

Let's play at the science lab: building a video game for the studies of cooperation

Fernando Teles¹, Maria de Fátima Aranha de Queiroz e Melo², Erivelton Geraldo Nepomuceno³

^{1,2}Fed. University of São João Del Rei, Dep. of Psychology, Brazil
João Del Rei, Dep. of Electricity, Brazil

³Fed. University of São

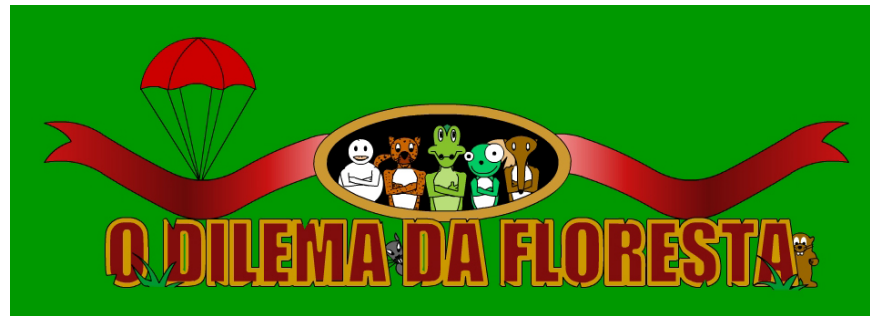


Figure 1: Introductory screen of the game O Dilema da Floresta

Abstract

The phenomenon of cooperation can create new forms of organization [Nowak, 2006]. It may be the reason why people live together or political groups get into conflict. It can explain the behavior of animals, insects, microorganisms, and even be exploited to produce artificially intelligent machines. Based on the importance of studying social dilemmas to elucidate the modern world's problems, this study proposes the use of a video game to understand how people cooperate while interacting. Altruism was observed as the commitment to participate in a group involved considering individual's gains and the group's.

Keywords: cooperation, multiplayer games, Prisoner's Dilemma, Actor-Network Theory.

Authors' contact:

¹nandotelles@yahoo.com

²queirozmaldos@uaivip.com.br

³nepomuceno@uufs.j.edu.br

1. Introduction

The study of social phenomena has advanced as old limitations are overcome among scientists. Today, cross-field investigations are possible partially because the emergence of new tools within the reach of researchers. This offers both new methods to clarify old concerns and better ways to inquire about problems created by modern society that can no longer fit in the frame of a single discipline [Klein, 2004]. This can be seen as a response to a rapidly changing world where an event or phenomenon is simultaneously related to a varied number of events, objects, technological gadgets, political issues etc.

The video game industry, for example, has recently faced a boom on consumption and use of multiplayer online video games, which is undoubtedly part of a wide social transformation. It's needless to say that previous popular criticisms and beliefs about the individualistic and isolating habits that were attributed to the act of playing video games have quickly turned into an anachronism. There's nothing new in the fact that this has always raised questions to be discussed by psychologists, sociologists, anthropologists, computer scientists and game developers, but any attempt to close the gaps among those fields should be, itself, a richer approach to the fast-growing social use of video games.

Once online communities, cybercafes, and other types of computer networks have been gathering together an increasing number of individuals around the task of playing, an important and outstanding subject that deserves some light shed on within those computer mediated forms of socialization is human cooperation. Our aim is not to establish comparisons between the way our ancestors used to organize to collaborate in ancient times and today's new forms of communication. The focus of this work is placed, instead, on how cooperation emerges in human groups and what are its underlying mechanisms throughout multiplayer games settings. In other words, we intend to use the virtual environment of a video game as a tool to learn how cooperation can be established, maintained and even broken down among people.

This investigation has adopted two basic theoretical frameworks that guide the development of a computer video game to be used in the context of simulating the cooperation phenomenon. Those are, namely, Actor-Network Theory by Latour [2000], and Robert Axelrod's Theory of Reciprocity [1984]. The former

one was chosen because of its flexibility in dealing with different knowledge fields without disciplinary constraints, and also because of its particular purpose in tracking down the pathway of events as they happen.

As acknowledged by Latour [2000], all scientific data or technological artifacts shared by humans may be considered as a black box. This concept suggests that the way something works or is used may be surrounded by controversies, so as to make its *opening* an opportunity for investigation. Therefore, the current paper considers cooperation as a phenomenon that may be outlined through an experiment, built around a computer game.

As for Axelrod's concepts about cooperation, our work is grounded on the assumptions of his seminal work with the *Prisoner's Dilemma* game. Concerned with the possibility of a worldwide collapse during the Cold War, this author suggested the *Prisoner's Dilemma* game as an abstraction to understand how cooperation evolves among humans, nations and even microorganisms.

Provided the above assumptions, this paper is intended to present a study of cooperation with a literature review of the works of different authors interested in theorizing the use of games to understand this social phenomenon. We will then suggest how games can play a crucial role in the investigation of complex real-world phenomena of cooperation. We will then provide a brief description about how the game was built for this research project and the results for the data collected when it was played by participants in multiplayer rounds.

2. Related Work

Generally speaking, multiplayer online games have attracted the attention of scholars from different fields interested in studying the complex organization of individuals around virtual worlds. A recent work by Lofgren and Fefferman [2007] examined the capacity of those games to provide explanations on applied epidemiology. These authors took the advantage of an accidental error that caused a large-scale epidemic outbreak in a *Massively Multiplayer Online Role Playing Game* (MMORPG) known as *World of Warcraft* (WoW), that took place on September 13, 2005, to measure the reach of its potential in shedding light on real-world phenomena. The incident started when *Blizzard Entertainment*, producers of *WoW*, distributed a patch containing the virus for users to download, available on their website. This software update spread a powerful virus throughout the software as users' interaction evolved.

Lofgren and Fefferman [2007] reported serious injuries to users generated by this fantastic and chaotic episode in that online play. The incident gained broader proportions as nearly 4 million players

invested their time and money to take part in that kind of virtual entertainment. Damages to social ties, strategic game planning and strong emotional involvement of players were taken into account by the authors that considered this phenomenon a crucial example of how a contagious disease dissemination can be simulated in computer games. Therefore, one of their important remarks suggests that unpredictability of human behavior can add more validity to studies around that type of virtual environments.

In regard to the possibility of cooperation among players online at that fateful day, Lofgren and Fefferman [2007] reported that users, in an unsuccessful attempt, tried to heal their fellows once they realized they had healing powers for it. They did not go any further in their description to provide an in-depth and focused account of cooperating individuals. However, although Lofgren and Fefferman [2007] were not explicitly engaged in analysing cooperation among players, their description brings interesting insights on how a phenomenon like that can be artificially arranged, having human subjects at hand to interact through it and feed it with the unpredictable outcomes of a real-world catastrophe. The results are impossible to number but they open an entire universe of possibilities to be exploited within the field of social sciences. From a psychological standpoint, we could even think on new ways to do more serious-play of that type: How would the players organize to help one another in epidemic-like virtual plays? Which other strategy could they use? What kind of event or strategy is more likely to reduce levels of cooperation?

Bainbridge [2007], also concerned with the possibility of exploring virtual worlds for scientific inquiry, believes that *WoW* and *Second Life* (SL), another popular online multiplayer game, can be used for field research as any other tool is used in a traditional ethnographic investigation. In *SL*, for instance, researchers could have a place in which subjects would be recruited, interviewed, observed, etc., similarly to the way this same ritual is conducted in real-world laboratories. For *WoW*, this author envisions a fruitful scenario for the studies of economic behavior, as players' interactions are also based on that aspect or social life.

According to Bainbridge [2007], this enthusiasm was already communicated in 1997 by an American organization called *National Science Foundation* (NSF). By that time, a workshop was held by *NSF* to promote the exploration of Web by scientists given its amazing advantages, which includes the possibility of doing experiments with thousands of subjects at once and from several sociocultural backgrounds. Bainbridge [2007] states that we are living a transition that may be soon left behind in time. Perhaps it will not take long until we have to look back by joining remaining pieces of history to understand this important phenomenon of online social interaction.

The work by Nardi and Harris [2006], *Strangers and friends: collaborative play in world of warcraft*, has a purpose closer to our own. The authors provide an interesting description of their journey throughout *WoW*. Aimed at dissecting in small details an entire universe of habits, social ties, entertainment of this *MMORPG*, they end up showing how rich in terms of sociability *WoW* can be. The essential features of their work go far beyond the structure of that game. It grasps meaningful elements that make collaborative entertainment a crucial personal life experience. The qualitative focus of their paper is an example of how human engagement is far more complex than game developers could ever imagine.

Another inspirational and increasing type of social research that incorporates videogame technology lies within the field of Social Life Simulations (SLS). Supporters of this field are also concerned with what has been stated above about modern world. Their multi or even inter-disciplinary efforts have been trying to study social reality as a system in which a possible pattern operates. As well as the current paper, such studies are mainly based on building models to explain and reproduce social dynamics. As the SLS field grows beyond the limits of Sociology or Computer Science, it is also an important representative of the new era of Artificial Intelligence [Davidsson, 2002; Gilbert et al., 2006; Macy, 1998; Teles et al., 2007]

3. The Dilemma of Cooperation

One main characteristic of human social groups seems to be the fact that individuals may be constantly faced with conflicting interests. Nevertheless, a conflict is more likely to arise when an underlying dilemma is identified. We can think of a number of situations in which that shows. One of the most emergent examples lies within the issues surrounding global warming [Milinks et al, 2006]. Stabilizing Earth's climate has already become a conflict, as scientific knowledge tries to reveal its basis and prospective outcomes, in case the dilemma is not solved: how can we share natural resources without killing ourselves?

That concern was already addressed by Hardin [1968] who believed that sharing public resources would always pose a problem for mankind. His idea is illustrated with the herdsman dilemma. Each herdsman is interested in maximizing his gain by adding more animals to his herd. Although that may produce positive outcomes to one herdsman, the negative effects are shared with all the others who won't reap the same commercial benefits of a large production. The costs, for example, of the overuse or pollution of natural resources as a consequence of breeding more animals automatically become a collective trouble.

For Kollock [1998], a range of problems can have their origin on a social dilemma, be it an international or an interpersonal matter. He also claims that it is

mainly linked with a rational individual decision causing an irrational collective result. A nation may benefit from making huge investments in industrial production, with no regard to how disastrous industrial pollutants may be to the world. Everybody may know the consequences from air pollution produced by automobiles, but nobody will necessarily do something to prevent it.

Whenever problems of that magnitude become conflicting, it seems rational to consider how they ever came to be in first place. Knowing its limitations and its possible underlying mechanisms can be even more helpful. Since we live in a world where social condition doesn't seem to be a choice, we are continually dealing with confrontation, negotiation, and thereby cooperation.

This theme alone has attracted an interdisciplinary attention due to its vast variety of possibilities to be studied or applied. Cooperation is not just a human social phenomenon. It can be found among other animals, insects, microorganisms, or even be implemented among artificial beings. One of the goals of this paper is to test the use of a video game to explore this phenomenon, by trying to simulate cooperation among a group of people.

A literature review has shown that, to date, there seems to be a huge interest of scholars from many fields in the studies of cooperation. Sociology, Computer Science, Psychology, and Biology, to name a few, are behind the most recurrent publications on that subject found in specialized journals. However, this topic does not appear to be as popular when in combination of game technology with Social Psychology studies.

In a broad sense, it is reasonable to trace the phenomenon of cooperation by assuming that a cooperating member's interest in a group has its origin in an initial individual need. As for a real scenario of human social history, we could suggest the fact that large groups can be formed and sustained around the satisfaction of the most basic human needs, like hunting and gathering food, for example.

Taborsky [2007], suggests an example of cooperation and cites the biblical narrative of the Tower of Babel. The myth tells a story of those who wanted to reach heavens by building a very high tower and had their organization broken by God's wrath. God's revenge worked to confuse the order of those willing to enter his realm, tearing apart their group with distinct languages. Although that may appear a mere illustrative analysis, the author points out that the term cooperation has been a problem to some authors that concentrate in the outcomes yielded by an action or interaction among individuals. According to Taborsky [2007], cooperative interactions are different from cooperative actions. The former ones suggest that

such an interaction produces outcomes to both parts involved, whereas the latter ones would only result in a benefit for solely one of them.

Taborsky's [2007] definition for cooperative interaction seems to be based on the idea that one deals with a kind of self-sustainable phenomenon. It depends on the individuals' networks. This is not to say that a group's behavior is never triggered by an *external* agent or action. An out-of-group entity can play the pivotal role of igniting a transformation and setting a scene for action. But its evolution in time, its maintenance, or fragmentation, finds in interactivity, an appropriate vehicle to translate events into unpredictable new things or meanings within the complex mechanism of group functioning.

However, concepts focused on the production of positive outcomes in the midst of cooperative behavior seem to avoid the analysis of undesired social products, also based on reciprocity. Assuming that cooperative relations can work to promote mankind's welfare, it may be helpful to include a range of other matters, apparently obscured by rash analyses of social life. Considering, for instance, drug traffic networks, or other groups whose activity has been proven to be socially threatening, we can find a less romantic view of communities in joint social action. This perspective should suggest a relativist standpoint when dealing with the concept of cooperation.

On the other hand, an approach to cooperation as something that surrounds the production of social welfare is treated in a more specific way by Fehr and Gächter [2007]. These authors state that during evolution, important human activities for survival, such as sharing food, the preservation of social properties, and war, became part of a social good. In this kind of organization, something is shared between many individuals, including those that paid no cost for it. This is crucial, according to the authors, and raises the question of why someone would regularly take part in relatively costly activities of cooperation, such as war and huting, for example.

According to Palmieri and Branco [2004], an individual's motivation to cooperate has roots in his/her beliefs, values, and drives. The authors concluded that influences generated by capitalist society on the production of individualism or competition seem to be explained by the fact that the need for survival may be reducing human cooperation to even more closed groups. The authors stated that capitalism raises a different kind of social grouping: corporativism, in which people tend to share common interests and act towards the fulfilment of their own individual goals only.

This viewpoint shows that social groups could be separated in terms of their cooperative relations; if we assume that such a concentrated organization is

possible. We could compare this kind of group using a metaphor of a tissue formed by a group of cells. Each cellular group would interact or engage in some sort of cooperation to maintain its integrity. What is left to know now is how resistant or selective those groups are as they interact with one another. After all, one can not state that a group whose relations are based only within its members can not have a relatively stable existence over time.

However, Fehr and Fischbacher [2003], consider heterogeneity as a vital condition for human groups' survival. Those authors believe that there are many interactions among selfish individuals, whether they are humans or animals. According to their environment, a smaller number of altruists may reinforce cooperation of a majority of selfish members or in contrast, it is also possible that selfishness could prevail and foster an end to altruism within the group. Kurzban and Houser [2005] classified the elements of this probable mixture and argued that people are divided into three stable groups: cooperators, who contribute to generate group benefits at their own cost; free-riders, who will not pay any costs; and reciprocators, who respond to other's behaviors under a conditional strategy.

The animal research by Rutte and Taborsky [2007] investigated interactive dynamics among rats, aimed at finding patterns of that behavior also in human society. According to their experimental findings, cooperation among rats was observed in the absence of both operant and respondent conditioning. They stated that their subjects generalized their cooperative behavior to other situations and under different conditions of those produced during the experiment.

Those data seem to corroborate the idea that the phenomenon of cooperation is not restricted to human sociability. Stevens and Hauser [2004] agree, but they state that most of the examples of cooperation among animals may be attributed to the selfish or indirect objectives by means of mutualism or helping similar individuals. They argue that reciprocal altruism is either rare or nonexistent among unrelated animals. In cases in which this could be observed in laboratory research, it is not clear if the observed patterns may be generalized to natural or less controlled conditions. These authors suggest that animal cognitive abilities restrict the possibilities to preserve reciprocal altruism.

Nowak and Sigmund [1998] suggest that, as opposed to the other examples of ultrasociality such as hives, termite colonies, ant colonies, etc, the emergence of human cooperation is less associated to kin selection than to forces grounded on moral social systems. Furthermore, they also state that the effects of reciprocity are stronger than those of nepotism. Nowak and Sigmund [1998] believe that in human societies, the ideal of "helping someone now that will help you in the future" is not the only prevailing one, but also

that one that states that “help anyone now and you shall be helped later”, or the religious statement that says: “give and you shall receive”. It is about two kinds of reciprocity, namely, a direct and an indirect one.

As stated by Fehr and Gächter [2002], indirect reciprocity theories show how larger groups' cooperation can emerge when members can build a reputation. Yet, the authors believe that such theories are able to precisely explain why cooperation is frequent in non-repeated interactions, when reputation gains are smaller or nonexistent.

Punishment, according to Fehr and Gächter [2002], would be a solution for this problem. If, for instance, free-riders are punished, cooperation may occur, but this would also bring the problem of the need of defining a punisher. The entire group would benefit from a free-riding discouragement, but nobody is encouraged to become a punisher. The question of punishing arises, according to the authors, as a second order benefit. Fehr and Gächter [2002] point out that such a problem could be solved if an enough amount of individuals had a tendency for altruistic punishment, even though they are faced by the necessary costs and the absence of rewards.

For Back and Flache [2006], reciprocity theory is aimed at explaining a wide range of domains, from commercial agreements to personal relationships. However, recent empirical studies of cooperative behavior show that reciprocity may be frequently much less strict and its actors much less inclined to keeping a certain social stability than suggested the original argument. Those authors state that when an individual intuitively recognizes that his/her cooperating partners are merely driven towards the fulfilment of his/her own interest, cooperation may actually grow weaker. They also argue that, as for more affective relationships between friends, there are not obligations of any sort for reciprocity because one expects that friends will help themselves eventually. That is to say, for emotional and not instrumental reasons.

Those statements seem to be more interested in opening the black box in which the phenomenon of cooperation is established. Although its cognitive or emotional roots are vital for the social interactions, the effects produced by actors' engagement are closer to the goals of an investigation intended to map out the interactive underlying dynamics of cooperative nets' emergence or fragmentation

4. Playing with a Dilemma

The development of the videogame on which this paper is based, is intended to verify how those nets are formed, maintained and/or broken down, according to methodological strategies suggested by Actor-Network Theory. The most common current

approaches to the dilemma of cooperation have also taken the advantage of computer technology to do so. Most of the similar works made upon the concepts of that method have strong influence from Axelrod's [1984] *The Evolution of cooperation*. This book introduced the use of Prisoner's Dilemma game as an abstraction for the comprehension of cooperation. The possible moves of this game, played in two-person rounds, are cooperation and defection. Each individual will score according to his/her opponent move combined to his/her own. When someone cooperates and receives cooperation in return, both players will gain the same amount, 3 points. When both defect, they'll both receive 1 point each. But if one player cooperates and the other one defects, only defection will be rewarded: 5 points to defector and 0 to cooperator, as seen on Table 1.

Table 1: Prisoner's Dilemma payoff matrix

		Player B	
		Cooperation	Defection
Player A	Cooperation	Player A receives 3 points. Player B receives 3 points.	Player A receives 0 points. Player B receives 5 points.
	Defection	Player A receives 5 points. Player B receives 0 points.	Player A receives 1 point. Player B receives 1 point.

Axelrod [1984] intended to apply this simple mechanism to shed light on the difficult and troubled relationships among the nations during the Cold War. He envisioned Prisoner's dilemma as a powerful theoretical model to describe how the interaction outcomes between individuals, animals, or countries may evolve and follow the patterns inscribed within their cooperation strategies. His experiments showed that reciprocity tends to be the best strategy a player can choose, namely *tit-for-tat*. In other words, to do whatever the other player does seems to bring the most advantageous results. Later on, this author decided to explore that idea on the complex settings of social groups [Axelrod, 1997a; Axelrod, 1997b; Axelrod and Hammond, 2003].

However, standing upon the assumptions of society proposed by Latour's Actor Network Theory (ANT) [2006], we adopted his concept of “association”, considering social groups as nets that are formed without the distinctions of macro or microsocial. This author supports the idea that the global should not be taken as a broader site, which contains smaller units. It is just another dimension, simply more connected in comparison to a smaller net. Revealing its structure in terms of how connections are established among its nodes is what really matters. Furthermore, it is not a

question of chartering territories but making visible the effects caused by the multiple connections of its actors at the same time as they happen.

Following the track left by Axelrod's and Latour's suggestions, and other contributions by many other theorists, we will present below how we built a video game to study the phenomenon of cooperation. Further, we will provide results and discussion on data collected by this game during experiments performed with a group of participants.

4.1 Preparing the game

Our video game is called O Dilema da Floresta and was designed to work on a computer network. Its main interface was created with Macromedia Flash 8 to draw the characters and implement interactivity according to the game's rules. It is supposed to be played by 5 players and the server-side connectivity requires specific softwares for that purpose. A main computer was then set up with the softwares Apache 2, PHP 5 and MySQL 5. Those softwares were used to allow server-to-client connection and data storage. Exchange of data among clients was possible due to a socket connection. It performs the task of distributing all players' inputs throughout the network.

Every time a point is received, denied or granted from one user to another, a database is updated with the new score values of both users involved in that transaction. These data can be later retrieved and analysed.

Interface layout and characters were designed in two-dimensional shapes, and inspired by minimalist cartoon styles. The characters are the Jaguar, the Tamandua, the Frog, the Alligator, and the Duck. Each one acts as a guardian for a food supply composed of 5 types of fruit. Additionally, the Mole and the Rat take part as non-player characters.

A story was written in order to provide a narrative for the game objectives to make sense. The Alligator's tree produces bananas; Frog's tree produces pineapples; Duck's tree produces cherries; Tamandua's tree produces apples; and Jaguar's tree produces strawberries. The animals are living a dilemma, once each one owns a tree that produces a type of fruit but needs all the other fruits to stay alive. This should create the problem of sharing, as players will have to manage their food supply by giving, denying or asking for more fruit to the group of players. A Mole may appear, at random, from underground to bring up any one of the types of fruit available in the game. A player who catches that fruit will be awarded by having points added to his/her score. A parachute is also randomly assigned to fall in different places of the screen carrying a gift box, which may contain either a fruit or the Rat. The Rat will punish the player by taking part of his/her fruits in case it shows up.

When the game is loaded the players will watch an animation telling the story of the characters and then a screen on which the button *play* is showed. By clicking on that button, the player will see the five characters as possible options to choose. After choosing the preferred character, the players will enter the game and his/her character's tree will appear. By pressing one of the four arrow-keys on the keyboard, a character can walk left, right, up, or down around the scenario. By clicking on a tree, players will know how many fruits there are available for the character to which that tree belongs. It is also possible to give or ask another player for a fruit by doing so. The food supply is slowly reduced as the game runs. If at least one of the fruits is out within a player's supply, that player loses the game and leaves the match.

Under Prisoner's Dilemma structure, our video game is defined to punish a player if he/she asks for cooperation and receives no help in return. That means that every time a player defects, the other player involved will lose one of his/her fruits. The last player to leave the game wins.

5. Methods

The five participants are undergraduate students from different majors. Before the session of matches carried on, they first watched a video with a short story to understand the objectives of the game. Later on, they received guidelines to learn how the game works and the functions of each button, menu and event. In order to make players proficient in operating the game interface, they firstly played in a exploratory way to familiarize with it.

Each character was once assigned to be controlled by each player, and there were no rearrangements among players. This prevented a player from playing with more than one character and provided more validity for the assumptions we make for a player's behavior.

Talking during the game was allowed, but players were encouraged to send text messages to others by using a text box defined for that purpose.

A player could monitor his/her remaining match time according to a progress bar located at the bottom of the screen. This bar counts down from 100% and its value is set according to the number of the fruit with the smallest amount. A player loses the game when he/she runs out of a type of fruit.

At the end of the first exploratory match participants were asked to talk about how they felt while playing and what kind of strategies they used, in case they were winners, or what they believe could explain why they lost it, if that was the case. The same was done after the following three matches. We

considered the fourth one for the following analysis and discussion.

6. Results and Discussion

The match took 7 minutes and 6 seconds to finish. The player controlling the Frog character won the game. The other participants left this match in the following order: Tamandua at 6 minutes and 4 seconds; Alligator at 6 minutes and 27 seconds; Duck at 6 minutes and 35 seconds; Jaguar at 6 minutes and 56 seconds; and finally the Frog left as a match wouldn't be possible with a single player.

Minutes before the beginning of that match players were fostered to talk about how they felt while playing. They made comments and speculated how the best strategy should be implemented. Those were moments of disagreements, discussion of new ideas, and even the proposition of hypotheses. Such moments played a key role in helping players to revise their strategic style. Once the dilemma upon which this game was modeled became a conflict, a new game started during the intervals. They devoted significant time to deliberate about a conflict that is by theoretical definition, the heart of some social problems in our world. Players' engagement seemed to have evolved from an exploratory stage to another one in which strategies were tested at will.

There was no relevant use of instant messages during the game play. Sending messages was just faced as an alternative to request or deny a fruit.

Figure 2 shows the amount of fruit each player had accumulated before leaving the game. Although Frog's best score reached was for the fruit produced by himself, that is to say pineapple, its lack was not the cause of the other players' failure. On the other hand, the Jaguar seemed to have concentrated the strawberry within his power, since the Tamandua and the Duck left the game due to a deficient supply of that fruit.

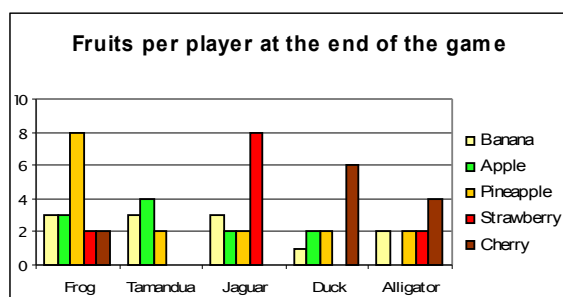


Figure 2: The amount of each type of fruit players accumulated at the end of the match.

All players' input count is shown in Figure 3. It is the sum of every individual interaction of players during a match. All entries in the database are considered and are not solely related to cooperation and defects. They also include the number of times a

player caught fruits left by the Mole, the times a player was requested by others, and the times he/she attempted to accumulate points by opening the gift box left by the parachute.

As seen on Figure 3, players that controlled the Frog and the Duck had the highest number of interactions. The opposite can be said about the Alligator. However, Figure 4 shows that this player seemed to have tried to establish cooperative interactions, as he/she and the Frog were the only players that cooperated with all the others.

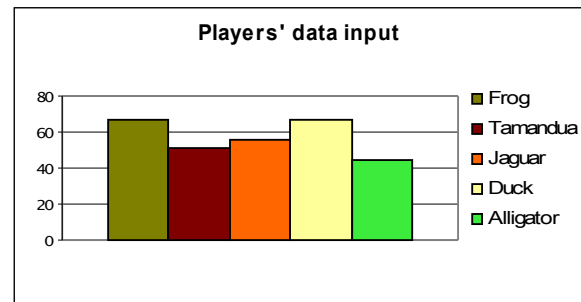


Figure 3: Players' input measured according to all data recorded in the database.

Figure 4 shows that Alligator cooperated with everybody, mostly with the Jaguar and the Tamandua. However, this player received no reciprocation back from the Jaguar, or from Tamandua either. As the Frog won the match, it seems possible to state that the player who controlled it did not give many fruits to a single player as the Alligator did. Instead, the Frog collaborated with all the others with an apparent caution.

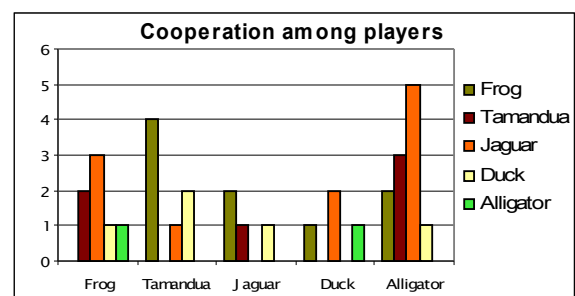


Figure 4: Number of cooperative interactions throughout the match.

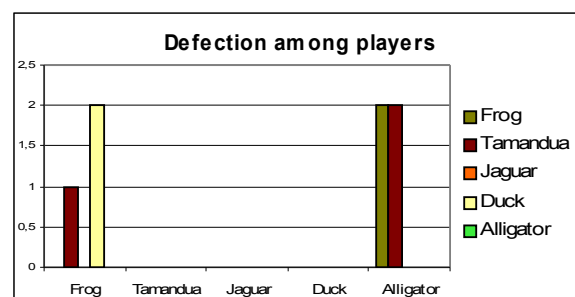


Figure 5: Number of defections throughout the match.

Figure 5 shows that the only defectors of this match were the Alligator and the Frog. The Alligator's sudden collapse seems to be explained by his poor number of interactions established. Most of the time, its gains were based on opening the gift box or catching fruits left by the Mole (see Figure 6), which could also produce an undesired outcome, e.g., an attack of the Rat (see Figure 7). Additionally, with such a noticeable selfishness, this character did not manage to get good results from denying fruits when requested. He received no cooperation from the Tamandua or the Jaguar, as seen on Figure 2.

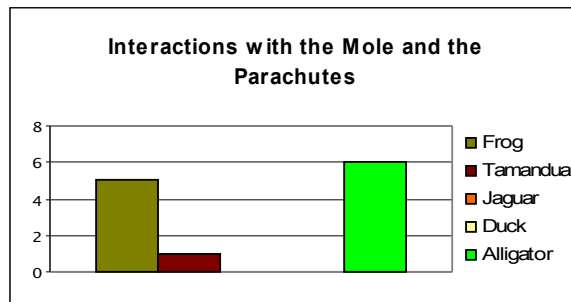


Figure 6: Number of times each player relied on easier ways to score points.

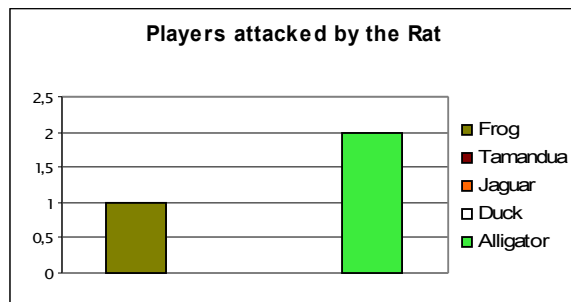


Figure 7: Number of times each player had each one of his/her fruits reduced in 10% when attacked by the Rat.

7. Conclusion

This paper intended to do a preliminary account for the complexity of cooperation without extrapolating the contextual limits of the game O Dilema da Floresta. According to our studies, the phenomenon of cooperation, if defined as the capacity of articulation among members of a group to generate mutual benefits, is common not just within humans but also among other animals. This statement finds meaningful resonance in research that presented the generalization of cooperation in the accomplishment of reciprocal altruism in unpredictable situations.

Altruism is a phenomenon that participates in the maintenance of a cooperative group. It is not just present in the actions directed to the achievement of a group's main task, but it is also part of what may preserve participants' interest to complete this task. Judging by the data collected through the experiment, the Jaguar seemed to have adopted a selfish strategy. It is also possible to infer that there was observable

altruism in most of the players' moves. However, the behavior of the Frog and the Alligator are particularly remarkable. Those characters seemed to have played altruistically as a strategy that appeared to be aimed at involving the whole group in it. Since those players also counted strongly on the outcomes produced outside the group (e.g., gains generated by the gifts brought by the parachute and the Mole), there was an intention in producing profits for themselves and for the group. Alligator's ineffective strategy, though, gives the impression of just being the result of bad encounters with the Rat, in an attempt to promote the same benefits for the group and for himself.

The game, in general, seems to offer a reasonable environment to observe group dynamics. It was possible to explore its potential in tracking players' moves, which wouldn't be able to do through traditional ethnographic strategies. Since the setting of a laboratory was merged with a real-world's scenario of a Lan House, almost every entry in the database could be analysed with the support of oral communication. A scream of surprise, or a gesture accompanied by an apprehensive statement was also taken into account, as they were meaningful portraits of a player's engagement in the task of playing.

Additionally, it is worth mentioning that the results of the previously reported experiments suggested that it is possible to break traditional dichotomies between investigation and intervention. The reflexive/active role our subjects played in the discussion of what was being investigated produced reciprocal effects. This is particularly interesting and shows that the exchanges among humans, even though they are mediated by technology, may operate transformations in a variety of dimensions: affective, cognitive, social, etc. Nevertheless, more experiments with a greater number of subjects must be carried out to put O Dilema da Floresta to the test of being able to make further general inferences.

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