concentrated on the studies as well as enjoy university life to the best extent possible.

# **Introduction**

Many questions remain on why video games can be so addictive and what causes these changes in people, making them crave for more dopamine inducing games, which create this vicious cycle of gaming.

What if you could know why this happens? That is the purpose of this dissertation, to find out why and how video game physics and mechanics affect playability and make players more engaged towards a more realistic physics engine or a more balanced and more “fake” physics engine.

As it is known, physics are the basis for any video game, these consist of interactions between player and map, to simulate gravity, make objects have weight and add movement to objects overall, it is the skeleton for all movement and interactions in a game, so knowing which type of physics players prefer would explain the likeability of certain games.

The focus of this dissertation, of course, will be through research on game mechanics and their effect on human satisfaction, and taking in people’s feedback on different game mechanics. All this to explain why realistic or less realistic games and their physics are more of a hit and make players more addicted to a certain game genre.

If not understood yet, this is more focused towards people who have experience with games and know a sufficient amount about the subject to be able to take their own conclusion from this paper.

# **Literature review**

## A Service to your reader

This project aims to focus on game physics, these have always been a fun aspect of every game and it makes each game unique, different genres have different physics and for some reason players choose one type of physics over the other, these being realistic or “fake”.

The objective/thinking behind this project becomes to understand why these physics are preferred over the other and to use this research later for game development. To be able to gather reliable data and make sure it was truthful, a questionnaire was made and research to back up the sample recorded will also be given.

Not make people seem to be interested behind the dopamine inducing mechanics and physics that exist, and this research would be promising in further games development. This is found to be a good justification to why this research was made, and this report exists.

## Current Primary sources

In terms of primary sources, a paper about “GAMEPLAY AND GAME MECHANICS DESIGN: A KEY TO QUALITY IN VIDEOGAMES” (1), which gives some really good information about how game mechanics work, how physics is behind them and how they are important for quality in video games.

For physics and the comparison that is made between the real world and games, this research was really good, “Comparing Physics in Video Games and In Real Life” (2), it gives examples of mechanics and physics that affect them also giving an opinion about these, realistic physics and non-realistic are spoken in this paper and some comparison as well.

Finally, to give a better insight to why this research is fundamental this website with some good information and analysis on “Realistic game mechanics and impacts on immersion and engagement, or Why we don’t have Fuel in Dredge” (3), it essentially goes over how these factors make games more immersive and fun to play.

Also, some other sources not referred here were used to support some of the information found on the above research papers and posts.

## Final argument

This seemed to be an interesting subject and question to answer as not many people have focused on this and being able to know the answer would be fundamental to creating a game where you know it will have improved chances of being played.

Many people keep questioning and creating posts all over the internet trying to understand which type of physics and mechanics should be implemented more in games, as asked by a user in this Quora post “Why do video games have real life physics” (4) and many others.

It is also a good subject to debunk, so we finally get an answer to what mechanics and physics to use in games.

# **Methodology/Methods**

## Context

To be able to gather sufficient data for this written report, a survey was conducted which focused on questions about different game mechanics and the physics that affect them, a total of 16 questions were made of which 37 people answered.

To give some context, the entire questionnaire will be present on the section bellow, this way the reader can have a better understanding of what the target audience and the research is about with more precision.

## Questionnaire

The questionnaire is split in 2 sections, one where 4 starting questions are responsible for filtering non-essential data, and the main questions where we get the important answers that will be used as the basis for this project.

### **Starting questions:**

Q1: Do you play video games? \*

A1: Yes, I play (Jump to Q2)

A2: No, I don't play (Jump to Q4)

Q2: Do you like to play video games? \*

A1: Yes, I do. (Jump to Q3)

A2: No, I don't. (Jump to next section)

Q3: Can you give some examples of games you play?

A: (open answer) (Jump to next question)

Filter question (to make sure people answer honestly):

Q4: This questionnaire is about video games; do you agree to do your best to answer these questions? \*

A1: Yes, I'm sure (Jump to Main Questions)

A2: No, I don't want to answer the questions (Submit the questionnaire)

### **Main questions**

To give you some understanding of this questionnaire, it focuses on video game mechanics and physics, and which ones, you as a player or games enthusiast, prefer when you’re playing. (In case you are in doubt about what game mechanics are, these are basically everything your game character can do, this can be jumping, running, interacting with the environment, or even shooting a weapon)

Q5: How many hours a week you play? \*

A1: 0 – 5

A2: 6 – 12

A3: 12 – 24

A4: 24+

Q6: Which platform do you use to play? \*

A1: PC

A2: Console

A3: Mobile phone

Q7: Which game genre would you rather play? \*

A1: Sandbox (e.g., “GTA”, “Minecraft” or “The Sims”)

A2: Shooters, FPS (e.g., “Halo”, “Battlefield” or “Counterstrike”)

A3: MOBAs (e.g., “League of Legends”, “Dota 2” or “Smite”)

A4: Role playing games (e.g., “Skyrim”, “The Witcher 3” or “Fallout 4”)

A5: Simulation and Sports (e.g., “Forza Motorsport”, “Madden NFL” or “NBA2K”)

A6: Adventure (e.g., “Star Wars Jedi: Fallen Order”, “Sekiro: Shadows Die Twice” or “Assassin’s Creed”)

A7: Platformer (e.g., “Cuphead”, “Crash Bandicoot” or “Ori & The Blind Forest”)

Q8: Why do you like the game genre you chose? \*

A: (open answer) (Jump to next question)

Q9: Given these 2 examples of physics, which one would you prefer to see in a game? \*

Desc.: For some context, coyote time consists of when the character can still jump after he is out of the platform and double jumping is when the character can jump twice in the air.

A picture containing icon

Description automatically generatedA picture containing several

Description automatically generated

Figure 1 Double jump

Figure 2 Coyote Jump

A1: Coyote jump

A2: Double jump

Q10: When you kill an enemy, which would you prefer? \*

Desc.: For some context, ragdoll consists of when the character or enemy dies and his body loses its “strength”.

A picture containing outdoor object

Description automatically generatedA video game screen capture

Description automatically generated with low confidence

Figure 3 Missing enemy

Figure 4 Ragdoll

A1: Ragdoll

A2: Enemy disappearing

Q11: Would you rather have your character do a big jump normally or a small one (more realistic)? \*



Figure 5 Jump height

A1: A bigger jump is always better

A2: No, I like it more realistic

Q12: Do you like when you can interact with the environment? \*

Desc.: Many videogames contain something called “Levolution”, this is when the players are able to modify the environment, either through explosion or bullets (Games such as Battlefield 4).

A high angle view of a building

Description automatically generated with medium confidenceA picture containing outdoor, way, road

Description automatically generated

Figure 6 Levolution

Figure 7 No levolution

A1: Yes, I like to destroy everything!

A2: No, I like the levels to keep the same

Q13: Do you like to have no bullet spread or realistic? \*

Desc.: Bullet spread in games is considered the spread of each bullet every second a weapon is shooting; real life contains bullet spread and it is a big factor for weapons.

A picture containing wall, indoor, ceiling, floor

Description automatically generatedA person holding an object

Description automatically generated with medium confidence

Figure 8 Realistic bullet spread

Figure 9 Less realistic bullet spead

A1: Realistic bullet spread

A2: Less realistic, please!

Q14: Which type of physics do you prefer? \*

Desc.: For some context, realistic physics consists of how the environment and player interact between each other, being realistic, or simulated physics (e.g., double jumping, coyote time).

A1: Realistic physics

A2: Simulated physics

A3: Neither I play board-based games

Q15: Knowing the different mechanics and physics from the other questions, which one would you like to see more in other games? \*

A1: Coyote Time

A2: Double Jumping

A3: Ragdoll

A4: Disappearing enemy

A5: Levolution

A6: Realistic bullet spread

Q16: Following the previous question, which ones do you not like? \*

A1: Coyote Time

A2: Double Jumping

A3: Ragdoll

A4: Missing enemy

A5: Levolution

A6: Realistic bullet spread

# **Evaluation / Results**

## Evaluating the questionnaire

In this section, we will go over the questionnaire, mentioned previously, and well compare each answer until we reach a conclusion.

Over 35 participants entered this questionnaire and answered fairly, meaning the data that was gathered is trustworthy, as a few questions were set up to prevent false data from being entered and disrupt the entire questionnaire.

For the questions, they will be represented bellow through graphics.

### **Starting questions**

The first question, if answered as “No, I don’t play” would take you to a section of the form where it would filter the trustworthy data from the disposable.

The second question was an obvious answer as this project if just about video games.

The third question was an open answer, users gave their opinions of some games they play, as is seen, a lot of games were talked about.

From this graphic alone we can conclude that most players enjoy games with more realistic physics, such as CS GO, FIFA and Call of Duty, speaking in terms of basic movement of course.

The fourth question was a filter to make sure people would answer honestly making all the gathered data trustworthy. If the users answered “No” in the first question they would be redirected straight to this one.

### **Main questions**

Here we can see the total hours our audience plays a week, 39% of the people plays between 0 to 5 hours.

Once again, to know where most of the target audience data was taken, the above question was made, where we can confirm that PC is the most used for gaming.

In this question we can confirm the fidelity of our data, as most people once again chose shooters as their most preferred game genre, on a previous question we confirmed that the users mostly play FPS.

**Why do you like the game genre you chose?**

The above question was more of an ice breaker, just to be able to get some feedback to why each user chose the genre they did, without going in dividually to each questionnaire filled in it is hard to answer. But here are some of the answers:

“Because my favourite game is CS-GO”;

“Because it feels more realistic”;

“Interesting world’s combined with good mechanics”;

“Since I was a child, shooter games were the genre I mostly played, even today I play mostly shooters”.

Many other answers of the same type were given, but these were the ones that most popped up, as we can see, people do prefer games with realistic and good physics and mechanics, and they seem to find it in shooters more.

In this question, we see that double jump was the most liked out of the 2 mechanics, now this can be seen as a question not focused on realistic physics, but this question is important as one of the 2 mechanics does approximate more to real life than the other.

In this one, Ragdoll was the most chosen, it is always more fun to see the enemies fall onto the ground with limp bodies, than seeing them disappear completely from the map.

To no surprise, players would rather play games where the jumping height is capped to a similar height as real life.

Most people would prefer game where they can interact with the environment, Levolution is a big deal and should be used more in games, and we can see a growing pattern in its use nowadays.

As is confirmed in the question above, people would prefer games where they have to control weapon recoil as this is more realistic than having none, also increasing the skill required to play.

This question is the literal focus of this report, so its existence in this questionnaire seems necessary, the conclusions we took from the previous questions are confirmed with this one, as more gamers would rather play games with realistic physics.

The top answers for this question were Ragdoll and Realistic Bullet spread, keeping the same consistency throughout the whole questionnaire, these are 2 mechanics affected by physics differently and are always present in most shooters.

On this last question we get a confirmation that non-realistic interactions in games actually makes it less enjoyable to play, Missing enemies when you kill them removes a certain degree of realism that games require.

### **Research results**

For the second main part of this report, we will go over the research made to support the previous questionnaire, also some contradictions will be shown, to prove that in fact some people prefer unrealistic physics, but as our survey proved, the vast majority would prefer real world physics.

Existing information was collected from the internet, using sources such as [www.google.com](http://www.google.com), [www.oecd.org](http://www.oecd.org) and [www.academia.com](http://www.academia.com), other sources were also used and will be referenced.

### **Preferred physics**

Game physics are an interesting and very deep subject which can branch out and extend into many possible paths which ultimately lead to a simulation, being realistic or not of the world as we perceive it, this section focuses on understanding through research, which was found online.

Starting with an interesting study research paper, done by a professor, about the process and physics behind shooting a gun, stating that “Gravity causes the bullet to have a downward acceleration while traveling. Drag, or the air resistance, decelerates the projectile with a force proportional to the square of the velocity. Wind makes the bullet stray from the trajectory path. Battlefield 4 incorporates programming of drag to simulate the bullet drop.” (1), as we can see it is more complicated than faking physics, but if a developer would take these steps to make bullets have all those attributes, gameplay would be much better, allowing for more immersion and recreating similar real-life events in games, as stated in this phrase “Battlefield 4's portrayal of destructible environments and realistic physics like bullet drop show that game developers want to immerse players into a dynamic 3D world. Grand Theft Auto V has 3D models which interact with an open world differently every time the game plays, causing physics in the game to be dynamic and fully dependent on how the player interacts with the environment.” (2).

We can also bring up another point, video game physics are connected to the way the game was intended to be made but being able to recreate a certain type of physics that makes most players enjoy it, will increase the amount of adherence from the audience, games like GTA V, Battlefield 4, Besiege and other games with realistic physics have been top hits since their launch and nowadays some are still played. One of the factors that determined the success of these games was exactly the physics and the mechanics used to make the experience desirable and addictive to a certain degree, as is mentioned on this short text extracted from the internet, the following is about GTA V, “From [cruel pushes](https://youtu.be/mmmHQDhjG84?t=81) to [comical stumbling](https://www.youtube.com/watch?v=FXngm3-pqkI), Rockstar’s crime ‘em up is a ragdoll paradise, casting you as both nasty minion of tyrannical physics and its [frequent victim](https://www.youtube.com/watch?v=FTk-E9bAVeI&feature=youtu.be&t=46). The physical laws of Los Santos will tolerate silly stunts, but they will not tolerate a head smashed against a sidewalk at speed.” (3)

Also, to quote a post about physics in games “Developers apply physics in games for a variety of reasons, but the most important factors to consider are intuitiveness and fun factor. If an object in a game does not behave in a predictable way, it would be tough for the player to figure out how to play.” (4)

From research papers, other players opinions and the questionnaire we can jump to the conclusion that games with more realistic physics are prone for success, rather than less realistic games, although, physics are related to the game genre that the players choose and will vary every time, nonetheless it is always more interesting to play these types of games according to most of the audience.

### **Preferred Game mechanics**

Game mechanics are a fundamental part of games as well as physics, these enable the player to interact with himself and the environment, something as simple as shooting a gun is considered a mechanic, to give a better understanding, this statement “The use of the toys (both in terms of modes and purposes) and their relationships are regulated by rules, which organize a set of ludic activities and turns it into a complete and coherent game” (5), considering “toys” as being everything that interacts in games.

From the survey, some information about video game mechanics, which are ultimately affected by physics, was also gathered and as discussed before the top choices for physics were ragdoll and realistic bullet spread, now this would make sense as these are a good approximation to real world simulation in terms of physics and interactions.

Now these are also really important for gameplay because they essentially are the visual and computational interactions of our character, which without physics would never function properly, as is mentioned in this statement “In fact, the combination of core and satellite mechanics permits having a limited number of gameplay activities with many variations for each one of them. This allows players to feel a continuous evolution and development of mastery in all the core gameplay activities” (6).

Having also confirmed that mechanics also affect realism, now let’s see some examples of life-like mechanics:

As mentioned before, Ragdoll is a good example of a life-like mechanic, as it consists of making the body of a dead player or NPC, get limp and without movement, and then applying gravity through physics, making this realistic interaction of the body with the environment.

Realistic bullet spread is also another really good example, in real life weapons have recoil and bullet spread, although some games in order to make the gameplay easier, don’t use these 2 factors, which ultimately removes realism and players seem to dislike that.

Just some more context, Levolution is also another good mechanic that allows the player to destroy the environment around him, being able to displace others and interact with simple things such as a chair. One more example of realistic mechanics which players also seem to enjoy but isn’t as present in games as it normally would. But this would imply other problems behind it which I will not talk about.

In conclusion of this section, we can use this sentence to describe the opinion of an individual about game mechanics, “Realistic mechanics is really the goldilocks conundrum of game design; too much isn’t good and too little isn’t either and each game needs to strike a different balance; playing a platformer where you can only jump 1/3rd of your player character’s vertical height sounds restrictive…”(7), this person agrees that realistic mechanics are good and should be applied, but the way they are applied is what matters, but once again it would also depend on the game genre.

* + 1. **Game genre effect in physics**

Game genre is a big influence on which type of physics to use in game development, arcade games tend to gravitate towards less realistic physics thus meaning less realistic mechanics as well, meaning the gameplay will vary and maybe some games are better due to less realistic mechanics.

This happens because of the way the core mechanics need to be for each genre, games genres like shooters and RPG’s will use more realistic mechanics which can described by this quote “In Far Cry 3, 4, and Primal, you can**slide down hills.**That might not seem like a big deal, but it adds a great sense of fun to just traversing about the world. At the top of a slope, you can start running down, and slide into a faster run at the bottom.” (8), what we conclude from this is that these types of games will be default have a realistic approach of dealing with physics.

In the case of arcade or 2D games, physics are calculated a little different, maybe allowing the player to jump higher than normal or be able to shoot a weapon with no recoil or bullet spread, the calculations made for the running of the game were simply not complex enough to achieve realism, to give some notion “Let’s go all the way back to Pong - two rigid bodies (ball and paddle) repeatedly colliding with each other. Gee, when you put it that way, it doesn’t sound fun at all” (9), as you can see, in the case of 2D games, quality is lost due to less data being processed, only possessing 2 rigid bodies.

Besides less calculations, “… the angle of the ball rebounding from the paddles was not calculated accurately” (10), showing us in fact that the physics present in these genres are less worked on, thus less preferred than real life physics.

But we can affirm that “The physics used in 3D games is not that much different than what developers used in their 2D cousins” (11), although there is a difference in terms of computation compared to 2D games, because like mentioned before “The main difference is the complexity of computations when adding in a third dimension (z-axis) and objects made up of multiple rigid bodies.” (12)

**Analysis conclusion**

After gathering all necessary data from the survey, analysing it and comparing it to the research made, we can safely assume that life-like physics prevail even though there were some discrepancies, besides searching through research papers and articles, some information was also gathered from community websites such as [www.steam.com](http://www.steam.com), although this information is not displayed on this report.

Game physics affect game mechanics in many different ways and depending on these, players have preference over others, once again most of the population went for realistic mechanics, once again backing up the conclusion reached before.

Although the vast majority chose life-like mechanics and physics, it does not mean that all games should have this type characteristics as genre variates the game style needed and thus altering the physics as well.

Players consistently discuss about game mechanics and physics being adapted to make the gameplay easier, thus ruining the experience overall, keeping physics legit and not too easy will make increase likeability but also require more player skill.

More realistic games such as GTA V, BF4, G mod and such are considered a more likely to be played game overall others because of their life-like mechanics and thought behind the gameplay.

# **Discussion**

### **Achievements**

Through this project, we reached the conclusion that physics, and mechanics are a fundamental part in games and a necessary aspect for likeability and gameplay, there are multiple types of physics such as li-like simulated physics, which simulate the real world as best as possible and less realistic physics which are similar but a little different.

Also reaching the conclusion that more realistic games are overall according to the majority as “better” and mechanics involved in them should follow the same procedure.

This report can be used as a basis when searching for which types of mechanics and physics to use when developing a game, as one may do.

We also confirmed that certain and which types of genres are most preferred by players and how physics are responsible for their behaviour.

### **Deficiencies**

In terms of deficiencies, more deep research could’ve been done to explain some more concepts of game mechanics and physics, but that would take us into a whole deeper subject but would be fundamental, nonetheless. Even so we are able to reach a conclusion where we can find a satisfactory answer and a way to achieve it.

The questionnaire could’ve included more questions more target towards physics, but mechanics also complemented the questionnaire and to not overburden the users, it was kept to a controlled number of questions that would help gather some reliable data.

Also, information in some of the papers found was old and maybe not as reliable, so these were not used as basis, but this made the search for material hard and time consuming.

### **What could’ve been done**

A test program or a playable level with some of the mechanics and physics described would’ve been complementing for the full completion of a complex research and answer to this report, but a questionnaire also achieves some level of certainty and relevance towards a concrete answer.

# **Project Management Chapter**

## Supervisor revisions

According to the supervisor, a subject that could tackle a specific question and be able to come to a conclusion should be the way to make this report, as well as including some information about specific concepts for physics and mechanics.

## Problems encountered

A big concern that was found was the amount of research papers about this subject, most of the papers were not up to date so it made research fidelity on some papers hard to confirm and be trustworthy, but after checking some more recent papers, that information could be debunked and confirmed.

Also, during the making of this report, it was hard to get a hold of the supervisor, as there was always a mismatch in timings, making the quality drop by a bit, but hopefully the feedback that was taken is enough to be of enough degree.

Another problem was the time that was permitted to finish this report, as with more time, a more complex answer and proof could’ve been achieved. Although this does make this report invalid, as information is backed up.

To be able to confirm all of this research, the questionnaire was used as a basis for the target answer and vice-versa, over 5 papers about game mechanics and game physics were studied thoroughly and attentionally.

Advice and opinions were also taken from multiple forums, as player feedback is always important to make sure the answer, we came up with is in fact according to the general rule, many posts about preferring one type of physics over the other were found but the vast majority, as mentioned before, stuck with realistic physics.

# **Conclusion**

In conclusion, video game mechanics and physics are an important part of games and surprisingly players do have a preference over the types of physics and mechanics that are currently available and used for game developing. This being said, players tend to go for realistic games where physics and mechanics obey to a certain degree the way real life works, having shown a big disapproval of exaggerated mechanics such as enemy bodies missing instead of going into ragdoll mode, or other mechanics such as bullet spread and recoil.

Realism is a big thing for players and most developers should search for a way to make this a thing in their games.

Also, game genres are directly responsible for what type of physics will be used, arcade games, will use less realistic while shooters and such will use realistic mechanics and physics.

The questionnaire helps to fill in some of the gaps in the research, making the information viable and the conclusion valid, in fewer words, realistic games are better than less realistic, of course this then becomes the opinion of whoever is reading this report, but the research and proof is all present to come to this answer.

# **List of References**

## Literature review sources

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