Cooperation in Board Games

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Abstract

Cooperative or collaborative processes feature in many activities. Some authors distinguish cooperation from collaboration [Roschelle and Teasley 1995; Cogo 2006], based on the interpersonal dynamics between the participants. These distinctions, however, superimpose a simple dichotomy over a complex reality. In order to explore several different cooperation dynamics, we offered an extension course, in which the enrolled participants played several cooperative board games. In this paper, we have used distinctive features (DFs) vectors [Duarte, Battaiola, and Silva 2014] to represent these games' main characteristics. One of our results is, accordingly, a DF inventory which can be used to represent cooperative games. The other result is a better understanding of interpersonal dynamics in cooperative environments.

Keywords: board games; cooperation; dynamics; distinctive features.

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1. Introduction

Collaboration, cooperation, coordination, competition. These words label different interpersonal dynamics, and their meaning is often imprecise — when not positively concurrent. For instance, the *Oxford Advanced Learner's Dictionary of Current English* defines cooperation ("cooperation"in British spelling) as "acting or working together for a common purpose" [Hornby 1989], and collaboration as "work together (with somebody), especially to create or produce something" [Hornby 1989].

Actually, as in any situation in which human actions and motivations are relevant, the interpersonal dynamics offer a vast array of possibilities. For instance, in a *Soccer* match, each team's eleven players are expected to cooperate or collaborate. But some players may want to further their personal careers, and thus try to upstage their team fellows, even if this is detrimental to the team's efforts. Personal motivations can and do affect cooperation, often in subtle ways.

Some authors have distinguished cooperation from collaboration. However, there is no common denominator to these distinctions, either in their formulations or in their foundations. For instance, Roschelle and Teasley put their focus on modes of labour organization:

> We make a distinction between 'coolaborative' versus 'cooperative' problem solving. Cooperative work is accomplished by the division of labour among participants, as an activity where each person is responsible for a portion of the problem solving. We focus on collaboration as the mutual engagement of participants in a coordinated effort to solve the problem together. [Roschelle and Teasley 1995]

On the other hand, Cogo bases her distinction on psychological development (translated from Portuguese):

> Collaboration is an interaction in which there is an exchange of thoughts, either through verbal communication or through coordinated points of view in discussion, without rational decisions, and there is not an operative framework. We could say that collaboration is a social exchange that predates cooperation.
>
> Cooperation is linked to interaction, and it requires the creation of links and the affective reciprocity between learning process subjects. Interpersonal interactions allow for changes in the subjects' and group's cognitive structure… [Cogo 2006]

In this paper, we do not distinguish cooperation from collaboration, and henceforth we use only **cooperation**. As a matter of fact, we argue that interaction dynamics, between several people, engaged in a common activity, go well beyond the cooperation–collaboration dichotomy; and furthermore, that cooperative dynamics can be present even in very competitive environments.

The perception of this very diverse range of dynamics prompted the first two authors to offer an extension course, in the department of Design of Universidade Federal do Paraná (UFPR). The course's objective was to showcase different cooperation dynamics, using commercial board games as the focus for each session. The course had in all nine four-hour sessions, from April 25 to July 4, 2015, with

seven enrolled participants. In each session, participants played one or two board games, which were discussed afterward, focusing on the cooperative processes that had been relevant during play.[1]

This paper presents the results attained in the course. Since our objective was to explore different interpersonal dynamics, this was also our focus when we started writing this paper. But we soon found out that our previous work with **distinctive features (DFs)** [Duarte, Battaiola, and Silva 2014; Duarte 2015] offered a very convenient way to represent relevant characteristics of the games we had used in the course.

We thus acquired a new objective: to create an inventory of DFs focused on cooperation-relevant characteristics of games. At the end of our discussions, we settled on a six-DF inventory, which we present in this paper, together with brief discussions on each game and their respective DF vectors.

2. Related Work

Game Theory, as a branch of Mathematics, has many studies on cooperative games, especially due to their complexity [Axelrod 1997]. But cooperative games are not restricted to academia; many cooperative games can be found with relative ease. Educational games are often cooperative, and *role-playing game*s (RPGs) — whether tabletop or digital — are almost always cooperative endeavours.

Previous SBGames symposia have featured papers on cooperative, educational games [André and Souto 2014]. However, what is most germane to our research are papers which reveal cooperative dynamics in competitive scenarios [Sato et al. 2011; Alves et al. 2012].

The distinctive feature (DF) framework, which we adopted for the representation of game characteristics, was proposed in a paper presented to SBGames 2014 [Duarte, Battaiola, and Silva 2014], and further developed in the master's dissertation of the first author [Duarte 2015].

3. Methodology

The overall methodology for our work is grounded theory (GT). GT asks for an iterative, inductive process, in which the construction of hypotheses and theories is thoroughly grounded on empirical data [Charmaz 2006, chap. 1]. Ideally, each new iteration will produce better representations of available data, and thus allow for better theories.

In our case, data were obtained as a result of the extension course mentioned above. In the course, the first author moderated and presented the rules of the games, while the second author played with the participants. This, in turn, means that our data collection methodology was **complete participation**, in which the researcher is an active part of the observed process [Savin-Baden and Major 2013, p. 396].

Preliminary analysis of collected data was used as the basis to create a distinctive feature (DF) inventory, which we then used to represent relevant characteristics of the games. Following the iterative cycle of GT, this theoretical model was then used as the basis for further analyses.

[1] In this paper, we deviate somewhat from good English writing practices. The English language lacks a word for "a playing of a game", unlike Portuguese ("partida"). We use "play" in this sense throughout.

4. Distinctive Features

The use of a distinctive feature (DF) framework in game studies was first proposed by Duarte, Battaiola, and Silva [2014]. In this framework, DFs are a lexicon of categories, created in order to represent relevant characteristics of a phenomenon. Each category represents a property which can be present **[+]** or absent **[–]** in any given instance of the phenomenon.

In this paper, we propose a DF inventory to represent characteristics of games — in particular, those characteristics that are relevant for the study of cooperation in games.

We stress that our inventory is based only in objective characteristics, i. e., those based on the game rules. We have discussed elsewhere [Duarte and Battaiola 2015] the need to focus on either objective or subjective characteristics in a DF inventory. Of course, a game goes well beyond its designer's intentions, creating emergent dynamics [Sweetser 2008, p. 3], and these dynamics were indeed the focus of our research.

However, it is our contention that these dynamics can only exist when the mechanical layer of the game — which was created by its designer — allows for this kind of player agency. In this sense, the DF inventory presented below reveals which design decisions have the potential to create cooperative dynamics in play.

The presentation of each characteristic includes both a brief discussion of its impact and the definition of the DF — or DFs — which we propose for its representation.

The real strength of a DF system does not lie in the enumeration of DFs, but rather in the interaction between them. In order to showcase the most relevant consequences of the DF interaction, we mention a few DF combinations and discuss their meaning; those combinations are marked with the symbol ✔.

However, one of the consequences of the use of a formal system is an overabundance of possible representations, or **overgeneration** — that is, there are formally possible DF combinations that do not represent any real-life games [Duarte 2015, p. 109]. We have tried to indicate such situations, which are marked with the symbol ✘.

It is worth noting that our research is based on an axiom. As in any game analysis, we assume that players will act rationally. "Rationality", in this limited context, means that players will try to win by the best means available within the rules of the game.

This axiom ties in with our previous observation about objective characteristics. It is indeed possible to play games in many ways; even *Chess* can be played cooperatively, for any number of reasons. But we do not include the human factor in our analysis, since this would completely blur any possible results.

We also need to add a further consideration. First, we note that **game state** is the set of information on the game at any given moment. This set includes information on the position of counters, players' abilities, cards held by players, and any other material elements of the game. It does not include players' intentions or decisions, except when they are conveyed by some game component.

Bearing this in mind, we stipulate that the DFs in our inventory must account for all possible game states, not only those present at any arbitrary instant (such as set-up or endgame).

4.1. Teams

Teams are an important feature of cooperative activities. There are games played by individual players, there are games played by teams only, and there are games played by both individual players and teams. Teams can be permanent or mutable.

In this sense, we understand a "team" as a grouping of players, as defined by the rules of the game. Informal teams can appear in many multiplayer games, such as some free-form first person shooter (FPS) games; but we deal here with teams formally defined by the game designer. It is worth noting that, in many games, a team may sometimes include just one player. This is usually the case when there are less players than the full complement (for instance, a six-player game played by just three people), although it can also happen when players change team affiliations.

We define two DFs to represent this:

[±individual]

This feature indicates whether there are players able to play as individuals, and not as part of teams.

- **[+individual]** represents a game in which at least one of the players can play by himself.
- **[–individual]** represents a game in which no player can play by himself.

[±single-team]

This feature indicates whether the game features exactly one team.

- **[+single-team]** represents a game in which there is exactly one team.
- **[–single-team]** represents a game in which either there are no teams, or there is more than one team.

From these two definitions, we can have four different game configurations:

✔ **[+individual, –single-team]** either a game with individual players and no teams, or a game with at least one individual player and at least two teams.

✔ **[+individual, +single-team]** at least one individual player, and exactly one team.

✔ **[–individual, +single-team]** all players are in the same team.

✔ **[–individual, –single-team]** no individual players, two teams or more.

✘ **[–individual, –single-team]** can also describe a game with no individual players and no teams. We believe that it won't be easy to find such a game…

One particular aspect of team games is the feature of "traitors": players which can change their team affiliation during play, as mentioned above. This can be represented by the following DF:

[±traitor]

This feature indicates whether a player can change his affiliation to a team.

- **[+traitor]** represents a game in which a player can change affiliation.
- **[–traitor]** represents a game in which affiliations do not change.

There is one impossible configuration from this definition:

✘ **[–individual, +single-team, +traitor]** would be a game in which there is only one team, and no individual players are allowed — so no change in affiliation is possible.

The definition of this DF does not distinguish different "treason" situations. They can be voluntary or not, and they also include situations in which one player pretends to be in a team, while he secretly plays against this team. His true affiliation can be revealed during play, or only at endgame.

4.2. Common defeat

Many games feature victory conditions, and there are also games in which there is no victory (such as many RPGs).

But there are some games in which all players can be defeated by the game system. We define the following DF:

[±defeat]

This feature indicates whether it is possible for all players to be defeated.

- **[+defeat]** represents a game in which all players can be defeated by the game system.
- **[–defeat]** represents a game in which at least one player must achieve victory, or in which there are no victory conditions.

✔ **[–individual, +single-team, +defeat]** is a prototypical cooperative board game: all players play as a single team, and they can win or lose together.

✔ **[–individual, +single-team, –defeat]** describes most tabletop RPGs: all players play as a single team, but there are no victory conditions.

4.3. Information

One widely-circulated definition of "game" includes a reference to inefficient means, or unnecessary obstacles [Suits [1978] 2005, chap. 3]. Although some aspects of Suits' definition have been contested [Duarte 2015, p. 18], it is quite the norm for games to create difficulties for the players.

One of the tools which a game designer can use to this end is the control of the information flow in the game, hiding or revealing elements of the game state. We can define two DFs to represent this:

[±state-info]

This feature indicates whether information about the game state is known to players.

- **[+state-info]** represents a game in which all information on the game state is known at all times by all players.
- **[–state-info]** represents a game in which some information on the game state can be unknown to players.

[±communication]

This feature indicates whether communication between players is subject to limitations.

- **[+communication]** represents a game in which players can communicate freely between them.
- **[–communication]** represents a game in which there are restrictions on communication between players.

The four possible combinations between **[±traitor]** and **[±state-info]** indicate whether a "traitor" is known to other players:

- ✔ **[+traitor, –state-info]** there can be hidden traitors, that is, some players can change their team affiliation unbeknownst to their team fellows.
- ✔ **[+traitor, +state-info]** players can change their team affiliations, but their affiliation is known at all times by all players.
- ✔ **[–traitor, +state-info]** players cannot change their team affiliations, and their affiliation is known at all times by all players.
- ✔ **[–traitor, –state-info]** players cannot change their team affiliation, but information on their affiliation may be hidden.

4.4. Representation vectors

The six proposed DFs can be arranged as a DF vector, in order to represent the corresponding characteristics in any given game. For instance, table 1 shows the DF vectors for *Chess* and *Bridge*.

Chess is the prototypical competitive two-player game, and *Bridge* is one of the better-known partnership card games. Neither of them presents "traitors", and there is no way for all players to be defeated in any of them. The game state in *Chess* is completely open; *Bridge*, however, as many card games, restricts information on part of the game state (the cards in players' hands). Unlike many card games, however, *Bridge* has strict rules limiting communication between players.

Table 1: DF vectors for *Chess* and *Bridge*

Chess	*Bridge*
[+individual]	**[–individual]**
[–single-team]	**[–single-team]**
[–traitor]	**[–traitor]**
[–defeat]	**[–defeat]**
[+state-info]	**[–state-info]**
[+communication]	**[–communication]**

5. The Games

With the proposed DF inventory, we are now able to represent the characteristics of the games which we used in the extension course. In the following sections, we present brief reviews of each games, and we mention the main cooperative dynamics which were revealed in actual play.

Following this, we present each game's DF vector, with brief notes explaining the game's relevant characteristics.

The games in the extension course were not randomly selected. We based our selection on our knowledge of these games, and on the perception that even superficially similar dynamics could lead to very diverse dynamics, as can be readily seen when comparing, for instance, the traitor role in *Shadows Over Camelot* and in *Battlestar Galactica*.

It is worth noticing that several of the games used in the course can be played in different ways — for instance, when optional rules are used, or when a game expansion modifies some rules from the basic game. We have restricted our analyses to the game versions played in the course, and thus they do not include all possible variants for each game.

Figure 1: *Red November*

5.1. *Red November* (fig. 1)

Players represent the officers and crew of the worthy submarine *Red November*, pride of the gnomish Navy. Unfortunately, this powerful vessel was sabotaged by evil enemy agents. As time ticks by, the hull starts leaking, circuits catch fire, equipments fail, and a great kraken threatens to grapple the proud boat. The players need to keep *Red November* seaworthy for one hour (in-game time, not playing time), until rescue vessels arrive.

Should any catastrofic failure happen before rescue arrives, all players lose the game. However, any player can leave the submarine through the hatch. If *Red November* sinks, but the escaping player survives, he wins and the other players lose.

During the game, players can perform maintenance on the several failing systems, using cards with tools and other advantages.

When playing *Red November* in the course, players opted to keep all their cards open at all times, so that everyone could discuss the best alternatives.

No player tried to leave the submarine, and indeed no player considered this possibility (as discussed in the post-game debriefing).

One observed dynamic was the "Alpha player", that is, one player who tries to take command and tell everyone else what to do. The decision to play with open cards favored this, but it didn't develop fully as there were two or three players trying to step in this role.

Generally, players cooperated freely, helping one another and discussing their course of action.

[+individual] a player can leave the submarine to try to win alone

[+single-team] all players are in the same team

[+traitor] a player can leave the team

[+defeat] all players can be defeated

[+state-info] game state information is known by all

[+communication] players can communicate without limitations

Figure 2: *Hanabi*

5.2. *Hanabi* (fig. 2)

All players in *Hanabi* cooperate to perform a beautiful fireworks show. The show is created through color cards. There are five color suits, and in each suit there are cards with numbers ranging from l to 5. A perfect fireworks show will have five l–5 sequences, one in each color.

Unlike what happens in most card games, players in Hanabi cannot see the cards in their hands, but only the cards held by other players. All players hold their cards with card backs to them, and values facing the other players.

In order to know what card to play, any player depends on hints from other players. When giving a hint, a player can tell another player either one number or one color among the cards held by him. There is a limited number of hints available.

The game can end prematurely, if players make too many mistakes (like playing cards in the wrong sequence, or giving information beyond what is allowed by the rules). No matter how the game ends, there is no defeat. The players' performance is evaluated according to the highest cards played in each color, and can thus reach 25 points.

In the course, *Hanabi* was played three times. The very nature of the game prevents the appearance of an Alpha player; players tried every time to coordinate their efforts, but the communication restrictions limited their ability to do so — especially when a player did not correlate the hints he had received with the game state.

[–individual] no player can play or win by himself

[+single-team] all players are in the same team

[–traitor] no player can leave the team

[–defeat] there is no victory or defeat

[–state-info] players do not know the cards in their own hands

[–communication] communication between players is strictly limited

Figure 3: *Shadows Over Camelot*

5.3. *Shadows Over Camelot* (fig. 3)

In this game, players represent medieval knights, the main characters in the Matter of Britain: king Arthur, sir Gawain, sir Palomides, and others. Their objective is to go in quests, such as finding the Holy Grail or defeating an invasion by the Saxons. In order to fulfill their quests, players use cards, which give them special abilities.

Players are opposed by the game system itself, for the quests gradually get more difficult — or even impossible to fulfill. Besides that, one of the players may be a traitor. At game set-up, each player receives one loyalty card, which he keeps secret from the other players, and which indicates whether he is a loyal knight or a traitor. During the game, a traitor can be revealed, usually when denounced by another player.

At game end, the loyal knights win if most quests were successfully resolved. If this does not happen, and there is no traitor, all players are defeated; if there is a traitor, this player wins.

Shadows Over Camelot was played twice during the course. The first play had no traitor, but there was one in the second play. In both plays, the possibility of a traitor was not a strong factor in players' consideration of strategies, although it was often mentioned in banter. Usually, actions were decided in open discussion.

In the second play, the traitor was not particularly active. This was partly caused by the game rules themselves, which do not allow many useful actions to a hidden traitor.

[+individual] the traitor can play and win against the loyal players

[+single-team] there is only one team

[+traitor] one player may be a traitor

[+defeat] all players may be defeated

[–state-info] loyalty cards and held cards are not revealed

[–communication] players cannot discuss the strength or the powers of their cards

Figure 4: *Fury of Dracula*

5.4. *Fury of Dracula* (fig. 4)

Four players team up as hunters, while the fifth player controls Dracula. The hunters' objective is to find and to destroy the vampire; Dracula's objective is to create new vampires in order to destroy his enemies and control Europe.

Each of the five characters has some special powers. The four hunters can also purchase equipment, like weapons or crosses. Dracula's main advantage is his hidden movement; most of the time, the hunters are searching for his trail all over Europe.

On the other hand, Dracula is alone against a formidable array of foes. In order to offset this, the rules stipulate that the hunters must openly combine their actions, allowing Dracula to overhear their conversation. Generally speaking, it is easier for the hunters to win this game.

We played *Fury of Dracula* once, with the first author playing Dracula, and each hunter being played by a pair of players. The hunters successfully coordinated their actions, and managed an early victory.

[+individual] Dracula is played by one player

[+single-team] all hunters play in one team

[–traitor] player affiliation cannot be changed

[–defeat] either the hunters win, or Dracula wins

[–state-info] Dracula movement is hidden, and several cards are also hidden from other players

[–communication] hunters may not engage in private conversation

Figure 5: *Nosferatu*

5.5. *Nosferatu* (fig. 5)

In *Nosferatu*, one of the players openly controls Renfield, a human allied to Dracula. Renfield secretly chooses one of the other players to be Dracula. During play, the other players, as vampire hunters, must find out who among them is Dracula, in order to kill him. Alternatively, they may also complete five mystical rituals, which will give them the means to defeat the vampire. Dracula, however, tries to sow suspicion among the players, subtly sabotaging their efforts, and tries to create new vampires. Renfield does not act directly, but he has the ability to subtly influence the game flow.

In the course, there were two plays of *Nosferatu*. Dracula and Renfield won the first play, the hunters won the second one. In both plays, rampant paranoia helped Dracula to keep incognito, and cooperation was difficult.

[–individual] there are no individual players

[–single-team] there are two teams

[+traitor] one player plays as part of the hunters team, but is actually Dracula

[–defeat] either the hunters win, or Dracula and Renfield win

[–state-info] players have no knowledge of held cards

[+communication] players can communicate freely

Figure 6: *Saboteur*

5.6. *Saboteur* (fig. 6)

Players in *Saboteur* represent dwarves, mining gold underground. However, some dwarves are secretly saboteurs, and they want to prevent the other dwarves from finding gold. In order to do this, they may lie, cause cave-ins, and break the tools used to dig tunnels.

One complete *Saboteur* game is played in three turns. At the beginning of a game turn, each player receives a card indicating whether he is a digger or a saboteur. About one quarter of the players will be saboteurs, but the exact number is not known, and even the saboteurs do not know each other. At the end of each game turn, the winning team — diggers or saboteurs — earns some gold nuggets, which are divided among its members.

There is no continuing affiliation between game turns; any given player may be a digger or a saboteur in any game turn. However, earned nuggets are kept from one game turn to another. At the end of the third game turn, the player with most gold nuggets is the winner.

During the course, some saboteurs acted openly, while others played more subtly. Generally, whenever one saboteur was acting in the open, and another one kept hidden, the saboteurs had the advantage. The prevailing paranoia also helped to foster false accusations, especially when a player made a mistake.

[+individual] players play in teams, but win as individuals

[–single-team] there are two teams

[+traitor] players can play as part of the digger team while secretly part of the saboteur team

[–defeat] at least one player will win

[–state-info] loyalty cards and held cards are not known by other players

[+communication] players may communicate freely

Figure 7: *The Republic of Rome*

5.7. *The Republic of Rome* (fig. 7)

The Republic of Rome simulates the Senate of Rome, in the two centuries prior to the establishment of the Augustan Principate. Each player represents a political faction, striving to become the dominant faction in the Republic.

However, players depend on their adversaries to earn prestige, and thus to win. The main sources of prestige are the high offices of the Republic, such as the consulate or the censorship, and the powers inherent to those offices, such as the imperium to command Rome's legions in foreign wars. The magistrates are always elected, and thus even a small faction can be relevant to tip the scales of Senate votes.

Fate can be unforgiving; Rome faces lots of internal and external problems: popular rebellions, wars, earthquakes. The Senate must guide the Republic in a dangerous world — for, if too many problems are left unresolved, all players lose when Rome falls.

In the course, the competition–cooperation dichotomy was very much in evidence. During the first game turns, the world was mostly calm, and Rome faced few problems. This allowed the players to concentrate in political infighting for the magistratures. However, when trouble started brewing, the previous competition poisoned the needed cooperation. Sometimes, a senator with better credentials to face a problem was passed over in favor of a less able colleague, so that the first one did not earn prestige. This ultimately helped to end the game, with all players defeated.

[+individual] each player plays by himself

[–single-team] there are no teams

[–traitor] there are no affiliations

[+defeat] all players can be defeated together

[–state-info] held cards are not known to other players

[+communication] players may communicate freely

Figure 8: *The Resistance*

5.8. *The Resistance* (fig. 8)

In *The Resistance*, players are members of an underground resistance group, and they must plan and execute missions against the tirannical government. Unfortunately, some of the resistance members are actually infiltrated spies.

At the beginning of the game, each player receives a card, which indicates whether he is a loyal member of the Resistance, or a disguised government spy. The spies will know each other.

In order to win the game, the Resistance must execute successfully three missions. During each mission planning, some players are selected as the mission team. The mission will fail if any team member sabotages it.

Play time is spent mostly in discussions and votes about who must go in each mission team. The spies try to acuse and incriminate other players, and try to be selected to the mission teams.

Playing in the course, spies were often able to coordinate their efforts, arguing successfully against other players and to benefit each other. Unlike what happened in *Saboteur*, in this game it is essential for a spy to keep hidden. Knowing each other gives a strong advantage to the spies.

[–individual] there are no individual players

[–single-team] there are two teams

[+traitor] spies pretend to be part of the Resistance

[–defeat] either the Resistance wins, or the spies win

[–state-info] cards are kept hidden from other players

[+communication] players may communicate freely

5.9. *Wealth of Nations* (fig. 9)

In this game, each player controls a fictitious nation in an abstract map. In each nation, industrial facilities produce resources — food, energy, qualified workers, and so on.

The game production mechanic favors specialization over diversification. Three farms together produce more food than three separate farms, representing returns to scale. Generally, it is better to have several facilities producing one or two resources, than few facilities producing several different resources.

Figure 9: *Wealth of Nations*

All nations need all resources; in order to obtain resources, nations can trade freely. Trade can involve barter and/or money considerations.

Playing the game in the course showed clearly that the game is very aptly named. Just as in Adam Smith's work, the invisible hand of economic forces led the players to cooperation. For instance, when food was scarce, food prices escalated; food-producing nations were stimulated to grow more food, which was then purchased by other players to enable their industries to grow, and so on.

The mutual interest of the players enabled the world economy to grow and benefit everyone. But this was not discussed among the players; only during the game debriefing they identified the subtle cooperation that pushed the game.

[+individual] each player plays by himself

[–single-team] there are no teams

[–traitor] there are no affiliations

[–defeat] at least one player will win

[+state-info] there is no hidden information

[+communication] players may communicate freely

5.10. *Battlestar Galactica* (fig. 10)

Battlestar Galactica is based on the eponimous TV series, in its 2003–2009 reimagined version. Players are divided in two teams, humans and cylons. At the beginning of the game, cylon players are hidden and infiltrated among the humans. Human players must escape from annihilation at the cylons' hands, and also try to root out the infiltrated cylons who sabotage their efforts.

At game start, each player receives one card indicating whether he is a human or a cylon. By midgame, a new loyalty card is received; a human player can suddenly find out that he was a sleeper cylon agent, whose programming has just been activated. The converse is not true; a cylon player who receives a human loyalty card will still be a cylon. Cylon players do not know who the other cylons are.

Game mechanics stimulate stress and paranoia. Unlike other games with traitors, in *Battlestar Galactica* cylon

Figure 10: *Battlestar Galactica*

players have many means to subtly sabotage the human players' actions.

During play, the two cylon players successfully managed to sow dissent among humans, before revealing themselves, and they won the game.

[–individual] there are no individual players

[–single-team] there are two teams

[+traitor] cylon players can pretend to be human, and human players can be transformed in cylon players

[–defeat] either the cylons win, or the humans win

[–state-info] loyalty cards and held cards are not known to other players

[–communication] players cannot talk about held cards

6. Final Thoughts

The extension course and the analysis of the games played led to two main results; the first one is analytical, the second one is synthetical.

The analytical result is represented by the DF inventory that we inferred from preliminary analysis of the data, and then used to represent the characteristics of the games used in the course (table 2). This corresponds to an iteration cycle according to the GT methodology. Ideally, future iteration cycles will try to use this model to analyze and represent characteristics of other games, and contribute to correct and perfect the inventory.

It is necessary to note that two games can have the same DF vector in this system. For instance, in our data, both *Nosferatu* and *The Resistance* share the same vector (cf. table 2). This is not an accident; we do not intend to create a DF system capable of distinguishing every single game (or even every single cooperative game). What we strived to create was to formulate a set of DFs that could describe the mechanical foundations of cooperative games. Indeed, our results enable us to formulate a working hypothesis:

> The DF inventory **[±cooperation, ±individual, ±single-team, ±traitor, ±defeat, ±state-info, ±communication]** is sufficient to represent any game's mechanical characteristics that enable cooperative dynamics.

The reference to "mechanical characteristics" in this hypothesis has a meaning all of its own. This is a direct reference to the Mechanics, Dynamics, Aesthetics (MDA) model [Hunicke et al. 2004], which can be used as an overall theoretical framework when using a DF model. One of the results of the combination of the two frameworks is the perception that a DF model will be effective when it involves characteristics from just one MDA layer of the game experience [Duarte 2015, p. 110].

In our model, cooperation is an emergent dynamics [Sweetser 2008], and thus lies in the Dynamics MDA layer. The characteristics that are represented in our DF inventory are the mechanical conditions that will enable cooperation to appear. However, although the game designer can create an environment that allows for cooperation, no game can force the players to act cooperatively; a disgruntled *Hanabi* player can easily wreak havoc with the game, if he decides to work against the team.

As in any game, the players must allow themselves to submit to the game's ethos. Cooperation, then, is a (very) human behaviour, which can flourish when the right conditions are present.

This is the second, synthetical result of our research. We find that studying all the various cooperative dynamics in these games enhances our understanding of other cooperative processes, even — especially! — those outside the game experience.

Let's adopt for a moment Roschelle and Teasley's view on cooperation and collaboration [Roschelle and Teasley 1995]. We can probably consider *Red November* a cooperative game, and *Battlestar Galactica* a collaborative game. What about *Nosferatu* or *The Resistance*? On the other hand, Cogo would probably consider *Red November* a collaborative game, but would have difficulty to recognize cooperation or collaboration in *The Republic of Rome*.

And what does that reveal about a work team — let's say a design team — that involves several stakeholders, each one of them with their own objectives and interests? All of them want the end of the design cycle and the final product; but will their diverse objectives impact the design process and the product?

Games can often be used as a tool to help analyze complex problems. But they cannot be used to solve problems:

> Unlike many other techniques of analysis, gaming is not a solution method. The output of a game is not a forecast or prediction, solution, or rigorous validation. The output of a good game is increased understanding.
> [Schwabe 1994]

Table 2: DF vectors for each game

Game	[±individual]	[±single-team]	[±traitor]	[±defeat]	[±state-info]	[±communication]
Battlestar Galactica	–	–	+	+	–	–
Fury of Dracula	+	+	–	+	–	–
Hanabi	–	+	–	+	–	–
Nosferatu	–	–	+	+	–	+
Red November	+	+	+	–	+	+
Saboteur	+	–	+	+	–	+
Shadows Over Camelot	+	+	+	–	–	–
The Republic of Rome	+	–	–	–	–	+
The Resistance	–	–	+	+	–	+
Wealth of Nations	+	–	–	+	+	+

Cooperative games reveal the complexity of cooperative dynamics. Understanding this complexity is useful knowledge; so much the better if it is taught by a fun game.

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