Ecofarm - a Persuasive Game

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Abstract

We developed a video game with the purpose of raising players' awareness for the conciliation of agriculture with biodiversity in the region of Castro Verde and motivate the players know more about the business and economics. We based our approach on techniques and strategies of Persuasive Games in order to create entertaining and persuasive gameplay in a serious context. With that, we came up with an approach on how to translate real-world context into persuasive gameplay elements so players were drawned to the agricultural and environmental issues of Castro Verde. We conducted tests to assess the effectiveness of the persuasive gameplay. The final evaluation results were consistent with our objective, which states that implementing persuasion techniques and strategies in our game persuades players to be aware of the issues of Castro Verde.

Keywords: Serious Games, Persuasive Games, LPN, Agriculture, Biodiversity

1. Introduction

The growth of the videogame industry over the past few years has been accompanied by the growing interest on Serious Games, which have been used for many and varied applications [15, 19]. Serious Games research is relatively new but is becoming more and more popular. The increase in interest in this specific area of games relates to the characteristics of video games, which can be used to integrate engagement and entertainment with serious content [8, 10, 17]. And recently a new genre of games has been growing in numbers, which purposes are to deliberately change and influence attitudes and behaviours, instead of traditional teaching: the so-called Persuasive Games. Several video games have been using the techniques and strategies of persuasion to raise awareness about social issues (*Food Force, Darfur is Dying*), *3rd World Farmer*), raise awareness about political issues (*Take Back Illinois!*), *Anti-Bush Game*), for advertising trademarks (*The J2O Toilet Training Game, Volvo Drive for Life*), for anti-advertising purposes (*Disaffected!*), *McDonald's Video Game*), for military recruitment (*America's Army*), etc.

LPN (*Liga para a Proteção da Natureza*) is a Portuguese environmental non-governmental organization, whose objectives are the preservation and protection of natural heritage, diversity of species and ecosystems who currently have a project aimed at promoting sustainable development of extensive agricultural systems in the Portuguese region of Baixo Alentejo, namely the region of Castro Verde. This provided a serious theme to develop a Persuasive Game and an opportunity to explore the techniques of persuasion in video games. In fact, two videogames were previously developed: *Ecofamer* [1] and *Rural Value*[1], but according to LPN, they both failed in persuading players to their purposes. Therefore, our objective was to create a video game capable of persuading players to LPN goals and raise their awareness to Castro Verde issues.

2. Related Work

Our related work centered in the characteristics and design of Serious Games, so we could keep players engaged while they learn about topics related to biodiversity and agriculture, and how Persuasive Games use persuasion techniques and strategies in order to make *Ecofarm* able to raise awareness about Castro Verde issues.

2.1. Serious Games

Serious games, defined as games with purposes beyond entertainment [5, 19], have been used in many diversed areas. Several studies have discussed how video games can be excellent learning tools [5, 16, 19] since they take advantage of the characteristics of video games and blend them with an educational context. Such characteristics include their ability to keep players engaged, making them learn things unconsciously [10, 16]; their capability of providing a meaningful context [8],

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[1]Rural Value Game: $http://www.facebook.com = RuralValueGame$

which creates a powerful interactive environment for learning, allowing players to have a sense of controll of their actions, compelling them to interact more, thus learning more [5, 17]; and the fact that video games provide fun and entertainment to players [13, 16], as the satisfaction that we receive from games ("fun") is closely related to reward system the brain uses to learn [14], making learning be perceived as an easier task.

However, it is difficult to blend the seriousness of the context with the entertainment provided by video games. It is very important to maintain a balance between this two concepts to create a good Serious Game [17], as too much entertainment can distract the player from learning and too much seriousness can bore the player, detracting him from learning. A good way to maintain balance is to design the learning process to be fun [5], i.e, the enjoyment of mastering of the game coincides with the enjoyment of acquiring and using knowledge [17]. This paradigm can be easily achieved if we try to find what is playable in the context, as the learning elements become the playable elements [18]. Eitheir way, gameplay is the key to create a good entertainment [16] (based on the idea of Flow [6]).

2.2. Persuasive Games

Persuasive Games are usually labeled as video games with the purpose of deliberately change players' attitudes and perspectives and to raise awareness on serious subjects [4, 9]. As this are purposes beyond entertainment, Persuasive Games take advantage of the characteristics of Serious Games, such as engagement and fun, to be effective in persuasion. In addition, Persuasive Games have the ability of videogames to use *procedural rhetoric*, defined as *the practice of using processes persuasively*, that makes them so effective in persuasion [4], i.e. use the gameplay rules and mechanics (procedures) to make an argument about some serious issue. Examples of games that use this kind of approach include *September 12*, a game meant to argue against American-style military intervention as a response to terrorism and *Super Energy Apocalypse* [7], a game about sustainable energy. Finally, some authors consider that is the ability of video games to implement Fogg's Persuasive Techniques [9] that makes them excellent vehicles of persuasion. This techniques are: *tunneling, conditioning, reduction, tailoring, suggestion, self-monitoring* and *survaillance*. If the system is being used in a connected environment we can add *comparison, recognition, cooperation, competition, normative influence* and *social learning*. These techniques have been highly used in both systems with persuasion goals [20] and in video games, such as *Smoke?* [12], *Farmer's Tale* [11] and *The Powerhouse* [2].

When designing Persuasive Games, persuasion must be an inteded effect on players [9]. Therefore, many authors [3, 4, 9] consider the first step to be defining the persuasion goals of the game, i.e., what messages are intended to persuade the players to. After this step, *procedural rhetoric* can be used as a design framework as it allows the creation of a conceptual model on which we can infuse gameplay rules to persuade players to such goals. Other authors point out the usefulness of the Persuasion Techniques to motivate the players to such goals, by, for example, making it an easier task to accomplish. In any case, Persuasive Games must also maintain the balance between entertainment and learning, as fun is still an important factor to keep the players engaged whilethey are persuaded.

3. Implementation

Following the practices for designing games with persuasion purposes, the first step was to define the persuasion goals of the game and the intended learning objectives. This is outlined below followed by a description of the playable elements found [18], then by what should be changed so the playable elements are in accordance to the persuasion goals (based on *procedural rhetoric* [4]) and, finally, a description of the resulting gameplay elements.

3.1. Persuasion Goals

With the help of LPN we were able to define a set of goals based on the messages intended to be transmitted in the game. These goals helped us in the design of gameplay in accordance to LPN's purposes and helped us later with the evaluation of the effectiveness of persuasion.

1. *Understand that agriculture is important to maintain biodiversity.*

2. *Understand that subsidies are important and justly earned, as farmers are doing the country as service.*

3. *Know more about farming and biodiversity facts.*

4. *Understand that farming involves a lot of commitments and trade-offs.*

5. *Understand that farming and preservation of biodiversity are both difficult and economically risky activities but can also be rewarding to society.*

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3.2. Playable Elements

This phase consisted in finding what was "playable" in the context of Castro Verde. The main idea was to convert every possible action, relation, price, entity, etc existent in reality into something that later can be tranformed into a gameplay element. Through literal precision was not intended, we wanted to achieve some kind of conceptual accuracy, in order to maintain the realism of the learning elements when converting them to playable elements. In a nutshell these are the playable elements: all the agricultural activities, such as crop cultivation and cattle production, along with their different methods, incomes and expenses, type of cattle and seeds, and their respective consequences in fertility and biodiversity; the growth of bushes and their impact on biodiversity and crop cultivation; fertility impact on agricultural actions and biodiversity; the different species of steppe-birds that represent the biodiversity in Castro Verde, along with the infrastructures that improve biodiversity; ecotourism and its respective infrastructures, along with how the steppe-birds affect the coming of tourists; the different types of subsidies and their requirements; and the random events that usually affect farmers in Castro Verde.
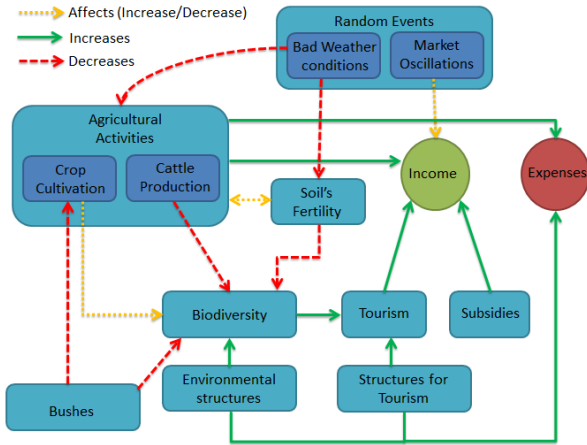

Figure 1: Conceptualization of the Castro Verde context.

3.3. Adapting to the persuasion goals

After listing all the playable elements of Castro Verde's context, we could change them to be in accordance with the persuasion goals defined previously. On an overall level, we reduced the complexity of some playable elements (*reduction*) and costumized some of them (*tailoring*) for a better understanding of the context.

Goal 1

To persuade players to understand the relation between agriculture and biodiversity in Castro Verde,

we exposed it through:

- Highlighting biodiversity in *Ecofarm* and drawing players attention to it, by using biopoints, steppe-birds and achievements as rewards for successful actions related to biodiversity (*conditioning*) and by displaying these points and other information in the main interface so they can easily track their performance on biodiversity (*self-monitoring*).

- Making the playable elements of agriculture and biodiversity depend on each other, thus making it very difficult for players to win the game if they choose solely to go through a agriculture path (the expenses of agriculture are more easily surpassed with the income from biodiversity subsidies and ecotourism) and having biodiversity improved only through doing certain agricultural actions.

- Guiding players to an environmental path that shows the relation between the activities (*tunnelling*), through the use of missions, such as "get X biopoints" or "get X steppe-bird", which gradually makes players interact with situations where biodiversity depends of certain agricultural activities.

Goal 2

To motivate players to this goal, subsidies must be an essential element of the game. Players cannot win without applying for subsidies, as their income is the only way to surpass the high expenses of agricultural activities. Further, the minimal expenses can be changed so the player is always loosing money each season, which can only surpass with the subsidies. In addition, the subsidies requirements for appliance must be related to actions that benefit both agriculture and biodiversity, so players see that farmers are doing the country a service.

Goal 3

The facts about agriculture and biodiversity are the playable elements, so players will learn about agriculture and biodiversity by simply playing *Ecofarm*, so there was not much to be done. However, fertility is an important factor in Castro Verde's context, so it was highlighted in *Ecofarm*, which was done through: **1)** points that reward or penalize players according to the soils' fertility and achievements for successful actions related to fertility (*conditioning*), **2)** by displaying the fertility points in the main interface so players easily track down their performance (*self-monitoring*) and **3)** by using missions which slowly gradually players the importance and benefits of high fertility in Castro Verde (*tunnelling*). Additionally, an

encyclopedia with more detailed information can also be added, so players can learn more about Castro Verde.

Goal 4

As it happens with the previous goal, the commitments and trade-off's existent in Castro verde are also playable elements and mechanics in the game. In addition, to persuade players to this goal, **1)** the main playable elements must be related to each other and one action must have some kind of consequence on other elements, so the players understand that there is always some kind of trade-off and **2)** players must have the possibility to choose different strategies to deal with each situation.

Goal 5

Overall, *Ecofarm* should be hard to win, so players understand better the difficulty and economical risk of agriculture and biodiversity maintenance in Castro Verde - the implementation of a fertility system, high expenses and low income, consequences of each agricultural action on biodiversity and random events that affect crops and the income, makes the game difficult to win. The playable elements themselves should also show the players the benefits of agriculture in Castro verde and in society - the improvement of biodiversity and fertility through certain agriculture actions, high profits from eco-tourism, the requirements of using subsidies.

3.4. Game Overview

In *Ecofarm*, the player owns an abandoned farm in the region of Castro Verde, in Baixo Alentejo. The game is limited to a single, non-scrolling map in which the player has a view of his farm which is divided in a diamond grid. *Ecofarm* is a turn-based game, with each turn representing a season. To win the game, the player must survive eleven years by earning enough money from agricultural activities and preservation of biodiversity, so he can cover the expenses of agricultural activities, plus the minimal expenses every season (this expenses make the player loose money every season, so if he does nothing, eventually he will loose). In the end of the game, he is evaluated for his management and is given a final score based on the missions completed and the total points (biodiversity, fertility and money) accumulated through all the years. If the player does not survive that long, he goes bankrupt. Bankrupted players are also evaluated for the points accumulated up to the turn they lost.

3.4.1 Agricultural Activities

The player can choose between crop cultivation or cattle production to earn income. Players seed (out of two methods: one expensive and fertility-friendly and another cheap method but that reduces fertility) cereals in Autumn and then decide to either do haymaking in Spring or harvest the crops in Summer. The first option provides the player with hay, which he can later sell for money or keep it to feed the cattle and the second option provides the player with income that depends of the terrain's fertility and market oscillations. After haymaking or harvesting a terrain, it becomes fallow and the player decides to use it again in the next Autumn or let it rest.
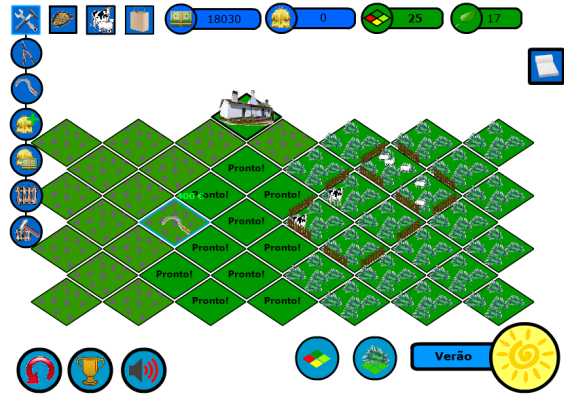

Figure 2: *Ecofarm* in action.

The player can choose between cows, sheeps or pigs for cattle production, each one with different prices and birth rates. This activity has higher income than crop cultivation but also higher expenses, as animals are expensive to buy and the player needs to fence the area where they roam. Each terrain has a maximum limit of animals that can feed on the normal pasture, so the player can fence a bigger area, seed the terrain with special pasture (which provides more quantity of pasture) or feed the animals with hay. Otherwise, animals not fed will die. Finally, each year, juvenils are born, which sell better than the adults.

3.4.2 Bushes

Each terrain has 4 levels of bushes (0 - empty, 4 - fully bushed). Players must have the terrains empty of bushes if they wish to use them for crop cultivation, so they can cut the bushes (out of two methods: one expensive and fertility-friendly and another cheap method but that reduces fertility) or place cattle, which will feed on the bushes (normal pasture) and reduce the levels until is empty. If a terrain is not being used, the bushes will grow one level every six turns. The bushes do not affect biodiversity until they reach the third level.

3.4.3 Fertility

Each terrain has 4 levels of fertility (0 - destroyed, 4 - fully fertile). These can be decreased one level when seeding cereals and cutting bushes (if the cheap method is chosen), haymaking or harvesting crops and whenever there is a drought. They can be increased when the terrain is fallow, one level every 4 turns (2 turns if player seeds special legumes) if the fertility level is above 0. If the player has cattle in that terrain, it will take more turns to increase one level of fertility (with the exception of pigs, which do not allow fertility to be increased). Is important to maintain the fertility as the prices of crops depend on the level, as well as there is a penalty on biodiversity for every level below the third and if a player uses one terrain many times, the fertility will become zero and that terrain is destroyed, which means that players cannot use it for anything within 12 turns.

3.4.4 Biodiversity

In *Ecofarm* biodiversity is represented by nine species of steppe-birds. The main mechanic is that each species has requirements that need to be fulfilled for them to appear in the farm. Each species has different requirements from the following:

- X number of terrains with crops or in the state of fallow.

- X number of terrains seeded with *green legumes*.

- Do not proceed with haymaking in Spring.

- There cannot be cows or pigs (or both) in the farm.

- Requires a specific environmental structure.

If the player respects these requirements, the steppe-birds appear in the farm, with each bird providing biopoints and tourists. Common steppe-birds provide few biopoints and tourists, but have easier requirements and come in larger number, while rarer steppe-birds provide much more biopoints and tourists, but come in fewer numbers and have harder requirements. In additon, once in the farm, some species can still be affected and their numbers reduced if players do not respect some conditions: the more animals there are in one area, less birds that area will allow to inhabit, the more fences the farm has, less steppe-birds there are and doing haymaking in spring can also reduce the populations of some steppe-birds. The terrain's fertility levels below the third have a penalty on the numbers of all species, while the fourth increases them by a small margin.

3.4.5 Environmental structures

Players need to build these structures to fullfil the respective requirement of some species of steppe-birds but if they build more than one, these structures increase the number of the birds of a specific specie or of all species. The structures are: nestboxes, nesting towers, pools of water and flagged fences.

3.4.6 Tourism

The more steppe-birds players have, more biodiversity there is and, thus, more tourists will come since each specie brings different number of tourists. As said before, common steppe-birds bring less tourists and rarer steppe-birds make more tourists come to the farm. Therefore, the more steppe-birds there are in the farm, more tourists will come, which results in more income, as each tourist has a base income value. If players are able to have a strong base of tourism income, they will cover the agriculture and seasonal expenses more easily.

3.4.7 Tourism structures

The total number of tourists and their base income value can be increased by investing in tourism structures, which will provide players with much more income. However, investing in all structures requires a careful management, as these structures are expensive. Players can invest in observation material, promotional sheets, farm's web page, tourism post, signalposted course and guesthouse. A combination of the first three is needed for tourists to appear in the farm, otherwise players will not benefit from tourism.

3.4.8 Subsidies

Players can apply for subsidies to help them covering the expenses. Each subsidy has specific requirements to be applied and conditions that must be respected every year so players can have receive the remuneration: there is one for improve biodiversity (with the higher remuneration), one for maintaining the fertility of soils and two for using sheeps or cows as cattle. The income from the subsidies is very important, as is the only way for players to cover expenses from doing agriculture activities, to profit from selling cattle (as the expenses from creating cattle surpass the income from selling it without subsidies) and provide the money necessary to build the tourism and environmental structures while covering the seasonal expenses.

3.4.9 Random Events

Finally, there are two types of random events that can affect the agricultural activities (drought and low precipitation) and affect the prices of produces (market oscillations). The first starts appearing only at the half of the game, while the former has

chance of happening every turn (market drops are much more frequent than market rises).

4. Results

We were able to recruit a total of 43 partipants, 21 of whom answered a longitudinal survey before and after playing *Ecofarm* and 22 answered only after they had played the game. Participants ranged from 18 to 57 years and included both males and females, from diverse areas of expertise, such as computer enginnering, medicine, law, education, etc.

The surveys included sets of questions related to the persuasion goals (with a range from 1 to 7), in order to check participants awareness and knowledge on each goal; plus questions related to the Persuasive Techniques used, to check for their effectiveness; and questions related to gameplay experience, to verify if they had an engaging and fun experience.

Goal 1

Before playing the game, 27% of the participants did not know if agriculture was harmful to the biodiversity and the those who answered were not fully conviced ($Mdn = 4$). However, after playing the game, there was a significant change ($\rho = 0.003$) of perspective on this matter. Only 5% of the participants did not answered and they have come to deeply believe that agriculture is not harmful to biodiversity in the context of Castro Verde ($Mdn = 1$) (the expected results were to be below 4).
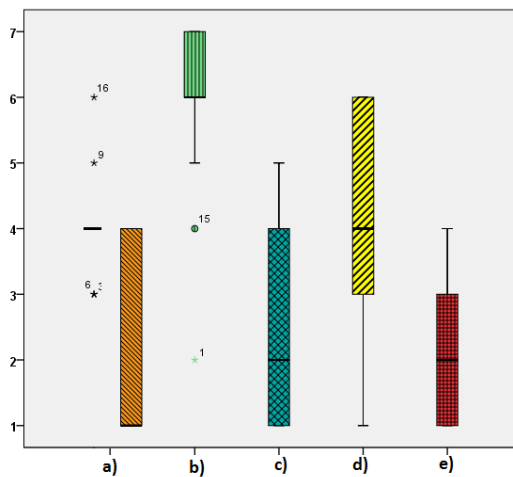

Figure 3: Boxplots of Goal 1 questions. a) Is agriculture harmful to biodiversity? b) Is it possible to conciliate agriculture with biodiversity? c) Is it possible to have biodiversity without agriculture? d) Is it possible to have economical success without biodiversity? e) Is it possible to have economical success only with biodiversity?

Furthermore, we tested with more detail participants' knowledge on this goal with more specific questions on the survey after (to which only an overall of 6.8% of participants answered "Don't know"). The expected results for the medians which proved that there was persuasion were to be below 4, except for the first question. After playing *Ecofarm* participants have come to highly believe that it is possible to conciliate the two activities ($Mdn = 6$) and that is impossible to have biodiversity without agriculture ($Mdn = 2$). However, they were not fully convinced that it may be possible to have economical success without biodiversity ($Mdn = 4$), though they highly think it may not be possible to have economic success only with biodiversity ($Mdn = 2$).

Goal 2

The medians should be above 4 to prove that there was persuasion to this goal. The percentage of "Don't Know", an overall of 21.4%, showed some lack of players' awareness on the importance and effects of subsidies in agriculture overall. From the remaining answers, results show that, before playing the game, participants had a slight idea that the subsidies are indispensable to farmers ($Mdn = 5$) and be justly earned by them ($Mdn = 5$). However, participants were uncertain to see agriculture as a economically sustainable activity ($Mdn = 4$) and, curiously, they already had a high recognition of agriculture's role in society ($Mdn = 6$).
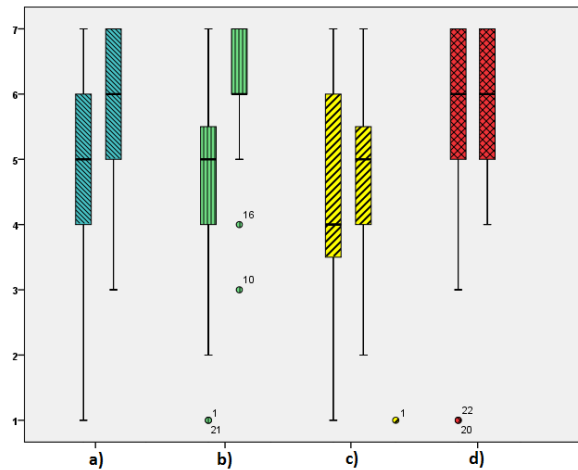

Figure 4: Boxplots of Goal 2 questions. a) Are subsidies indispensable to farmers in Castro Verde? b) Are subsidies justly earned by farmers in Castro Verde? c) Is agriculture a sustainable activity in Castro Verde? d) Does agriculture has an important role in society?

However, the results of the second survey clearly express the positive change of players' perspective on what matters to subsidies, after they have

played the game. Participants were expected to choose values above 4 to prove that there was persuasion.Overall, more players know about the importance and effects of subsidies, as shown by only a 9.2% of "Don't Know" answered in the second survey. Furthermore, as there was a significant different between the two first questions ($\rho = 0.03$, $\rho = 0.002$), players clearly have come to see the subsidies as indispensable for farmers ($Mdn = 6$) and as justly earned ($Mdn = 6$). Although not significantly ($\rho = 0.527$), most of participants have come to think that agriculture is a economically sustainable activity ($Mdn = 5$). Finally, their awareness on the importance of agriculture to society did not change and remained high ($Mdn = 6$, $\rho = 0.576$).

Goal 3

The results showed a large lack of knowledge of biodiversity and farming facts before playing *Ecofarm*:

- Regarding the farming effects in biodiversity, overall, 57.8% of participants answered "Don't know" and only 55% of the remaining answers were correct.

- Regarding the farming effects in fertility, overall, 77.5% of participants answered "Don't Know" and only 25.8% of the remaining answers were correct.

- Regarding biodiversity facts (correct species of steppe-birds), participants answered only a total of 35 out of 110 possible correct answers, of which only 14% were correct.
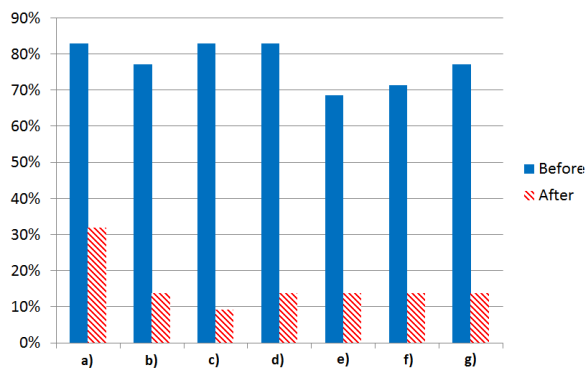
Figure 5: Percentage of "Don't Know" on farming effects in fertility. Which actions maintain the fertility of soils: a) harrowing, b) traditional sowing, c) direct sowing, d) chipper, e) place cows, f) place sheeps, g) place pigs

However, after they have played *Ecofarm*, there was a great change of awareness ($\rho = 0.001$, $\rho = 0.002$) and players have come to know more about biodiversity and farming in Castro Verde:

- Regarding the farming effects in biodiversity, overall, only 20.7% of participants answered "Don't Know" and 70% of the remaining answers were correct.

- Regarding knowledge on fertility, overall, only 15.6% of participants answered "Don't know" and 80.6% of the remaining answers were correct.

- Participants have come to know much more about biodiversity, as a total of 92 out of 110 possible correct answers were answered, of which 64% were correct.

Goal 4

Due to the nature of this goal, questions related to it could only be answered after the game was played since they required knowledge of gameplay. Nevertheless, since there has been a great change of perspective on most of the other goals, we considered the results valid to express the players' awareness on this goal. To this goal, we expected participants to choose a value below 4, except for the fourth question.
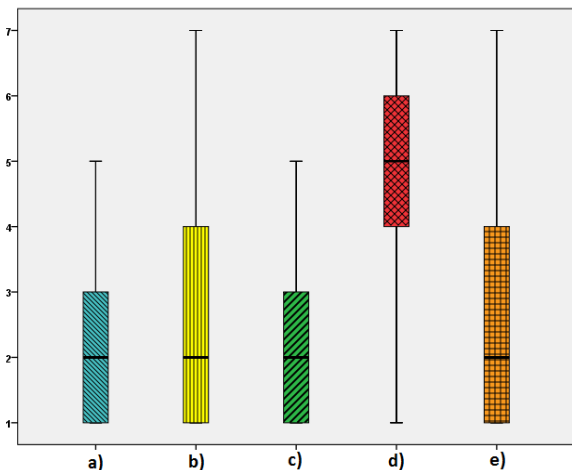
Figure 6: Boxplots of Goal 4 questions. a) Can you use the same strategy every year? b) Can you use the same seeding and plowing methods every year? c) Can you use the same type of cattle every year? d) Are there years which is better not do anything? e) Do cattle production and crop cultivation have the same disadvantages?

Results expressed that, after playing the game, an overall of 12.5% of players answered "Don't Know". The remaining answers show that in fact players have come to realize that there are commitments and trade-off's in Castro Verde. Players understood that they cannot use the same strategy every year ($Mdn = 2$), understood that they cannot use the same seeding and plowing

methods every year ($Mdn = 2$), nor the same type of cattle ($Mdn = 2$). Players acknowledged that there are some years that is better not do anything ($Mdn = 5$) and can clearly distinguish the disavantages of crop cultivation and cattle production, as they consider them not to be the same ($Mdn = 2$).

Goal 5

The expected values to prove that there was persuasion after playing the game had to be above 4. Analysing the results of the first survey of group A, it shows that participants' awareness was not far from the objectives of this goal, as the medians before the game were already above 4. Participants already understood that agriculture can be risky ($Mdn = 5$, 11.4% of "Don't Know"), that farmers have economical dificulties ($Mdn = 5.5$, 11.4% of "Don't Know") and highly believed that farmers can have economical success ($Mdn = 6$, 2.8% of "Don't Know"). In addition, participants who were not sure if agriculture benefits Castro Verde ($Mdn = 4$, 48% of "Don't Know") but believe by a small margin that it benefits the country ($Mdn = 5$, 5%).

After participants had played *Ecofarm*, they still understood the risk of farming in Castro Verde ($Mdn = 5$), they had come to have a slightly greater awareness of the difficulties of farmers in Castro Verde ($Mdn = 6$), and their perspective on farmer's economical success did not change ($Mdn = 6$).
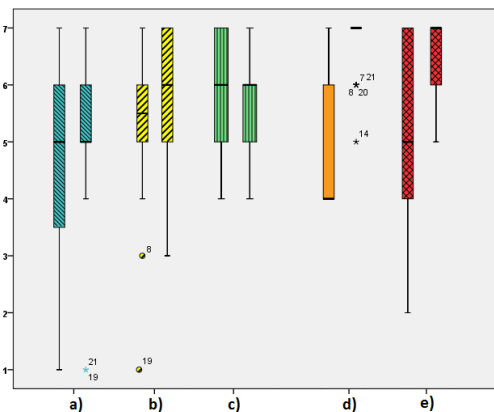

Figure 7: Boxplots of Goal 5 questions. a) Is agriculture in Castro verde a risk activity? b) Do farmers in Castro Verde have economical difficulties? c) Do you think that farmers can have economical success in Castro Verde? d) Do you think agriculture benefits Castro Verde? e) Do you think agriculture benefits society?

However, there was a great change of awareness relatively to the benefits of agriculture in both Castro Verde ($\rho = 0.001$) and the country ($\rho =$ 0.001), with only 4.5% of participants answering "Don't Know" to the first and with every participant answering the latter. The results show that participants have come to deeply believe that agriculture benefits both Castro Verde ($Mdn = 7$) and society ($Mdn = 7$).

Persuasive Techniques

Missions (67.4% of votes) were the gameplay element that contributed more to motivate participants to improve the biodiversity. This leads us to conclude that the technique of **tunneling** helped players to follow a biodiversity path, as intended. In addition, biopoints also had impact on participants, at the end of the game (44.2%), at the end of each year (55.8%) and in the interface (37.2%), which proves the usefulness of **conditioning** to draw players' awareness to biodiversity.

Relatively to what had contributed more to motivate the participants to maintain fertility, it were the fertility points in the interface (46.5%) and at the end of each year (55.8% for both) that motivate the most, although the missions are not far behind (53.5%) as well as the fertility points in the end of the game (41.9%). Although the technique of **tunneling** guided participants to maintain fertility (with 53.5% of votes for missions), the fertility points had a high impact on motivating participants to maintain fertility, proving, once again, the effectiveness of **conditioning** to change players' awareness to the persuasion goals. In addition, the high percentage of the annual report and the points in the interface also shows that **self-monitoring** successfully helped participants to maintain their farm's fertility.

The money points in the main interface (60.5%), in the annual report (48.8%) and the funds report menu (48.8%) were the main gameplay elements that helped participants with their decisions each turn, unlike biodiversity points which had a small effect on participants decisions for being in the interface (37.2%) and in the end of each year (37.2%) (but still above the remaining gameplay elements) to which we conclude that money was a more important factor in participants strategies (**conditioning** had only a small impact on participants choices related to biodiversity).

Finally, relatively to what motivated participants to play more times (either they had won or lost), the results showed that it was the challenge present in the game that cause participants to play again (60.5%). Their interest in finding out other ways to play the game also had effect (53.5%) as well getting a better final score (48.8%). Getting

a better highscore than other players (37.2%) and a better final bioscore (37.2%) only affected some of participants. Verifying these percentages we conclude that the gameplay was challenging enough to keep participants engaged and trying to win the game, as well it shows that the game offer various ways to play (otherwise players would not be curious to know other ways of playing). In addition, biopoints had a small influence on players, but enough to motivate them to get a better final score of biodiversity. Moreover, the high influence of other players highscores show that **comparison** and **competition** motivated participants to play more times.

Gameplay

Overall, *Ecofarm* was played 372 times (one time is either one win or one loss) which makes it 8 times per participant, thought there were participants that played as much as 59 times and as low as only 2 times. Only 14% of the participants won the game, and the mean of turns played is 21 (out of a total of 44) which means that, even if only a few reached the end of the game, most of them got to the middle of it. In addition, results show that participants were not averange gamers ($Mdn = 3$) which explains the low number of plays for some players and the some of the results in persuasion goals.
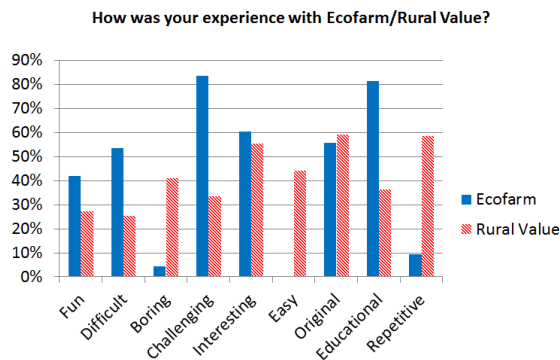

Figure 8: Percentage of votes of each type of experience felt by participants that played *Ecofarm* and *Rural Value*.

Despite the low number of plays, the participants liked to play *Ecofarm* ($Mdn = 6$). They considered mostly to be an educational (81.4%) and challenging (83.7%) experience, but also find *Ecofarm* to be an interesting (60.5%) and original (55.8%) game, though not being much fun (41.8%). This last value can be explained by the fact that many players considered *Ecofarm* a difficult (53.5%) game. However, very few participants found *Ecofarm* as boring (4.3%) or repetitive (9.3%) and none thought that it was easy.

When compared to *Rural Value* we can safely say that *Ecofarm* was a more enjoyable experience. Results from Group C show that more participants were bored (40.7%) and did not have much fun (27%) with *Rural Value* and thought that it was a very repetitive (58.5%) experience. Consequently, not many had challenge (33.3%) or difficulty (25.2%, and 44.1% for easy) . Still, they see *Rural Value* as an interesting (55.1%) and original (58.9%) experience, though not very educational (39.1%).

5. Conclusions

After analysing the results we can safely say that playing *Ecofarm* changes participants' awareness to the context of Castro Verde issues. There was a reduction on the lack of awareness (as show by the high percentage of "Don't Know" before playing the game and then, the low percentage after participants played *Ecofarm*) and, overall, players' perspective changed significaly towards all persuasion goals, with the exception of goal 5, to which players were already aware before playing *Ecofarm*.

Although we could not test if all the Persuasive Techniques we used in our solution had effect in *Ecofarm*, for the ones we tested with the surveys (tunneling, condition, self-monitoring, comparison and competition) we can say that they successfully had effect both in persuasion and in gameplay and that they can help in fact the designers with persuading players to their goals. In addition, taking the fact that persuasion goals were successfully achieved, we can say these techniques had overall success in their tasks, since some persuasion goals relied on these techniques success to be persuaded to. Thus, we proved the usefulness of using Persuasive Techniques to make *Ecofarm* persuasive to our persuasion goals.

Although results show that players enjoyed *Ecofarm*, there is still a low number of plays by some participants, a very low number of winners and the mean of turns played is only at the half of the game. This leads us to conclude that gameplay is yet too difficult, mainly to casual gamers (considering that the participants do not play much video games and considering the number of votes on "Difficult"'). The reason behind this is an irreduceable complexity existent in Castro Verde context, that is difficult to be understood by players through gameplay. This explains also some of the answers on the persuasion goals. If participants did not have difficulty, if they had played more or explored enough the gameplay,

more participants would have understood that is impossible to have success without biodiversity or more participants would have answered questions related to goal 4, for example.

Still, results have shown that participants liked to play it and thought the gameplay to be engaging and interesting (otherwise, not even the goals would had been achieved), making *Ecofarm* an overall enjoyable experience. But more importantly, as they did not think the game to be boring and repetitive, and taking the success of persuasion , *Ecofarm* was able to maintain the balance between learning and entertainment. Furthermore, results also express that participants enjoyed more playing *Ecofarm* than *Rural Value*, since they though the latter to be more repetitive and boring, which proves that, despite the difficulty and low fun that players had with *Ecofarm* it still has engaging gameplay. On a final note, the results show that participants think that both games are interesting and original, which confirms the capabilities that this context has to make a video game.

In conclusion, while the gameplay could be improved in many ways, the foundation where *Ecofarm* was built upon - using gameplay to persuade players to the issues of Castro Verde - is solid and our approach can be used as a model to translate real-world context into persuasive gameplay elements and mechanics.

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