Conflict and Communication in Massively-Multiplayer Online Games

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Abstract. Massively-multiplayer online games (MMOGs) can serve as a unique laboratory for studying large-scale human behaviors. However, one question that often arises is whether the observed behavior is specific to the game world and its winning conditions. This paper studies the nature of conflict and communication across two game worlds that have different game objectives. We compare and contrast the structure of attack networks with trade and communication networks. Similar to real-life, social structures play a significant role in the likelihood of inter-player conflict.

Keywords: social network analysis; massively-multiplayer online games

1 Introduction

Most online social media platforms are optimized to support a limited range of social interactions, primarily focusing on communication and information sharing. In contrast, relations in massively-multiplayer online games (MMOGs) are often formed during the course of gameplay and evolve as the game progresses [1]. Even though these relationships are conducted in a virtual world, they are cognitively comparable to real-world friendships or co-worker relationships [2]. The amount and richness of social intercourse makes it possible to observe a broader gamut of human experiences within MMOGs such as World of Warcraft [3], Sony EverQuest II [1, 4], and Travian [5, 6] than can be done with other data sources.

In particular, inter-player aggression is more openly expressed within MMOGs since combat often comprises a large portion of gameplay. This paper studies how conflict in MMOGs shapes the underlying social networks. In MMOGs, conflict and cooperation are inextricably linked since many attacks are launched by coalitions of players to gain resources, control territory, or subjugate enemies. For our analysis of conflict within MMOGs, we selected two browser-based games, Game X and Travian, in which there have been extensive previous studies of cooperation between players [5–10]. The two games differ in game objectives: there is no official winning condition for Game X. In contrast, Travian players develop their civilizations over a fixed period of time in order to be the first to build a magnificent Wonder of the World, a construct that can only be erected through extensive collaboration among a team of players. Constant raiding is required to amass the resources required to grow one's civilization.

To analyze the players' behavior, we constructed multiplex networks for both games, with link types for attack, communication, and trading. Our research compares and contrasts the network structure of players in both games; while there have been other studies of multiplex networks in a single game (e.g., [1,8]), there have been few studies that have looked for gameplay patterns across multiple games. For instance, griefing behavior was compared between World of Warcraft and Toontown, but not within the context of social network structures [11].

The overarching aim of our study is to understand the evolution of conflict in different game worlds. First, we discuss how differences in MMOG game objectives shape the structure of conflict. Then we study how the attack networks differ from communication and trade networks. Finally, we analyze how communication, trade, and geographic connections affect the likelihood of two players engaging in hostilities.

2 Related Work

Massively-multiplayer online games have been a fertile testing ground for many types of human studies, enabling scientists to overcome key difficulties in studying social dynamics by providing an experimental platform for collecting high resolution data over longer time period [1, 3, 5, 6]. They have been particularly valuable for studying groups [3], teams, and organizations [5], since banding together yields economic and combat advantages in most games. Geographically-separated players must work together to achieve shared goals using a similar combination of email, chat, and videoconferencing as remote employees, hence game guilds can be viewed as analogous to virtual workplace organizations [5]. Trust between guild members is positively correlated with group performance [10], and willingness to grant shared access to property, items, or user accounts can be used to measure trust between players. Roy et al. [1] demonstrated that network structures in multiplex networks are very useful for predicting trust between MMOG players. Similarly we believe that the network structure of multiplex networks is correlated with the likelihood of conflict among players.

In real-life there are myriad potential motivations for choosing to fight. Humphreys and Weinstein [12] categorized key determinants of participation in conflicts as being long-term grievances (i.e. economic or political disenfranchisement), selective incentives (money or safety), and community cohesion. Community cohesion predicts that a person is more likely to join the conflict if they are members of a tightly-knit community and their friends have already joined. This factor is the most relevant to fighting within MMOGs. Not only are there conflicts between guilds and alliances, but pick-up groups may spontaneously form to tackle larger challenges such as boss fights [13].

2.1 Game X

Game X is a browser-based exploration game in which players act as adventurers traveling a fictional game world in a vehicle. Similar to real-life, there is no absolute victory within the Game X world; instead players are engaged in an ongoing process of exploring the game world, mining resources, and engaging in commerce and battle with other players. Players can use resources to build factory outlets and create products that can be sold to other players. Unlike other MMOG's like World of Warcraft (WoW) and Everquest (EQ), Game X has a turn-based play system. Every day each player gets an allotment of turns. Every action (except communication) requires some number of turns to execute; example actions include: 1) move vehicle 2) mine resources 3) buy/sell resources 4) build vehicles, products, or factory outlets, 5) fight non-player characters 6) fight player characters. Players can communicate with each other through in-game personal messages, public forum posts and in chat rooms; they can also denote other players as friends or as hostiles.

In Game X fighting is one mechanism for advancement, but since fighting expends turns, the players must carefully weigh the tradeoffs between combat and pursuing an economic agenda. Players can engage in combat with non-player characters, other players, and even market centers and factory outlets. A player's skills affect the ability to attack/defend, and they can modify their vehicles to include new weaponry and defensive elements.

Game X contains four types of groups: 1) nations 2) agencies 3) races and 4) guilds. Wars in Game X can only occur between nations. There are three nations in the game, which were pre-defined by the game creators. Joining a nation provides access to restricted nation-controlled areas, quests, and vehicles. Each nation can have one of the following diplomatic relations to all others: benign, neutral, strained, or hostile. If enough members of a governing body select hostile diplomatic relations against another nation, a war is declared between the respective nations. After war has broken out, additional combat actions are available for the warring nations. In particular, war quests are available, which provide medals of valor to the players that wish to undertake and complete the quests. Any attack against the opposing nation results in accumulating a set number of war points. When the war ends, these war points determine the "winner" of the large-scale conflict. A war situation will (via the game's design) gravitate towards a state of peace. Each of the respective governing bodies must maintain a majority vote to continue the war effort. Over time, the amount of votes required to continue is increased by the game itself. Eventually, no amount of votes will suffice and the nations return to a state of peace.

Players also have a bidirectional "reputation" measure with the nations in the game. Combat with members of other nations incurs a negative penalty to this measure. During the war period this negative penalty is dropped for players of the two warring nations – allowing unrestricted combat.

2.2 Travian

Travian is a popular browser-based real-time strategy game with more than 5 million players. Games can be played in over 40 different languages on more than 300 game servers worldwide. Players start the game as chieftains of their own villages and can choose to be a member of one of three tribes (Gaul, Roman, or Teuton). Each of these three tribes has its own advantages and disadvantages. For instance, Teutons produce the cheapest military units and are the best raiders, whereas Gauls are the best at living in peace and have fast units and merchants. Players seek to improve their production capacity and construct military units in order to expand their territory through a combination of colonization and conquest. Each game cycle lasts a fixed period (a few months) during which time the players vie to create the first civilization to complete construction on one of the Wonders of the World. In the race to dominate, actors form alliances of up to 60 members under a leader or a leadership team. Alliances are equipped with a shared forum, a chat room and an in-game messaging system. Similar to the real world, teamwork and negotiation skills play a crucial role in game success.

Conflicts in Travian can be divided into two categories: attacks and raids. The goal of an attack is to destroy its target, whereas raids are meant to gather bounty and are much less vicious. The armies will do battle until at least one side is reduced in strength by 50%, and therefore the loss on both sides is usually smaller. For this paper, we construct an attack network from the raid data. A trade is an exchange of different resources (gold, wood, clay, wheat) necessary to upgrade a village's buildings. In Travian, villages may trade their resources with other villages if both villages have a marketplace. Travian has an in-game messaging system (IGM) for player communication. IGMs can also include broadcast messages, i.e. messages sent to all players by the game moderators. To study these processes we created trade and communication networks. However, in this analysis, broadcast messages were not considered as their volume could introduce bias in the results.

3 Analysis

The Game X dataset consists of data from 730 days, and the Travian data is composed of one game cycle on a high speed server in an expedited game (a period of 144 days). The experiments in this paper were conducted on a 30 day period in the middle of the Travian game cycle. This period has fewer transient bursts of activity and a more stable network than the early period (which has many less committed players who drop out) and the late period where the focus is on the Wonder of the World construction.

To analyze the relationship between conflict and communication in Game X and Travian, we identified a period of the game with comparable attack network statistics. First, for every day of the two games, we created a vector of features (the network properties from Table 1). Then, using the standard Euclidean distance measure, we find the most similar day from the Game X data for every

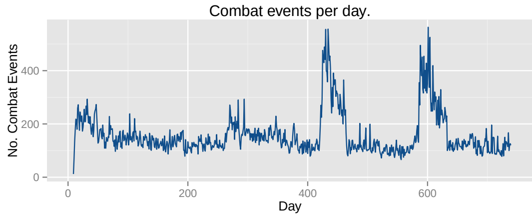


Fig. 1: Frequency of attacks in the Game X dataset (730 days). The peaks in activity represent the first and second declaration of war between nations.

Table 1: Travian and Game X attack, message, and trade network statistics

	Travian			Game X		
Parameter	Attack	Message	Trade	Attack	Message	Trade
# of Vertices	4418	3092	2649	2898	5112	5860
Frequency	633105	451669	271039	14270	907868	389629
Diameter	17	9	10	14	8	10
Avg. Path Length	5.312	3.471	2.849	4.476	3.402	4.218
Avg. Degree	7.998	14.591	32.828	8.375	27.645	25.01
Avg. Clustering Coefficient	0.065	0.319	0.154	0.012	0.137	0.117

Travian day. The features included: 1) nodes, 2) edges, 3) average path length, 4) diameter, 5) local transitivity, and 6) global transitivity. Results of this comparison reveal that the days found using this matching algorithm tend to fall in a 30 day period ([590,620]) within the second major Game X war (Figure 1). Table 1 shows the statistics for attack, trade, and message networks during the time period selected for this analysis.[1] In these networks, each node represents an individual player, and directed edges represent attacks, trades, and messages between players. Attack graphs in both Travian and Game X have a higher diameter, lower average degree, and lower clustering coefficient than either the message or trade graphs.

Although Travian and Game X possess many commonalities, an important difference between the two games is in the role of combat in gameplay. In Travian, attacking (raiding) is one of the easiest pathways for gaining the necessary resources for growing one's civilization. In Game X, attacks between players cause a loss of reputation if they are performed outside of war periods. The role of time is different in the two games. In Travian, players need to rush to grow their civilizations within a short period of time. In Game X, the players have infinite time to explore the richness of the world, but they can only take a limited number of actions per day. Each action spent fighting limits the number of actions available for economic development, hence Game X has a lower absolute frequency of attacks.

[1] This dataset has been made available at: http://ial.eecs.ucf.edu/travian.php

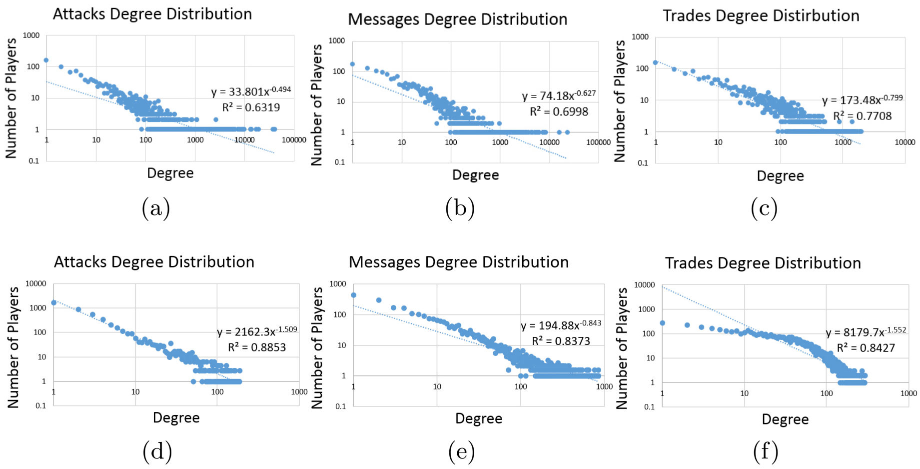
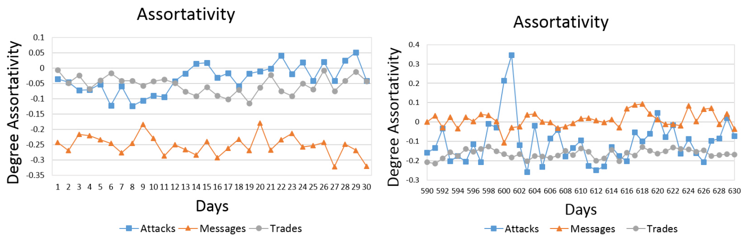


Fig. 2: Degree distribution (log-log scale) for (a) attack, (b) message, and (c) trade networks from Travian (top) and Game X (bottom)

Interestingly, the degree distributions of attack, messages, and trades in both games conform to a power law distribution (Figure 2). Clauset et al. [14] proposed a robust estimating technique to estimate the parameters of a power law; to verify the distributions, we used this method which employs a maximum likelihood estimator. This model calculates the goodness-of-fit between the data and the power law. If the resulting value is greater than 0.1 the power law is a plausible hypothesis for the data, otherwise it is rejected. Visually the trades in Game X appear to follow a double pareto lognormal distribution, with an exponential decay for higher trade values [15].

Assortativity is a preference for a network's nodes to attach to others that are similar in some way. Though the specific measure of similarity may vary, network theorists often examine assortativity in terms of a node's degree. Correlations between nodes of similar degree are found in the mixing patterns of many observable networks. For instance, in social networks, highly connected nodes tend to be connected with other high degree nodes. This tendency is referred to as assortative mixing, or assortativity. On the other hand, technological and biological networks typically show disassortative mixing, or dissortativity, as high degree nodes tend to attach to low degree nodes [16].

For Travian, as shown in Figure 3, while the message network displays disassortative mixing, attack and trade networks tend to show a non-assortative mixing. This suggests that players who send more messages are in contact with others who rarely send messages; communication in Travian often flows from alliance leaders outward to the other alliance members, reflective of a spoke-hub communication structure. In contrast, the degree of the members appears to be an unimportant consideration in dictating connectivity in the attack and



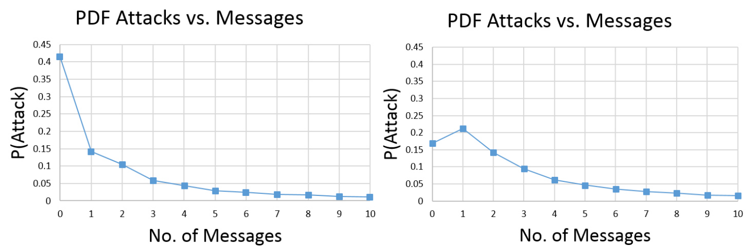
(a) (b)

Fig. 3: Travian (a) and Game X (b) node degree assortativity

trade networks. Non-assortative networks may arise either because the networks possess a balanced number of assortative and disassortative links or because a greater number of links in one direction is counterbalanced by a greater weight in the other [17].

For Game X, the attack and trade networks show a disassortative mixing while the message network displays non-assortative mixing. This indicates that attack and trade activity is centered around group leaders, whereas communication is more likely to be agnostic to node degree. Note that Game X has a more complicated group structure since players can belong to nations, guilds, and agencies.

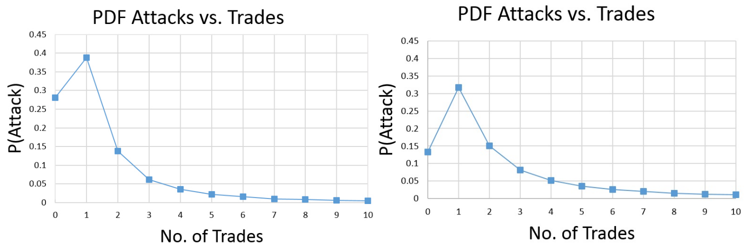
Attacks in both Travian and Game X are generally inversely proportional to other types of activity. In Travian, in 41% of cases, players do not attack other players with whom they have been in contact at least once (Figure 4). On the other hand in Game X, the above statement stands for only 17% of attacks. 21% of attacks occur between players who have exchanged one message.



(a) (b)

Fig. 4: Probability of attacks occurring between a pair of users vs. the number of messages they have exchanged (P(Attack and Message=x)) in Travian (a) and Game X (b)

In Travian a large number of players do not attack players with whom they have traded resources. As shown in Figure 5, 28% of the attacks in Travian occurred between two players without any trade history. However, this rate is surprisingly low in Game X; only 13% of attacks occur between players who lack a trade history. Once players have traded together, there is a sharp increase, followed by a slow decrease in attack frequency. Trading with other players indicates that they have desirable resources, making them worth attacking, and after only one trade, the players are unlikely to have established the sense of trust that may deter an attack. We believe that in some cases players who have never traded together or exchanged messages are geographically separated; hence they are less likely to attack each other because they are unaware of each other's existence.



(a) (b)

Fig. 5: Probability of attacks occurring between a pair of users vs. the number of trades they have made (P(Attack and Message=x)) in Travian (a) and Game X (b)

To test this hypothesis, we analyzed the probability of attack based on the distance between player territories in Travian (Figure 6). It was not possible to conduct a similar analysis in Game X, which has a spatial layout based on discrete tiles. To estimate distance, we calculated the territory centroids by averaging the latitudes and longitudes of the villages. Then, standard Euclidean distance was used to measure the distance between each pair of players in the attack network. Our analysis shows that attacks between immediate neighbors are frequent. Attacks with close (but not immediate) neighbors are common, followed by a decay in attack activity with distance.

Attacks are generally rare between alliance and guild members, indicating a strong level of trust in those relationships. In Travian, 4% of the attack edges are between two players within the same alliance. Surprisingly, the same rate stands for Game X, and only 4% of players attack their guild-mates.

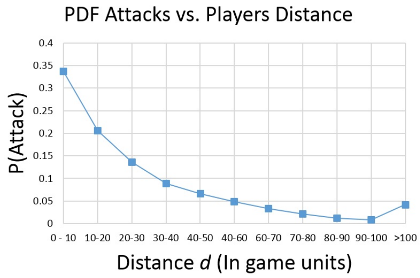


Fig. 6: Probability of attacks based on players' distance from each other

4 Discussion

In summary, our analysis reveals the following.

1. The attack networks in both Travian and Game X share a higher diameter, lower average degree, and lower clustering coefficient than either the message or the trade networks.
2. All networks in both games have similar power law degree distributions, but different degree assortativity. In Travian attack networks show non-assortative mixing, whereas in Game X they are disassortative.
3. The general trend is that attacks are inversely proportional to message frequency, trade frequency, and distance, with some specific exceptions. Players rarely attack fellow alliance or guild members in either game.

5 Conclusion and Future Work

This paper summarizes our findings across two massively multiplayer games with different game objectives, GameX and Travian. Despite the fact that Travian's game structure encourages a higher level of combat activity than Game X, attack networks in both games possess a similar network structure, and are distinctly different from message and trade networks. In future work, we hope to leverage these similarities to produce a general link prediction model for multiplex networks in MMOGs.

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