Beyond Collaboration and Competition: Independent Player Goals in Serious Games

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Abstract: Many serious games simulate critical issues, such as social justice, ecological sustainability, and economic inequity using collaborative and competitive rules. However, in real life, these situations often are not purely collaborative or competitive. Rather, they may involve many actors who have individual goals but must share social systems and common resources. This research demonstrates how independent goals in games support the emergence of cooperative, collaborative, and competitive interactions characteristic of these real life situations. Computer simulations and human playtests of *The Farmers*, an original tabletop game with independent goals, are compared to collaborative and competitive variants. These comparisons indicate that independent goals lead to play styles distinct from collaborative and competitive variants.

Tabletop games in which players win or lose independently of how well or poorly other players do are extremely rare. More common are games in which a player's success requires another player to lose (competitive games) or the entire group to win (collaborative games). In contrast with these games, achievement in life can be independent or at most tangentially related to others' success.

In life, conflicts and coalitions are not usually predefined. Rather, they more often emerge within shared economic, political, and social systems. This can happen when actors disagree or agree about notions of justice, fair resource use, and rights of access in those systems. Tabletop games offer a method for simulating interconnected economic, political, and social systems in which conflicts between actors can emerge. Furthermore, simulations can be used to illustrate how cooperation can emerge between actors that share goals or believe that cooperating around goals is in the mutual best interest or ideologically beneficial.

Many of the most important cases to simulate for educational and research purposes are *social dilemmas*, situations in which an actor is forced to choose between acting in self-interest and the interest of a common group (Kollock, 1998). One specific kind of social dilemma is the *common pool resource dilemma*. Common pool resource dilemmas are situations in which several actors can freely access an area of common resources and use those resources for personal benefit. Fisheries are an example of common pool resource. They are not owned by anyone, are openly accessible, and difficult to regulate. When too many fish are removed, the result can be the depletion of the fishery. This can happen because many people have personal incentive to take from the commons even though this action is not sustainable and not desirable for humanity. When a commons is affected negatively in this way, this is known as a *tragedy of the commons* (Hardin, 1968). Understanding how to deal with and prevent the tragedy of the commons is one of the most urgently important topics in scientific research (Ostrom, 1999). Smith (2006, 2007) examined the emergence of the tragedy of the commons in online games, but did not examine games that specifically have mechanics that support the emergence of the tragedy of the commons.

This research examines *The Farmers*, a common pool resource dilemma game that accounts for several elements that support play that is not purely collaborative or competitive. *The Farmers* employs the use of shared resources, complementary abilities, and varied goals among players that lead to interactive synergies, which support the emergence of cooperation (El-Nasr, et al, 2010; Rocha & Mascarenhas, 2008; Zagal, Rick, & Hsi, 2006). Finally, *The Farmers* discourages *pyrrhic victories,* situations in which being ahead of others is not a victory if the world is destroyed as a result of actions taken to come out ahead.

The Game

The Farmers is a card game (see Figure 1a) in which three players harvest and plant resources in a common space (see Figure 1b). These resources include trees, which protect against floods, wheat and pasture lands. Each round, land in the commons may be eroded if there are not enough trees. Players do not want erosion, but have a personal incentive to take from the commons to gain points (therefore increasing the likelihood of erosion). Each turn, the three players take one action: either harvesting, planting, gaining a point, restoring eroded land, or sanctioning (see Figure 1c). After actions occur, the commons react to the modifications that have been wrought by the players, negatively impacting everyone if the land has not been managed sustainably. Players have unequal abilities and different desires, and are often not the best at planting or harvesting the resources they most desire.

***Figure 1a*: A computerized version of *The Farmers* game.**

***Figure 1b*: The commons in *The Farmers*.**

***Figure 1c*: A player's hand in *The Farmers*. They have options for planting and harvesting each of the three resources (trees, wheat, pastures) and may also sanction, gain a free point, or restore devastated lands.**

In *The Farmers*, players are given independent goals and told to optimize their own personal scores. This means that all players at a table can win, all can lose, or some can win and others can lose. Farmers A, B, and C at one table are compared to Farmer A', B', and C' at another table. Farmer A is playing versus Farmer A', B versus B', and C versus C'. Similarly, when two tables of players are not available, players can compete against preset distributions to compare their score to percentiles of past players. This independent goal setup is different from asking players to combine their score into a group score (a collaborative game) or requiring a player to have the most points at the table (a competitive game). In the independent goal version, there is no interaction or information exchange between tables, keeping the groups completely separate during game play.

Methods

Computational simulations and human playtests of *The Farmers* were performed. One set of tests was done using the independent goal game rules as described above. In addition to the independent goal game, tests were run on collaborative and competitive variants. In the collaborative variant, players were told to work as a group to have a total group score higher than another group. In competitive games, players were asked to simply have a higher score than other players at the same table and to ignore how other players from other tables were doing.

Evolutionary algorithm simulations show that there are drastic differences amongst these variants in terms of optimal strategies and game outcomes. Solutions were assumed to be in the form of mixed strategies. Thus genomes were representative of action probability distributions. The evolutionary algorithm used competition selection with a small rate of permutation and random combination points. The fitness functions were used to differentiate the three types of game play. In the cooperation version, the fitness of each player was calculated as the sum of the scores of all players. In the competition version, the fitness of each player was their score minus the average score of the other two players. In the self-scored version, the fitness was just the score of that individual.

Computational Simulation Results

Even with such a simple representation of this solution space (ignoring other player actions, time into the game, etc.) the artificial intelligence (AI) agents played quite differently across the versions. In the collaborative version, combined group scores were high (the average score was about 200 points, making the group score nearly 600 points) but one player scored the majority of the points (see Figure 2a). Because one of the three farmer roles is able to generate more points than others, the optimal strategy in the collaborative game is for the other two players to assist this player in optimizing their collection and therefore their score. In the independent goals version (see Figure 2b), AI players are evolved to optimize personal scores. The total number of points earned for the group is less in the independent goals version (only about 300 points with an average score of 100 for each player) than in the collaborative rules condition, but on the other hand points are distributed more equally among AI players. AI testing thus distinguishes between the collaborative and independent goals conditions.

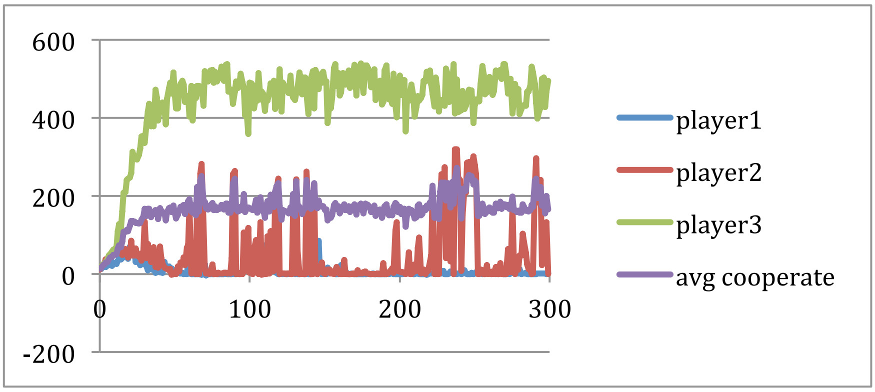


***Figure 2a*: Results of 300 simulations of the collaborative condition.**

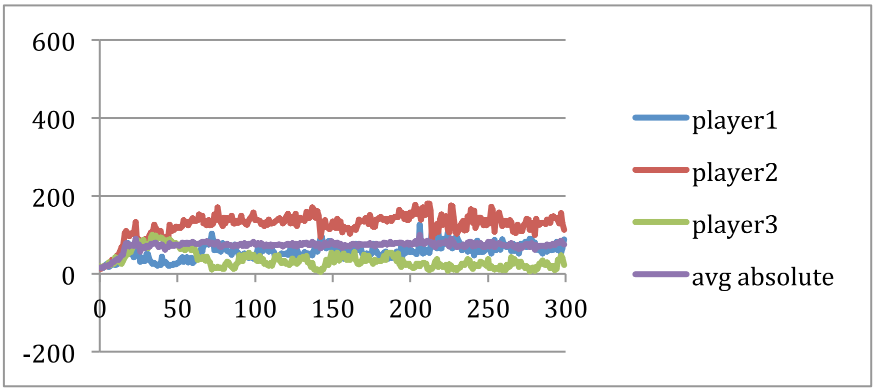
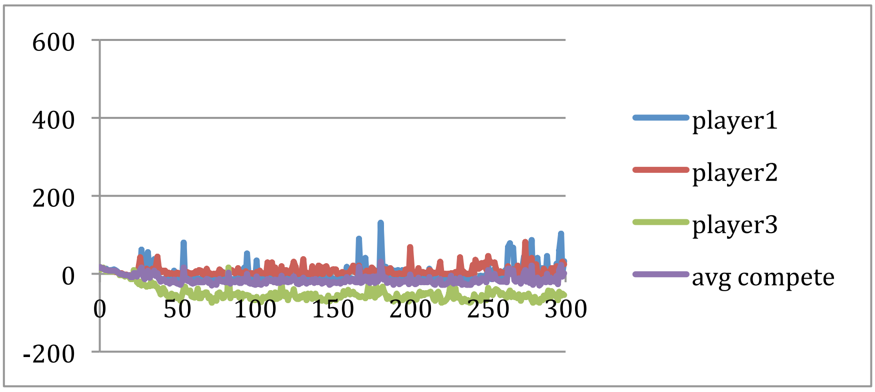


***Figure 2b*: Results 300 simulations of the independent goals condition.**

In the competitive version (see Figure 2c), AI players usually earned far fewer points than they did in other variants both as a group and as individuals. Since they were evolved only to try to earn more points than the other farmers in the same space, and not to earn as much as they could, AI players resorted to actions such as sanctioning to reduce the score of opponents. Unlike in other states in which the land was not often completely eroded, the final state of competitive game simulations was regularly one in which the land was destroyed. AI players evolved selfish and punishing strategies that did not regard the commons simply to maintain a higher score than others. In fact the average scores were close to 0, even negative in many trials. In the competitive condition AI players win as long as they do better—even if their world is destroyed, but a *pyrrhic* victory is not a real victory in the independent goals game, so AI players in the independent goals game evolve cooperative strategies. This shows the independent and competitive conditions to be distinct.

Figure of 300 of the goals 

***2c*: Results simulations competitive condition.**

Human Playtest Results

Human playtests revealed the same play styles and outcomes as the AI simulations. Differences in player communication and interaction patterns were observed between the variants. Human playtest groups were very consistent in collaborating in the collaborative condition and in competition in the competitive condition. However, human playtests of the independent goals version showed a wide range of play styles. Some groups were very aware of the need to work as a group to avoid erosion from the beginning and others not. Players were seen shifting between altruist and selfish play based on the actions of others. Occasionally players in this version chose to sacrifice their ability to take resources, an altruistic act. Some players of the independent goal version of *The Farmers* stated they were constantly emotionally torn between the need to work as a team while still striving to protect their own private interests, while players of the collaborative and competitive variants focused only on their collaborative or competitive goals respectively.

Conclusions

Human playtests and computational simulations of *The Farmers* suggest that providing players independent goal states leads to play that is genuinely different from both cooperative and from competitive play. Designers of serious games, and in particular designers of tabletop simulation games, may wish to consider using independent (and non-zero sum) goals within game designs.

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