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Studying Responses to Norm Violations Using Computer Games

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Abstract

When an individual violates a norm, they infringe one or more principles of proper conduct, presenting behaviours that should not be accepted in a society. However, there are studies showing that norm violators are afforded and perceived with more power than norm abiders. To understand the *When*, *Why* and *How* of these findings, we implemented a video game research tool.

This dissertation describes the development process of a configurable resource-management first-person multiplayer game, where players are able to follow or violate norms during resource collection and transactions. In the game, there is one leader responsible for taking or giving power to other players, within actions such as the distribution of resources and the selection of the following leader.

We conducted an experiment with 20 participants to verify if the created tool was in line with prior findings. Subjects played the leader role and interacted with two confederates, a norm violator and a norm abider. We measured power perception and affordance given subjects' game actions and answers from a questionnaire.

We found results that contradicted prior studies. Only 35% of subjects selected the norm violator as the leader. Additionally, during resource distribution, subjects favoured the norm abider compared to the norm violator. Given these results, we realized that the scenario of our experiment was unbalanced - the norm violator's scripted behaviour was extremely selfish compared to the norm abider. Even so, we noticed that a few subjects still perceived the norm violators as more skilful and, therefore, more worthy of power.

Keywords

Power, Social Norms, Norm Violation, Computer Game, Multiplayer

Resumo

Alguém que desrespeite normas sociais, infringe princípios de conduta adequada, revelando comportamentos que não deveriam ser aceites numa comunidade. Ainda assim, há estudos que indicam que os violadores de normas são concedidos mais poder do que os cumpridores. Para entendermos o *Quando*, *Como* e *Porquê* destes resultados, implementámos uma ferramenta de investigação na forma de um videojogo.

Esta dissertação descreve o processo de desenvolvimento de um jogo *multiplayer* configurável de gestão de recursos, onde os jogadores podem cumprir ou violar normas durante a coleção e transação de recursos. Dentro do jogo, existe um líder responsável por tirar ou dar poder a outros jogadores, em ações como a distribuição de recursos ou a seleção do próximo líder.

Realizámos um estudo com 20 participantes para verificar se a ferramenta criada estava de acordo com estudos anteriores. Os participantes desempenharam o papel de líder, interagindo com dois atores, o violador de normas e o cumpridor de normas. Medimos o poder inferido e concedido a partir de ações do jogo e de respostas a questionários.

Os resultados obtidos divergiram de estudos anteriores. Apenas 35% dos participantes selecionaram o violador de normas como líder e grande maioria favoreceu o cumpridor de normas na distribuição de recursos. Dados estes resultados, percebemos que o cenário da nossa experiência era assimétrico - o comportamento do violador de normas era extremamente egoísta em comparação com o do cumpridor. Porém, identificámos alguns participantes que consideraram os violadores de normas mais experientes dentro do jogo e, portanto, mais dignos de poder.

Palavras Chave

Poder, Normas Socias, Violação de Normas, Jogo de Computador, *Multiplayer*

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Acronyms

FK	Foreign Key
FPS	First-Person Shooter
RPC	Remote Procedure Call
UI	User Interface

1

Introduction

Contents

If norms are essential for maintaining well-functioning communities, why do we afford norm violators influence?, Prof. G.A. van Kleef, 2019.

Social norms are "generally accepted ways of thinking, feeling, and behaving that people agree on and endorse as right or proper" [1]. Norms such as fairness, honesty, respect and care should be followed, since they are essential to maintain harmony within a chaotic society. They usually guide the behaviour of individuals in a community, yet there are a few exceptions - the norm violators. A norm violation is "a behaviour that infringes one or more principles of proper and acceptable behaviour" [2].

One would expect that an individual who breaks the norms would lose influence within a community, however recent findings say otherwise. There are studies [2, 3] indicating that norm violators are perceived as more powerful than norm abiders, and can even be afforded more power. Powerful people encounter "fewer social constraints and more resource-rich environments" [3]. Then, when an individual breaks a norm, they might be seen as having no fear of the negative consequences of their actions, conveying behavioural disinhibition, which may signal perceptions of power [3].

Throughout the years, there have been studies investigating the relation between power and norm violations. Researchers responsible for these studies are interested in solving the initially posed paradox, believing it is the key to understanding norm violating behaviours and, most importantly, that it will help identify in which circumstances norm violators are given power. Typically, fictional scenarios or confederates are used in these studies, however the mentioned research methods present several limitations, such as decreased ecological validity, restrictions in the reproduction of specific situations in the real world or even extremely time-consuming preparation of the experiments. So what if there was an easier and less costly research method to study norms and power? We believe that computer games are the answer.

Computer games are useful for studies in the field of psychology since they allow the recreation of unethical situations impossible to simulate in the real life and they can be distributed on a large scale, in order to provide a wide range of data about human behaviour. Games are easy to configure as well, meaning that researchers could perform more than one experiment using the same game, just by altering a few of their parameters. In addition, computer-controlled characters may also be implemented within games, which could be extremely beneficial for researchers, given that the time and money they usually spend on confederates would not be necessary anymore.

In general, researchers show an higher interest in the responses of subjects in the context of a group. Then, games designed for research are usually multiplayer. Nowadays, we can find several examples of these type of games being applied in research and education as well. They can be useful in the simulation of several game theory paradigms in an engaging manner [4] or even to teach key social behaviours, such as leadership and teamwork [5].

Nevertheless, using games in research can also present some disadvantages, in particular when

studying social norms. Given that players are inserted in a virtual world, their behaviours within the game may not be an exact representation of their actions in the real world. Players might violate norms inside a game, since they know their actions will not have real life consequences. Then, researchers should consider using games with higher ratings of engagement and immersion, providing that an accurate representation of the physical world within the game will increase the ecological validity of the experiment. Higher immersion can be accomplished, for example, with rich graphics, a first-person perspective and realistic animations and expressions within players' avatars. Furthermore, given that not everyone is familiar with games, research using video games may require that subjects practice beforehand, or the target of the experiments will have to be reduced to participants comfortable with games.

1.1 Problem

Considering the previous motivation, our objective, in this dissertation, is to address the following research question using, for that effect, a video game:

When, why and how norm violators gain or lose influence?

As a way to develop this research tool disguised as a video game, we will focus on prior experiments studying the relation between norm violations and power, and extract the absolutely necessary requirements of a norm violating game. Having said that, our intention is that the implemented computer game allows researchers to further investigate how humans respond to norm violations and in what situations they afford power to individuals who break the rules. However, we are concerned with the fact that findings within the game context may not be in line with previous studies suggesting that norm violations fuel perceptions of power and power affordance. Therefore, in the current dissertation, our focal point will be to attempt to prove the following hypothesis in the game environment:

Subjects perceive norm violators as more powerful and afford them more power.

In order to verify the previous hypothesis, following the development of the research tool, we will establish a scenario within the game (using confederates at this phase) where subjects will face two simultaneous conditions, norm violator and norm abider. Then, they will perform decisions on power affordance, according to their perceptions of each confederate. If the previous hypothesis is proven, we will be able to validate the created video game to be used in further studies related to our research question.

1.2 Contributions

According to the developed work, we highlight the following contributions:

- The concept of a norm violating “realistic” game, to be used as a research tool, in which players can break or follow norms and give or take power.
- The implementation of the proposed game, which parameters may be configured according to the desired experiment.
- A study attempting to validate the game, testing if norm violators are perceived and afforded more power than norm abiders within the game world.

1.3 Outline

Our document is divided into five chapters, excluding the introduction.

In Chapter 2 (Background and Related Work), we start by providing a background on social norms, power and research methods used in psychology. Then, we focus on game theory, behavioural and experimental economics. Following this, we discuss the advantages of video games and computer simulations for research and educational purposes, giving a few examples.

Moving on to Chapter 3 (Game Concept), we propose the concept of the game, fulfilling the necessary requirements to build a norm violating research tool.

Chapter 4 (Game Implementation) details the iterative process of development of the game defined in the previous chapter.

Concerning Chapter 5 (Evaluation), we evaluate how well the research tool performs according to our hypothesis, describing the scenario and methodology of the experiment and discussing its results.

Regarding Chapter 6 (Conclusion), we write an overview of the current document and define what needs to be improved in the future.

2

Related Work

Contents

In this section, we initially provide a background on norms, power and traditional research methods and their pros and cons.

Then, we define game theory and experimental and behavioural economics, highlighting experimental games tested in laboratory. Following this, we consider the benefits and disadvantages of using video games as a tool for research, and introduce a tool called *INVITE framework*, mentioning as well other online immersive multiplayer games.

Lastly, we make a final overview of the section, performing a comparison between video games and more traditional research methods.

2.1 Background on Norms and Power

2.1.1 Norms and Definitions

Social norms are defined as the "rules and standards that are understood by members of a group, and that guide and/or constrain social behaviour without the force of laws" [6]. Norms like fairness, honesty, respect and care are the basis of ethical decisions.

Fairness In general, fairness "relates to the just distribution of resources" [1]. Jon Elster [7] divided this norm into different behaviours, such as the rejection of unfair division and reciprocity. A fair division may be equal for all parties involved, however that's not obligatory. "To each according to his X", where X could be effort, efficiency or need. This means that it might be fairer to split a resource unequally and provide more to someone with a higher value of X. Reciprocity "regulates the exchanges of goods and services between people" [1], requiring them to help those who help them and allowing them to hurt those who hurt them. However, the former can be seen more as revenge.

Honesty According to Michael Josephson [8], there are two dimensions regarding honesty: communications and conduct. Honesty in communications is telling the truth the best as we know it, not transmitting it in a way that will deceive. It is fundamental to maintain a society that supports free and rational choices by each individual member, since distorting or hiding information can, ultimately, alter individuals' choices [9]. Honesty in conduct is following the rules, without stealing or cheating.

Respect In order to be a respectful person, one should treat people with consideration (and not use intimidation, coercion or violence), allow all individuals to have a say in decisions that may affect them and accept personal differences and beliefs without discrimination [8].

Care Finally, "to care" is to be concerned with the well being of others. The care norm supports the notion that one should not intentionally cause unjustified harm while performing one's duties [8].

2.1.2 Norm Violation and Power

Gerben van Kleef et al. [3] researched about power and norm violation. Power corresponds to the capacity of controlling others' outcomes by providing or denying resources or administering punishments. Norm violation corresponds to the infringement of one or more principles of proper behaviour. When a person gets caught violating a norm, feelings of embarrassment, anxiety, guilt and shame can emerge [10]. However, these feelings may depend on the amount of power someone holds, since powerful people seem to be unaffected by others [3].

Gerben van Kleef et al. drew a few conclusions about rule-breaking behaviour and power:

- High-power individuals encounter fewer social restrictions and more resource-rich environments, acting without fear of negative consequences – behavioural disinhibition. On the other hand, low-power individuals encounter more social constraints, threats and punishments, which causes them to restrict their actions – behavioural inhibition.
- Several studies suggest that norm violations can lead to perceptions of power. In other words, individuals who break norms might be perceived as more powerful than those who follow them. The reason behind this is that power is associated with lack of constraint, so when individuals violate norms, it is implied that they have high levels of power that enable them to behave as they want.

2.1.2.A Prosocial Norm Violation

Besides the fact that a rule-breaking behaviour signals power, power may only be given to norm-violators in specific situations. According to Gerben van Kleef et al. [11], prosocial norm violations can lead to power affordance, which means that people who break the rules in order to benefit someone or a group may be perceived as more worthy of power. This implies that power can be provided to norm violators, given that the norm violation is prosocial instead of selfish. It is also revealed that less power is afforded to a norm-abiding individual with a prosocial behaviour than to a norm-violator individual with a prosocial behaviour.

2.1.2.B In-group Bias

Apart from preferring prosocial over selfish individuals, people also favour individuals who belong to their own group instead of other groups. This phenomenon is called "in-group bias": people evaluate their in-group more favourably than an out-group, allocating more resources to in-group members than to out-group members [1]. Most people have a tendency to cooperate with members of their own group, because they want to increase their reputation inside the group which, consequently, benefits them, since they expect indirect reciprocity (hope for something in return) from in-group members [12].

Also, there's a chance that, if an individual of a group violates a norm, other members of the same group might adjust their own moral compass and, consequently, imitate that individual's behaviour. Therefore, regarding an in-group context, norm violations turn out to be contagious, especially when the norm violator represents an authority figure [7].

2.1.3 Research Methods

In order to investigate responses to norm violations, more specifically in what situations people afford power to a norm-breaking individual, several experiments can be made. During these experiments participants can have a passive or an active participation. The former means that participants just observe the main action of the experiment as outsiders. The latter means that participants are part of the main action of the experiment.

2.1.3.A Passive Participation

Usually, experiments with passive participation follow three main steps. First of all, participants are randomly assigned certain conditions of a short scenario. Then, each participant reads or watches (observes) the scenario with the assigned conditions. Finally, participants are asked to fill a questionnaire to evaluate the consequences of each combination of conditions and to verify if they understood the scenario.

In one of Gerben van Kleef et al.' [11] experiments, a short movie clip with three individuals in a waiting room was shown to participants. Later in the video, one of the individuals stands up to close a window. The conditions tested were Norm Violation vs. Control (the window has a "Do not touch" sign, so closing it constitutes a norm-violation vs. the window has no sign, so opening it is allowed) and Prosocial vs. Selfish (the other two individuals are cold, so closing the window benefits them vs. the other two individuals are very warm and sweating, so closing the window does not benefit them). By combining and testing the previous conditions with different participants, experimenters could measure how much power each participant afforded to the individual closing the window and what was the perceived prosocial behaviour of that same individual.

2.1.3.B Active Participation

Experiments with active participation are very similar to experiments with passive participation, in the sense that they follow its first and last steps (assign conditions and questionnaire). However, in these types of experiments, each participant usually has to interact with a confederate, an actor that performs actions according to the set of conditions assigned to the participant. Most of the times, both participant and confederate have to perform a task together.

Gerben van Kleef et al. [11] described a study using active participation. There were three individuals inside a room: an experimenter, a confederate and a participant. The experimenter started by explaining that both confederate and participant would be playing a game together. Then, the experimenter left the room. In specific cases, before leaving, the experimenter invited the individuals to drink coffee from the coffee pot on their desk; in other circumstances, the experimenter wouldn't mention the coffee. Despite this, the confederate ended up always drinking it. The conditions tested were Norm Violation vs. Control (the experimenter didn't invite any of the individuals to drink coffee, so drinking it constituted a norm violation vs. the experimenter invited the individuals to drink coffee, so drinking it was allowed) and Prosocial vs. Selfish (the confederate offered coffee to the participant vs. the confederate didn't offer coffee). Then, the participants filled a questionnaire in order to assess power affordance and prosocial behaviour perception, similar to the previous experiment with passive participation

2.1.3.C Confederates and Fictional Scenarios

During social psychology experiments as the ones described above, researchers may decide to use fictional scenarios and/or confederates to test their hypotheses. Despite presenting a few benefits, the use of the mentioned research tools can also exhibit some limitations.

- **Advantages and Disadvantages of Fictional Scenarios:** David Wilson et al. [13] identified some advantages and disadvantages about the use of fictional scenarios. Their advantages include easy and precise manipulation of imaginary situations and inexpensive measurement of emotional and actional responses of large numbers of people. Regarding the disadvantages, the one standing out the most is the ecological validity of these experiments, since reactions to a fictional scenario may not be the same as in a comparable real-life event. Then, it can't be assumed that responses to imaginary and real environments are equivalent. Nevertheless, imagined responses can still be an important object of study, since storytelling is essential for social interactions and internal psychological processes.

- **Advantages and Disadvantages of Using Confederates:** Mike Allen [14] mentioned a few pros and cons of using confederates in research studies. Starting with the advantages, a single confederate can be used to play different roles in an experiment, so there's no need for researchers to spend more resources and time than needed. Also, confederates are useful to assess participants' reactions when they come across an individual (the confederate) with an unusual behaviour. Regarding the disadvantages, the most problematic issue is the fact that the deception used in the experiment, by scripting the confederate's speech and actions, may invalidate the results of the study, since social psychology's main goal is to study genuine interactions.

2.2 Game Theory

Game theory is a mathematical language used to describe games, outlining players' strategic interactions and their expected outcomes. Its main goal is to predict players' strategies during a game by assuming that they are rational and want to maximize their payoffs [15].

2.3 Behavioural and Experimental Economics

In classical economic theory, humans are seen "as self-interested agents who seek optimal, utility-maximizing outcomes" [16], however behavioural and experimental economics contradict this concept, as we'll see in further experiments during the next sections. Experimental economics is a methodology that uses controlled laboratory experiments to study economic questions, while behavioural economics attempts to incorporate insights from psychology into economics, trying to understand how and why psychological aspects have an influence in economic behaviours [17].

2.4 Measuring Social Norms with Experimental Games

In the game theory point of view, it is expected that players always choose the self-interested strategy during a game. However, their choices often deviate from this prediction, because of the existence of social norms. Colin Camerer et al. [15] listed and described several experimental games illustrating this, such as the Public goods Game, the Ultimatum Game, the Dictator Game and the Third Party Punishment Game.

2.4.1 Public Goods Game

There are n subjects deciding at the same time about their contribution g_i, $0 \leq g_i \leq y$, where y is players' revenue. Each player i earns $\pi_i = y - g_i + mG$, where G is the sum of the contributions of all n group members and $m < 1 < mn$. Game theory predicts that selfish players will not contribute, so $g_i = 0$. However, the experimental results show that most players start by contributing 50% of their revenue. Still, these contributions decrease by playing the game for a finite number of times, since reciprocal players are only willing to cooperate if the other players do it too, refusing to be explored by selfish players that never contribute. To counteract that, individual punishment opportunities were inserted into a variant of the game, allowing reciprocal players to punish selfish players and increasing contributions. This game reflects in situations with overuse of common goods, where people enjoy the resources provided without making any contribution (free-riders).

2.4.2 Ultimatum Game

There are two subjects involved, the Proposer and the Responder. The goal is to divide a fixed sum of money S between them. Proposer offers x. If the Responder rejects x, both subjects earn nothing. If the Responder accepts x, the Proposer earns $S - x$ and the Responder earns x. Game theory predicts that selfish and rational players will offer the smallest money unit possible and accept any $x > 0$. However, the experimental results show that many Proposers offer x between $0.3S$ and $0.5S$, anticipating that Responders will reject low offers ($x < 0.2S$ are rejected half the time). This means that Responders punish unfair offers, refusing them, giving up their own money and preventing Proposers from earning any money (negative reciprocity). This game reflects in negotiations made just before a time deadline (take it or leave it bargaining).

2.4.3 Dictator Game

This game is similar to the Ultimatum Game, however, instead of a Responder, there's a Recipient, who can't accept or reject the Proposer's offer - the Proposer dictates. Game theory predicts that selfish and rational players won't offer anything to the Recipient, keeping all the money S for themselves, so $x = 0$. However, the experimental results show that many subjects allocate something to the Recipient, $x = 0.2S$. Still, this can change according to the experimental design: when Proposers know their decisions are completely anonymous, most allocate nothing; when Proposers listen to Recipients giving a short description of themselves, the average allocation rises to half of S. This game reflects in the charitable sharing of unexpected gains (e.g. winning the lottery).

2.4.4 Third Party Punishment Game

There are three subjects involved, A, B and C. Only A and C have resources, but C has less resources that A. A and B play a dictator game and C knows how much A offered to B. C can punish A, however it will be costly. Game theory predicts that A, as a selfish player, won't offer anything to B, and also that C, being self-interested, will never punish. However, experimental results show that players (A) that offer less than half of their resources are punished by C, so the less A allocates to B, the higher the punishment of A is. This means that C punishes the violation of a fairness norm. This game reflects in the social disapproval of inappropriate treatment of others.

2.5 Modifying Experimental Games

John List [18] explored the Dictator Game more profoundly, by changing its action set and the origin of the money. He designed an experiment in which participants were randomly placed in one of two rooms

(A or B) without having any previous contact. A baseline and three variations were tested:

- **Baseline:** Equal to the standard Dictator Game. Players from each room were allocated $5, and players from room A were allocated an additional $5 (endowment). During a one-shot game, dictators had to decide how much of their endowment they wanted to allocate (from $0 to $5) to their randomly selected partner in room B.
- **Take ($1):** Identical to the baseline treatment, but dictators had one more action available - they could take $1 from room B participants.
- **Take ($5):** Identical to the Take $1 treatment, but dictators had one more action available - they could take up to $5 from room B participants, making their choice set symmetric (giving or taking up to $5).
- **Earnings:** Identical to the Take $5 treatment, but participants in both rooms earned the initial money by performing a task before the allocation part - subjects of room B(A) were told that room A(B) subjects earned $10($5) by completing the task.

One would think that the results of the variations shouldn't be that different from the standard Dictator Game, since, as we've seen before, social norms have a big impact on the strategy chosen by the player, so a simple manipulation of the choice set shouldn't affect the outcomes that much.

However, after testing, List obtained surprising results in the variations of the game. As expected, he found that, in the baseline game, the data was similar to the data from other dictator games (amount given was close to 25% of the money). But, by merely adding the "Take" actions, he noticed a considerable change in behaviour: many fewer participants gave money when the "Take" actions were included in their action set, especially when they had the "Take ($5)" action available, in which many participants decided to take the full amount. Interestingly, in the "Earnings" experiment, the results obtained were different from the previous variations, since a lot less individuals decided to take the money and many stayed neutral (not taking, nor giving).

By analysing these results, List concluded that interpretations obtained from standard dictator games need to be revised, since the simple change of the choice set appears to invoke different social norms (taking money and not giving any money seem to have different moral costs). Also, given the results of the "Earnings" experiment, it was possible to infer that taking earned money is seen with much more social disdain than taking given money.

2.6 Research using Video Games

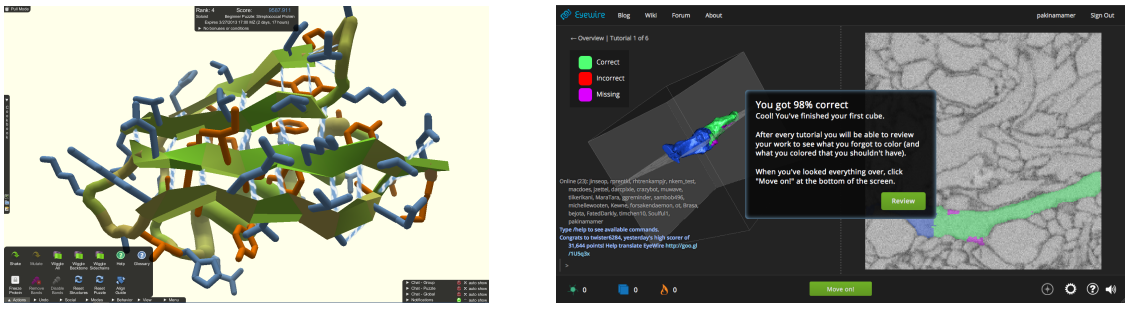
Games are considered useful tools for psychological research. First of all, they are designed to be engaging and motivating to play. This gives them a leverage comparing to other not so engaging research

methods. Also, players can be completely immersed in the game, which allows them to avoid distractions from their surroundings [19].

A video game is a successful type of game that's been used in an increasing number of psychological studies over the years, because of its many advantages. These include the ability to model interpersonal interactions, without having to spend money or time on confederates (when the game has computer-controlled players), the capacity to easily record data (e.g., decision branches, conversation logs) and the possibility of simulating situations impossible or unethical to test in real life. In addition, video games reveal to be much more engaging than traditional research methods, keeping the player focused on the experiment [19].

Furthermore, the use of video games in research is very beneficial for scientists, especially "Citizen Science" games [20]. They are defined as a "form of collaboration involving ordinary citizens in scientific research projects to address real-world problems" [20]. Therefore, regular individuals help experts complete their research studies, by participating and contributing actively for their scientific work.

There are many examples of citizen science games, especially from the biology field [20]: *Fold it* [See figure 2.1(a)], a puzzle game where players fold the structures of proteins in order to discover stable configurations; *Eyewire* [See figure 2.1(b)], a game where players map the structure of neurons, helping researchers know how they are connected; *Tiger Nation*, a game where players are asked to provide photos of tigers photographed in wilderness reserves and to identify unique tigers in these photos, in order to monitor the life of endangered tigers.



(a) Fold it Game **(b)** Eyewire Game

Figure 2.1: Examples of citizen science games

Regarding the economy field, there are a few tools using games that allow researchers to easily conduct economical experiments, such as the *Colored Trails* tool, that allows the configuration of experiments like the prisoners' dilemma, public goods, ultimatum games, dictator games, trust, gift exchange and third party punishment games, using a non-immersive 2D environment where players have to decide how to use their resources in order to satisfy their goals [20], and the *INVITE framework*, described in section 2.7.

Despite the video games' benefits, they also present several disadvantages. They can be less intuitive to play, meaning that research participants unfamiliar with the technological resources used to play the game, may have to spend a lot of time learning them [19]. Also, it can be difficult to obtain valid results in a research through video games, especially if the goal of the research is to study social norms. Many players are stimulated by games where norm violation is possible, since the violation of socially accepted norms in virtual words doesn't normally cause any harm, unlike in the real world [21]. So, to counteract this, researchers should focus on experiments using immersive and realistic games.

2.6.1 Game Immersion

Immersion is the sensation of being surrounded by a completely other reality, as stated by Alison McMahan [22]. In a game context, it means that the players are so caught up inside the world of a game, that they tend to "forget" about the real world. Therefore, the main conditions needed to create immersion in a game are [22]:

- Player's expectations of the game must be similar to the game's conventions.
- Player's actions should have a significant impact on the game environment.
- Game's conventions should be consistent.

Narrative is usually used to define conventions of a game, so the game should be consistent in its logic and, consequently, fulfill the player's expectations [22].

One way to assess the levels of immersion experienced by players in a game is to use the IEQ (Immersive Experience Questionnaire) [23]. This questionnaire has been widely tested in a variety of different scenarios and game types, using a five-point Likert scale to measure player experience [24].

Alison McMahan also concluded that immersion could be improved by changing the game's perspective. When comparing a god view/isometric perspective and a first-person/virtual reality perspective in terms of immersion, there's a few aspects that make the former much more immersive than the latter. The major difference is that VR/first-person games allow players to explore the full game environment by using a non-restrictive camera.

Then, a simulation/game is realistic and, consequently, valid for research if it presents rich graphics and an immersive environment, actions in the game that have consequences just like in the real world and "missions with predefined goals" [25], in order to make players feels like their actions within the simulation have a purpose.

As we can see in section 2.8, online multiplayer realistic video games are perfect to teach players useful social behaviours, allowing researchers to perform experiments concerning social norms as well, given their high immersion and engagement scores.

2.7 INVITE framework

The *INVITE framework* [4] is a great example of a useful research tool in the form of a video game. Its high level of flexibility allows the configuration of several game theory paradigms, like public goods experiments, in an engaging and immersive environment, since the framework includes a 3D multiplayer video game, called *Volcano Island* [26] [See figure 2.2].

"The game is set on a desert island after a plane crash. A volcano's eruption is eminent and the players only chance of survival is to built a raft to escape the island's destruction. Dilemma arises as greed can lead players to prefer to act solely on their personal interest and collect a private resource (such as gold) instead of contributing in favour of the group's common goal." [4]

(a) Configuration Tool

(b) 3D Environment

(c) Player Avatar

Figure 2.2: Volcano Island Screenshots

The scenario above can be seen as a public goods game, since it presents a social environment where each player has to decide whether or not to contribute ("gather wood to build raft") to a common resource, that is then going to be shared by all players ("escape the dangerous island", "raft sold and earnings distributed"). According to game theory predictions, rational and selfish players won't contribute

to the common goal and will try to collect all the gold instead (free-riders). However, as we've seen before, most real players contradict this behaviour and contribute, guided by the existence of social norms.

A simple interface [See figure 2.2(a)] is offered by the framework to researchers, in order for them to easily configure their desired experiments in the game scenario above. Some of the parameters necessary to configure an experiment are the number of teams, the number of players per team, earnings obtained by one unit of wood (after selling), distribution of team earnings (equal for all players, dependent on player's contribution, ultimatum game), type of game (neutral game, competition or cooperation between groups), and many others.

According to the experiments' parameters, another great advantage of the *INVITE framework* is the fact that it allows the creation of teams inside the game, by setting the number of teams with a value superior to 1. This is useful to compare the interaction of groups and individuals, or just study the relation between members of the same team. For example, Jorge Peña et al. [27] conducted a team study using the *INVITE framework* and found that playing a video game in groups in the presence of in-group social identity cues (i.e. avatars dressed with the same colours - shared social identity) increased enjoyment and in-group attachment, compared to groups where avatars are dressed differently. Furthermore, this framework provides valuable data to researchers regarding human behaviour by the means of a video game, allowing the simulation of deadly situations, that are somewhat impossible to test in the real world.

2.8 Social Behaviours and Norms in Multiplayer Games

Multiplayer games have a lot of potential in research and educational fields. They may provide players with useful social skills, such as learning how to lead and cooperate, or allow researchers to study social interaction, considering that real-life social norms may also be present in a multiplayer video game context. Then, in the following sections, we will see with more detail the possibilities of multiplayer games.

2.8.1 Leadership and Cooperation

Multiplayer video games can teach several social behaviours involuntarily. A project called *PlayOn* [5], in which researchers recorded and analysed many hours of game play of online multiplayer games, revealed that these types of game are much more than earning experience points. In these games, players can learn a lot of different social behaviours just by being integrated in a community of players. Some of these behaviours can be:

- **Teaching other players:** Some players learn how to help others with actions within the game,

even without receiving anything in return, being this a demonstration of altruism.

- **Observe other players:** Less skilful players learn how to observe more successful players, in order to gain knowledge from others.

- **Leadership:** Advanced players learn how to be good leaders "and orient the activities of newcomers" [5], reinforcing an efficient behaviour of the group and, at the same time, showing empathy for other players.

- **Instrumental Coordination:** Players learn how to work as a team in order to fulfil the game's goal.

This to say that a lot of commercial multiplayer games used purely for entertainment can teach several social skills by "accident". One of the most valuable skills learned in these type of games is "social learning, where a community of players in cooperation learn and master a game" [28], even when the designed game has a different purpose.

As an example of the previous statements, we have found a multiplayer game, *Matematris* [28], created with the goal of teaching mathematical skills to students in a fun way. This game was played in teams, one member of the team was playing regular *Tetris* and the other members were creating pieces of *Tetris*. Each piece was produced by solving a mathematical problem. If players from a team got the problem right, the piece produced would go to other team's *Tetris* player, otherwise the piece would go to their own team. Then, the goal was to create a lot of pieces for the other teams in order to win. However, it was not expected that the team members would start communicating in the physical world to win the game. When the game was tested, the *Tetris* player of a team started telling their team members which pieces fitted in their own *Tetris* game, so they would purposely answer the most difficult math problems wrong in order to deliver to their *Tetris* player pieces that could be easily placed. If the problem was easy, they would solve it and those pieces would go to other teams. This prolonged their game and increased the score of the *Tetris* player. Therefore, a game with the purpose of teaching math allowed players to develop "strong cooperative skills in learning how to manipulate the game structure to accommodate the social actions" [28].

Then, we can see that "new strategies, norms and rules are developed" within multiplayer games, which creates "potential for social learning" [28]. With that said, researchers can use serious multiplayer games to study or teach specific social skills. As an example, we have *Infiniteams* [25], a multiplayer online serious game designed to improve leadership skills and team dynamics. All players have to work in team in order to fulfil the game goal, completing several puzzles during their game play. A random player is assigned as the team leader at the beginning of the game, and members of the team have to cooperate to overcome all obstacles within the game.

2.8.2 Social Norms

Social norms are often developed within multiplayer online games, such as *The Sims Online* [29] and *Second Life* [30], given the rules and goals of the game. The provided examples are 3D online multiplayer games with rich and realistic virtual environments, where players can create their own customized avatar and communicate with other users via written text. Researchers participated and observed interactions within these games, intending to discover how social norms arise in multiplayer games and what influences them.

In *The Sims Online*, researchers discovered that during players' actions and interactions, social norms emerged. They observed that text-based interactions were used to condone or praise players' behaviours. Additionally, the game environment had a big impact on what kind of norms were present. Then, depending if players were visiting other players' houses or were participating in group events, the social norms varied. For example, in weddings organized within the game, players were expected by the wedding organizers to make their avatars perform adequate actions, such as standing and applauding at the end or hugging the bride and the groom. In case there were players that did not follow those standard rules, other players would call them out or they could be even kicked out by the wedding host [29]. With that said, researchers concluded that norms found in the mentioned game followed real world norms accurately, being influenced not only by the game environment, but also by the existence of realistic human-like avatars to represent the players and, consequently, their actions.

Concerning Second Life, researchers were interested in exploring if real-life social norms of "gender, interpersonal distance and eye gaze" [30] were replicated within the game. They found that social interactions in multiplayer online realistic games were "governed by the same social norms as social interactions in the physical world" [30]. These findings demonstrate that virtual environments are a great tool to study real social interactions. Even when people navigate within a virtual environment using a keyboard and a mouse, they still follow the same social rules of the physical world, which means that we can generalize players' interactions within immersive and realistic games into real life interactions.

When researchers want to explore social norms using multiplayer online games, it is valuable to consider that the expressions and animations of the avatar of a player, while reacting to another player following or breaking a norm, are valuable not only to display more accurately the emotions felt by the player, but also to reflect the importance of the norm. For example, a player might react with an action that shows a more angry expression and body movement of the avatar, which may reveal that the norm violated was very serious.

In order to illustrate the previous situation, we will give the example of a computer simulation done with virtual agents studying norms and emotional reactions [31]. In this environment, agents presented emotional responses given the fulfilment or violation of a norm. Norms' salience could vary, so the emotional response could be triggered or not depending on this value.

Subjects were place in a virtual scenario within a bar. They were sitting with two agents representing two friends, one of them was a smoker and the other was not. Also, there was a smoking ban, which subjects were told about at the start of the study. Participants of the experiment could be in one of two scenarios: a low-salience version [See image 2.3(a)] or a high-salience version [See image 2.3(b)]. In the first one, the smoker agent started smoking within the bar and the non-smoker perceived this norm violation, however since the salience was low, the non-smoker did not show any emotion. The second version was similar to the first, but given that the salience was higher, the non-smoker reacted making a frown expression. In general, researchers were interested in verifying if subjects would see the norm of smoking as more important in the high salient scenario, proving then that participants "did relate the differences in the versions to the importance of the norm" [31].

(a) Low Salience Version - No Emotion **(b)** High Salience Version - Frown Expression

Figure 2.3: Smoking Norm Experiment with Agents

2.9 Concluding Remarks

In this section, following the definition of norms and power, we started by compiling the conclusions drawn in several studies about these two components. We highlighted that individuals high on power find less social restrictions, being this one of the possible reasons why there are studies revealing that norm violations lead to power perception and affordance.

Additionally, we found that researchers typically use confederates and fictional scenarios on their experiments, however we verified that these research methods have several disadvantages, being the low ecological validity the most prominent.

Following this, we proceeded to list some results of laboratory experiments, showing that subjects' behaviour deviated from the self-interested strategy in experimental economics games, however these experiments were still low on immersion. Therefore, we started focusing on research using video games.

Then, we found that video games are a much more complete research tool, given that researchers

can easily record data, simulate unethical situations, or use computer-controlled characters instead of confederates. However, we discovered a few cons, such as the learning difficulty of video games. We also highlighted the fact that researchers had to guarantee that the game was immersive enough to increase the ecological validity of experiments. Therefore, we listed the main conditions to create immersion within games, as a way to solve the mentioned problem.

We concluded that, despite of the disadvantages, if researchers conduct experiments using an immersive and engaging video game, they could obtain more valid results compared to experiments conducted in laboratory, where immersion is lacking. Therefore, video games, in specific multiplayer games, can be used as tools to study economic experiments (*INVITE framework*) or even social norms (*The Sims Online*), teaching beneficial social skills as well, such as leadership and team work.

3

Game Concept

Contents

In this chapter, the concept of a norm violating game, which will be used as a research tool, is defined. Initially, we list the main requirements of the game. Following this, we approach each requirement one by one, suggesting how to fulfil them within the game. Finally, we give an overview of our game concept, providing a summary of the players' actions and information.

3.1 Game Requirements

The main requirements of a norm violating game were identified before defining the game concept. These requisites were discussed with Professor Astrid Homan and Professor Gerben van Kleef, from the *University of Amsterdam*, who have been investigating the relation between norm violations and power for a long time now. In their experiments, participants encountered one of two conditions, norm violation (confederate violated a norm) or control (confederate followed a norm). Given these experiments and our discussion with the professors, we gathered the main requirements we needed to fulfill, in order to create a norm violating game:

- **Opportunities to follow or violate norms:** it was essential to create norm violation situations in the game, that would contrast with norm abiding behaviours.
- **Norm violations visible to players:** norm violation situations needed to be clear and obvious for all players during the game.

We considered two other requisites for this project. Even though they were not necessarily the most important requirements for a norm violating game, they were still fundamental in our concept. Given our need to embrace the benefits of using a computer game as a research tool, we addressed these two "secondary" requisites:

- **Highly engaging and "real" game:** this would help increase the ecological validity of the experiments, in the sense that if players felt that their actions mattered in the game, researchers could transpose their behaviours within the game into real life situations.
- **Emotion and behaviour registry throughout the game:** players' actions and feelings during the game needed to be registered, especially their behaviours towards norm violating players, since this would allow researchers to carry out a more thorough analysis of the results obtained.

3.2 Game Requirements Mapping

Given the previous requirements, we proposed a concept for the game with the intention of fulfilling every single requisite.

3.2.1 Game Context

In order to create opportunities for a player to follow or violate a norm, there should always be a reason for them to do so. The main question was: Why would a player violate a norm? A stressful situation, such as surviving in extreme conditions, could be enough reason to violate a norm. Therefore, we agreed that players should be trapped inside a closed space with limited resources available. This would, consequently, establish circumstances within the game where they would have to consider whether to obey or break a norm, while interacting with other players. As a result, we classified the game as a survival resource management multiplayer game.

3.2.2 Norm Violation

The previous scenario led us to the following question: How could a player violate a norm given the situation described? Given that players had limited resources available, this would allow the existence of several norm violating behaviours.

Players would have to gather resources in the game in order to survive. The accumulated resources could go to a group stash, shared by all players, or an individual stash, containing the resources held only by the player. This implied that there would be individual and group resources within the game, which was extremely helpful in defining norm violating vs. norm abiding actions.

We concentrated primarily on norms such as fairness/reciprocity, honesty/truthfulness and care/no-harm, defining three distinct ways of breaking or following norms [See table 3.1]:

- **Resource Collection:** After catching the resources, players would have to decide how many of the gathered resources they would like to give to the group (group stash) – norm abiding action – and how many they wanted to keep to themselves (individual stash) – which could be, depending on the situation, a norm violating action. If the norm of sharing with the group is perceived with a higher importance, the act of collecting a lot of individual resources could be seen as a norm violation. For example, if there is a significant contrast between the behaviour of two players while collecting resources, the mentioned norm could appear more important: if one player collected all group resources and the other collected only individual resources, the second player would look like a norm violator compared to the first player. In addition, this action could be seen as an adaptation of a public goods game [15], since players would decide whether or not to contribute to a common supply that was going to be shared by all of them, which, in this situation, corresponded to the group stash of resources.

- **Resource Request:** When a player was in trouble (no individual resources and low health), they would have the possibility of requesting resources from another player that had enough resources

to help. The player that received this request would have two responses available: accept the request – norm abiding action – or deny the request – norm violating action.

- **Resource "Exchange":** Players could steal or give resources from/to other players without their permission. A player could be really dishonest and steal individual resources from other player even if they had enough personal resources available – norm violating action - or they could be really selfless and give their own individual resources to other players, without having to receive a request – norm abiding action. We had trouble finding a reason for players to perform these actions which we will discuss later in section 4.4.4

Table 3.1: Game Actions and Norms Violated

Action	Norm Abiding	Norm Violation	Norm
Resource Collection	Give most collected resources to the group (group resources)	Keep most collected resources to themselves (individual resources)[a]	Honesty, Truthfulness, Fairness, Reciprocity
Resource Request	Accept player's request and help player in trouble	Refuse player's request and disregard player in trouble	Care, No-harm
Resource "Exchange"	Give resources willingly to another player	Steal resources from another player	Honesty, Truthfulness, Fairness, Reciprocity

a. Considering the norm of sharing resources with the group has a high degree of importance

3.2.3 Visibility of Norm Violation

Within the game, players would be able to violate certain norms, as described previously. But how could other players see the norm violation occurring at the right moment? We agreed that making a log of activities available to all players, where they would be able to read everything going on inside the game, was the best and easiest way to guarantee the fulfilment of this requirement. Actions such as those mentioned in table 3.1 should be explained in short and insightful sentences, which would allow the player to process and analyse the registered data much faster. Ideally, the interpretation that each player made of the listed actions would influence some of their choices inside the game.

3.2.4 Engagement and Realism

Although not a main requirement, we decided to consider engagement and realism within the game, since we wanted to create a more immersive and appealing experiment in which players could feel like their actions were significant. Then, we concentrated on the game perspective and the plot, aiming to develop a game that satisfied the mentioned requirement.

Regarding the game perspective, the best choice was a 3D first-person game, since immersion has been shown to improve using this form of game perspective [22]. Concerning the game story, we wanted to create a hypothetical real-world scenario where all actions made sense, having the situation of being trapped inside a closed space, with limited resources, as a starting point to create the game plot. In order to do so, we focused on the following points:

- **Why and where were players trapped?** An external threat seemed like the most logical way of explaining why the players were trapped. Inspired by an apocalyptic scenario, we decided that infected humans were trying to attack the players and, consequently, they had to stay inside a closed space for an arbitrary number of days in order to survive. Concerning the space itself, having an engaging story was the main goal, so we thought of a bar, since we could create an appealing story around it and integrate the players in that same story, as depicted in the game narrative.

- **What were the resources and why do players needed them?** As time went by inside the bar, players would lose health, so they would need to collect resources [See resource collection in table 3.1] in order to survive. Resources were going to be in a specific area inside the bar that we called the dangerous zone, and this area would be full of the infected humans previously mentioned. For simplicity reasons (better understanding of the game by the player), there should be only one type of resources – medicine – which would allow players to improve their health when consumed.

By answering the questions above, we managed to create an entertaining game narrative:

> *After a busy night working in the bar Las Moscas, you decide to have a drink with your colleagues. It is Thursday, 4 a.m. and all the clients already left. The TV catches your attention: Breaking News: Unknown virus is causing strange behaviours around the world: people are presenting extreme rage attacks and attempting to kill each other! We advise you to stay inside, wherever you are. Stay safe!*
>
> *A sudden noise coming from the main door startles you. You look through the window and realize your worst nightmare came true: violent looking humans killing everyone in their field of view, biting arms and legs off and breaking bones. Finally, it hits you: you are trapped inside the bar with your colleagues and you have limited resources available. Will you be able to survive?*

3.2.5 Player's Emotions

Capturing how players felt when they came across norm violating players was necessary for researchers to obtain enough data for their analysis. We considered two approaches in order to satisfy this requirement. Initially, we explain the key power giving and taking behaviours that we decided to include in the game and how we inferred players' emotions according to them. Then, we proceed to discuss about an emotion recording method that we decided to use in order to obtain even more relevant data.

3.2.5.A Actions and Power Giving and Taking Behaviours

Returning to our research question, it is important to recall that our primary goal was to see how players would respond to a player who violated a norm and what kind of circumstances they would afford them power in. Then, it was beneficial to define power giving and taking behaviours within the game, since it would allow researchers to infer how a player felt about another player based on the type of behaviour shown.

In order to illustrate these behaviours in more detail, we needed to introduce the role of the *Leader*. Players would spend an arbitrary number of days inside the bar and, during each day, one of the players would be the leader. When the day ended, the leader would have two tasks to perform, in which they would have to make certain decisions that would, consequently, demonstrate power giving or taking behaviours [See table 3.2]. The tasks in question were:

- **Resource Distribution:** Following the end of the day, the leader had to perform the task of distributing the collected group resources between all players. If the leader decided to give more resources to a player that violated norms, they might have been showing support for that same player and their actions. On the contrary, if the leader wished to provide less group resources to a norm violating player, they could have been exhibiting a behaviour of opposition against that same norm violator. In case the leader distributed the same amount of resources to players who broke the norms and to players who followed the norms, they were possibly showing that they allowed the behaviour of norm violators, which implied they did not display any opposition against such actions nor did they support them (acquiescence). This task could be seen as a dictator game [15], since the other players had no other choice than to accept the distribution dictated by the leader.

- **Leader Assignment:** Following the resource distribution, the leader had to select a player to be the new leader for the next day. If the chosen player violated norms and the leader was aware of their conduct, they were demonstrating that they supported the actions of the norm violator. If the new selected leader did not break norms, the leader might have been demonstrating that they were opposed to the behaviour of the norm violator.

Given the described tasks, it should be possible to obtain a big share of information regarding players' emotions. In the first place, we could link their actions to specific feelings: opposition revealed anger, support showed admiration and acquiescence might have been linked to fear. Besides that, we could also relate their decisions with power giving or taking behaviours. So, when the leader supported the norm violator, they were revealing a power giving behaviour, as their decision to distribute more resources to them and/or select them as a leader made norm violators have more power within the game. In contrast, if the Leader opposed the norm violator, they were demonstrating a power taking behaviour.

Table 3.2: Game Actions and Power Giving and Taking Behaviours

Action	Support	Opposition	Acquiescence
Resource Distribution	More resources to norm violator	Less resources to norm violator	Same number of resources to norm violators and norm abiders
Leader Assignment	New leader is norm violator	New leader is not norm violator	—

3.2.5.B Journal

Furthermore, we wanted a way for players to openly express their feelings within the game, which also had to make sense considering the game's context. Since this was survival type game, we thought it would be enjoyable to have a place for players to write their survival story. At the end of each day, after the Leader Assignment, players would be invited to write in their own personal journal, where they could share how they felt about the other players (performance and behaviours) and also write about the game itself (visuals and mechanics). They were going to be free to write what they wanted, which would be a useful way to capture their feelings and obtain more information for analysis.

3.3 Game Overview

After fulfilling all the requirements of this norm violating game, we decided to make an overview of the game itself, defining in more detail the information and actions of each player and building the main game loop.

3.3.1 Player's Information

While playing the game, players would have several information available about them and other players on their screen. It was crucial to have a visible health bar in order for them to be aware of their need for resources, since their health would improve with its consumption. It was also necessary to show their

name on the screen, and also an indication if they were the leader in the current phase. Besides seeing their own information, players would also be able to visualise information about the other players: their name, their health bar and, in case one of the other players was the Leader, an indication of that as well.

Additionally, players would be able to see the number of resources they collected in the dangerous zone, before performing the resource collection action, as well as the amount of resources owned only by them (individual resources) and also by all players (group resources). In order to situate players in time, the number of the day and a countdown timer that indicated how much time was left for the day to end would be accessible as well.

Finally, as mentioned in section 3.2.3, players should be able to read, on their screen, logs of specific actions happening within the game. These logs would be updated in real-time and would always be visible.

3.3.2 Player's Actions

Players would have standard actions available, like walking, changing direction and jumping. As defined in the previous sections, other actions allowed were related with norm-violating/abiding and power giving/taking behaviours. Players would also be able to write in the journal.

In table 3.1, it was possible to see the two sides of the player's actions, norm abiding and norm violation, and what were the norms followed/violated in each case. These actions included resource collection, resource request and resource "exchange" as defined before.

Regarding table 3.2, we could observe how some of the player's actions could show support (power giving behaviour), opposition (power taking behaviour) or acquiescence to norm violating players during tasks such as resource distribution and leader assignment, which were only performed by the player that was currently the leader.

3.3.3 Game Loops

Finally, we decided to summarize the game in a main game loop [See image 3.1]. In short, players were going to spend an arbitrary number of days inside the bar and the goal was to obtain resources and consume them in order to survive. In the first day, one of the players was going to be the leader. At the end of each day, the leader distributed the group resources between the players and voted for the next leader. Following the selection of the leader, all players wrote in a journal.

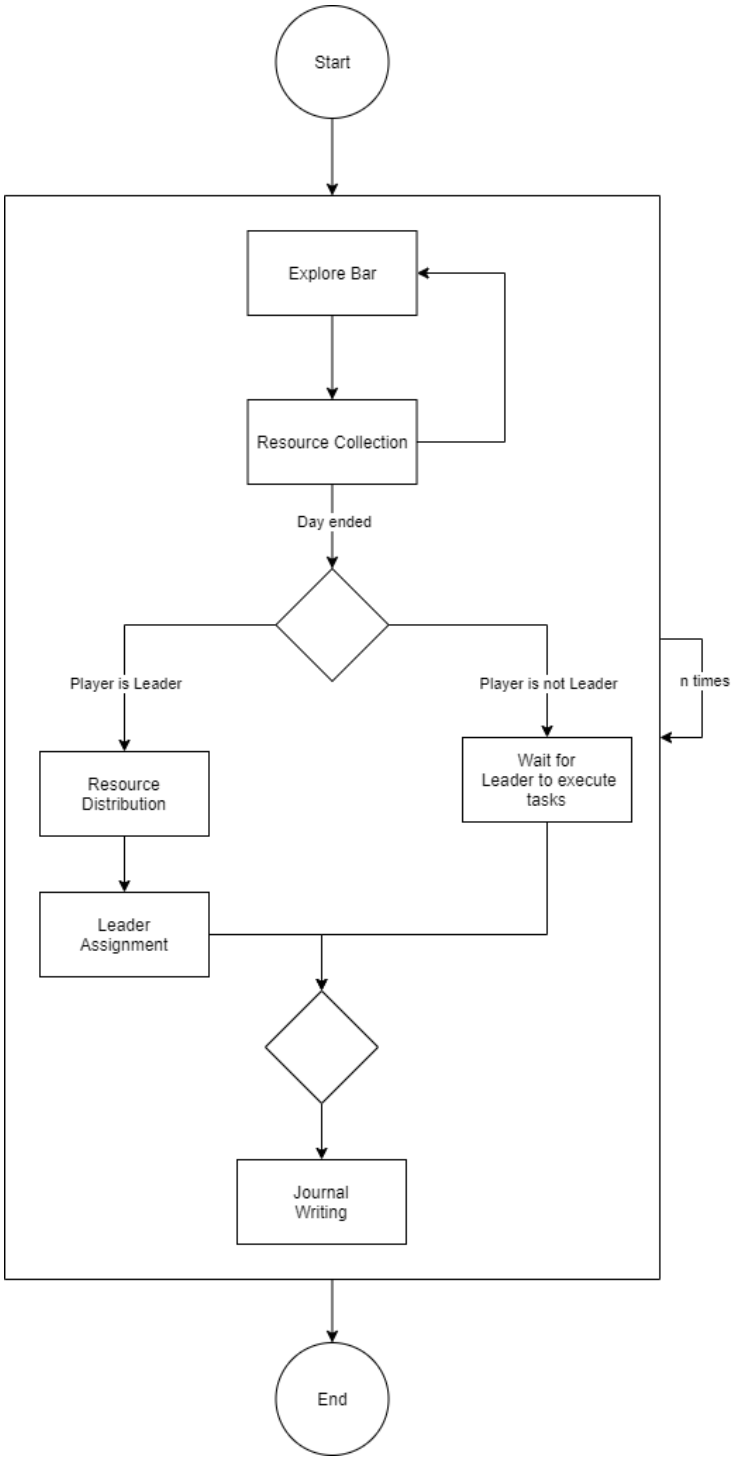


Figure 3.1: Main Game Loop

3.4 Concluding Remarks

As a way to create a simple, yet useful research tool, we focused on defining and fulfilling the strictly necessary requirements of a norm violating game. In addition, we considered a few extra requisites, thinking on how to approach our research question and also on the validity of the experiment.

Thus, in our game concept, we introduced actions related with norms and power, with the intention of using the game to explore how norm violation influenced power giving and taking behaviours. All of these actions were based on the fact that the game was a survival resource-management game. Moreover, we agreed that a first person 3D perspective would be ideal to create a more immersive experiment within the game.

4

Game Implementation

Contents

The current chapter describes the implementation process of the game previously defined in Chapter 3. We start by introducing the tools used during this process. Then, we divide the implementation into three iterations and, in each one of them, we provide a detailed report of our development process, and list the problems found after testing with a few users. Given the problems discovered, we detail how we solved them in each new iteration. Finally, we give a more elaborate view of some features of the game.

4.1 Tools

The game was implemented using *UnityEngine*[1]. In order to add multiplayer to the game, we used a *Unity* package for multiplayer games called *Photon Pun*[2][3]. It was simple to use, included a lot of documentation and allowed for reliable synchronization of players' information and actions during the game.

4.2 First Game Iteration

4.2.1 Environment, Characters and Resources

The first step was to create our initial *Unity* scene and start building the game environment – the bar [See image 4.1]. We looked for 3D unity assets[4][5] that we could use in order to make players feel like they were in a realistic bar: wooden tables and chairs, bar stools and counters, leather sofas and a few cabinets. We also found some other assets[6][7] which complemented the space, such as drinking mugs and glass cups, candles, barrels and a few eery wall decoration (goat's head, shields, axes). All of these assets already included lighting maps and colliders. Then, we applied only a few point lights to the bar's ceiling, with the intention of illuminating the space lightly and, consequently, giving the game a dark and spooky atmosphere.

Following the previous step, we focused on the character used to represent the players. We discovered an asset of a 3D rigged model of a human[8]. The character included a set of animations (idle, walking, jumping, ...) and also had a gun [See image 4.2]. We started by programming the player movement, such as walking in all directions (tweaking the player speed as our implementation evolved),

[1] Unity Engine: https://unity.com/
[2] Photon Engine: https://www.photonengine.com/pun/
[3] Photon Engine Glossary: https://doc.photonengine.com/en-us/pun/current/reference/glossary/
[4] Furnished Cabin: https://johnnykasapi.com/portfolio/furnished-cabin-unity-asset/
[5] Medieval Tavern: https://assetstore.unity.com/packages/3d/props/furniture/medieval-tavern-pack-112546/
[6] See footnote 5
[7] Hut Pack: https://assetstore.unity.com/packages/3d/props/free-hut-pack-130776/
[8] Adventurer Blake: https://assetstore.unity.com/packages/3d/characters/humanoids/adventurer-blake-158728/

jumping and rotating. Then, we defined the camera movement, which consisted in allowing the players to look around the scene in a first-person perspective.

(a) Ortographic Mode - Top View

(b) Perspective Mode

Figure 4.1: Bar Environment

Figure 4.2: Player Character

We proceeded to define the limits of the dangerous zone, mentioned in section 3.2.4, within the bar area. In this zone, we positioned the infected humans, as a symbol of danger, and the resources, as seen in image 4.3. For the former we used the asset of a zombie[9], with animations included, and for the latter we found an asset of a first-aid box[10]. After this, we added a plain health bar to the game, which decreased according with the time passed inside the bar multiplied by a constant coefficient. If players were inside the dangerous zone, that same coefficient would increase. Then, we implemented our first attempt at the resource collection action, where players had to click resources to grab and throw them.

[9] Zombie: https://assetstore.unity.com/packages/3d/characters/humanoids/zombie-30232/
[10] Survival Game Tools: https://assetstore.unity.com/packages/3d/props/tools/survival-game-tools-139872/

Figure 4.3: Dangerous Zone with zombies and resources

4.2.2 First Steps of Multiplayer

We began adding multiplayer to the game, starting by setting up *Photon Pun* and creating a second *Unity* scene. This scene contained only a hidden *Start* button, which would become visible if players/*clients*[11] connected to the *Photon master server*[12] successfully. Connecting to the *master server* implied that players were ready to initialize the *matchmaking*[13] process. Upon connection, players were given a random name. When a player clicked on the button, they would try to join an existing random *room*[14], and if not possible, they would create a new room, with a random name and a specific number of players. The player that created the room was the *master client*[15] of that specific room, and only the *master client* could load the multiplayer scene (the first scene we created). By setting the *Photon Pun* property *AutoSyncScene* to *true*, all other players that joined an existing room would automatically be sent to the scene controlled by the master client. For each player that entered the multiplayer scene, we had to instantiate a networked player object – our character game object. This process is presented in figure 4.4. During this implementation stage, players could now see other players in the same scene, however they were unable to see their movement, so we proceeded to implement the synchronization of players' position and rotation.

[11] Applications that connect to a server are called clients.
[12] The Master Server handles the matchmaking for a region or cluster.
[13] The process of finding a game or match.
[14] Players meet in rooms to play a match or communicate. Any client can only be active in one room.
[15] Master Client is a "special" client per room. In absence of custom server code, it can be made responsible for handling logic that should only be executed by one client in a room.

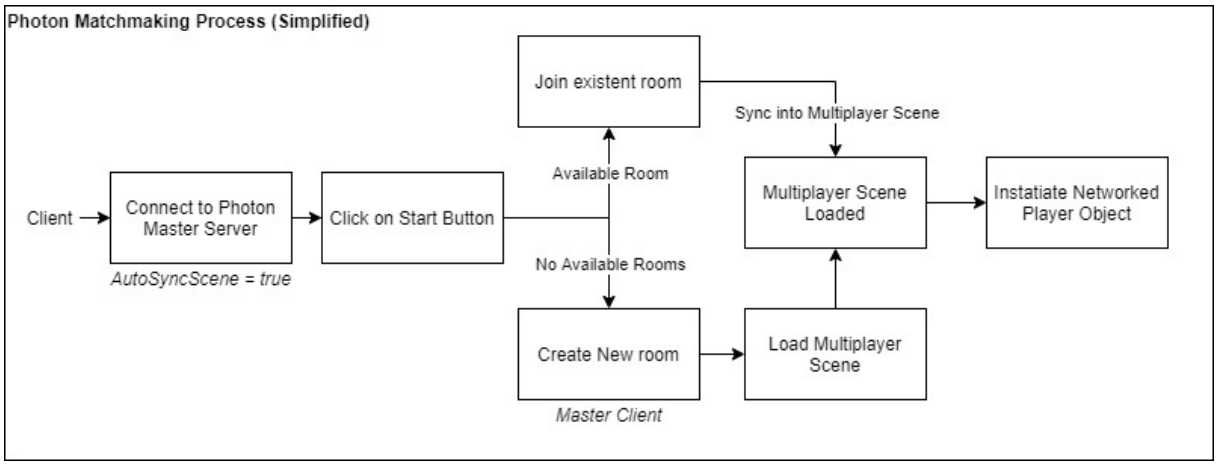


Figure 4.4: Matchmaking Process using Photon Pun

4.2.3 Player's Information

Following the matchmaking process, we focused on the player's interface, obtaining assets of User Interface (UI) icons[16], which we applied in several menus of the game. We improved the health bar appearance and displayed the player name on top of the bar. In addition, we updated players' health using a Remote Procedure Call (RPC)[17], and allowed for players' health and name to be visible for other players on top of their characters. We also started implementing the *Leader* role, selecting at first the master client as leader, with an RPC, and displaying the word *Leader* above the selected leader's name.

We proceeded to add the countdown timer and the day incrementor to the game, as a way of indicating the days passing by within the game, as mentioned in section 3.3.1. First, we specified the maximum number of days spent inside the bar and then we defined the maximum number of seconds in a day. After this, we made the master client responsible for decreasing the timer and updating it with an RPC. All players, having access to the updated current time, would convert it to a string, with a *mm:ss* format, to be shown at the top of their screen. When the timer reached 0 seconds, the master client would increase the number of the day, which was also displayed on players' screen, over the timer. The game would finish if it were the last day, otherwise players would return to their initial position and keep playing. In addition, as a way of increasing the game's level of difficulty, the coefficients used to reduce players' health within the game were augmented as the days were incremented.

4.2.4 Resource Collection

We returned to the resource collection action, deciding to simplify it as much as possible. We agreed that players would just have to click on a resource to collect it and the resource would automatically

[16] User Interface Icons: https://assetstore.unity.com/packages/2d/gui/icons/icons-ui-95116
[17] It refers to calling a method on remote clients within PUN games.

disappear, being respawned again after a specific time. We also had to deal with the synchronization of the resources' disappearance/appearance, in order for players to be in the same game state, using RPCs for that effect. We tweaked this process a bit and ended up allowing the player to collect resources only when they were close to them and inside the dangerous zone. Furthermore, we wanted players to be informed on how many resources they collected, so we displayed that information on their screen. At first, we limited the number of resources collected each time players entered the dangerous zone however this was altered, as it will be explained later in section 4.2.10.

Following this, we began implementing the *Resource Collection Menu* [See image 4.5]. When players left the dangerous zone with collected resources, the referred menu would appear on their screen. In here, they had to decide on how many of the collected resources they would like to give to the group or keep to themselves. In the beginning of our implementation, the menu was automatically filled (half of the collected resources for each stash), however we agreed it was safer to start with 0 resources in each stash in order not to influence players' behaviour. Just like the collected resources, we also displayed the number of individual and group resources on the players' screen.

Figure 4.5: Resource Collection Menu

After the resource collection, we implemented the resource consumption action. Players could consume their individual resources by simply clicking on the *R key* of the keyboard, and, consequently, increase their health. We used RPCs to update the number of individual and group resources during these actions, since we needed these variables synchronized throughout the whole game.

4.2.5 Log of Actions

We moved on to implement the log of actions [See image 4.6], displaying a scrollable panel in the lower right corner of the screen, available for all players to read. As explained in more detail in section 4.6, it included text logs of important game behaviours. At first we started by displaying logs related with the resource collection action. Then, as we introduced other mechanics into the game, we proceeded to add more logs. As a way of improving their readability, we decided to highlight the logs' key words, using

bold and the colour red, choosing also to darken the panel's background colour.

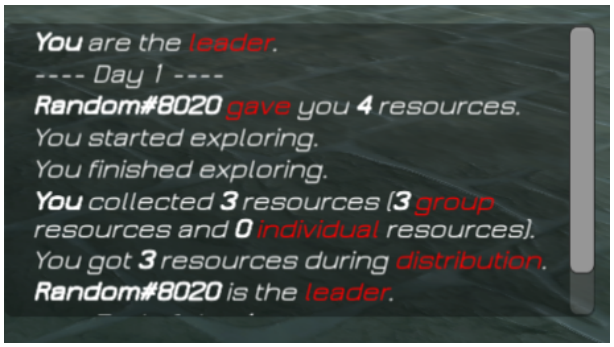


Figure 4.6: Log Of Actions Panel

4.2.6 Resource Distribution and Leader Assignment

Since we had already implemented the end of the day mechanic, we started adding the *Resource Distribution* action to the game. When the day ended, the *Menu* representing this action [See image 4.7] would show up on the leader's screen, while the rest of the players had to wait. In order to provide more information to these waiting players, we decided it was important to show them a waiting screen, notifying them that the leader was deciding. We started by implementing the resource distribution one player at a time, however we agreed that it was easier to understand this task if we showed all players of the game on the same screen. In this menu, the leader was in charge of distributing all the group resources collected during the current day between all players. Since we wanted the leader to make an informed decision, we wrote a small text in the menu suggesting them to read the log of actions. After distribution, players' individual resources were updated, as well as the number of group resources.

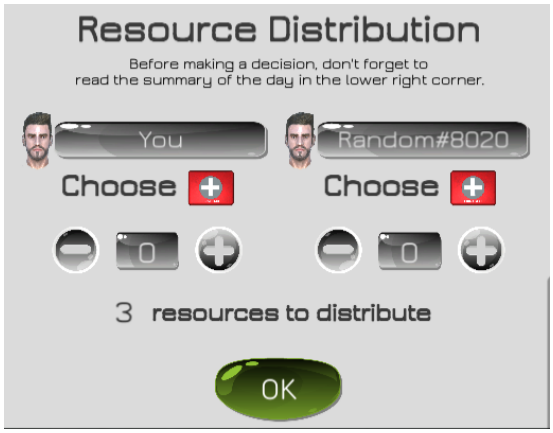


Figure 4.7: Resource Distribution Menu

Then, we included the leader assignment action. After closing the distribution menu, the *Leader*

Assignment Menu [See image 4.8] popped up for the leader, while the other players kept seeing the waiting screen. The leader had to select one of the other players to be the new leader, using the arrows to go through their names. The same paragraph of the distribution menu warning the leader to read the log of actions was also added into this menu. After this power giving action, the leader role was updated.

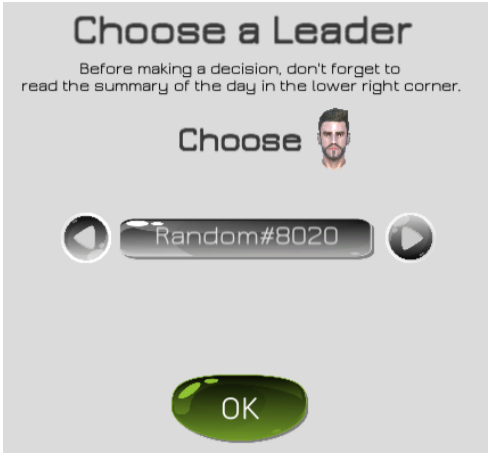


Figure 4.8: Leader Assignment Menu

4.2.7 Journal Writing

We proceeded to add the journal writing action to the game. After the execution of the leader assignment task, the *Journal Writing Menu* [See image 4.9] would be displayed on the screen of all players. In this menu there were two panels, one above the other. The one at the top showed everything the player wrote in their journal within the game, while the one at the bottom worked as an input text box where the player could write without restrictions before officially sending it to the panel above. We also added an introduction on the menu stating that players could share their feelings freely in the journal, providing them with more information on what we expected with this diary. When we began this implementation, the journal appeared at the start of each new day, meaning that the timer was already counting when players were writing. However, since we did not want players to feel pressured about writing fast in the journal, we agreed it was better to only start the timer of the new day after all players wrote in their own journal. Therefore, we had to implement another waiting screen informing players they needed to wait for everyone to finish writing in order to advance to the next day.

4.2.8 Resource Exchange

We moved on to implement the resource “exchange” action. Essentially, we allowed players to click with their mouse on another player in order to open the *Steal or Give Menu*. At first, players could be far away to perform this action, yet we decided it made more sense to only allow this action when players were

Figure 4.9: Journal Menu

facing each other. In this menu, players would decide on their action, steal or give, and the respective sub-menu would open according to their decision [See image 4.10]. They could steal all of the chosen player's individual resources or give them all of their own. Following this transaction, all players involved would have their individual resources updated.

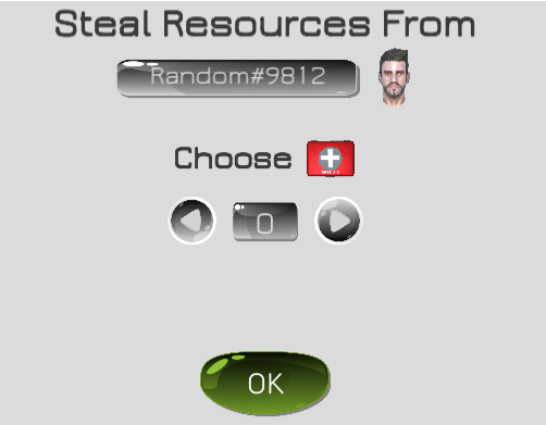
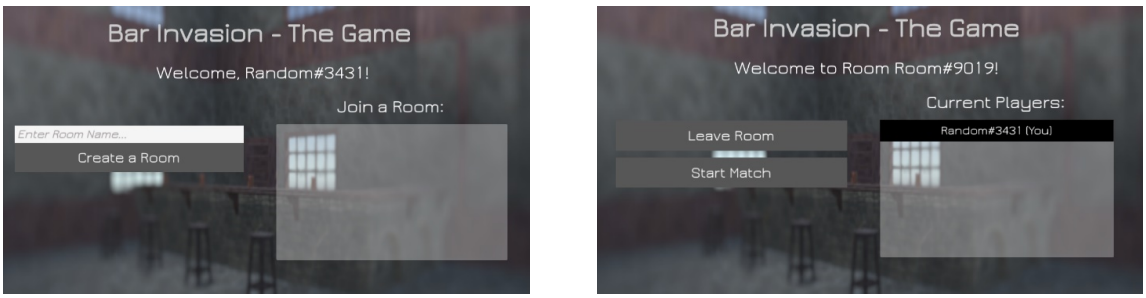


Figure 4.10: Steal Sub-menu

4.2.9 Multiplayer Start Menu and Player Interface

Having all of these actions programmed, we agreed to concentrate on the interface of the matchmaking process, upgrading our start menus. First, we gave players the chance of writing any name they desired to play with. Then, we added a *Create Room Screen* [See image 4.11(a)], where players could see all rooms available in the *Photon Server* and join one of them or host their own. This allowed players to join any room they wanted and not being randomly assigned to one, which would also give the

researchers more control during the game experiments. Lastly, we created the *Current Room Screen* [See image 4.11(b)], in which players could see who they were playing with, and also had the option of leaving the room. Moreover, the master client was the only one who could start the match, given that only this player had access to the *Start Match Button*. As soon as the game started, we decided to hide the current room from new players so that only the players present in the room could be a part of that match, meaning that all of them started playing the game simultaneously.



(a) Create Room Screen **(b)** Current Room Screen

Figure 4.11: Game Start Menus

Since we were focused on improving UI, we decided to upgrade our player information section [See image 4.12] as well, giving it a darker background to increase visibility and also positioning some elements differently. In addition, we added the instruction on how to consume resources above the number of resources, since we did not have that information anywhere in the game.

Figure 4.12: Player Information Section

4.2.10 Resource Collection Details

In parallel, we concentrated on some aspects regarding the resource collection. Granted that we wanted players to feel like collecting resources was a risky and not so linear task, we agreed to remove the threshold of collected resources within the dangerous zone, in order to allow players to collect an “unlimited” number of resources with a specific rule. The rule was “the more resources collected by the player the more health the player would lose”. We computed a linear interpolation between the minimum and maximum health coefficients of the dangerous zone, having the percentage of caught resources (given a maximum number of resources) as a parameter. The result obtained corresponded to the coefficient

used to reduce health inside the dangerous zone. We included a blood splatter near the health bar on each resource click, as a way to represent the described mechanic to players. Furthermore, within the dangerous zone, we decided to display a frame simulating blood on the players' screen, whose opacity would increase with the decline of players' health, aiming to make players perceive the zone with a higher sense of danger.

We also opted to limit the number of times a player could enter the dangerous zone in a day, since we did not want them to be performing the resource collection throughout the whole game. This was due to two reasons. The first one was the fact that, without this restriction, the game would be much easier for players, making the collection rule described before pointless, given that they could easily catch a lot of resources by entering the dangerous zone several times. The second reason was because we wanted subjects to focus on the other players and their actions as well, and not only on this action.

4.2.11 Final Steps

Following the previous improvements, we had only minor details left to implement. We programmed the death mechanic of the game, trying to make it more challenging, defining a maximum number of lives. If players were about to lose all of their health, a warning would be displayed under their health bar. In case their health reached 0 and they still had lives left, players would respawn with half of their individual resources (rounded up) and one third of a full health bar. Additionally, a panel stating they were injured and advising them to be careful would show up on their screen. When players lost all their lives, the game would end for them.

Then, we displayed a few simple panels with text information throughout the game, intending to help and guide the players during their gameplay: game story, controls, start of the day, end of the day ... Additionally, we decided to add an extra scene to the game, thanking participants for playing.

Furthermore, we saved all game actions into a database, using *PostgreSQL* and *PHP*, since we needed to record players' actions to be able to analyse them during our experiments. The database structure we built was very straightforward as described in section 4.5. During this first phase of implementation, we stored the player in the database with two random unique identifiers, their *roomId* and their *playerId*, and also a string for the room name. Considering that we wanted players to answer a questionnaire external to the game during testing, we needed a system to link the answers from the questionnaire with the data from the database. Therefore, we decided to display these identifiers on a menu at the beginning of the game, instructing players to copy and paste them into the questionnaire.

Then, we added animations (included in our character asset) to the players – idle, walk, jump - seeking to confer more realism to the game. The parameters of these animations (*isWalking*, *isJumping*) were synchronized between players using RPCs. Aiming to make the game feel a bit more immersive and

engaging, we decided to include sound and music as well, such as player movement sound effects[18][19], eery background noises for when players were just wandering through the bar[20], and a stressful music for when they were exploring inside the dangerous zone[21]. Sounds for when a player picked up[22] or consumed a resource[23] were also included. In addition, we added sound effects to the buttons[24], trying to help players navigate easily throughout the game menus.

Lastly, we exported the game to *WebGL*, given that it was easier to request subjects to test the game by following a link, instead of running the *Unity* executable.

4.2.12 Testing and Identified Problems

We did our first test of the game with 5 players, 3 in one group and 2 in another. Players had to spend three days inside the bar, 3 minutes each day, and they could only enter the dangerous zone once a day. We randomly selected one of the players of each group to create the room. This was an uncontrolled remote experiment, without confederates, and our main goal was to obtain player feedback regarding the current implementation of the game and get a sense if players understood how to play it clearly. We sent a link with the questionnaire [See questionnaire in Appendix A] to players and they began answering it, starting by the demographic section. Then, in another link, they proceeded to play the game, having to copy the identifiers given in the game to the questionnaire. As soon as players finished the game, they returned to the questionnaire link, answering a few questions about the game itself and stating their opinions. In order to find the problems of this first iteration of the game, we focused more on the questionnaire's open-ended questions (Overall, what would you change/add to improve the current version of the game?), on the feedback a few players gave us during and after the experiment and also on a few of the data from the database (Did players give or steal? How many resources could they collect? How many times did they die?).

Overall, players asked us too many questions throughout the test, since they did not understand the goal of the game and, consequently, they did not have a good game experience. Having said that, we managed to find the following main problems in this first iteration of the game:

1. Players were having trouble copying and pasting the room and player identifiers into the questionnaire
2. Players were not aware of the game goal
3. Players thought they were not given enough instructions

[18] Footstep Sound: https://freesound.org/s/166506/
[19] Jumping Sound: https://freesound.org/s/422426/
[20] Ambience Sound: https://freesound.org/s/270387/
[21] Stressful Music: https://freesound.org/s/428862/
[22] Pick Up Sound: https://freesound.org/s/216629/
[23] Consume Sound: https://freesound.org/s/348112/
[24] Menu Sound: https://freesound.org/s/166186/

4. Players did not pay much attention to the text panels within the game
5. Players entered the dangerous zone and left right away, spending a whole phase without catching any resources
6. Players did not understand why they could not enter the dangerous zone again after leaving
7. Players took a long time figuring out how to catch resources, not collecting a lot in general
8. Players did not realize they could give and steal resources
9. Players did not know right away how to write in the journal
10. Players lost very easily

4.3 Second Game Iteration

During this second iteration, our main goal was to eliminate the problems listed in section 4.2.12.

4.3.1 Player Identifier

Starting with the identifiers problem, we realized that having this menu at the beginning of the game decreased the players' focus in the game right as it started, raising too many doubts. So, we agreed to move the task of copying and pasting the identifiers to the end scene of the game. Moreover, we realized it did not make sense to have two unique identifiers in order to identify the player in the database, one would be more than enough, given that we already had the room name in there, which allowed us to identify which subjects played together in the same room. Therefore, we kept only the *playerId*, predicting that this would also bring less confusion to players while answering the questionnaire, going from filling the inputs of two unique identifiers to only one.

4.3.2 Website and Game Appearance

Given the second and third problems, we decided it would be easier for players to understand the game if we implemented a game website with full game instructions. We used *HTML*,*CSS* and *JS* to develop a website[25] with the following structure: an introduction header with the game name, *Bar Invasion*, a slider presenting illustrated instructions of the game [See image 4.13] and also its goal, the survey used in the experiment, our game ready to play and a contacts section, in case players had any further questions. Our intention was to make the instructions easier to retain, using many illustrations and not a lot of text to

[25] Bar Invasion Website: https://web.tecnico.ulisboa.pt/~ist424817/BarInvasionTheGame/

provide examples of every action of the game. Additionally, we inserted one more panel at the beginning of the game clearly stating its goal, in order to provide even more information to the player.

Figure 4.13: Game Website - Instructions Slider

Regarding the fourth problem, by developing an appealing website for the game, we, optimistically, managed to partially solve this issue, since we attempted to make the game a lot more attractive to play, which could make players more focused on text written within the game panels. Furthermore, we added bold and the colour red on key words of the game goal, so that if a player only read those words, they would understand what the aim of the game was. Finally, we upgraded the appearance of the controls' window [See image 4.14]. Instead of being just plain text, we added a few images representing the mouse and keyboard keys and reduced the text length as well, making the controls easier to memorize.

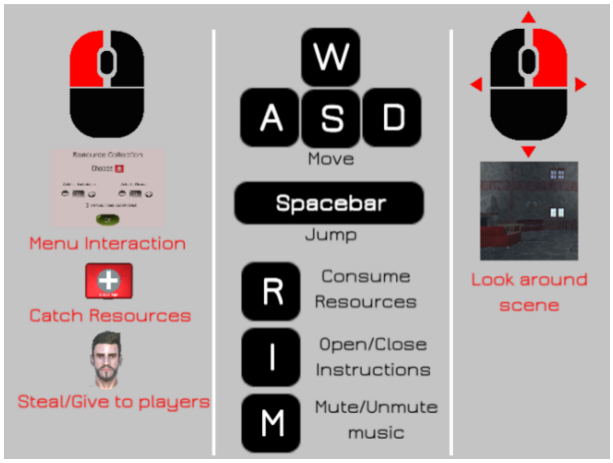


Figure 4.14: Controls of the Game

4.3.3 Highlight Shader

Concerning questions number 7 and 8, we decided to highlight the resources [See image 4.15] and players on mouse hover, seeking to make the actions of catching resources and stealing or giving resources more evident to players. In order to do so, we changed the selected game object's shader to an outline shader, given the condition that players had their cursor on top of the chosen object. Furthermore, at the start of the game, we positioned all players in a circle facing each other, intending to make everyone aware of the existence of other players in the same space as them, which could, consequently, give more visibility to the steal and give action.

Figure 4.15: Highlight Resources on Mouse Hover

4.3.4 Journal Writing and Resource Consumption

In our first iteration, the writing order in the journal followed a bottom to top flow, which was not intuitive for a few players. As a solution, we swapped the positions of the text panels [See image 4.16], so players would write on the top panel instead and read on the bottom. In addition, we also increased the journal width and displayed the writing day in front of each journal log, aiming to improve its readability.

For the final problem, we just had to tweak the health given by the consumption of a resource, increasing it to 50%.

4.3.5 Administrator Mode

As an extra, during this second iteration, we decided to implement an administrator mode within the game. The researchers could use this feature to have more control of their experiments, being able to be a hidden spectator of the game [See image 4.17], just like a ghost inside a room, which would allow

Figure 4.16: Journal Menu Upgrade

them to verify if players had any problems during their game play (connection issues to the photon server, issues understanding the controls,...) and also to visualize their actions in real time, having access to the log of actions. Additionally, in the current room menu, administrators could select any player they wanted to be the leader before starting the match, which would, then again, give them more control of the experiment. In order to have access to the administrator mode, researchers needed to enter the game with a specific password.

Figure 4.17: Administrator Mode View

4.3.6 Testing and Identified Problems

We did our second test of the game with 6 players, 3 in each group. Just like in the first iteration, players spent three days within the bar, 3 minutes each, and they could only collect resources once in a day. This time, the researcher was the one creating the room, proceeding to select one of the players to be

the leader, in order to test the new administrator feature. This experiment had the same aim as the first one, which essentially was to obtain feedback in order to solve any further problems in the game. Players were sent the link of the game website, and followed this sequence: read instructions, fill the first part of the questionnaire, go to the game section and play, finish playing and copy player identifier, return to questionnaire and paste the identifier, continue filling the second part of the questionnaire. The questionnaire had the same questions as in the first experiment, therefore we used similar methods to assemble the problems found.

In general, players had a much better experience than in the first test, asking only a few questions after playing. Nevertheless, we still managed to register a few problems:

1. Players were still confused about copying and pasting the player identifier into the questionnaire
2. A few players mentioned they wanted to use the character's gun to kill the zombies
3. Players had trouble collecting resources in the first day, though most of them managed to succeed in the second
4. Players did not steal or give resources that often

4.4 Third Game Iteration

Then again, our intention was to solve the problems found in section 4.3.6.

4.4.1 Player Identifier

Starting by the first problem, we decided that copying and pasting the player identifier should not be a task executed by the subjects. Therefore, we agreed that it would be better to generate the identifier using *JS* and save it into a browser cookie, populating the identifier field from the questionnaire automatically and sending this same identifier to the game, once it loaded, to be added into the database. Therefore, the subjects did not need to participate in this process. In addition, we chosen to improve the way players navigated through the game website, splitting our questionnaire into two, being the first the demographic questionnaire, and the second the one that contained survey questions that could only be answered after playing the game. We thought this would be less confusing for the players, since they would just have to follow the sequence of the website (instructions – questionnaire 1 – play – questionnaire 2), not having to go back and forth like they did in the previous experiments.

4.4.2 Player's Gun

For the second problem, we decided not to add any use to the player's gun (for example, attack zombies), believing it would take the focus out of the other actions of the game. Furthermore, it would be one more mechanic for players to learn, which would bring even more difficulties to their game play and would not provide relevant data to researchers, at least at this stage of implementation. Therefore, we simply hid the gun included in our character's mesh.

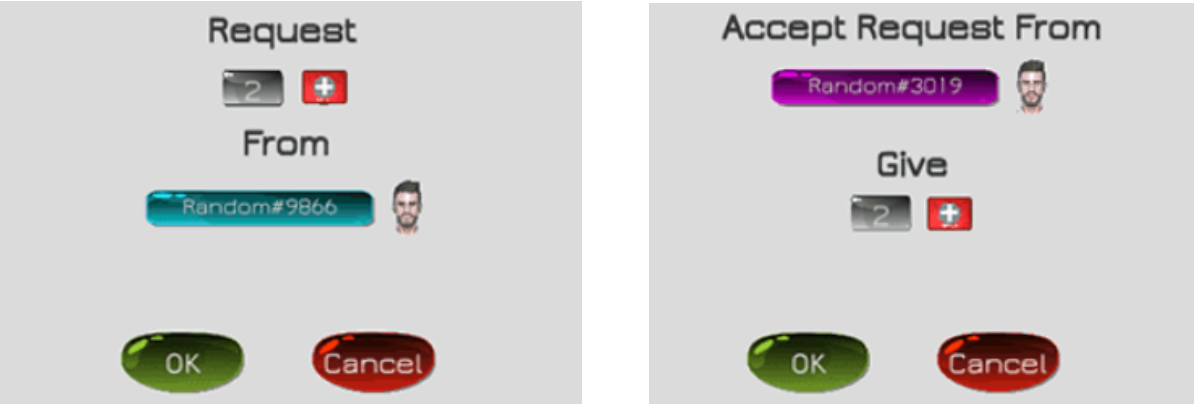
4.4.3 Training Phase

Moving on to the third problem, we decided we should implement a training phase (phase 0), where players could learn the game before going to the first real phase. This would help them have more time to adapt to the controls and mechanics of the game and, simultaneously, would make them take the following phases more seriously. At the beginning of the day, we displayed a screen telling players they were in a training phase. They would learn how to perform the game actions: explore the bar, collect resources, distribute resources, ... When this phase ended, we showed a panel warning them that the training was concluded and that their actions would begin counting starting from the following phase. All players' actions and resources would be reset after the end of the practice, therefore everything started from zero on the first real phase of the game.

4.4.4 Resource Request

Given the fourth problem, we decided to hide the steal and give action. Players could not find a reason to steal from others without their permission, not having any motivation to give resources as well. So, we focused on the resource request action, which made a lot more sense, in particular when we performed the evaluation [Chapter 5], given that if a player had low health and no resources, that same player had a valid reason to request resources. We allowed players to request resources by clicking on the players, just like the steal and give actions, however their health had to be really low and they could not have any individual resources left to consume in order to open the *Resource Request Menu* [See image 4.18(a)]. If all of these conditions verified, we displayed a warning near the player's health bar alerting them they could request resources. After the request, the player had to wait for the corresponding response. The player which received the request would have a menu displaying on their screen [See image 4.18(b)] where they had to decide if they wanted to accept or reject the request.

Furthermore, to simplify this interaction as much as possible, players could not decide on the amount of resources they would like to request or to offer, meaning that the number of resources would be fixed instead.



(a) Request Menu

(b) Response Menu

Figure 4.18: Resource Request Menus

4.4.5 Final Steps

After solving these problems, we made a few extra improvements following a final revision. First, we wanted to easily identify other players in a questionnaire, therefore we used the three primary colours (cyan, magenta and yellow) to do so. Our intention was that in a group of three players all the colours were different between them. We randomly assigned a colour to each player and changed the material of their character's t-shirt according to their designated colour. We had to synchronize the colours using RPCs, so that all subjects could see other players' colours. Moreover, within the game menus, we changed the background colour of each one of the rectangles containing the name of the players, according to their respective colour.

Figure 4.19: Log of Actions and UI Upgrade

Then, we wanted to make sure the leader would actually read the action logs on the resource distribution and leader assignment actions, therefore we increased the height of the panel of actions during

these tasks, giving it also a bold and red title at the top, *Player's Actions*, as a way of making it stand out [See image 4.19]. In order to improve its readability, we added more spacing between the logs. We focused on the user interface once more, reducing the opacity of the minus and more buttons when they could not be used, as a way to demonstrate they were inactive. Also, instead of putting the image of the resource on top of the input value, we decided to place it on its right side [See image 4.19].

Additionally, we proceeded to change the leader assignment menu, since it was not consistent with the other menus, using arrows to navigate through the players. Just like the resource distribution task, we decided to display all players on the leader's screen (except for the leader, in this case), and the leader had to essentially click on the player they wanted as the new leader [See image 4.20]. The previous implementation was a bit biased, given that a player was already selected when the menu opened, so if the leader clicked to proceed instead of clicking the arrows, the new leader would always be the one appearing first in that menu. Therefore, this implementation was much less unfair.

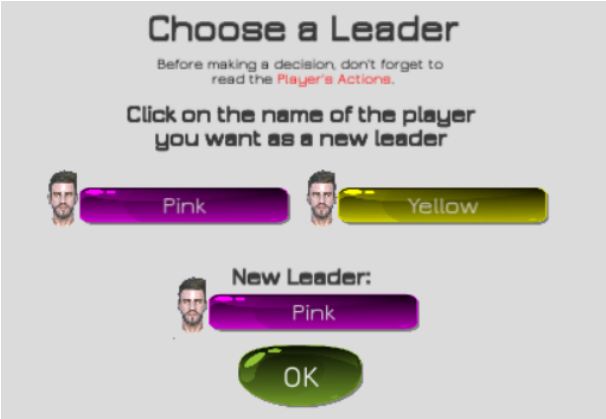


Figure 4.20: Leader Assignment Menu Upgrade

As a final improvement, we implemented a way for researchers to be able to configure some game variables, in order to generate different experiments according to what they intended to test. At the start of the game, we read a *JSON* file holding the game configurations, and then we initialized several game variables using these values. The configurations are explained with more detail in section 4.7.

4.4.6 Testing and Identified Problems

After this implementation, we did not have further time to test and obtain user feedback, so we proceeded to the experiment described in the evaluation [Chapter 5]. We only tweaked two details during these experiments, however they did not have a lot of impact in the process of evaluation. In particular, we changed the name of each player to their assigned colour, in order to be easier to remember, and added a panel informing players that after the training phase everything would be reset.

4.5 Database

The database would record every single game action, including what players wrote in their journal, being fundamental for the evaluation [Chapter 5] of the game, more specifically for the analysis of the results. Its data could be easily exported to *CSV*, for example, given it's a widely accepted format, and then be imported and analysed in a statistical software tool. Our database structure ended up being very simple. We had a table to upload all the subjects called *bar_invasion_subjects*, which included these columns: *playerID*, that was the primary key, *playerName* and *roomName*. We also had a table that recorded the player's colour string, having the *playerID* as a Foreign Key (FK). Regarding the other tables necessary to register the players' actions, we listed the most relevant in table 4.1.

Table 4.1: Database Tables and Columns

Action	Database Table	Database Column
Resource Collection	*bar_invasion_collection*	player_id : varchar (FK) group_resources : integer individual_resources : integer phase_num : integer
Resource Exchange	*bar_invasion_steal* *bar_invasion_give*	giver_id/stealer_id : varchar (FK) receiver_id/victim_id : varchar (FK) num_resources : integer phase_num : integer
Resource Request	*bar_invasion_request*	requester_id : varchar (FK) responder_id : varchar (FK) response : integer num_resources : integer phase_num : integer
Resource Distribution	*bar_invasion_distribution*	leader_id : varchar (FK) receiver_id : varchar (FK) num_resources : integer phase_num : integer
Leader Assignment	*bar_invasion_power_give*	leader_id : varchar (FK) receiver_id : varchar (FK) num_resources : integer phase_num : integer
Journal Writing	*bar_invasion_write*	leader_id : varchar (FK) journal_content : text phase_num : integer

4.6 Log of Actions

Our log of actions worked like a summary of the day. In table 4.2 it is possible to see a rundown of the main logs displayed to players according to the action performed. In the table, we used the word *Player* to symbolize the players performing the action, and *x, y, z* to represent a variable number of resources.

Table 4.2: Log of Actions

Action	Log
Entrance/Exit Dangerous Zone	*Player* started/finished exploring
Resource Collection	*Player* collected *z* resources (*x* group resources and *y* individual resources), where *x + y = z*
Resource Exchange - Giving	*Player1* gave *x* resources to *Player2*
Resource Exchange - Steal	*Player1* stole *x* resources from *Player2*
Resource Request - Requester	*Player1* requested *x* resources from *Player2*
Resource Request - Responder	Accept: *Player1* accepted the request and gave *x* resources to *Player2*; Deny: *Player1* denied the request from *Player2*
Resource Distribution	*Player* got *x* resources during distribution
Leader Assignment	*Player* is the leader.

4.7 Game Configurations

Researchers had the possibility of editing a *JSON* file in order to configure their desired game experiments. This file included 19 configurations, listed below:

- ***playerNumber (Integer)***: maximum number of players allowed inside a room
- ***phaseNumber (Integer)***: number of days spent inside the bar, excluding the training phase
- ***trainingPhase (Boolean)***: include training phase
- ***phaseTimer (Integer)***: number of seconds of each day
- ***playerColour (Boolean)***: assign random colours to players
- ***numberLives (Integer)***: number of lives of each player (-1 for infinite)
- ***respawnHP (Integer)***: health of player after respawn
- ***warningHP (Integer)***: health of player to trigger warnings of low health

- ***resourceValue (Integer)***: health provided to player upon resource consumption
- ***numberOfIndividualRes (Integer)***: initial number of individual resources
- ***numberGroupRes (Integer)***: initial number of group resources
- ***collectionMenu (Boolean)***: include Resource Collection action (if false, resources will go automatically to the group)
- ***numberCollection (Integer)***: maximum number of times players can collect resources in a day (-1 for infinite)
- ***giveStealMenu (Boolean)***: include Resource Exchange action
- ***requestMenu (Boolean)***: include Resource Request action
- ***simplifyMenus (Integer)***: fixed number of resources to use in the exchange and request actions (if -1, there is no fixed number and players can decide on the number of resources they would like to give/steal/request)
- ***showAllInfoLogs (Boolean)***: display everything happening in the game in the actions log (if false, players will not be able to read other players' actions, only their own)
- ***mandatoryJournal (Boolean)***: journal is mandatory
- ***distributeAllRes (Boolean)***: all resources have to be distributed in Resource Distribution

4.8 Concluding Remarks

During this chapter, we described the three stages of development of our game.

In the first phase of the implementation, we built a significant share of our game. We implemented multiplayer features, added norm violating and norm abiding actions and inserted power giving and taking behaviours within the game. During this process, we refined some of the game actions and menus, thinking often on how to improve game and user experience. In addition, we stored all players' actions into a database.

The second iteration was more about focusing on the game instructions. We created a game website to guide players during testing and improved the appearance of the panel explaining the game controls. We also wanted researchers to have more control over the experiments, so we added an administrator mode within the game.

Finally, in the last iteration, we attempted to clear up everything that could bring confusion to players during experiments with the game. Besides this, we also implemented the resource request action.

Thinking on further questionnaires where researchers had to ask questions about other players, we assigned a colour to each player making them easier to identify. Moreover, we allowed researchers to customize their game experiments by editing a configuration *JSON* file.

5

Evaluation

Contents

In this chapter, we describe one study we performed with our implemented norm-violating game, *Bar Invasion*. We start by stating our goal and defining our hypothesis. Then, we proceed to describe the game scenario and how we prepared the experiment. Following this, we explain the methodology used and analyse and discuss the results.

5.1 Objective

The following research question is the basis of this dissertation:

When, why and how norm violators gain or lose influence?

We developed a computer game tool to address the previous research question, following a set of criteria referred to in section 3.1, which have prior studies concerning norm violators and power affordance as a foundation [2, 3]. As it was already described, within the game, players can be norm violators, see other players breaking norms and also decide if they want to allow them power. Having said this, our aim is to verify if the video game we created is appropriate to conduct any of the mentioned studies. Moreover, since the game is configurable, different game scenarios can be tested by changing the game settings, depending on the hypothesis researchers are studying.

5.2 Experiment

Former studies indicate that norm violators can be perceived by others as more powerful. Then, in order to verify if we could obtain these same results with the implemented norm violation video game, we conducted an experiment described during the following sections. Our hypothesis was that *subjects perceive norm violators as more powerful and afford them more power*.

5.2.1 Game Scenario and Configurations

For this experiment, we tested a game scenario where the participant could engage with a norm violator and a norm abiding player. These two roles were played by two confederates following a script. We chose to allow only two actions where norm violation was possible, resource collection and resource request, since we could not find a justification for a player to perform the resource “exchange” action, as explained in section 4.4.4.

The game scenario had two phases, five minutes each, the first one being a training phase and the second one being the first real phase. Since our goal was to identify who the participant would give power to, we selected them as the leader before starting the game, so the subject would be the leader in the training stage and also during the following phase (since everything is restarted after the practice

stage). In order to obtain even more information on the subject's decisions within the game, writing in the journal at the end of each phase was mandatory.

Thinking about the possibility of having participants who were not very skilful while playing, we agreed that players should have limitless lives, since we wanted all subjects to fully complete the two phases. Also, for simplicity reasons, we decided to have a fixed number of resources during the Resource Request action. Another important detail was the decision of associating different colours to each player, as this allowed them to be easily identified during the questionnaire.

In table 5.1, it is possible to see how we mapped the described experiment by altering some of the game configurations.

Table 5.1: Experiment Configurations

Configuration	**Value**
playerNumber	3
phaseNumber	1
trainingPhase	true
phaseTimer	300
playerColour	*true*
numberLives	-1
respawnHP	40
warningHP	20
resourceValue	50
numberIndividualRes	0
numberGroupRes	0
collectionMenu	*true*
numberCollection	2
giveStealMenu	*false*
requestMenu	*true*
simplifyMenus	2
showAllInfoLogs	*true*
mandatoryJournal	*true*
distributeAllRes	*true*

5.2.2 Experiment Preparation

There were four individuals involved in each session: the researcher, two confederates and the subject. In order for the experiment to be successful, the researcher and the actors had to do some preparation in advance.

The researcher had three different tasks:

- **Train the confederates:** define a script for the confederates, assign them roles (norm violator or

norm abiding) and rehearse the script with them before the experiments.

- **Communicate with the subject:** schedule an hour for the experiment and help the subject if any problems occur.

- **Start the game:** enter the administrator mode of the game, create a room and wait for all players to enter, select the subject as the leader and start the game, always observing everything happening within the game and verifying if the confederates are executing their actions properly.

Regarding the script, confederates had to perform a list of actions during the game. In the beginning of the training phase, both actors had to pretend they never played the game before, in order not to seem suspicious in front of the subject. Initially, they performed some of these actions:

- Having trouble with the controls, taking a long time to rotate the avatar

- Not going right away to the zone with the resources and exploring the bar instead

- Getting close to the infected humans and then walking away, simulating fear

- Standing near the resources without catching them

After performing these actions, confederates started to execute specific norm violating or norm abiding actions, as defined in table 3.1, according to their assigned role. The norm abiding actor had to collect only group resources throughout the game. The norm violator, on the contrary, had to collect only individual resources. Since the norm abiding actor did not have any individual resources to consume, this confederate had to perform another action, which was requesting resources to the norm violating confederate. The norm violator's response to any resource request received was always to deny, as that was the correct norm violating action to perform. Consequently, the norm abider, having no individual resources, would get injured within the game. In total, four actors were trained to assist the researcher during the experiments, more specifically two for each role. It is important to emphasize that one of the most challenging issues about using confederates as players was the fact that all experiments depended on their time availability, so this evaluation process moved very slow.

5.2.3 Methodology

Each experiment was executed remotely, and the chosen participants did not have any information about the game and its purpose. After a few initial tests, we observed that more useful results were obtained with gamers, so during most of our selection process, we tried to opt for participants whom we knew were more comfortable with video games.

At the beginning of the study, participants were asked to follow a link which redirected them to the game website[1]. They started by reading the game instructions and then they began filling the first questionnaire.

The first questionnaire [See Appendix A.1] opened with a description of the experiment embedded in a consent form. If a player chose to continue, the experiment could proceed, otherwise the experiment had to stop. Following this introduction, we asked a few demographic questions, including age, gender, education and occupation. Then, participants had to answer a short version of the *Big Five Personality Test* [32], since it was less time consuming than the full one, yet still valid for the experiment. Finally, a few questions about gaming habits were asked, focusing essentially on how frequently participants played and their preferences on multiplayer vs. single player games. After answering the first questionnaire, a short video was shown to participants explaining how to start playing the game.

Participants could now move on to the *Play* section of the website. They had to enter the room created by the researcher and wait for the game to start, in order to play the game scenario described in section 5.2.1. At the end of the playthrough, a screen was shown instructing players to advance to the second questionnaire.

The second questionnaire [See Appendix A.2] started with a few questions regarding participants' game experience. First, we began with questions measuring immersion and engagement based on an existing *Immersion and Engagement Questionnaire* [33] containing 32 statements. We decided to shorten the questionnaire, selecting only 14 of them, but still considering questions about awareness of time and the real world, and about involvement within the game as well. Then, we focused on questions about the subjects' social experience, compiling a few statements based on *The Social Presence Module of the English Version of the Game Experience Questionnaire* [34]. In particular, we selected 10 items from this module, 3 of them considering *Behavioural Involvement* and the remainder considering *Psychological Involvement* (to be more specific, 3 questions were about *Empathy* and the other 4 regarded *Negative Feelings*). For both of these questionnaires we used a *Likert Scale* from *Strongly Disagree* (1) to *Strongly Agree* (5). Then, we also asked a few questions concerning the menus, the journal and the action log, which were not really relevant for this experiment, since they were taken from a previous questionnaire used during the game implementation.

Subjects also had to respond to an *attention check* question, which was essential in determining whether or not we should include the results of the participant's experiment in the analysis. The purpose of this question was to verify if subjects saw the norm abiding player requesting resources from the norm violating player and, additionally, if they realized the request was denied by the norm violator. If subjects failed to answer this question correctly, their results had to be removed from the analysis.

Then, we asked a few questions about perceived social power regarding the other players, using

[1] Bar Invasion Website: https://web.tecnico.ulisboa.pt/~ist424817/BarInvasionTheGame/

once again a *Likert Scale* from 0, given there was an option named *Doesn't Apply*, to 5. We selected 10 items from an existing table of *Social Power Scales* [35], more specifically 1 about *Reward*, 3 about *Reference* and 6 about *Expertise*, which had to be slightly adapted to fit the game context. Additionally, during this section of the questionnaire, players were identified by their colour within the game, so we were counting that subjects were able to memorize them. Finally, the questionnaire finished with an open-ended question regarding the choice of the leader, working as a confirmation or justification of the subject's decisions inside the game.

Both questionnaires had an auto-populated field [See section 4.4.1], corresponding to the player identifier, which was needed in order to associate the questionnaires to the database information obtained during the playthrough.

5.3 Results

A total of 23 subjects participated in this study, however only 20 answered the attention check (Were you able to see if one of the other players requested resources from another player?) correctly (Yes, and the request was denied.), therefore we decided to only consider these 20 participants for the analysis, since we were only interested in the data of players that were completely aware of the confederates' actions.

5.3.1 Demographics

Subjects' ages varied from 18 to 34 years old, in which 85% had ages ranging from 18 to 25 years old. Concerning their gender, 60% of the participants were male and 40% were female. Additionally, 85% of the tested subjects were students with a bachelor's degree.

Most of the participants considered themselves gamers, only 20% answering *No*, and 75% of them admitted to playing frequently. Regarding their gaming preferences, 65% of them said they would rather play online, especially with friends, and 60% of the subjects selected First-Person Shooter (FPS) as one of their favourite gaming genres.

5.3.2 Game Experience and Performance

We obtained a mean score (μ) of 3.054, s = 0.523, for immersion and engagement within the game, in a scale going from 1 (The game was very far from being immersive or engaging) to 5 (The game was very immersive and engaging). In table 5.2, we can observe the scores of each question with more detail. The question which presented the lowest mean score was "I was aware of surroundings", μ = 1.95 and s = 0.759. We had to reverse the scale of this question, since we wanted the lower value to represent less immersion (Players were completely aware of their surroundings) and the higher value to represent

more immersion (Players were completely unaware of their surroundings), in order to follow the main scale order. Then, concerning this question, less immersion was shown. The question that revealed the highest mean score, μ = 4.00 and s = 0.973, was "The controls were not easy to pick up", whose scale had to be reverted as well, meaning that the lowest score would show less engagement (The controls were far from being easy...) and the highest score would show more engagement (The controls were very easy...). Therefore, regarding this question, players showed more engagement.

Table 5.2: Immersion and Engagement Questionnaire - Detailed Scores

Question	**Score (1 to 5)**
I did not feel any emotional attachment to the game (RS)	μ = 3.00 and s = 0.973
I felt bored (RS)	μ = 3.05 and s = 0.945
I enjoyed the graphics and imagery of the game	μ = 3.40 and s = 1.046
Playing the game was not fun (RS)	μ = 3.50 and s = 0.761
I felt content	μ = 3.40 and s = 0.754
The controls were not easy to pick up (RS)	μ = 4.00 and s = 0.973
I felt challenged	μ = 2.75 and s = 1.069
I became unaware that I was even using controls	μ = 2.40 and s = 0.940
I was in suspense about whether I would win or lose the game	μ = 3.00 and s = 1.076
I was aware of surroundings (RS)	μ = 1.95 and s = 0.759
I felt completely absorbed	μ = 2.70 and s = 0.865
I felt frustrated (RS)	μ = 3.60 and s = 1.314
When playing the game time appeared to go by very slowly (RS)	μ = 2.85 and s = 1.040
I felt skillful	μ = 3.15 and s = 1.089
Total	μ = 3.054 and s = 0.523

Note: RS (Reverse Scale)

Concerning subjects' social presence, we obtained a mean score of 3.183, s = 0.637, regarding empathy felt for other players, in a scale going from 1 (less empathy) to 5 (more empathy). Additionally, participants revealed a mean score of 2.00, s = 0.346, related to negative feelings felt towards other players, being that 1 was the lowest score (fewer negative feelings) and 5 the highest (more negative feelings). Finally, regarding behavioural involvement, players presented a mean score of 3.713, s = 0.386, in a scale ranging from 1 (lower behavioural involvement) to 5 (higher behavioural involvement). In table 5.3, we can see the full scores obtained regarding social presence.

We decided to evaluate subjects' performance within the game, by considering the in-game variable *resources collected* as a performance measure. For each player, we summed the total of resources (individual and group resources) caught during the two phases of the game and obtained a mean of 24.95 resources, a median of 21 resources and a high standard deviation of 24.063. The maximum number of resources caught by a participant was 88 and the minimum was 0. By comparing the resources collected of each player to the mean, we computed that 45% of the subjects obtained a *Z-score*

Table 5.3: Social Presence Questionnaire - Detailed Scores

Social Presence Component	Question	Score (1 to 5)
Empathy	I emphatized with the other(s)	μ = 3.50 and s = 0.761
	I found it enjoyable to be with the other(s)	μ = 3.60 and s = 0.754
	I admired the other(s)	μ = 2.45 and s = 0.686
	Total	μ = 3.183 and s = 0.637
Negative Feelings	I felt jealous about the other(s)	μ = 1.80 and s = 0.616
	I felt revengeful	μ = 2.40 and s = 1.314
	I felt schadenfreude	μ = 1.80 and s = 0.894
	Total	μ = 2.00 and s = 0.346
Behavioural Involvement	What the other(s) did affected what I did	μ = 4.10 and s = 0.789
	What I did affected what the other(s) did	μ = 3.25 and s = 1.020
	My actions depended on the other(s) actions	μ = 3.55 and s = 0.999
	I paid close attention to the other(s)	μ = 3.95 and s = 0.945
	Total	μ = 3.713 and s = 0.386

higher than 0 - resources collected were higher than the mean value. We agreed to differentiate players between low performers and high performers, as a way to verify if there was a correlation between players' performance and their decisions within the game, most precisely in the leader assignment task [See section 5.3.4]. We split the players into two equal sized groups, given that we had a small sample, by comparing the median value of caught resources to each of the subject's number of resources collected, as seen in image 5.1. Therefore, players that collected less than 21 resources were considered low performers, while players that collected more were considered high performers.

5.3.3 Hypothesis Testing

Given the main hypothesis, we defined three sub-hypotheses, two of them related to *Power Affordance* and the other to *Power Perception*.

We measured power affordance using two in-game variables, resources distributed to norm violator and norm abider during Resource Distribution and leader selected during Leader Assignment.

Starting with the Leader Assignment task, we verified that 35% of the subjects selected the norm violator as the Leader in the training phase, and at the end of the next phase as well. First, we applied

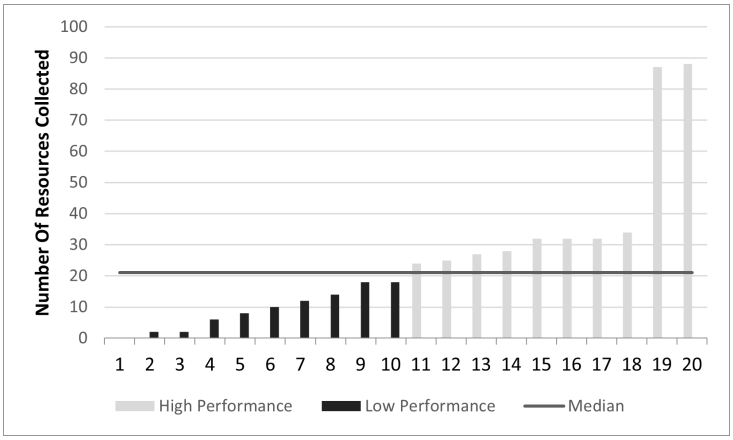


Figure 5.1: Graphic of Player Performance given Resources Collected

a *McNemar's* test in order to verify if there was a difference in the choice of the leader within the two phases. Our dependent variable was the selected leader, which had two categories, norm violator and norm abider. We obtained a *p-value* of 1, meaning that the mentioned difference was not statistically significant. Then, given the previous result, we agreed to focus on only one stage of the game to analyse our sub-hypothesis, which was H_1*: The norm violator is selected as leader more times compared to the norm abider*.

We proceeded to perform a binomial test, or one sample proportion test, since we had only one categorical variable, leader choice, that could contain values from one of two categories, norm violator or norm abider. Also, given that our sample was small ($n < 30$), the chosen test seemed appropriate. First, we defined the null hypothesis, H_0: The norm violator is selected as leader less (or equal) times compared to the norm abider. Then, we computed the *p-value*, 0.942 (> 0.05), which was nowhere near sufficient to reject the null hypothesis, being statistically insignificant, meaning that we did not obtain enough evidence to prove H_1.

Following onto the Resource Distribution, we computed the means and standard deviations of the total amount of resources distributed to the norm violator, μ_v = 8.95 and s_v = 7.141, and to the norm abider, μ_a = 11.6 and s_a = 5.844. As observed, the mean of resources given to the norm abider was higher than the norm violator's mean (11.6 $>$ 8.95), however we still decided to focus on this second sub-hypothesis, H_2*: The norm violator is given more resources compared to the norm abider,* $\mu_v > \mu_a$.

Given that we were trying to compare the means of two paired samples – only one group of subjects, but two distinct moments, resource distribution to norm violator and resource distribution to norm abider – we decided to use the *Wilcoxon Signed-Ranks Test*, which is also adequate for small samples. We did not use a *paired T-Test*, since the dependent variable, number of resources distributed, did not have a normal distribution (*Skewness* was -0.279 which was fine since it was between -1 and 1, however *Kurtosis* was 1.996 which was higher than 1). In order to perform the *Wilcoxon Test*, we defined the null

hypothesis, H_0*: The norm violator is given less (or equal) resources compared to the norm abider,* $\mu_v \leq \mu_a$. By applying this test using *SPSS*, we obtained table 5.4 and, as we can observe, the sum of positive ranks is way higher than the sum of negative ranks (86 $>$ 19), meaning that more resources were distributed to the norm abider. This difference was statistically significant since the *p-value* obtained was 0.035 ($<$ 0.05). Therefore, the *Wilcoxon Signed-Ranks Test* indicated that more resources were distributed to the norm abider (mean rank = 8.60) compared to the norm violator (mean rank = 4.75), Z = -2.109, p = 0.035, meaning that we were not able to reject the null hypothesis and failed to prove the alternative hypothesis, H_2. In short, we obtained a significant, but unexpected, result, given that the norm abider was favoured instead of the norm violator.

Table 5.4: Wilcoxon Signed-Ranks Test - Ranks Table Output: Resource Distribution

		N	Mean Rank	Sum of Ranks
RD to NA - RD to NV	**Negative Ranks**	4^a	4.75	19
	Positive Ranks	10^b	8.60	86
	Ties	6^c		
	Total	20		

a. RD to NA $<$ RD to NV

b. RD to NA $>$ RD to NV

c. RD to NA = RD to NV

Note: RD (Resources Distributed); NA (Norm Abider); NV (Norm Violator)

Moving on to the Power Perception, we analysed the responses obtained from the perceived social power questionnaire. In this questionnaire there was an option named *Doesn't Apply*, because all players' colours were randomized, and we did not want subjects to answer questions about self-perception of power (containing their own colour). However, a few people answered *Doesn't Apply* in some questions regarding the norm violator and the norm abider, so the results obtained may not be completely accurate. Given this problem, we agreed to compute *Cronbach's alpha* for the norm-violator's and norm-abider's power perception questionnaire, in order to assess the reliability and internal consistency of these two sets of questions. We obtained a *Cronbach's alpha* of 0.910 and 0.935, respectively, which was very good ($>$ 0.9).

Given the previous results, we started analysing the power perception scores obtained. On a scale ranging from 0 (lower power perception) to 5 (higher power perception), we obtained a mean score (μ_v) of 1.985 for the norm violator, s_v = 0.843, and a mean score (μ_a) of 2.115 for the norm abider, s_a = 0.986. As we can see, power ratings were higher for the norm abider compared to the norm violator, nevertheless we still needed to test the third sub-hypothesis, H_3*: The norm violator is perceived with more power compared to the norm abider,* $\mu_v > \mu_a$.

During the testing of this sub-hypothesis, we also applied the *Wilcoxon Signed-Ranks Test*, for the

same reasons mentioned in the Resource Distribution sub-hypothesis. In this case, the dependent variable, power perception scores, did not have, once again, a normal distribution (*Skewness* was -0.249 which was fine since it was between -1 and 1, however *Kurtosis* was 1.410 which was higher than 1). Our null hypothesis was H_0*: The norm violator is perceived with less or equal power compared to the norm abider,* $\mu_v \leq \mu_a$. We obtained table 5.5 and we observed that the sum of positive ranks was higher than the sum of negative ranks (82 $>$ 54), showing that the norm abider was perceived with more power. However, this difference was not statistically significant since the *p-value* obtained was 0.467 ($>$ 0.05). Given that the difference of power perception was not significant, and it actually was in favour of the norm abider, we could not reject H_0, nor had enough proof to say that H_3 was true.

Table 5.5: Wilcoxon Signed-Ranks Test - Ranks Table Output: Power Perception

		N	Mean Rank	Sum of Ranks
PP of NA - PP to NV	**Negative Ranks**	8^a	6.75	54
	Positive Ranks	8^b	10.25	82
	Ties	4^c		
	Total	20		

a. PP of NA $<$ PP of NV

b. PP of NA $>$ PP of NV

c. PP of NA = PP of NV

Note: PP (Power Perception); NA (Norm Abider); NV (Norm Violator)

5.3.4 Player's Performance

As we said before, we divided our subjects into low performers and high performers, thinking it would be interesting to verify if *Performance* and the *Leader Assignment* action were in any way associated. In this case, we only considered the leader choice of the first real phase of the game. We observed that 7 high performers and 6 low performers selected the norm abider as a leader, and 3 high performers and 4 low performers selected the norm violator. Given that the two variables in question, performance and leader assignment, were categorical, we performed a *Chi-squared Test of Independence*. Our null hypothesis was *Performance and Leader Assignment are independent*, and our alternative hypothesis was *Performance is not independent of Leader Assignment*. The *p-value* obtained was not statistically significant 0.639 ($<$ 0.05), meaning that we were not able to reject our null hypothesis, so no evidence was found suggesting that performance and leader assignment had an association.

5.3.5 Player's Personality

Regarding subjects' personality, players were ranked (using a scale from 1 to 5) in openness to experience (O), μ_O = 3.45 and s_O = 0.583, conscientiousness (C), μ_C = 2.95 and s_C = 0.647, extroversion (E), μ_E = 2.9 and s_E = 0.926, agreeableness (A), μ_A = 3.55 and s_A = 0.510, and neuroticism (N), μ_N = 3.3 and s_N = 1.117. Similarly to the previous section, we were interested in verifying if there was a relation between the participants' personality and the leader choice. Given that we wanted to measure the association between one categorical variable, leader assignment, and each one of the continuous variables of the big five personality test (O, C, E, A, N), we applied a *Point-biserial Correlation*. In this case, a positive (negative) correlation between one of the components of the personality and the leader choice meant that subjects with higher ratings of that same component typically selected the norm violator (abider) as leader. The lowest *p-values* obtained were for Conscientiousness (positive correlation, r = 0.308, p = 0.187) and Extroversion (negative correlation, r = -0.383, p = 0.095), however they were not statistically significant ($p < 0.05$). Then, we could not find any evidence that personality and leader assignment were correlated.

5.3.6 Text Analysis

For further information about subjects' decisions, we decided to analyse the data of the journal. Initially, we compiled everything players wrote in the journal, during both stages of the game, in only one column, where each row corresponded to the journal content of each subject. We proceeded to read every single line, looking for subjects that mentioned the other players in their journal, since we were more interested in identifying participant's feelings concerning other players. We managed to find 10 subjects who wrote about the others. The rest of the subjects had to be excluded from the journal analysis, since we were not able to extract anything from their journal content, given that they did not acknowledge other players in there.

Following this, we determined the main feelings, from the 10 players we considered, present in each journal, finding more negative feelings (anger, disgust, frustration, fear) than positive feelings (admiration). Then, we identified which feelings were addressing each actor, norm violator or/and norm abider, in order to perform a more organized descriptive analysis. We verified that 90% of these subjects showed *Negative Feelings* regarding the norm violator, mentioning that this player was "mean. He ain't saving no one." or that the player was "an a**hole who keeps everything for himself", which revealed *Anger* and *Disgust*. In addition, 40% of these participants demonstrated *Negative Feelings* concerning the norm abider. One of them was "worried about him", showing *Fear*, however the rest felt *Frustration* about the player's performance ("needs to keep some for him and stop asking", "still doesn't consume the medicine", "press R to heal...!"). Concerning the *Positive Feelings*, only 20% of the 10 partici-

pants showed *Admiration* regarding the norm abider (“only tries to help the others without thinking about himself”, “shared all resources with group”).

Regarding the open-ended question from the questionnaire, where we asked subjects to choose the leader one more time and justify their choice, we obtained the following results concerning all of the 20 participants:

1. 45% of the participants would **choose the norm abider as leader**, and in more detail:
   (a) 30% felt the norm abider was less selfish than the norm violator:
      i. “since he offered his resources to the team”
      ii. “because he was giving all the resources to the group, unlike” the norm violator
      iii. “we cared for the group”, the norm violator “sucked and hoarded the items”
      iv. “was the only one to add supplies to group supplies”
   (b) 10% did not justify their choice
   (c) 5% felt sorry for the player’s performance: “so that he can decide how to distribute resources best, given that he couldn’t find a way to get many of them.”
2. 30% of the participants would **choose the norm violator as leader**, since these subjects felt the player was more skilful than the norm abider:
   (a) “he seemed to know how better to play this game”
   (b) “Better at find resources than other”
   (c) “he knew more about the game than” the norm abider
   (d) “the action of rejecting the” norm abider’s “request showed he was assertive”
3. 20% of the participants would **choose themselves as Leader**, in more detail:
   (a) 10% said they had the fairest behaviour of the group
   (b) 10% felt the norm violator was selfish and that the norm abider was incompetent:
      i. The norm violator “kept the resources all to himself and” the norm abider “doesn’t keep any for him and almost died”
      ii. The norm violator “is selfish and” the norm abider “is dumb and always almost dies”
4. 5% did not gave a valid answer

5.4 Discussion

As we can see, our sample was a bit small and we did not achieve the expected results, but we find it positive, regardless of that, that 87% of the subjects that tested the game were attentive to the confederates' behaviour.

The immersion and engagement scores were average, however most of the players felt at ease with the game controls. That being said, given the immersion ratings, we cannot state that subjects cared about the outcome of the game or that they were emotionally involved in it, therefore we can't really guarantee the validity of their decisions within the game. As for the social presence scores, we can highlight the behavioural involvement component, which presented a favourable score, meaning that subjects were aware of other players' actions and that these actions probably influenced their own behaviour.

Concerning the number of resources collected, most subjects managed to adapt to the game and gather enough resources to survive, however there were a few outliers, in particular the participant that did not catch any resources (extreme low performance), which might be justified by the lack of experience this player had with games. Regarding the high performers, the participants that collected more than 80 resources should be analysed. During the experiments, we observed how these two players managed to catch so many resources. The first time they entered the dangerous zone, they collected a few individual resources. Then, they entered this area again, for the second and last time during the day. While they clicked on the resources, they were simultaneously consuming the resources they collected previously, which allowed them to recover health at the same time they were catching resources. Having said this, perhaps consuming resources should only be allowed outside of the dangerous zone, because if these assets become too easy too collect they will lose their value within the game.

Regarding our hypothesis, it was not possible to prove that *Subjects perceive norm violators as more powerful and afford them more power*. In fact, in the game, the norm abider was afforded more power than the norm violator, especially during the *Resource Distribution* action, where there was a significant difference (p = 0.035) between the resources distributed to both confederates. Additionally, norm abiders were selected as leaders more often than norm violators. Regarding the power perception, even though norm abiders were perceived with more power, the power ratings' difference was not statistically significant. Overall, these findings were not consistent with what has been found in previous studies about norm violations and power [2, 3].

One possible reason for the previous results was the asymmetric design of the study. Returning to section 5.2.2, where we defined the script used during the experiments, we can observe that the norm violator's behaviour was very selfish, contrasting extremely with the norm abider's conduct. If we only allowed the resource collection task (collect only individual resources or only group resources), the experiment would have been much more balanced. However, once we added the resource request

action, the experiment became asymmetric. When the norm violator rejected the norm abider's request, not only this increased the selfishness factor, but it also showed participants that the norm violator did not care about the other players. Therefore, given the global results of the experiment, we concluded that the level of norm violation of the confederate was too extreme, speculating that this was the reason for such considerable differences in the power giving tasks of the game.

Nevertheless, the text analysis still revealed a few interesting results. Even though many subjects mentioned the selfishness of the norm violator, some of them perceived the norm violator as more skilful and the norm abider as a poorly performing player. Furthermore, the subjects that praised the norm violator's skills said they would choose the norm violator as leader. Therefore, within the game context, we believe that players who violate the norms might be seen by a few subjects as more experienced and knowledgeable compared to norm abiders, and, consequently, worthy of power.

Concerning the players' performance and personality, we could not find significant correlations between the mentioned parameters and the chosen leader. However, regarding personality, given that we used a short *Big Five Personality Test* these results might have not been the most accurate. Even so, we think it would be worth, in the future, to perform more experiments with the full version of the questionnaire and attempt to verify, once more, if there is any relation between each personality trait and the selected leader, especially *Extroversion* and *Conscientiousness*.

6

Conclusion

Contents

This research aimed to define and develop a computer game tool addressing the following research question:

When, why and how norm violators gain or lose influence?

We implemented a resource-management multiplayer computer game called *Bar Invasion*, where players were presented with opportunities to follow or violate norms, during actions involving the collection, exchange and request of resources. These actions were visible for all players in an action log displayed on each player's screen. Within the game, we also introduced the role of the *Leader*. The leader was responsible for distributing resources between players and selecting the following leader. The decisions made during these two actions could convey power giving or taking behaviours concerning the other players. For example, giving more resources to another player or choosing a player to be new leader revealed power affordance. Furthermore, we intended to obtain additional information covering players' decisions and feelings, so we implemented a journal inside the game where players could write freely. These game features would allow researchers to create norm violating scenarios within the game, as an attempt to find responses to the mentioned research question.

We also wished for the game to be highly engaging and realistic, since this would help increase the ecological validity of experiments conducted using the game. Then, we developed a first-person 3D game with an engaging story inspired on an apocalyptic survival scenario. The game environment created was of a bar, players were employees of that same bar and they were being threatened by infected humans. Therefore, the players' goal was to survive within a closed space during a specific number of days.

The created game tool was implemented in three iterations, in which we conducted intermediate tests to obtain feedback regarding the game, fixing along the way some of the issues found in previous iterations. With this iterative development process, we minimized the errors that could have been found in the game version used during the evaluation phase. Following the implementation of all the actions and behaviours defined in the game concept, we added some other features during this process. We created a web page for the game, aiming to help players fully understand it and presenting illustrative and appealing instructions for that effect. The website was also used as a guide for the experiments executed with the game, given that it presented the steps of the experiment in a sequential manner, which was easier for players to understand. Even with all of the instructions, we still implemented a training stage within the game, allowing players to play a game phase where they only needed to adapt to the environment and the controls before playing more seriously. Moreover, in the game's start menu, we added an administrator mode for researchers, allowing them to visualize experiments in real time without being seen, and also to select a specific player to be the leader when starting the game. Finally, we allowed for various parameters of the game to be configured just by altering a *JSON* file, which would let researchers conduct their desired experiments according to their focus hypothesis.

In this dissertation, we intended to validate how the developed game tool would behave in a scenario where a subject was confronted with a norm violator and a norm abider simultaneously. Prior studies reveal that norm violators are perceived with more power, and can even be afforded more power than norm abiders. Then, within the game context, our hypothesis was:

Subjects perceive norm violators as more powerful and afford them more power.

Attempting to prove the previous hypothesis, we conducted an experiment. We scripted the behaviour of two confederates, a norm violator and a norm abider. The norm abider would collect only group resources and request resources to the norm violator. The norm violator would collect only individual resources and reject the norm abider's request. The subject would then interact with these confederates within the game. During the experiments, the participants would always play the role of the leader, being selected by the administrator. We would, consequently, evaluate the subject's decisions during resource distribution and leader assignment to conclude if more power was afforded to the norm abider or to the norm violator. In addition, subjects would have to fill two questionnaires during the experiment, one before playing (demographics, personality and gaming habits) and another one after (immersion, engagement and power perception).

The results obtained with a sample of 20 valid participants did not confirm our hypothesis, given that 65% of subjects selected the norm abider as leader during leader assignment. Moreover, there was a significant difference during the resources distributed to both confederates, however the mentioned difference was in favor of the norm abider. Regarding power perception, no significant differences were found between the two confederates, even though the norm abider obtained higher ratings of power. These results were explained by the asymmetry of actions of both confederates, given that the norm violator's behaviour was too selfish, causing an unbalanced experiment. Regardless of that, during text analysis we could still find interesting results, highlighting the fact that a few players associated norm violations with having more skill and experience within the game, and, consequently, with being more deserving of power.

Although we did not prove our hypothesis, we believe that the game tool created still has potential to be used in the study of responses to norm violations, given that most subjects were aware of the norm violations happening inside the game. Then, in general, we can say that we fulfilled all the key game requirements of a norm-violating game. Nevertheless, there is still a lot of space for improvements, so we will discuss future work in the next section.

6.1 Future Work

First of all, before improving anything within the game, another study should be conducted using a balanced scenario and having the current hypothesis of this dissertation as a basis. It could just be a

simple setting, where the norm violator collects only individual resources and the norm abider collects only group resources. Following this, we should attempt to validate the hypothesis once more.

Then, we believe that using a full version of the *Big Five Personality Test* will possibly provide interesting results when verifying if there is any relation between personality and leader choice. With that said, the sample used should be higher than 20 subjects. We decided on using the short version in order to reduce the experiment time, however if we intend to detect significant correlations, the full questionnaire is more adequate.

Now, we can start focusing on the game itself. First, we think that the resource consumption action should not be allowed inside the dangerous zone, since we need players to feel like the resources of the game are a significant asset, as explained in section 5.4.

It would also be interesting to define and add more norm violating behaviours within the game, for example, stealing resources from the group stash, creating a wide variety of possible experiments. Moreover, we suppose it would be useful to allow researchers to add instructions within the game, highlighting certain norms, in order for them to study other hypothesis, such as *There will be greater anger when norms are perceived as more important*.

Following this, we believe it would be helpful to let researchers configure their game experiments in the start menu of the game instead of having to alter the *JSON* file, predicting this would be easier and more automatic for them. Then, we suggest the implementation of a configuration interface which could only be accessed by game administrators.

At last, we agree that adding computer-controlled characters to the game, which can follow or break norms, can help researchers obtain even more data without having to be concerned about finding and training actors, since the amount of time consumed training confederates or waiting for their availability was one of the main reasons we did not perform more tests with the game.

Bibliography

[1] H. Lodewijkx, "The norm of reciprocity." Gale, Farmington Hills, MI, 2008, pp. 107–109.

[2] E. Stamkou, G. A. Van Kleef *et al.*, "Do we give power to the right people? when and how norm violators rise to the top," *J.-W. van Prooijen & PAM van Lange (Eds.), Power, politics, and paranoia: Why people are suspicious about their leaders*, pp. 33–52, 2014.

[3] G. van Kleef, A. Homan, C. Finkenauer, S. Gündemir, and E. Stamkou, "Breaking the rules to rise to power: How norm violators gain power in the eyes of others," *Social Psychological and Personality Science*, vol. 2, no. 5, pp. 500–507, 2011.

[4] M. Baptista, H. Damas, J. Dimas, G. Raimundo, R. Prada, C. Martinho, P. Santos, and J. Peña, "A serious game based on a public goods experiment." IEEE, September 2013, pp. 774–781.

[5] N. Ducheneaut and R. J. Moore, "Gaining more than experience points: Learning social behavior in multiplayer computer games," in *Conference proceedings on human factors in computing systems (CHI2004): Extended Abstracts*, 2004.

[6] R. B. Cialdini and M. R. Trost, "Social influence: Social norms, conformity and compliance." McGraw-Hill, 1998, pp. 151–192.

[7] J. Elster, "Fairness and norms," vol. 73, no. 2. The Johns Hopkins University Press, 2006, pp. 365–376.

[8] M. S. Josephson and W. Hanson, "Making ethical decisions." Josephson Institute of ethics, Los Angeles, CA, 2002.

[9] D. Wells and A. Molina, "The truth about honesty," *Journal of Public and Nonprofit Affairs*, vol. 3, 2017.

[10] J. Elster, "Social norms and economic theory," *In: Journal of Economic Perspectives*, vol. 3, no. 4, pp. 99–117, 1989.

[11] G. van Kleef, A. Homan, C. Finkenauer, N. Blaker, and M. Heerdink, “Prosocial norm violations fuel power affordance,” *Journal of Experimental Social Psychology*, vol. 48, no. 4, pp. 937–942, 2012.

[12] T. Yamagishi, N. Jin, and A. S. Miller, “In-group bias and culture of collectivism,” *Asian Journal of Social Psychology*, vol. 1, no. 3, pp. 315–328, 1998.

[13] D. S. Wilson and R. O’Gorman, “Emotions and actions associated with norm-breaking events,” *Human nature*, vol. 14, no. 3, pp. 277–304, 2003.

[14] M. Allen, “The sage encyclopedia of communication research methods.” SAGE Publications, 2017.

[15] C. F. Camerer and E. Fehr, “Measuring social norms and preferences using experimental games: A guide for social scientists,” 2003.

[16] Homo economicus. [Online]. Available: https://www.behavioraleconomics.com/resources/mini-encyclopedia-of-be/homo-economicus/

[17] G. Loewenstein, “Experimental economics from the vantage-point of behavioural economics,” *The Economic Journal*, vol. 109, no. 453, pp. F25–F34, 1999.

[18] J. List, “On the interpretation of giving in dictator games,” *Journal of Political Economy*, vol. 115, no. 3, pp. 482–493, 2007.

[19] G. Freedman and M. Flanagan, “From dictators to avatars: Furthering social and personality psychology through game methods,” *Social and Personality Psychology Compass*, vol. 11, no. 12, 2017.

[20] “Volcano island a game for science: fostering research in scenarios of conflict.” Unpublished manuscript.

[21] D. Bylieva and T. Nam, “Social norms in virtual worlds of computer games.” Atlantis Press.

[22] A. McMahan, “Immersion, engagement, and presence: A method for analyzing 3-d video games.” Routledge, pp. 89–108.

[23] C. Jennett, A. L. Cox, P. Cairns, S. Dhoparee, A. Epps, T. Tijs, and A. Walton, “Measuring and defining the experience of immersion in games,” *International journal of human-computer studies*, vol. 66, no. 9, pp. 641–661, 2008.

[24] A. I. Nordin, A. Denisova, and P. Cairns, “Too many questionnaires: measuring player experience whilst playing digital games,” 2014.

[25] T. C. Lisk, U. T. Kaplancali, and R. E. Riggio, “Leadership in multiplayer online gaming environments,” vol. 43, no. 1. Sage Publications Sage CA: Los Angeles, CA, 2012, pp. 133–149.

[26] Invite, social identity and partnership in virtual environments. [Online]. Available: http://gaips.inesc-id.pt/invite/?page_id=71

[27] J. Peña, J. Ghaznavi, N. Brody, R. Prada, C. Martinho, P. Santos, H. Damas, and J. Dimas, "Effects of human vs. computer-controlled characters and social identity cues on enjoyment," *Journal of Media Psychology*, 2017.

[28] R. Magnussen and M. Misfeldt, "Player transformation of educational multiplayer games," *Proceedings of other players*, 2004.

[29] R. M. Martey and J. Stromer-Galley, "The digital dollhouse: Context and social norms in the sims online," *Games and Culture*, vol. 2, no. 4, pp. 314–334, 2007.

[30] N. Yee, J. N. Bailenson, M. Urbanek, F. Chang, and D. Merget, "The unbearable likeness of being digital: The persistence of nonverbal social norms in online virtual environments," *CyberPsychology & Behavior*, vol. 10, no. 1, pp. 115–121, 2007.

[31] N. Ferreira, S. Mascarenhas, A. Paiva, F. Dignum, J. Mc Breen, N. Degens, and G. J. Hofstede, "Generating norm-related emotions in virtual agents," in *International conference on intelligent virtual agents*. Springer, 2012, pp. 97–104.

[32] B. Rammstedt and O. P. John, "Measuring personality in one minute or less: A 10-item short version of the big five inventory in english and german," *Journal of research in Personality*, vol. 41, no. 1, pp. 203–212, 2007.

[33] C. Jennett, A. L. Cox, P. Cairns, S. Dhoparee, A. Epps, T. Tijs, and A. Walton, "Measuring and defining the experience of immersion in games," *International journal of human-computer studies*, vol. 66, no. 9, pp. 641–661, 2008.

[34] W. A. IJsselsteijn, Y. A. de Kort, and K. Poels, "The game experience questionnaire," *Eindhoven: Technische Universiteit Eindhoven*, pp. 3–9, 2013.

[35] J. E. Brill, "Scales to measure social power in a consumer context," *ACR North American Advances*, 1992.

A

Questionnaires

A.1 Before Playing Questionnaire

Bar Invasion - The Game

Welcome!

I'm a student from Instituto Superior Técnico, currently working on my master thesis in Games, which includes the development of a first-person 3D multiplayer game, 'Bar Invasion'. In the hopes of obtaining honest and valuable feedback regarding the game, I kindly invite you to participate in this experiment. Your answers will be very much appreciated during the implementation of the following versions of the game.

The experiment is divided into three parts. Initially, you'll be asked some questions about demographics, personality and gaming habits. Afterwards, you'll be requested to start playing the game. Lastly, you'll have to answer a few questions about your game experience. This study takes approximately 20 to 30 minutes.

Ideally, the game should be played by three or more players, therefore I'll organize all the participants of this experiment in groups of three or four elements.

Your participation in this study is completely voluntary. If you decide to participate, you are free to withdraw at any time. In order to protect your privacy, the questionnaire will not request any information that will personally identify you. Furthermore, all data collected during the game and the survey will be used for academic and research purposes only.

Please contact me if you have any questions about this research study, by sending an email to ines.lobo@tecnico.ulisboa.pt

Thank you for you time,
Inês.
*Obrigatório

1. I have read and understood the previous consent form and I'm willing to participate in this experiment. *

   Marcar apenas uma oval.

   - ◯ Yes
   - ◯ No

2. Player ID (field filled automatically - please do not alter) *

Demographics, Personality and Game Habits

This section includes a few demographic questions, a short personality test and, finally, some questions regarding your gaming habits.

3. What is your age range? *

Marcar apenas uma oval.

- ◯ Under 18 years old
- ◯ 18-24 years old
- ◯ 25-34 years old
- ◯ 35-45 years old
- ◯ 45-55 years old
- ◯ 56-70 years old
- ◯ 70 and above

4. What is your gender? *

Marcar apenas uma oval.

- ◯ Female
- ◯ Male
- ◯ Non-binary
- ◯ Prefer not to say
- ◯ Outra: _____

5. What is your highest level of education? *

Marcar apenas uma oval.

- ◯ Less than a high school certicate
- ◯ High school certificate
- ◯ Higher Diploma
- ◯ Bachelors
- ◯ Master Degree
- ◯ Doctorate
- ◯ Outra: _____

6. What is your employment status? *

Marcar tudo o que for aplicável.

- ☐ Employed
- ☐ Employed Part-time
- ☐ Self-Employed
- ☐ Unemployed
- ☐ Retired
- ☐ Student
- Outra: ☐ _____

7. If you are employed, what's your current occupation?

_____

8. How well do the following statements describe your personality? I see myself as someone who ... *

Marcar apenas uma oval por linha.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
... is reserved					
... is generally trusting					
... tends to be lazy					
... is relaxed and handles stress well					
... has few artistic interests					
... is outgoing and sociable					
... tends to find fault with others					
... does a thorough job					
... gets nervous easily					
... has an active imagination					
... is considerate and kind to almost everyone					

9. Would you consider yourself a gamer? *

Marcar apenas uma oval.

- Yes
- No
- Maybe

10. How often do you play games on your computer? *

Marcar apenas uma oval.

- ◯ Never
- ◯ Rarely
- ◯ Sometimes
- ◯ Often
- ◯ Daily

11. Do you usually prefer to play online/multiplayer games or single player games? *

Marcar apenas uma oval.

- ◯ I prefer to play online with friends
- ◯ I prefer to play online on open servers
- ◯ I prefer to play single-player games
- ◯ None of the above

12. What are your favourite gaming genres?

Marcar tudo o que for aplicável.

- ☐ Action
- ☐ Sports
- ☐ Adventure
- ☐ Battle Royale
- ☐ Role-Playing
- ☐ Racing
- ☐ Fighting
- ☐ Real-Time Strategy
- ☐ SImulation
- ☐ First Person Shooter

Outra: ☐ _____

A.2 After Playing Questionnaire

[1]

[1] During implementation, questions 6, 9 and 10 from *Bar Invasion - The Game - After Playing* were not included. Instead, we had an open-ended question *Overall, what would you change/add to improve the current version of the game?*.

Bar Invasion - The Game - After Playing

This last part of the experiment includes questions about your game and social experience. You're also asked a few specific questions about the game, including an open-ended question to conclude the questionnaire.

*Obrigatório

1. Player ID (field filled automatically - please do not alter) *

2. How well do the following statements describe your personal experience while playing the game? *

Marcar apenas uma oval por linha.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
I did not feel any emotional attachment to the game					
I felt bored					
I enjoyed the graphics and imagery of the game					
Playing the game was not fun					
I felt content					
The controls were not easy to pick up					
I felt challenged					
I became unaware that I was even using controls					
I was in suspense about whether I would win or lose the game.					
I was aware of surroundings.					
I felt completely absorbed					
I felt frustrated					
When playing the game time appeared to go by very slowly.					
I felt skillful					

3. How well do the following statements apply to your social experience inside the game? *

Marcar apenas uma oval por linha.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
I emphatized with the other(s)					
My actions depended on the other(s) actions					
I paid close attention to the other(s)					
I felt jealous about the other(s)					
I found it enjoyable to be with the other(s)					
I admired the other(s)					
What the other(s) did affected what I did					
What I did affected what the other(s) did					
I felt revengeful					
I felt schadenfreude (pleasure about another player's misfortune)					

4. How satisfied were you with the menus presented in the game? e.g. Resource Collection Menu; Resource Distribution Menu; Leader Assignment Menu; ... *

Marcar apenas uma oval.

- Very satisfied
- Somewhat satisfied
- Neither satisfied nor dissatisfied
- Somewhat dissatisfied
- Very dissatisfied

5. Were you able to follow and understand your actions, and the actions of other players, throughout the game? e.g. How many resources I gave to the group; Who requested resources from whom; Who is the new leader; ... *

Marcar apenas uma oval.

- ◯ I understood and was aware of both my actions and those of other players
- ◯ I only understood my actions
- ◯ I only understood other player's actions
- ◯ I didn't understand and wasn't aware of any actions, mine included

6. Were you able to see if one of the other players requested resources from another player? *

Marcar apenas uma oval.

- ◯ Yes, and the request was accepted
- ◯ Yes, and the request was denied.
- ◯ Yes, but I don't know if the request was accepted or denied
- ◯ No

7. How motivated were you to write in the journal at the end of each day? *

Marcar apenas uma oval.

- ◯ Very motivated
- ◯ Somewhat motivated
- ◯ Neither motivated nor unmotivated
- ◯ Somewhat unmotivated
- ◯ Very unmotivated

8. Regarding the previous question, if you felt unmotivated how do you think you could feel more motivation to write in the journal?

The following questions take into account that you remember the other players' colors (Cyan, Pink and Yellow).

9. Select one answer for each one of the following statements. (If a statement mentions your player color, select 'Doesn't Apply') *

Marcar apenas uma oval por linha.

	Doesn't Apply	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
In the game, I am dependent on Cyan's willingness to grant me good things	◯	◯	◯	◯	◯	◯
In general, Cyan's opinions and values are similar to mine.	◯	◯	◯	◯	◯	◯
Being similar to Cyan is good.	◯	◯	◯	◯	◯	◯
In the game, my behavior is similar to Cyan.	◯	◯	◯	◯	◯	◯
In the game, I don't know as much about what should be done as Cyan does.	◯	◯	◯	◯	◯	◯
I trust Cyan's judgement.	◯	◯	◯	◯	◯	◯
Cyan's expertise makes them more likely to be right.	◯	◯	◯	◯	◯	◯
Cyan has a lot of experience.	◯	◯	◯	◯	◯	◯
Cyan knows best in the game.	◯	◯	◯	◯	◯	◯
Cyan is intelligent.	◯	◯	◯	◯	◯	◯
In the game, I am dependent on Pink's willingness to grant me good things	◯	◯	◯	◯	◯	◯
In general, Pink's opinions and values	◯	◯	◯	◯	◯	◯

are similar to mine.						
Being similar to Pink is good.						
In the game, my behavior is similar to Pink.						
In the game, I don't know as much about what should be done as Pink does.						
I trust Pink's judgement.						
Pink's expertise makes them more likely to be right.						
Pink has a lot of experience.						
Pink knows best in the game.						
Pink is intelligent.						
In the game, I am dependent on Yellow's willingness to grant me good things						
In general, Yellow's opinions and values are similar to mine.						
Being similar to Yellow is good.						
In the game, my behavior is similar to Yellow.						
In the game, I don't know as much about what should be done as Yellow does.						
I trust Yellow's						

judgement.						
Yellow's expertise makes them more likely to be right.	◯	◯	◯	◯	◯	◯
Yellow has a lot of experience.	◯	◯	◯	◯	◯	◯
Yellow knows best in the game.	◯	◯	◯	◯	◯	◯
Yellow is intelligent.	◯	◯	◯	◯	◯	◯

10. If you had to play again with the same players, which player would you like to be leader? And why? *